2023

Fall Undergraduate Research Expo

Purdue University

Office of Undergraduate Research

FALL UNDERGRADUATE RESEARCH EXPO

SCHEDULE OF EVENTS

NOVEMBER 14, 2023 | PMU SOUTH BALLROOM

9:00AM-10:00AM	**Poster Session 1**
10:30AM-11:30AM	**Poster Session 2**
12:00PM-1:00PM	**Poster Session 3**
1:30PM-2:30PM	**Poster Session 4**

NOVEMBER 15, 2023 | STEW 214

9:00AM-5:00PM	**Research Talks**

NOVEMBER 14-21, 2023 | ONLINE

Virtual presentations

*Available at **purdue.edu/undergrad-research/conferences/fall***

We encourage those with a Purdue account to provide feedback to presenters. **To submit feedback, please scan this QR code with your device's camera!**

POSTER SYMPOSIUM

Posters sorted by last name of first author within each session.

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

POSTER SESSION 1 | 9:00AM-10:00AM

1000 *Julieta Aguilar†*
Mentor(s): Jeremy Reynolds

1001 *Abdulrazzaq Altararwa†; Elizabeth Lawson†; Alexandra Wildridge†*
Mentor(s): Jennifer Brown; Stephen Beegle; Luis Gomez

1002 *Sarah Alvarez†; Sajal Salim‡*
Mentor(s): Mike Reppert; Jacob Hnatusko Wat

1003 *Aditi Anand†; Amrutha Vaidyam†; Adithya Chandrasekar‡; Christin Huene‡*
Mentor(s): Somali Chaterji

1004 *Ethan Baird†*
Mentor(s): Mark Johnson

1005 *Samyukta Balaji†; Aditya Sivathanu†; Ava Fasano†; Cassidy Brown†*
Mentor(s): Aaron Ault; James Ogg

1006 *Joe Basti†; Grant Capps‡; Eric Wang‡; Mario Arenas‡; Max Kerkho‡*
Mentor(s): Shreya Ghosh

1007 *Emma Benefiel†*
Mentor(s): Reuben Dass

1008 *Anna Brantley†*
Mentor(s): Denny Yu; Marian Obuseh

1009 *Jaden Brooks†*
Mentor(s): Sydney Trask; Kimberly Kinzig; Brent Bachman; Erisa Met Hoxha

1010 *Phuong Bui†*
Mentor(s): Paul Parsons; Prakash Shukla

1011 *Liying Che†*
Mentor(s): Jo Davisson; Amr Mohamed Elkabbany

1012 *Evan Chen†; Andrew Huang†*
Mentor(s): Shreya Ghosh

1013 *Ethan Chiao†; Stephanie Close†*
Mentor(s): Lucas Cohen

1014 *Ronald Cutler†*
Mentor(s): Julia Laskin; Hugo Samayoa-Oviedo

1015 *Sophia Dietz†*
Mentor(s): Fai Leung; Beichen Wang

1016 *Alivia Dwire†*
Mentor(s): Alex Pasternak; Alyssa Smith

1017 *Vincent Feliciano†*
Mentor(s): Linda Wang; Clayton Gentilcore; Cagri Un; Daniel Hristov

1018 *Nicholas Ganino†*
Mentor(s): Wenzhuo Wu; Nachiket Vatkar; Don Perera

1019 *Braden Garretson†*
Mentor(s): Danny Milisavljevic

1020 *Rygel Ginete†*
Mentor(s): Michelle Garrison; Abrianna Anderson; Garrett Price

1021 *Maren Gingrich†*
Mentor(s): Gudrun Schmidt

1022 *Nina Gruteser†*
Mentor(s): Michael Johnson

1023 *Rohin Gupta†*
Mentor(s): Michael Johnson

1024 *Tyler Hsieh†*
Mentor(s): Rua Williams; Michelle Garrison

1025 *Sierra Hunnicutt†; Luca Iacobucci*; Hannah Reyes Charles*; Abigail Seybert*; Anthony Tan**
Mentor(s): Kristen Bellisario

1026 *Keila Jellings†*
Mentor(s): Leonor Chagas Boavida

1027 *Ashwin Kidambi†*
Mentor(s): Liang Pan; Justin Weibel; Zekun Wu

1028 *Delaney Knipstein†*
Mentor(s): Annabelle Atkin

1029 *Courtney Lacy†; Mary Noonan†*
Mentor(s): Nilupa Gunaratna; Savannah O'Malley; Yumary Ruiz; Jason Reed; Ramya Ambikapathi

1030 *Ryan Lee†*
Mentor(s): Ryan Altman; Andrew Intelli

1031 *Kathryn Lund†*
Mentor(s): Yang Yang; Brody Deming; Jingliang Zhang

1032 *Anne Malott†; Kritika Kumar†; Logan Kitts‡*
Mentor(s): Gudrun Schmidt

1033 *Rashmika Manipati†*
Mentor(s): Nusrat Jung; Brandon Boor; Jordan Cross; Brian Magnuson

1034 *Tristan Marta†; Yu-Chun Lin†; Kyung Jun Lee†*
Mentor(s): Pramey Upadhyaya; Abhishek Solanki

1036 *Nathaniel Mathew†*
Mentor(s): Michael Johnson

1037 *Kathryn McCauley†*
Mentor(s): John Tesmer; Priyanka Naik

1038 *Mikey Paulson†*
Mentor(s): Michael Johnson

1039 *Quinn Phillips†*
Mentor(s): Karen Byrd; Lucheng Wang

1040 *Ariane Rednour†*
Mentor(s): Nusrat Jung; Hongbo Lu

1041 *Prudence Regacho†*
Mentor(s): Kristine Marceau

1042 *Hannah Reyes†; Abigail Seybert*; Anthony Tan*; Luca Iacobucci*; Sierra Hunnicutt**
Mentor(s): Kristen Bellisario

1043 *Kenneth Rodriguez-Lopez†*
Mentor(s): Shalini Low-Nam; Kevin Scrudders; Suriya Selvarajan

1044 *Miray Simsek†*
Mentor(s): Kristin Whitney; Kalpana Bhatt

1045 *Diya Singh†*
Mentor(s): Wenzhuo Wu; Pedro Henrique de Souza Barbosa

1046 *Sydney Sneed†*
Mentor(s): Scott Pluta; Hayagreev Keri

1047 *Yubo Song†*
Mentor(s): Tiwei Wei

1048 *Anika Sood†*
Mentor(s): Daniel Szymanski

1049 *Alexa Striebeck†*
Mentor(s): Victoria Lowell; Youli Mantzicopoulos-James; Hannah Kim

1050 *Daanish Suhail†; Benjamin Hodonicky†; Phone Paing†; Kshitij Shah†; Zafeer Reza†; Shao-Yuan Chang†*
Mentor(s): Chih-Chun Wang; David Love; James Krogmeier

1051 *Yunlei Tang†; Danhe Tang†*
Mentor(s): Matthew Lanham

1052 *Dhanush Tipparaju†; Alex Nishio†; Alex Lai‡; Miles Flippin‡; Zihan Lin‡; Jayson Stansbury*; Ruoyi Li**
Mentor(s): Abolfazl Hashemi; Zijian He; Shivam Bhat

1053 *Aditya Tiwari†; Jason Becker†; Rezza Hadian†; Gino Daniels†*
Mentor(s): Andreas Jung; Lingqiang He

1054 *Griffin Tresse†*
Mentor(s): Julia Chester; Alisha Aroor

1055 *Ariadin Vest†; Thomas Slamecka†; Cade Rigg†; Parvesh Venugopallavanya†; Braden Garretson‡*
Mentor(s): Danny Milisavljevic; Braden Garretson

1056 *Nicole Wang†; Asav Gandhi†; Stephen Fetterman†*
Mentor(s): Mark Johnson; Sutton Hathorn

1057 *Christian (Casey) Ward†; James Strayhorn†; Liam Gallegher†; Richie Tan†*
Mentor(s): Husheng Guan

1058 *Katherine Yi†*
Mentor(s): Leanne Nieforth

1059 *Xinmeng Zhou†*
Mentor(s): Youli Mantzicopoulos-James

POSTER SESSION 2 | 10:30AM-11:30AM

1200 *Rebeca Appelmann†*
Mentor(s): Shalamar Armstrong; Frank Johnson

1201 *Ilan Benschikovski†; Ishaan Rath†*
Mentor(s): Mark Johnson; Cole Nelson

1202 *Amelia Binau†*
Mentor(s): Andreas Jung; Hans Dembinski

1203 *Lorenzo Cacciapuoti†*
Mentor(s): Mark Johnson; John Peterson

1204 *Indrayudh Chowdhury†*
Mentor(s): Mark Johnson; Rauf Erkiletlioglu

1206 *Aya Elsawy†*
Mentor(s): Ignacio Camarillo

1207 *Jacob Eyster†*
Mentor(s): Jonathan Shannahan; Arjun Pitchai; Li Xia; Amber Jannasch; Bruce Cooper

1208 *Paige Fulkerson†*
Mentor(s): Kris Acheson-Clair; Phuong Tran; Alankrita Chhikara

1209 *Eric George†*
Mentor(s): Jeffrey Simpson; Suresh Annangudi

1210 *Evelyn Girardi†*
Mentor(s): Robin Tanamachi

1211 *Morgan Gyger†; Brandon Mar†*
Mentor(s): Kari Clase

1212 *Joshua Harp†; Jason Cachur†; Olivia Phillips†; Ashley Lund†; Annabelle Nelson†; Kirsten Strout‡; Hannah Negash‡; Kellyn Bucceri‡; Reagan Fahey‡; Chris Parrett‡*
Mentor(s): Laura Moffat; Katharine Czech; Alec Pannunzio

1213 *Daniel Hristov†*
Mentor(s): Julia Laskin; Hugo Samayoa-Oviedo

1214 *Guillaume Hu†; Ronit Nallagatla†; Ansh Patel†; Zachary Lagpacan†*
Mentor(s): Mark Johnson; Tim Rogers; Abinands Ramshanker

1215 *Joshua Hyatt†; Atharv Bhatter†; Ethan Farkas†; Austin Lee†; Stephen Widjaja†; Evan Cahoon†; Alejandro Diaz Contreras†; Mahineer Ghosh†; Parth Karande†*
Mentor(s): Charles D'Onofrio

1216 *Future Jani†; Emma Jeffries‡*
Mentor(s): Gudrun Schmidt

1217 *Temirlan Karataev†; Tim Nadolsky‡; Shrish Senthilkumar‡; Caasi Boakye*; Tanin Padungkirtsakul*; Guanxi Zhou**
Mentor(s): Yung-Hsiang Lu; Kristen Yeon-Ji Yun

1218 *Claire Keirn†*
Mentor(s): Jennifer Brown; Stephen Beegle; Sofia Rubi; Luis Gomez

1219 *Junhyeok Kil†*
Mentor(s): Eduardo Barocio

1220 *Carolina Kim†*
Mentor(s): GuangJun Zhang; Ziyu Dong

1221 *Seongyun Kim†*
Mentor(s): Garam Kim; Sungjun Choi

1222 *Mikayla Klemp†*
Mentor(s): Kirstin Gotway; Lana Newhart-Kellen

1223 *Andree Kolliegbo†*
Mentor(s): Nadia Lanman

1224 *Dominic LaRouche†*
Mentor(s): Elena Benedicto; Kathleen Wagner

1225 *Ju Na Lee†*
Mentor(s): Wenzhuo Wu; Ruifang Zhang

1226 *Simon Lin†; Ryan Seller†; Matt Elliott†*
Mentor(s): Garam Kim; Jacob Montrose; Timothy Ropp

1227 *Ethan Lu†; Colby Acton†; Vinay Jagan†; Marvin Lim†; Ruth Sugiarto†; Weicheng Lee†; K Annapoorna Prabhu†; Yi-Ruei Weng†; Suraj Kadajji*; Alex Beuerle**
Mentor(s): Qiang Qiu; Wei Zakharov; Zichen Miao

1228 *Avery Mann†*
Mentor(s): Sarah Eason

1229 *Shamiso Marondera†; Brynne Mills†*
Mentor(s): Elena Benedicto; Eunice Opoku

1230 *Audrey Middaugh†*
Mentor(s): Annabelle Atkin; Nathan Lieng; Rich Lee; Amelia Blankenau

1231 *Cole Murphy†; Sean Wall†; Bornik Nag†; Fabiana Correa†*
Mentor(s): Robin Carpenter

1232 *Brian Ng†; Haichang Li†; Samantha Sudhoff†; Tim Nadolsky*; Joshua Kamphuis**
Mentor(s): Kristen Yeon-Ji Yun; Yung-Hsiang Lu

1233 *Haley Oliver†*
Mentor(s): Chris Rochet; Bryce Colon; Aswathy Chandran

1234 *Aditya Pillai†*
Mentor(s): Sidney Ducleroir

1235 *Alana Powell†; Oluwapamimo J. Fafowora‡; Anayra Maldonado‡*
Mentor(s): Kathryn LaRoche; Sophie Shank

1236 *Adithi Praveenkumar†; Ishaan Bajpai†; Julia Dolpies†; Brian Qi†*
Mentor(s): Santiago Arias

1237 *Santosh Ramesh†*
Mentor(s): Wenzhuo Wu; Robert Ccorahua

1238 *Jared Robbins†; Taylor Clark‡; Sarah Keller‡; Liam Robinson‡; Lukas Hecht**
Mentor(s): Kristen Bellisario

1239 *Rahul Saproo†; Rohan Aryan†*
Mentor(s): Seema Mattoo; Sherlene Brown

1240 *Roxanne Schwab†*
Mentor(s): Beate Allert

1241 *Reva Simmons†; Harry Lee‡*
Mentor(s): Garam Kim

1242 *Prisha Singhal†; Mahad Faruqi†; Nathon Tubbs**
Mentor(s): Ali Shakouri; Jabir Jahangir

1243 *Jack Snelling†; Paraj Goyal†*
Mentor(s): Tho Le

1244 *Jacob Strietelmeier†; Alex Carroll†; Akshith Karri†*
Mentor(s): Andreas Jung

1245 *Maia Talbert†; Ana Rojas†*
Mentor(s): Pamela Sari; Manabu Taketani; Stewart Chang Alexander

1246 *Summer Thomlison†*
Mentor(s): Alex Pasternak; Alyssa Smith; Devon Anderson

1247 *Benjamin Traylor†; Joel Jarrett†; Joon Kang†*
Mentor(s): Jim Tanoos

1248 *Caelan Tucker-Camou†; Tayden White†; Anirudh Emani†; Aryan Jumani†*
Mentor(s): Andreas Jung; Robin Carpenter

1249 *Jacob Valdez†; Sayantan Mukhuti†; Swami Karunakaran†*
Mentor(s): Karen Marais

1250 *Katherine Veth†*
Mentor(s): Bill Truitt; Andrew Burke

1251 *Vincent Wang†; Jacob Valdez‡; Gabriel Oliviera‡; Josh Mansky‡; Max Lantz‡; Katie Kneeland‡*
Mentor(s): Alina Alexeenko; Tony Cofer; Steven Pugia; Jesus Meza-Galvan

1252 *Elena Warble†; Anaelle Gackiere†; Mattia Moran†; Elainna Papandrea†; Marissa Santia†; Abigail Rosborough†; Jack Bonnell†; Aneesh Poddutur†; Subbi Sathya†; Katharine Czech‡*
Mentor(s): Laura Moffat

1253 *Bruce Ward†*
Mentor(s): Jeff Lucas; Jonathan Jenkins

1254 *Tayden White†*
Mentor(s): Michael Johnson

1255 *Cecilie Wiuff†; Dhruv Sharma†; Castor Yuan†*
Mentor(s): James Garrison

1256 *Daniel Zou†*
Mentor(s): Severin Schneebeli; Anthony Mena

POSTER SESSION 3 | 12:00PM-1:00PM

1400 *Mukul Agarwal†; Mayank Hothur†; Kodiak Ortiz†; Isaac Mei†; Branden Cho†; William White†; Daniel Yang†; Sanya Dod‡; Joshua Kamphuis‡*
Mentor(s): Yung-Hsiang Lu; Kristen Yeon-Ji Yun

1401 *Lillian Andis†*
Mentor(s): Alex Pasternak

1402 *Nathan Arnold†; Jatin Soni†; Alexander Eiguren†; Alan Chao†; Grant Sims†; Om Muthyala†*
Mentor(s): James Goppert; Nicole Adams; Kong

1403 *Kara Benbow†; Gabriela Surdyka†*
Mentor(s): Joe Kokini; Harrison Helmick

1404 *Tori Burke†; Roma Kamat‡*
Mentor(s): Julia Chester; Soyol Enkh-Amgalan

1405 *Adrian Calderon†*
Mentor(s): Gaurav Nanda

1406 *Jacob Chappell†*
Mentor(s): Mark Johnson

1407 *Arunima Chowdhury†; Esharaqa Jahid†; Sami Zagha†; Mert Ryan Kiroglu†*
Mentor(s): Renee Murray; Frederick Berry

1408 *Nicholas Cline†*
Mentor(s): Yan Xin

1409 *Peyton Dow†*
Mentor(s): Sidney Ducleroir

1410 *Avi Dube†; Isaac Fuksman†; Peter Zakariya†; Sully Cisco‡; Rishabh Agarwal‡; Justin Gan‡; Derek Matthei‡; Annie Mitten‡; Renee Patton‡; Dinesh Ruben‡*
Mentor(s): Shreyas Sundaram; Younggil Chang

1411 *Delilah Flora†*
Mentor(s): Harm HogenEsch; Ahmed Hassan; Raluca Ostafe

1412 *Alaina Gartner†; Keila Jellings‡*
Mentor(s): Leonor Chagas Boavida

1413 *Anjali Gupta†*
Mentor(s): Bryan Duarte

1414 *Denison Guvenoz†; Avery Kruppe†*
Mentor(s): Sooyeon Jeong; Dong Won Lee

1415 *Jaya Hari†; Dheepa Hari†; Alice Dragnea†; Junpei Ota†; Aryan Srivastava†; Natasha Gundapaneni‡; Sarah Sawhney‡*
Mentor(s): Yung-Hsiang Lu; Jiwoo Rachel Kim; Worawis Sribunma

1416 *Alden Hartman†*
Mentor(s): Sidney Ducleroir

1417 *Timothy Hein†; Miguel Isrrael Teran†*
Mentor(s): Mark Johnson; Conor Green; Swapnil Bansal

1418 *Allison Herr†; Duc Le†; Vicky Zheng†; Ethan Lin†; Devin Reynolds†; Yen-Hsi Lai†; Sienna Moon*; Linda Zou*; Kayla Gaerte**
Mentor(s): Laura Moffat; Katharine Czech; Alec Pannunzio

1419 *Cami Howard†*
Mentor(s): Julia Chester; Soyol Enkh-Amgalan

1420 *Kyochul Jang†; Jacob Carroll†; Ilhoon Lee†; David Cho†; David Lender†*
Mentor(s): Matthew Swabey

1421 *Mateusz Jaszczuk†*
Mentor(s): Akshay Jacob Thomas

1422 *Yuvraj Jhanwar†*
Mentor(s): Michael Johnson

1423 *Megan Johnson†; Rafaela Besse†*
Mentor(s): Andrew DeWoody; Natalie Allen

1424 *Christine Kaylor†*
Mentor(s): Tugba Karabiyik

1425 *Mingyu Kim†; Heesoo Kim†*
Mentor(s): James Davis; Wenxin Jiang

1426 *Anna Klupshas†; Emanuel Borror†; Timur Uxukbayev†; Quinten Sanders†*
Mentor(s): Andreas Jung; Lingqiang He; Amelia Binau

1427 *William Koppin†*
Mentor(s): Sidney Ducleroir

1428 *Partth Kulkarni†*
Mentor(s): Sidney Ducleroir

1429 *Aditya Kuniyil Kattil†*
Mentor(s): Sidney Ducleroir

1430 *Max Lantz†; Jacob Valdez†; Josh Mansky†; Gabriel Oliveira†; Vincent Wang†; Katie Kneeland†*
Mentor(s): Jesus Meza-Galvan; Steven Pugia; Tony Cofer; Alina Alexeenko

1431 *Felix Li†*
Mentor(s): Michael Johnson

1432 *Jiawe Li†*
Mentor(s): Zhihong Chen; Joerg Appenzeller

1433 *Kenneth Liendo†; Darbin Oh†; Benjamin Tofil†; Gangsan Lee†; Ryan Bailey†; Ho Jun Lee†; Jensen Lee†; Jiawei Li†; Armaan Kanchan†; Joshua Kim‡; Lyu-Jia Su‡; Cheng-En Yeh‡; Brett Chen‡*
Mentor(s): Zhihong Chen; Joerg Appenzeller; Richard Harlan; Ronald Reger

1434 *Sydney Ludwig†; Sophia Vargas*; Jackson Murray**
Mentor(s): Nathan Cheek

1435 *Eric Luscher†*
Mentor(s): Eduardo Barocio; Pasita Pibulchinda; R Byron Pipes

1436 *Jenna Ma†*
Mentor(s): Michael Johnson

1437 *Camila Andrea Martinez Montes†*
Mentor(s): Eduardo Barocio; R Byron Pipes; Garam Kim

1438 *Stephen Mills†*
Mentor(s): Chris Oakley

1439 *Areej Mirani†; Zihao Ye‡; Brandon Orbach‡; Sejal Kumar‡*
Mentor(s): Yung-Hsiang Lu

1440 *Andrew Modin†; Daniel Wu†; Mariam Ghoneima†; Brogan Holt†; Max Cervantes†; Catherine Mayer†; Dylan Hall†; Zach Tan†; Josh Beigel†; Hey Chuck Lo†*
Mentor(s): John Sheffield

1441 *Jason Packard†*
Mentor(s): Ethan Adams

1442 *Patrick Pannier†; Sierra Norris†; Jackson Murray*; Sydney Ludwig*; Michelle Zhao**
Mentor(s): Nathan Cheek

1443 *Sucheta Parthasarathy†*
Mentor(s): Sidney Ducleroir

1444 *Rohini Pillai†*
Mentor(s): Michael Johnson

1445 *Matthew Pung†*
Mentor(s): Lisa Bosman

1446 *Paulo Ramirez†; Tejas Kamdi†; Yahor Lechanka†; Benjamin Roeder†; Shreya Sandu†; Matt Wheeler†*
Mentor(s): Alina Alexeenko; Jesus Meza-Galvan; Steven Pugia

1447 *Zachary Ramirez†; Shams Hoque†*
Mentor(s): Tho Le

1448 *Sejal Rhodes†; Paul Ulrich*; Sarah Pushparaj**
Mentor(s): Wenzhuo Wu; Pedro Henrique de Souza Barbosa

1449 *Nemisa Samanthapudi†*
Mentor(s): Tho Le

1450 *Vinayak Shankar†*
Mentor(s): Yang Yang; Maria Olivero-Acosta

1451 *Lauren Spedale†; Teagan Drumm†*
Mentor(s): Breanya Hogue

1452 *Amogha Tejas Sunkara†*
Mentor(s): Michael Johnson

1453 *Ethan Szajko†; Maria Camila Escobar Herrera†*
Mentor(s): Daniel Szymanski; Alexander Howell

1454 *Daiana Valenzuela†*
Mentor(s): Eduardo Barocio; R Byron Pipes; Garam Kim

1455 *Jackson VonBlon†*
Mentor(s): Chris Rochet; Magaly Guzman Sosa

1456 *Alexander Walters†*
Mentor(s): Michael Johnson

1457 *Qiaoqiao Wang†; Huimin Gai†*
Mentor(s): Youli Mantzicopoulos-James

1458 *Francesca Werner†*
Mentor(s): Michael Johnson

1459 *Jiaming Zhang†*
Mentor(s): Holly Wang

1460 *Brooklynn Fugate†; Erin Kramer†; Arpita Rattan†*
Mentor(s): Amy Reibman; Haoyu Chen

POSTER SESSION 4 | 1:30PM-2:30PM

1600 *Mohammad Alfaili†*
Mentor(s): Zijian He; Shivam Bhat

1601 *Megan Ashby†*
Mentor(s): Alex Pasternak

1602 *Ryland Barton†*
Mentor(s): Laura Bowling; Dongseok Yang

1603 *Andrew Behl†; Benjamin Dravis†; Thomas Greer†; Matthew Tolla†*
Mentor(s): Shivam Bhat; Zijian He

1604 *Sarah Bennett†*
Mentor(s): Qixin He; Pavel Klimov

1605 *Veronica Brems†*
Mentor(s): Deniz Besiktepe; Sogand Hasanzadeh

1606 *Josie Bull†; Grace Gilbert†; Lourdes Bengero*; Samantha Katovich*; Catherine Kruger**
Mentor(s): Jennifer Hall

1607 *Isabella Carpenter†*
Mentor(s): Sidney Ducleroir

1608 *Hannah Carreon†; Sarah Eyles†; Anne Gilhooly†; Simran Zaveri†*
Mentor(s): Jennifer Brown; Stephen Beegle; Sofia Rubi

1609 *Yen Jung Chen†; Seungkeun Oh†*
Mentor(s): Sam Labi; Shreya Ghosh

1610 *Annabella Chen†*
Mentor(s): Henry Chang

1611 *Ashish Chenna†; Ayusha Patra†; Aarav Kumar†*
Mentor(s): Andreas Jung; Robin Carpenter

1612 *Piyush Chhallare†; Angela Mao‡; Michael Wang‡*
Mentor(s): Andreas Jung; Lingqiang He

1613 *Sydney J. Clifford†; Ella Rose D. Chianis‡*
Mentor(s): Brittany Allen-Petersen; Claire Pfeffer; Jennifer P. Morton; Jukka Westermarck

1614 *Matthew Corson†; Sofia Schumann‡*
Mentor(s): Jason Cannon; Fatema Currim; Josephine Brown; Reeya Tanwar

1615 *Vamsi Deeduvanu†; Joseph Carrig†; Aryan Khanolkar†*
Mentor(s): Ali Shakouri; Martin Jun; Jiho Lee; Junyi Yuan; Yuseop Sim

1616 *Quan Dinh†; Pratheek Kotla**
Mentor(s): Hua Cai; Zhuoli Yin; Laura Almeida Tinjaca

1617 *Indiraa Doraivel†*
Mentor(s): Brittany Allen-Petersen; Garima Baral; Claire Pfeffer

1618 *Hanna Ertel†; Jaehyuk Lee†; Sejal Kumar†; Paolo Gumasing†*
Mentor(s): James Ogg; Aaron Ault

1620 *Roy Galazka†; Logan Carleton‡; Aniruddh Srivastava‡; Dhiresh Himthani‡*
Mentor(s): Sayan Ghosh; Husheng Guan

1621 *Alyson Godwin†; Lara Staton**
Mentor(s): Guri Johal

1622 *Brandon Goeppner†*
Mentor(s): Shreya Ghosh

1623 *Xinyi Guan†; Jon Kouki Saathoff†*
Mentor(s): Jan Allebach; Xiaoyu Ji

1624 *Alex Hartman†; Jasper Hochbaum‡; Drake Hagerman‡; Mohammed Khan‡; Ella Goodrich‡; John Min‡; Grace Gellatly‡*
Mentor(s): Shreya Ghosh

1625 *Katherine Hutzel†*
Mentor(s): Daniel Suter; Paola Rodriguez

1626 *Grace Kuntz†*
Mentor(s): Sidi Deng

1627 *Jordan Larson†*
Mentor(s): Alexander Wagner

1628 *Ann Zi Lau†; Mohammed Rafi†; Gokulkrishnan Harikrishnan†; Varun Gannavarapu†; Richard VonTersch†; Michael Fuchs†; Pranay Jaggi†; Roan Numa†; Praneel Bhandari†*
Mentor(s): Abinands Ramshanker; Mark Johnson

1629 *Kenzie Lawhorn†; Samuel J Gray‡; Mila Opacich‡; Amos Buschkoetter‡*
Mentor(s): Randolph Hubach; Brendan Bowns; Stewart Chang Alexander

1630 *Aditi Lohar†*
Mentor(s): Betsy Parkinson; Amir Alwali; Carson Roberts

1631 *Erica Long†*
Mentor(s): Tim Johnson; Jacquelyn Boerman; Isabela Garcia Mendes de Araujo Santos; Madison Simonds

1632 *Luke Luschwitz†; Abhilash Saravana†; Chaeeun Kim†; Sam Desai†; Selina Li†; Nikhita Madhavan‡*
Mentor(s): Edward Delp

1633 *Anika Mathur†; Matthew Roxas†; Chingwo Cheung†; Arin Asawa†; Lourdes Ignacio†*
Mentor(s): Edward Delp; Carla Zoltowski

1634 *Mia May†; Sho Amagai†*
Mentor(s): Severin Schneebeli; Kyle Faivre

1635 *Sahda Mohammadu Haroon†*
Mentor(s): David Warsinger; Sudharsh Anandan

1636 *Amir Mokhtarpour†; Yash Mishra†; Yilin Xu†; Sahil Mitra†; Cade Edward Shock†; Siddarth Calida†; Matthew Robert Walter†; Jerry Chen†*
Mentor(s): Mark Johnson; Jude Pinto; Cole Nelson

1637 *Rebecca Mold†*
Mentor(s): Eun Joong Oh; Fransheska Semidey

1638 *Jack Morehouse†*
Mentor(s): Jason Hoverman; Devin Jones

1639 *Tess Obuchowski†*
Mentor(s): Mike Eddy; Disha Okhai; Ryan Ickert

1640 *Heemir Patel†*
Mentor(s): Michael Johnson

1641 *Victoria Patellos†*
Mentor(s): Kimberly Kinzig; Dan Foti

1642 *Nicholas Pecoraro†; Shane Limas†*
Mentor(s): Jae Hong Park; Chang G. Lee

1643 *Stanislav Pelipad†*
Mentor(s): Lucas Cohen

1644 *Vinh Pham Ngoc Thanh†; Eduard Tanase†; Vignesh Charapalli†; Connor Behrend†; Zeyad Aljaali*; Vaibhav Turaga**
Mentor(s): Aravind Machiry; Fabiha Hashmat

1645 *Sarah Pushparaj†; Paul Ulrich†; Sejal Rhodes†*
Mentor(s): Wenzhuo Wu; Pedro Henrique de Souza Barbosa

1646 *Misha Sachdeva†*
Mentor(s): Michael Johnson

1647 *Felipe Sandoval†; Georgia Griffin†; Ben Eng†; Victoria Chen†; Nicholas Helushka†; Naren Rachapalli†*
Mentor(s): Thomas Roth; Samuel Elkin; Soomin Moon

1648 *Abby Seybert†; Luca Lacobucci*; Anthony Tan*; Sierra Hunnicutt*; Hannah Reyes Charles**
Mentor(s): Kristen Bellisario

1649 *Melody Shimba†*
Mentor(s): Danny Milisavljevic; Daniel Bardayan

1650 *Colby Smock†*
Mentor(s): Aaron Thompson

1651 *Anthony Tan†; Luca Lacobucci*; Sierra Hunnicutt*; Hannah Reyes Charles*; Abigail Seybert**
Mentor(s): Kristen Bellisario

1652 *Amy Tong†; Tejasvi Nallagundla†; Siddhant Tandon†; Josh Chang†*
Mentor(s): Dave Barbarash

1653 *Anjali Vanamala†*
Mentor(s): Tzu-Wen L. Cross; Anna Clapp Organski; Abigayle M. R. Simpson; Kimberly Kinzig

1654 *Mary Vaughan†; Riley Arnholt†; Sunehra Saleha†; Chengyu Chiu†; Feichi Huang‡*
Mentor(s): Peter Bermel; Saeed Mohammadi

1655 *Sofia Vogt†*
Mentor(s): Michael Johnson

1656 *Vlada Volyanskaya†; Kabir Batra†; Shubham Shrivastava**
Mentor(s): Di Qi; Wen-wen Tung; Rishabh Gupta

1657 *Gwyneth Wong†; Allison Peterson†; Emelia Koester†; Anna Leah**
Mentor(s): Stephanie Gardner; Jill Cornell

1658 *Yu-Xuan Yang†; Franco Harding†; Siddhart Gaur†*
Mentor(s): Zhihong Chen; Saeed Mohammadi

1659 *Phoebe Zhou†; Mustafa Albahrani†; Raymond Glowner†*
Mentor(s): Danny Milisavljevic; Ziwei Ding

Poster Presentation Abstract Number: 1000
Presentation Time: Session 1: 9:00am-10:00am

Gig vs. Conventional Work: Job and Life Satisfaction Levels of Workers Involved in Two Lines of Work

Social Sciences/Humanities/Education

Author(s):

Julieta Aguilar† (HHS, Liberal Arts)

Abstract:

Many studies have aimed at determining the level of satisfaction of workers across occupations and settings (Brown et al., 2012; Wheatley, 2017; Wu & Zhou, 2022; Zou, 2015). However, among those studies, only a few have been interested in the differences in satisfaction between those who have conventional jobs and gig workers (Bhattacharya & Shepherd, 2021; Spreitzer et al., 2017). Gig workers are defined as those who engage in short-term arrangements through online platforms. Our research comes from survey data collected from workers on Amazon Mechanical Turk (simple online tasks) who also indicated they had a conventional job. Then we determined their levels of satisfaction with each while controlling for any worker characteristics that could have an effect. Our results indicate that respondents report lower satisfaction levels with their gig employment than in their conventional job and that both are correlated with life satisfaction at similar levels even after controlling for several variables. We also found that the extent to which work, and life satisfaction are related is different for respondents depending on the age and presence of children in the household. While previous studies have implied that gig workers are more satisfied with their gig employment than with conventional jobs due to the autonomy and freedom to choose their schedule, our results contradict this theory, providing a new understanding of the satisfaction levels of gig workers. Future research should examine the relationship between satisfaction with gig vs. conventional work on other online gig platforms.

Keywords: Gig Work, Conventional Job, Job Satisfaction, Life Satisfaction

Mentor(s):

Jeremy Reynolds (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1001
Presentation Time: Session 1: 9:00am-10:00am

Implementation of Integrated Infectious Disease Care and Substance Use Disorder Treatment: Review and Implications

Social Sciences/Humanities/Education

Author(s):

Abdulrazzaq Altararwa† (HHS); Elizabeth Lawson† (HHS, Liberal Arts); Alexandra Wildridge† (Agriculture, HHS, JMHC)

Abstract:

Disparities in healthcare access and providers’ gaps in knowledge prevent individuals with substance use disorders (SUD) from receiving effective treatment for co-occurring infectious diseases. Ongoing substance use damages the immune system and intensifies viral replication in infectious diseases (e.g., HIV); despite this, there are limited interventions that simultaneously treat infectious diseases and SUD.

The purpose of this literature review was to examine studies that implemented integrated care models of infectious diseases and SUD treatment and discussed associated implications for these care models.

Articles were found using PubMed databases. Studies met inclusion criteria if they studied integrated care models of infectious disease and SUD treatment or discussed recommendations regarding the implementation of these models.

The review included 6 articles, one qualitative study, one cohort study, one systematic review, a theoretical paper and two cross-sectional surveys. According to results in Serota et al. (2022) patients with severe injection-related infections (SIRI) treated by SIRI-dedicated teams were more likely to receive medication for opioid use disorder (MOUD) (93.2% vs 32.9%, p<.01). Based on our analysis, the SIRI team was the most effective integrated care model.

We examined the effectiveness of and preferences for integrated care models for infectious diseases and SUD treatment. Our findings suggest that the SIRI team is effective for improving treatment outcomes and providing MOUD to patients. Patients also preferred integrated care models compared to traditional SUD treatment. Further work should examine the effectiveness of integrated models through randomized controlled trial methodology to effectively implement them in other areas

Keywords: Infectious Disease, Integrated Care Model, Substance Use Disorder

Mentor(s):

Jennifer Brown (HHS); Stephen Beegle (HHS); Luis Gomez (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1002
Presentation Time: Session 1: 9:00am-10:00am

Exploring Protein-bound Chlorophyll a's Vibrational Spectrum at Room Temperature Through Microsampling and Isotope Substitution

Life Sciences

Author(s):

Sarah Alvarez† (Agriculture, Science); Sajal Salim‡ (HHS)

Abstract:

Photosynthetic proteins have been optimized by evolution to provide for organisms' growth and survival; however, they are inefficient on a large scale, which is needed for biofuel production. By understanding the optical properties of chlorophyll-protein interactions we can manipulate these interactions and make light harvesting more efficient through site-directed mutagenesis. This research focuses on isolating the vibrational spectrum of chlorophyll a in a model protein environment. We focus in particular on the 1650-1700 cm-1 region, which provides us with information about chlorophyll-protein hydrogen interactions. Unfortunately it is masked by a protein peak, thus making it difficult to analyze the vibrational spectra of chlorophyll a. Preliminary measurements show a vibrational signal, but it is partially obscured by the protein vibrational background. Current experiments aim to use isotope substitution and microsampling to eliminate the protein vibrational signal and provide a clean window on chlorophyll vibrational properties in native proteins.

Keywords: Photosynthesis, Vibrational Spectroscopy, Chlorophyll, Mutagenesis

Mentor(s):

Mike Reppert (Science); Jacob Hnatusko Wat (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1003
Presentation Time: Session 1: 9:00am-10:00am

Microwave-aided Early Detection of Congestive Heart Failure

Mathematical/Computation Sciences

Author(s):

Aditi Anand† (Engineering); Amrutha Vaidyam† (Science); Adithya Chandrasekar‡ (Science); Christin Huene‡ (Engineering, JMHC)

Abstract:

We propose a microwave-based framework for the early detection of congestive heart failure (CHF). CHF is often diagnosed by the appearance of accompanying pulmonary edema. Current approaches, most commonly chest radiographs, can only detect high levels of pulmonary edema, limiting their capability to diagnose CHF at an early stage. Our method is based on the observation that microwaves passing through the thoracic cavity experience significantly higher attenuation in the presence of fluid. Our detection method consists of a microwave source in the form of a two-dimensional array of low-power emitters placed on one side of the thoracic cavity, a corresponding array of receivers on the other side, and signal processing to compute the attenuation of microwaves as they pass through the body. We develop an electromagnetic simulation model to evaluate the proposed method and apply it to compute microwave attenuation in the absence and presence of various levels of pulmonary edema. Our experiments suggest that the method is sensitive to even mild and moderate levels of pulmonary edema that are difficult to detect using current first-line diagnostic methods. Our work makes a case for microwave-based detection as a safe, low-cost diagnostic method for CHF at earlier stages where there is a good potential for improved patient outcomes.

Keywords: Congestive Heart Failure, Early Detection, Pulmonary Edema, Microwave Imaging, Cardiovascular Imaging

Mentor(s):

Somali Chaterji (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1004
Presentation Time: Session 1: 9:00am-10:00am

The Feasibility and Future of Semiconductor Manufacturing

Innovative Technology/Entrepreneurship/Design

Author(s):

Ethan Baird† (Engineering, JMHC)

Abstract:

Following the rise of the CHIPS and Science Act and the increased interest in the semiconductor market, more students are focusing on semiconductor development. This project compares the current and past feasibility of students in a college setting being able to create their own custom Application-Specific Integrated Circuits (ASICs) designs and provides insight into future steps that will continue to grow interest in the field by targeting high school students with unique projects.

Keywords: Semiconductors, Manufacturing, Feasability, Students

Mentor(s):

Mark Johnson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1005
Presentation Time: Session 1: 9:00am-10:00am

Global Lexicon: Your Window to the Past

Innovative Technology/Entrepreneurship/Design

Author(s):

Samyukta Balaji† (Engineering); Aditya Sivathanu† (Engineering); Ava Fasano† (DSB); Cassidy Brown† (DSB)

Abstract:

The Global Lexicon is an extensive database to facilitate the exploration and understanding of geological formations around the world. The associated websites allow users to access detailed geological information and visual representations of various formations using models of the ancient Earth. We have added a user-friendly homepage as a central hub connecting all the individual lexicon websites, thereby ensuring convenient access to geological data from different regions across the globe. Users can effortlessly navigate this repository of knowledge through a clickable world map, which grants access to a wide array of geological information from diverse locations, such as Africa, Niger, Qatar, South America, China, the Middle East, Thailand, Vietnam, Belgium, and Panama. The Global Lexicon is a powerful resource that empowers users to gain a deeper appreciation for our planet's natural history.

Keywords: Geospatial Database, User-Friendly Interface, Visual Representations, Interactive World Map, Geological Data Repository

Mentor(s):

Aaron Ault (Science); James Ogg (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1006
Presentation Time: Session 1: 9:00am-10:00am

Autonomous Vehicles and Their Impact on The Automotive Industry

Innovative Technology/Entrepreneurship/Design

Author(s):

Joe Basti† (DSB); Grant Capps‡ (DSB); Eric Wang‡ (Unknown); Mario Arenas‡ (DSB); Max Kerkho‡ (DSB)

Abstract:

The purpose of this study was to understand what affect autonomous vehicles will have on the world, especially the automotive industry. Through research on traffic patterns, mobility, travel duration, maintenance costs, environmental impact, safety implications, employment shifts, and infrastructural adaptations, several key insights have emerged. When researching traffic and travel time, we found that clear and concise results were hard to come by. All the concrete data that has been published related to simulations only. Maintenance expenses are anticipated to rise due to the sensitivity and high-cost sensors integral to autonomous vehicles, projected to be approximately two and a half times higher than non-autonomous cars. Infrastructure will require substantial change, mainly increased cybersecurity measures and the implementation of an advanced sensor infrastructure. Roads and highways will require updated paint and street signs so these autonomous cars always know where they are, and always know what to do. After conducting research on how the market is going to be affected by autonomous vehicles, we concluded that the industry will make a big shift. The traditional manufacturing jobs are going to be lost, however, there will be a surge in jobs related to technology (software, sensors, AI, etc.). Professions directly tied to driving are anticipated to face significant job displacement, particularly in sectors like trucking and public transportation. In relation to safety, 94% of crashes are due to human error. Also, these vehicles will have increased safety measures to prevent crashes before they happen. Therefore, through autonomous driving, crash rates would naturally decrease substantially. This study concludes that the future of autonomous vehicles will promise a transformative shift in the automotive industry, as well as the transportation industry as a whole.

Keywords: Autonomous Vehicles, Automotive Industry, Technology

Mentor(s):

Shreya Ghosh (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1007
Presentation Time: Session 1: 9:00am-10:00am

Design and Synthesis of CD38-Targeting Ligands for Multiple Myeloma

Life Sciences

Author(s):

Emma Benefiel† (Science)

Abstract:

Multiple Myeloma (MM) is a type of blood cancer where hypersomatic mutations in plasma cells of the immune system lead to the clonal expansion of these mutated plasma cells that secrete aberrant antibodies. The disease begins in the bone marrow and eventually progresses to extramedullary indications. Further disease progression leads to kidney failure, anemia, osteolytic lesions and ultimately death. To date, there is no known cure for Multiple Myeloma. Current treatment is designed to reduce the number of malignant plasma cells, symptom management and palliative care in patients.

One of the challenges in formulating effective treatments for MM is the highly immunosuppressive bone marrow (BM) microenvironment in MM. The BM microenvironment is primarily responsible for the short-lived effects of current MM therapies and the high rate of relapse and refractory MM. The BM microenvironment in MM has a high concentration of Adenosine (ADO). ADO is the product of an ecto-enzymatic cascade on the stromal and plasma cells in the BM. One of the ecto-enzymes is CD38, also known as cyclic ADP ribose hydrolase. CD38 has hydrolase and cyclase activity wherein nictotine-adenine dinucleotide (NAD+), it's primary substrate is converted to NAD gylcohydrase or cyclic adenosine monophosphate (cAMP) respectively. Both enzymatic products are then converted downstream to ADO.

Interestingly, CD38 is primarily expressed on plasma cells (4-6x more than in normal cells) and data shows that the overexpression increases by another 2 to 3-fold on plasma cells in MM. In effect, CD38 is a highly specific surface receptor that can be exploited for the design of targeted therapeutics against MM. This project aims to develop highly potent and selective targeting ligands for CD38 to aid in the development of imaging agents, radiotherapy, and immunotherapy against MM.

Keywords: Multiple Myeloma, CD38, Bone Marrow (BM), Adenosine(ADO), NAD+, NAD, cAMP

Mentor(s):

Reuben Dass (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1008
Presentation Time: Session 1: 9:00am-10:00am

Sensor-based training interventions to enhance robotic surgeons non-technical skills

Innovative Technology/Entrepreneurship/Design

Author(s):

Anna Brantley† (Engineering)

Abstract:

Surgical outcomes are of focus within the medical community, specifically those that result in adverse events. Traditionally, adverse events have been attributed to deficiencies in technical skills of the surgeon. However, given recent research findings, more adverse effects are believed to be the result of the lack of non-technical skills (NTS), including clear communication, decision-making, leadership, teamwork, and situational awareness. This research dives into the sensor-based assessment and enhancement of NTS of surgeons performing robotic-assisted surgeries due to the specific challenges that are present in these surgeries. To do this, we will observe the main robotic surgeon by equipping them with Tobii eye tracking glasses to record their eye behavior and a microphone to record their verbal communication. We will also mount a GoPro camera to capture and record the panoramic view of the entire operating room (OR). Twelve surgeons will be participating in this study: each undergoing three observations and two post-operative coaching sessions between observations. These coaching sessions are based on both qualitative and quantitative findings from a team of four to seven experts utilizing the non-technical skills for surgeons (NOTSS) tool to assess the surgeon's NTS during specific events and periods. We hypothesize that these personalized coaching sessions will increase robotic surgeons' NTS. Based on the findings, we can explore the potential of sensor-based training interventions to improve NTS and subsequently, patient safety.

Keywords: Non-Technical Skills, Robotic-Assisted Surgery, Training Intervention

Mentor(s):

Denny Yu (Engineering); Marian Obuseh (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1009
Presentation Time: Session 1: 9:00am-10:00am

Weak Shock Exposure Is Behaviorally Different From Extinction In Reducing Stress-Enhanced Fear

Life Sciences

Author(s):

Jaden Brooks† (Science)

Abstract:

Exposure to extreme stress can negatively alter behavior and lead to prolonged fear sensitization. This can be studied using the stress-enhanced fear learning (SEFL) behavioral paradigm in which prior exposure to an extreme stress renders later contextual conditioning resistant to extinction. Our lab has recently characterized a way to reduce behavior through presentations of a weaker version of the unconditional stimulus (termed 'deflation') that is behaviorally and neurobiologically distinct from extinction. We predict that deflation, but not extinction, will weaken a stress-enhanced fear memory. Following either footshock stress or matched chamber exposure (i.e., no stress), male and female Long Evans rats were given contextual fear conditioning. Animals were then given either extinction or deflation prior to behavioral testing. Blood plasma was collected before and after each day's behavioral session. Behavioral data showed that while prior stress rendered extinction ineffective, both the stress and no stress deflation groups showed a decrease in freezing behavior. Suggesting that the deflation group rodents began to characterize the context as safe. Whereas hormonal data showed similar levels of stress in both extinction and deflation groups independent of prior stress, possibly due to the added stress of blood collection before behavioral testing. While further studies are needed to understand rodents hormonal behavior, our behavioral data provides preliminary evidence that deflation is unaffected by prior stress and may be a more effective alternative to extinction.

Keywords: Stress-Enhanced Fear Learning, Extinction, Deflation

Mentor(s):

Sydney Trask (HHS); Kimberly Kinzig (HHS); Brent Bachman (HHS); Erisa Met Hoxha (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1010
Presentation Time: Session 1: 9:00am-10:00am

Problem Formulation and Solution Generation in Data Visualization Practitioners

Innovative Technology/Entrepreneurship/Design

Author(s):

Phuong Bui† (Polytechnic)

Abstract:

The development of data visualization (datavis) knowledge is predominantly rooted in academic design work, with limited integration of insights from design practitioners. This knowledge gap hinders our understanding of real-world design practices and impedes practitioners' utilization of available scientific knowledge. This research aims to gain a deeper understanding of design judgment, particularly in how they formulate problems and generate solutions.

The recruitment of design experts and novices with active datavis projects starts with an initial survey, where they will be selected based on their years of experience, work portfolio, and background assessments, among other criteria. Upon confirmation of participation, a design challenge will be available, during which participants will create visualizations and document their thought processes and the underlying rationale for their design decisions. Subsequently, participants will keep a diary of a datavis project for 6 to 8 weeks, dedicating 15 minutes each week to record relevant artifacts, notes, and sketches. The insights obtained from these 2 activities will prepare for the subsequent semi-structured interviews with the participants. They can clarify and interpret in further detail their preliminary work and design choices, enhancing the understanding of various forms of design judgment at play.

This study will advance our comprehension of the cognitive processes of design practitioners in areas like cognitive biases when confronting complexities in datavis work. Furthermore, it will contribute to the development of practical design support for practitioners and will hold educational value for future designers.

Keywords: Data Visualization Design, Design Judgment, Problem Formulation, Solution Generation, Design Practice

Mentor(s):

Paul Parsons (Polytechnic); Prakash Shukla (Polytechnic)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1011
Presentation Time: Session 1: 9:00am-10:00am

Diphyllin Derivatives Synthesis as V-ATPase Inhibitors Against Ebola Viral Entry

Life Sciences

Author(s):

Liying Che† (Pharmacy)

Abstract:

Filoviruses are a family of viruses known for causing hemorrhagic fevers and complications, which are severe and often life-threatening diseases characterized by bleeding and organ failure. Ebola virus (EBOV) is a filovirus that is widespread globally and causes outbreaks in various regions. The disease primarily spreads through handling or consuming infected animals. The significance of understanding EBOV and other filoviruses lies in the need to prevent their spread and manage outbreaks. The goal of my research is to synthesize small molecule drug candidates that inhibit EBOV entry into cells, preventing the spread of EBOV disease. Previous research has shown that the inhibitors of V-ATPase could work to block the endosomal acidification to affect viral entry. Vacuolar ATPase (V-ATPase), a membrane-bound protein complex that transports protons across the plasma membrane of certain specialized cells, causes acidification of intracellular compartments. Sensing endosomal acidification triggers the release of EBOV cores into the cell cytosol. The natural product diphyllin is proved to be effective against V-ATPase, which is less toxic than other natural products, but is less potent, metabolically stable, and soluble. Thus, the objective of my research is to synthesize diphyllin analogs that improve potency and drug-like properties to find better drug candidates. Side chains are added to the analogs to further improve potency. In conclusion, the most promising derivative synthesized so far is D33 (EC50=86nM), which is a pyridine with carbonyl fluoride attached to the bottom of its middle ring, improving potency by 20-fold and metabolic stability by 2-fold compared to diphyllin.

Keywords: Ebola Virus, Diphyllin, Synthetic Chemistry, Potency and Efficacy, V-ATPase

Mentor(s):

Jo Davisson (Pharmacy); Amr Mohamed Elkabbany (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1012
Presentation Time: Session 1: 9:00am-10:00am

VIP AMP -- Lane Detection on Race Track

Innovative Technology/Entrepreneurship/Design

Author(s):

Evan Chen† (Engineering); Andrew Huang† (Engineering)

Abstract:

Lane detection is a critical aspect of road safety and finds extensive applications in real-world scenarios, aiding drivers in maintaining proper lane adherence. Moreover, it is a fundamental requirement for autonomous motorsports, guiding high-speed vehicles along race tracks. This study focuses on implementing lane detection on a laneless race track utilizing the Yolo v8 open-source machine learning model. Yolo v8 is notable for its effectiveness in classification, segmentation, and detection tasks. In this research, we specifically leverage the segmentation model from Yolo v8.

We commence by preprocessing racing footage data, where the track lacks traditional white-separating lines. The video data is segmented into 30 frames per second (FPS) and manually labeled to denote the lane positions. The labeled dataset is then partitioned into training and testing batches, serving as input for the Yolo v8 machine learning model. Following 50 training epochs, the model is evaluated using unseen images.

The results demonstrate promise, showcasing the model's ability to accurately detect lanes while maintaining a high processing speed. For future work, we aim to develop a custom machine learning model using the same dataset for comparative analysis against the Yolo v8 model. This comparison will help identify potential areas for improvement and fine-tuning in lane detection algorithms for laneless race tracks.

Keywords: Lane Detection, Machine Learning, Autonomous Motorsports

Mentor(s):

Shreya Ghosh (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1013
Presentation Time: Session 1: 9:00am-10:00am

Silicon Microring Resonators for On-Chip Quantum Photon-Pair Generation and Crosstalk Mitigation

Mathematical/Computation Sciences

Author(s):

Ethan Chiao† (Engineering); Stephanie Close† (Engineering)

Abstract:

Silicon photonics is a technology in which optical circuits are written onto a silicon chip, by means of CMOS processing identical to that of the electronics industry. A critical component on silicon photonic circuits is the microring resonator. The microring enables narrowband filtering functions and provides a means for enhanced nonlinear optical effects due to the build up of light within the resonator on resonance. For these reasons, the microring resonator is commonly used as a photon pair source for on-chip quantum optical systems. The resonance frequencies of the devices are typically tuned via thermo-optic effects. In addition, because of the frequency-dependent photon pair generation of these microrings, additional microrings are often used to demultiplex these photons. However, when multiple microrings are used on the same chip and require individual tuning, thermal crosstalk between devices presents challenges towards the scalability. Here, we investigate (1) the photon-pair generation properties of microring and (2) the design of thermal tuning devices and reduction of thermal crosstalk.

Keywords: Silicon Photonics, Thermal Crosstalk, Thermal Tuning, Microring Resonator, Quantum Optical Systems

Mentor(s):

Lucas Cohen (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1014
Presentation Time: Session 1: 9:00am-10:00am

Comparison of the Electrochemical Performance of Viologens in Ionic Liquid and Water

Physical Sciences

Author(s):

Ronald Cutler† (Science)

Abstract:

Viologens are molecules that can undergo up to two electron transfers with each oxidation state conferring a particular color to the solution they are dissolved in. This property makes them suitable candidates for the preparation of electrochromic devices. The color change viologens undergo at different voltages may be controlled by varying the alkyl chains attached to the bipyridine center. However, this reduces their solubility and complicates analysis in an aqueous solution. A strategy to enhance the performance of derivatized viologens is to utilize an ionic liquid as the main solvent. Ionic liquids are compounds composed of ions usually having melting points close to room temperature. In an aqueous solution, an inert electrolyte is required to complete the electrochemical system. The ionic liquid itself acts as an electrolyte and thus removes the need to add salt to the solution. Ionic liquids have a larger electrochemical window of stability compared to commonly used solvents. In this work, we will determine the electrochemical properties of methyl, benzyl, and heptyl-substituted viologens in 1-ethyl-3-methylimidazolium tetrafluoroborate compared to aqueous solution. To extract the electrochemical parameters, we will use square wave voltammetry, a sensitive technique that facilitates the understanding of the complex electron transfer mechanisms of the systems. Overall, this work shows that ionic liquids are suitable solvents for studying the electrochemical properties of viologens.

Keywords: Square Wave Voltammetry, Viologen, Ionic Liquid, Electrochemistry

Mentor(s):

Julia Laskin (Science); Hugo Samayoa-Oviedo (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1015

Presentation Time: Session 1: 9:00am-10:00am

Is a cure already out there? Repurposing an FDA-approved drug for night blindness in zebrafish model

Life Sciences

Author(s):

Sophia Dietz† (Science)

Abstract:

Retinitis pigmentosa (RP) is an inherited condition causing degeneration of rod photoreceptors and vision loss. Despite efforts, the condition remains largely incurable, leaving 1 in 4000 individuals subject to its effects. To address the need for a therapeutic preventing blindness in patients with RP, I am attempting to repurpose FDA-approved drugs for other conditions to reduce rod death in RP. RHO mutations are the most common mutation type linked to autosomal dominant RP (adRP), and P23H is the most common RHO mutation reported in the Caucasian population. To this end, I utilize a P23H-RHO transgenic zebrafish (Danio rerio) model to characterize the disease's pathogenesis in response to the repurposed pharmaceuticals. The zebrafish subjects, utilized for their accuracy in comparison to the human eye, express GFP-marked rhodopsin, allowing for clear visualization of rod photoreceptors with and without treatment. Because oxidative stress is a known contributor to rod death in adRP, experiments will begin by utilizing a beta-blocker, carvedilol, to evaluate whether reducing oxidative stress can prevent rod death in the P23H mutant. Carvedilol has shown to reduce rod death in the Q344X mutant for adRP, but this experiment confirms the same treatment can applied to the P23H mutant. Confirming these results not only establishes Carvedilol as a promising pioneer in successful pharmaceutical repurposing, but also ignites the journey towards exploring other drug candidates aimed at reducing photoreceptor death in adRP, including methotrexate. Altogether, this drug screen offers new perspectives about potential treatments for retinitis pigmentosa.

Keywords: Drug Discovery, Retinitis Pigmentosa, Carvedilol, Zebrafish, Night Blindness

Mentor(s):

Fai Leung (Science); Beichen Wang (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1016
Presentation Time: Session 1: 9:00am-10:00am

Investigating the Impacts of Hypothyroidism on Cell Division in the Fetal Pig Brain

Life Sciences

Author(s):

Alivia Dwire† (Agriculture)

Abstract:

Hypothyroidism is among the most common endocrine disruptions seen during pregnancy and is known to adversely impact fetal growth and neurological development. However, the temporal sensitivity of the fetus to such endocrine perturbation is not well understood. The objective of this study is to assess the impact of fetal hypothyroidism on cell division at two gestational time points using a porcine model. A total of N=12 pregnant gilts were used in a 2x2 factorial design, where N=6 were treated with methimazole, and N=6 with a sham control, with treatment initiated on either day 45 or 65 of the normal 114 day gestation period. After 21 days of treatment, all fetal brains and thyroids were weighed and tissue samples collected from 2 female fetuses per litter. Fetuses from methimazole treated gilts were confirmed hypothyroid by a significant increase in fetal thyroid weight and a corresponding histological appearance consistent with goiter. The 24 brain samples were then homogenized under liquid nitrogen and a subsample used to extract total RNA using a double precipitation method with TRIzol reagent. RNA purity and concentration were assessed on a nanodrop spectrophotometer, and integrity confirmed via denaturing gel electrophoresis prior to reverse transcription. Moving forward, the expression of three cell cycle promotors (CDK1, CDK2, and CDK4) and one cell cycle inhibitor (CDKN1A) will be assessed by qPCR. Differences in gene expression between the methimazole and control groups within each time point will then be compared in order to better understand the effects of fetal hypothyroidism on cell division in the brain.

Keywords: Fetal Hypothyroidism, Fetal Pig Brain, Cell Division Regulation, Cell Cycle Inhibitor, Cell Cycle Promoter

Mentor(s):

Alex Pasternak (Agriculture); Alyssa Smith (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1017
Presentation Time: Session 1: 9:00am-10:00am

Utilizing LP-HTP in Conversion of ABS to oil

Innovative Technology/Entrepreneurship/Design

Author(s):

Vincent Feliciano† (Engineering)

Abstract:

Redacted

Keywords: Acrylonitrile-Butadiene-Styrene, Low-Pressure Hydrothermal Processing, Feedstocks, Pyrolysis, Supercritical Water Liquefaction

Mentor(s):

Linda Wang (Engineering); Clayton Gentilcore (Engineering); Cagri Un (Engineering); Daniel Hristov (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1018
Presentation Time: Session 1: 9:00am-10:00am

Physics Based Modeling and Validation of Triboelectric Inks Using Screen Printer Digital Twin

Innovative Technology/Entrepreneurship/Design

Author(s):

Nicholas Ganino† (Engineering)

Abstract:

Triboelectric nanogenerators (TENGs) use materials that can cause surface electrification through friction, helping to provide a signal to an attached electrode using induction. This electrification can occur in two primary modes, through sliding friction or by repeated contact separation. To facilitate this, TENGs are comprised of 2 triboelectric materials with dielectric properties sandwiched between electrodes. Some of these functional materials can be processed into inks, enabling screen printing, a production method where ink is pulled through a fine mesh and onto a substrate, to be an effective, low-cost option for manufacturing TENGs. Validating the physical properties of the triboelectric ink such as viscosity and surface tension within a production environment is a crucial first step toward the large-scale manufacturing of TENGs. Our project aims to validate and refine our physics-based model of the ink by using a digital twin developed in Unity to simulate the screen-printing process and the effect of production on the inks. This digital twin enhances our analysis by introducing adjustable printing parameters such as print speed and squeegee pressure, expanding the scope of the ink's testing environment. This work aspires to improve our current model of the ink's properties through the application of a digital twin and by doing so pave the way for scalable ink-based TENG manufacturing.

Keywords: Triboelectric Materials, Physics Based Modeling, Screen Printing, Digital Twin, Model Testing

Mentor(s):

Wenzhuo Wu (Engineering); Nachiket Vatkar (Engineering); Don Perera (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1019
Presentation Time: Session 1: 9:00am-10:00am

Rapid Supernova Model Inference using Amortized Posterior Estimation

Physical Sciences

Author(s):

Braden Garretson† (Science)

Abstract:

Current physical models of supernovae use high dimensional semi-analytical models or hydrodynamical simulations combined with time consuming Approximate Bayesian Computation (ABC) methods, such as Markov chain Monte Carlo (MCMC), to infer their physical properties. While very accurate, this method of inference takes many CPU hours on average, and must be repeated whenever new observations become available, thereby making it practically infeasible to infer the explosion properties of the hundreds of thousands of supernovae that future modern all sky surveys will discover. In this work, we use Amortized Neural Posterior Estimation (ANPE), which is a simulation-based inference method that uses neural networks to estimate posterior probability distributions, to accurately estimate the posteriors of the supernovae models implemented in the Modular Open-Source Fitter for Transients (MOSFIT) python package. Once trained, it can rapidly infer model parameters of any event orders of magnitudes faster than traditional methods (< 1 second). This approach of adapting physical models to neural networks will be essential to estimate the posterior of model parameters and conduct population scale studies of supernovae for the terabytes of data per night that future all-sky surveys, such as the Vera Rubin Observatory will produce.

Keywords: Machine Learning, Supernovae, Astronomy

Mentor(s):

Danny Milisavljevic (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1020
Presentation Time: Session 1: 9:00am-10:00am

iOS Passive Screen Time Collection Protocol

Social Sciences/Humanities/Education

Author(s):

Rygel Ginete† (Science)

Abstract:

Cell phone usage has become prevalent in everyday life, yet screen time research is still underdeveloped. Previous screen time research from Saunders & Vallance suggests that increased levels of screen time are associated with worse health outcomes, but few longitudinal studies have been conducted overall.

One limitation is that similar research has generally used self-reported observations of screen time data. Self reported data is prone to human error, resulting in a decrease of accuracy. This is due to cell phone usage being short in duration, and over a span of applications. More accurate data is necessary to validate associations with health outcomes. While passive screen time measurement techniques have been explored for Android devices, they have yet to be extensively replicated on Apple (iOS) devices. We aim to capture both screen time measurements and additional metrics collected automatically from iOS devices, such as notification and app pickup data. Currently, there is no direct way to export this data into a readily processable format. The Sleep Equity Lab at Purdue University presents an approach that will allow for this screen time data to be collected from iOS devices. We are developing a protocol for collecting various screenshots of information provided by the device's Settings app. We then plan to process this data with screenshot analysis techniques. By implementing a method of collecting richer and more accurate data from a wider audience, we hope to support future research related to screen time and health outcomes.

Keywords: Screen Time, Passive Media Sensing, Data Collection, Smartphone Usage

Mentor(s):

Michelle Garrison (HHS); Abrianna Anderson (HHS); Garrett Price (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1021
Presentation Time: Session 1: 9:00am-10:00am

Time Dependent Curing of Adhesives in Different Types of Water

Physical Sciences

Author(s):

Maren Gingrich† (Science)

Abstract:

We investigate adhesives made from zein and tannic acid that binds to a wide variety of substrates while underwater. Previous studies have suggested that water type (deionized versus sea) does not greatly affect the strength of these adhesives and that they get stronger over time. In this study, we investigated the time-dependent color alterations of adhesives submerged in saline solution. Glass substrates were glued together then submerged in saline and observed for times ranging from two to twelve hours. Depending on the time frame, changes were recorded every 5-10 minutes or every hour. The adhesive started as a translucent amber liquid and hardened into an opaque yellow solid when exposed to the saline. When the samples were removed from the solution, the opaque sections of the adhesive were brittle and the amber sections were gum-like. This alteration can be related to how the components of the adhesive interact with water. The zein within is soluble in ethanol but not in water. This causes phase separation when it comes in contact with water. The surface area of the hardened section grew as time passed, eventually encompassing the entire sample. While the sample appeared cured to the naked eye, data from lap shear testing showed that the adhesive's strength had increased with time, measured after 24 hours, two weeks, and three weeks. This, combined with qualitative observations, suggests that curing adhesives underwater involves multiple mechanisms happening simultaneously. The preliminary data presented here will help in understanding some of the kinetics involved.

Keywords: Adhesives, Curing, Color, Zein, Underwater

Mentor(s):

Gudrun Schmidt (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1022
Presentation Time: Session 1: 9:00am-10:00am

Evaluation of Purdue University's Adaption to Education with Generative Artificial Intelligence

Social Sciences/Humanities/Education

Author(s):

Nina Gruteser† (Science)

Abstract:

The recent breakthrough of Generative Artificial Intelligence (GAI), specifically ChatGPT, has been impacting many domains, one of them being the education field. With its ability to expertly answer questions, write, and code computer programs, ChatGPT can prove to be valuable and disadvantageous in academic settings. The purpose of this study is to discover if and how Purdue University supports students' learning through the transition into a world with GAI. Various peer-reviewed sources from the Purdue Library Databases on GAI in college education were analyzed to conduct this investigation. Using data from Purdue University's webpage and Purdue Today, the official Purdue newsletter, this study aims to determine whether GAI is integrated into the classrooms at Purdue and if Purdue effectively educates students on AI and GAI. Since GAI will only improve and have a bigger impact on education, work, and life, it is crucial to teach students how to effectively use GAI and expose them to its capabilities. This will prepare students for the workforce and assist them throughout their higher education.

Keywords: Artificial Intelligence, Generative Artificial Intelligence, ChatGPT, Purdue University, Education

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1023
Presentation Time: Session 1: 9:00am-10:00am

Effectiveness of Purdue University's Implementation of Educational Technology

Social Sciences/Humanities/Education

Author(s):

Rohin Gupta† (Science)

Abstract:

Educational Technology refers to a broad category of tools that are specifically designed to be used in academic contexts. Traditional forms of this technology include email, instructor’s websites, etc. (Rueda et al., 2017). However, with the rapid development of technology in the past 20 years, the scope of technology’s role in education has expanded vastly. As a result, universities across the nation have continued to invest in new ways to encourage the adoption of new technologies, or redesign/upgrade existing technologies. New forms of these tools include digital note-taking apps, task-managing apps, and completely on-line classes. This paper aims to explore if Purdue University has effectively used educational technology to impact their students’ academic performance and work/study habits, and whether or not they should continue to promote its use. This study employs a combination of methods to investigate this relationship. For example, in one case, semester GPAs from in-person classes and their on-line counterparts were compared to measure effects on academic performance. In other cases, this study relies on qualitative evidence from sponsors and users of such technology. This includes observations of positive/negative impacts through instructors, assessments of benefit from users, and interviews with individuals associated with the introduction of these technologies to gauge results on study/work habits. Ultimately, this study helps educators and institutions as they strive to optimize technology’s impact on their students.

Keywords: Educational Technology, Work/Study Habits, Academic Performance

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1024
Presentation Time: Session 1: 9:00am-10:00am

Gaze-Based Navigation to Support Sustainable Interactions in Recreational and Therapeutic Virtual Environments

Innovative Technology/Entrepreneurship/Design

Author(s):

Tyler Hsieh† (Engineering, JMHC)

Abstract:

Eye tracking hardware for paraplegic users is predominantly focused on therapeutic activities related to training more efficient eye-gaze targeting to improve communication and interaction productivity. There is sometimes a barrier to tech adoption for people who could benefit from gaze-based interfaces due to the clinical nature of these interfaces. Our lab is designing a "passive" or "relaxation"-focused approach to gaze-based interfaces that promotes engagement through gentle, low-cognitive demand navigation of a graphically-rich environment. Such experiences may improve user attitudes toward gaze-based controls and lead to long-term comfort with and adoption of gaze-based communication tools. Such relaxing experiences may also benefit other user groups. Passive relaxation-based experiences can support emotional regulation, stress management, and even sleep patterns. Our gaze-based navigation prototype minimizes cognitive load in scene navigation, is customizable, and can be integrated in an infinite variety of virtual environments and contexts. We have developed a research protocol to validate cognitive load, engagement, usability, and feasibility in both the paraplegic population and in users without upper limb mobility impairment. This protocol will engage participants in a series of relaxing tasks, assess their perceived cognitive load through standard measures, and then follow up with narrative reflection about the experience for qualitative evaluation.

Keywords: Eye Tracking, Gaze-Based Interactions, Human-Computer Interaction, Gaming, Recreational Therapy

Mentor(s):

Rua Williams (Polytechnic); Michelle Garrison (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1025
Presentation Time: Session 1: 9:00am-10:00am

How does road proximity in Tippecanoe County impact acoustic richness and dispersal of birds using comparative AI vs human-based recognition?

Life Sciences

Author(s):

Sierra Hunnicutt† (Science, JMHC); Luca Iacobucci* (Agriculture); Hannah Reyes Charles* (Agriculture, JMHC); Abigail Seybert* (Agriculture, JMHC); Anthony Tan* (Science, JMHC)

Abstract:

Roads cause various negative effects for wildlife such as fragmentation, destruction, and degradation of habitat (Hui et al. 2018). Roads create artificial boundaries for wildlife, raising the need for wildlife corridors to connect the fragmented habitats. Wildlife is often inhibited or impacted by human development, specifically roads, whether by affecting mortality, limiting territory size, or reducing species dispersal. Bobcats (Lynx rufus) have historically held a crucial position in the Indiana ecosystem as prominent mesocarnivores that feed on rabbits, rodents, and birds. This study will attempt to determine how proximity to roads in proposed bobcat corridor land may impact the acoustic richness and dispersal of bird species in the area. We used camera traps and acoustic sensors in six locations along the Wabash River in various states of ecological health and with varying proximities to Tippecanoe Country roads to collect acoustic data on the types and frequencies of bird calls heard in each location. The intent of this large-scale study is to determine viable land for conversion into wildlife corridors that would encourage bobcat population movement back into northern Indiana.

Keywords: Bobcats, Acoustic Monitoring, Ecological Corridor, Road Proximity, Dispersal

Mentor(s):

Kristen Bellisario (JMHC)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1026
Presentation Time: Session 1: 9:00am-10:00am

A perspective of mitochondrial functions in sperm cells and double fertilization

Life Sciences

Author(s):

Keila Jellings† (Agriculture, Science)

Abstract:

In flowering plants, double fertilization involves the delivery of two sperm cells to the embryo sac, where each sperm cell is destined to fuse with the egg cell or the central cell giving rise to a zygote and the nourishing endosperm. However, a long-standing question remains: are sperm cells inherently predetermined to fuse with a specific gamete?

Mitochondria play a central role in the metabolism of all cells, generating ATP as the primary energy source, and as a byproduct they produce Reactive Oxygen Species (ROS). They also contribute to maintaining Ca2+ cytoplasmic homeostasis. Both Ca2+ and ROS are crucial for cellular signaling. In animals, mitochondrial dysfunction in sperm cells has been linked to reduced sperm viability, activity, and defective egg activation. Although sperm mitochondria are eliminated from the zygote upon fertilization in all eukaryotes, the biological relevance to the process of fertilization remains unclear.

Our previous work revealed differences in mitochondrial content between twin sperm cells, leading to our hypothesis that such cellular dimorphism may have implications in sperm cellular metabolism, signaling, as well as its fusion fate or potential to activate the egg cell. To test this hypothesis, we used a sperm-specific mitochondrial fluorescent marker line in combination with genetic mutants affecting mitochondrial function or sperm cell function or fate. Along with observations of the fusion destination and mitochondria dynamics, these results are expected to contribute to our understanding of sperm cell dimorphism and its role in fusion fate and egg activation during double fertilization.

Keywords:

Mentor(s):

Leonor Chagas Boavida (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1027
Presentation Time: Session 1: 9:00am-10:00am

Power Ground Network Optimization for High-Performance Silicon Die Packages

Mathematical/Computation Sciences

Author(s):

Ashwin Kidambi† (Engineering)

Abstract:

Advances in very large-scale integration (VLSI) technology have led to the rapid increase in densities of microprocessors and hence an increase in power consumption. This has resulted in an increase in the voltage potential drop across the power/ground (P/G) network, decreasing the effectiveness of the power delivery. A uniform P/G network that satisfies the voltage potential drop requirement of current chips takes up valuable space in the silicon wafer that could be optimized to improve signal routing. In this work, we present an algorithm to optimize the P/G grid given the required voltage and power density for a microprocessor. This is done by optimizing the wire widths of P/G lines at different sections of the chip to meet the power and area requirements. This algorithm will be used in the thermal-electrical co-optimization of next generation backside power delivery networks (BSPDN).

Keywords: Power Ground Network, Optimization, VLSI, Design

Mentor(s):

Liang Pan (Engineering); Justin Weibel (Engineering); Zekun Wu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1028
Presentation Time: Session 1: 9:00am-10:00am

Associations between White Privilege Awareness and Acceptability of Racial Microaggression Usage

Social Sciences/Humanities/Education

Author(s):

Delaney Knipstein† (HHS)

Abstract:

Racial oppression has been maintained as a result of the seemingly invisible power that accompanies White privilege, yet not much research has been done on the topic (Curran et al., 2023). White privilege can be defined as benefits that come along with being White in the U.S. where White is the dominant racial group (Pinterits et al., 2009). Previous research suggests that people who are more conscious of White privilege are less likely to have racist attitudes (Curran et al., 2023). The goal of this study is to investigate whether individuals who are more aware of White privilege are more likely to recognize that racial microaggressions are not acceptable. Microaggressions can be defined as “subtle everyday experiences of racism” (Wong et al., 2014, p. 181). Specifically, we looked at whether participants rated acceptability of microaggressing statements that blame racial minorities for circumstances caused by systemic racism. For example, participants were asked to rate the acceptability of the statement “there won’t be racial progress until racial minorities stop relying on handouts from the government." We analyzed correlations between White privilege awareness and the acceptability of victim blaming microaggressions, and found a strong negative correlation, r = -.604, p < .001. This suggests that the more aware you are of White privilege, the more likely you are to think that victim blaming microaggression statements are not acceptable to say. Implications of these findings are that if individuals were more educated on White privilege, they may be less likely to microaggress racial minorities.

Keywords:

Mentor(s):

Annabelle Atkin (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1029
Presentation Time: Session 1: 9:00am-10:00am

Pesticide Exposure Among Latino/a Adolescent Farmworkers

Life Sciences

Author(s):

Courtney Lacy† (HHS); Mary Noonan† (HHS)

Abstract:

The widespread use of pesticides poses serious health hazards to farmworkers, including Latino/a farmworkers. Evidence shows that some pesticides may be carcinogens, affect hormone levels, and damage the endocrine system. Adolescent farmworkers are exposed to the same pesticides as adults, but are more vulnerable because they are still developing. Drawing from a larger systematic literature review examining how farmwork affects the health and well-being of Latino/a adolescents, we review pesticide exposure and impact among adolescents. The larger systematic literature review was conducted using 7 databases and keywords representing the population, exposure, and outcomes of our research question. Each article was evaluated by two researchers for inclusion and discrepancies were discussed until a consensus was reached. At least two reviewers extracted data from and assessed quality of 23 total articles. For this study, we included a subset of eight articles that measured exposure to pesticides. Research has been published from North Carolina and Oregon between 2001 and 2021. When pesticide exposure was objectively measured through wristbands, almost three-fourths of Latino/a adolescent farmworkers were exposed in the previous day. However, less than half had received pesticide training. Among adolescent girls, 50% exposed to pesticides reported at least one menstrual irregularity, suggesting that pesticide exposure can have major health consequences. Latino/a adolescent farmworkers are frequently exposed to pesticides, lacked safety training, and exposure was found to be associated to menstrual irregularities. However, more longitudinal studies which examine multiple health outcomes are needed to establish the effect of pesticide exposure on long-term health.

Keywords: Pesticides, Exposure, Adolescents, Latino/a Farmworkers, Systematic Review

Mentor(s):

Nilupa Gunaratna (HHS); Savannah O'Malley (HHS); Yumary Ruiz (HHS); Jason Reed (Libraries); Ramya Ambikapathi (Cornell University)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1030
Presentation Time: Session 1: 9:00am-10:00am

Peroxide-Initiated Hydrophosphinylation of gem-Difluoroalkenes

Physical Sciences

Author(s):

Ryan Lee† (Pharmacy, JMHC)

Abstract:

The installation of fluorine and fluorinated functional groups into drug-like scaffolds can perturb the physicochemical, pharmacokinetic, and pharmacodynamic properties of compounds. However, some potentially useful fluorinated substructures reside predominantly outside the realm of the current synthetic methodologies. One such substructure, the α,α-difluorophosphine oxide, might be convergently prepared by the reaction of a gem-difluorinated alkene with a P–H bond, though such nucleophilic reactions instead proceed through a C–F substitution pathway that delivers monofluorovinyl products. In contrast, we report a peroxide-initiated hydrophosphinylation reaction of gem-difluoroalkenes that avoids C–F substitution and produces a wide range of α,α-difluorophosphine oxides and functions using readily available reagents and green solvents.

Keywords:

Mentor(s):

Ryan Altman (Pharmacy); Andrew Intelli (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1031
Presentation Time: Session 1: 9:00am-10:00am

Kv1.1 Channel Opener and Viral Vector Expression Recover Neuronal Excitability and Social Defects in Transgenic Mice with Severe Nav1.2 Deficiency.

Life Sciences

Author(s):

Kathryn Lund† (Science)

Abstract:

In 2020, the Centers for Disease Control and Prevention (CDC) reported that approximately 1 in 36 children in the United States were diagnosed with autism spectrum disorder (ASD). It is well-established that a significant proportion of ASD cases can be attributed to loss of function mutations in SCN2A, a gene encoding the Nav1.2 voltage-gated sodium channel. Nav1.2 plays a critical role in the initiation and propagation of action potentials. It is localized to key neuronal compartments such as the axon initial segment. Heterozygous knock-out mouse models of Nav1.2 often display mild phenotypes, making the evaluation of potential rescues challenging. To address this limitation, our laboratory has developed a novel mouse model that allows 25% of Nav1.2 to be expressed which displays severe social deficits. This provides a robust platform for investigating potential interventions. Further investigations of our model revealed hyperexcitability in the medium spiny neurons of the striatum and a severe downregulation of potassium channels. We explored the potential of a Kv1.1 opener, 4TFMPG, and found that a bath solution of this compound reduces hyperexcitability, indicating Kv1.1 perturbation in Nav1.2-deficiency as a promising therapeutic approach. To deepen our understanding of the role of Kv1.1 in SCN2A-related autism, we utilized an adeno-associated viral vector to overexpress the human Kv1.1 channel in Nav1.2-deficient mice. This intervention rescued the social deficits observed in these mice without adversely affecting their activity levels. These findings offer a novel perspective on the potential utility of Kv1.1-based gene therapy in mitigating disease phenotypes associated with SCN2A-related ASD.

Keywords: Nav1.2, Kv1.1, Adeno-Associated Virus, Autism Spectrum Disorder

Mentor(s):

Yang Yang (Pharmacy); Brody Deming (Pharmacy); Jingliang Zhang (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1032
Presentation Time: Session 1: 9:00am-10:00am

Plant-Based Adhesives for Gluing Coral Substrates in Sea Water

Physical Sciences

Author(s):

Anne Malott† (Science); Kritika Kumar† (Science); Logan Kitts‡ (Science)

Abstract:

The purpose of this research project was to prepare and evaluate strong underwater adhesives that would be optimized for use in ocean water and on coral skeleton substrates. The initial adhesives were made from cost efficient and sustainably sourced corn protein, tannic acid, and inorganic components. About 10 different sample compositions were prepared for gluing substrates together in sea water (artificial ocean water). Limestone was used as model substrate to search for samples with optimal adhesion properties. Limestone was chosen because it is similar in chemical composition to coral skeletons and also more abundant. Substrates were glued together underwater and left there to cure for 24 hours. Using lap shear methods, the glued substrates were pulled apart, forces recorded, and bond strengths calculated. Trends in bond strengths were compared to the curing rates of adhesives determined from color changes observed in sea water. Color changes can be observed when an adhesive drop is sandwiched between microscopy slides and then placed in sea water. As the adhesive cures, the color changes to yellow opaque while the uncured initial solution remains amber translucent. The best formulation, which is the strongest adhesive, was tested by gluing coral to stone in artificial sea water. After about 5 minutes, the coral was lifted up and remained stuck to the stone. Complete curing required 24 hours underwater. During this time the adhesive became harder and stronger. These preliminary data suggest that our research may eventually provide new non-toxic adhesives for planting corals and restoring the reefs.

Keywords: Adhesive, Coral, Inorganic Components, Corn Protein, Sustainable

Mentor(s):

Gudrun Schmidt (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1033
Presentation Time: Session 1: 9:00am-10:00am

Coupling an Olfaction Chamber with Proton Transfer Reaction Mass Spectrometry for Evaluating Human Response to Scented Product Emissions

Life Sciences

Author(s):

Rashmika Manipati† (Engineering)

Abstract:

Commonly used household and personal care products, categorized as Volatile Chemical Products (VCPs), contain and release Volatile Organic Compounds (VOCs) that contribute significantly to indoor air pollution. Extensive research has been conducted on the physical effects of VOCs on human beings. However, the effects of VOCs on human emotional and physiological responses have received less attention and need to be explored, with no definitive conclusions regarding their specific impacts. This study aims to investigate the effects of volatile organic compounds (VOCs) emitted by Scented Volatile Chemical Products (sVCPs) on humans' emotional and physiological responses and to characterize and identify VOCs. This study aims to achieve this by developing and using a controlled olfaction chamber with a high-resolution Proton Transfer Reaction Time-of-Flight Mass Spectrometer (PTR-TOF-MS). The sVCPs are placed inside the olfaction chamber to isolate the product emissions from outside contaminants fully.

Additionally, the PTR-TOF-MS monitors, measures, and speciates the type of VOCs released by the sVCPs. Simultaneously, participants are directed to inhale the emissions from the chamber through a specifically designed sniffing port. A smartwatch monitors the participant's heart rate and blood-oxygen saturation levels at various linear intervals. Concurrently, the participant's odor assessment is conducted using the Geneva Emotion and Odor Scale (GEOS), allowing for the subjective evaluation of the perceived odors. Researchers can gain insights into the potential physiological and emotional effects by combining objective physiological measurements with subjective odor assessments. Overall, the findings from this research will contribute valuable knowledge that can facilitate informed decision-making regarding purchasing and using household products.

Keywords: Volatile Organic Compounds (VOCs), Indoor Air Pollution, Volatile Chemical Products (VCPs), Olfaction Chamber, Odor Assessment

Mentor(s):

Nusrat Jung (Engineering); Brandon Boor (Engineering); Jordan Cross (Engineering); Brian Magnuson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1034
Presentation Time: Session 1: 9:00am-10:00am

Quantum Materials

Innovative Technology/Entrepreneurship/Design

Author(s):

Tristan Marta† (Engineering); Yu-Chun Lin† (Engineering); Kyung Jun Lee† (Engineering)

Abstract:

The "Automation of Quantum Materials 2D Transferring" project is a bold attempt to transform the handling and conveyance of two-dimensional (2D) quantum materials, potentially leading to revolutionary developments in quantum computing, photonics, and nanoelectronics. 2D quantum materials with unique electrical characteristics and prospective uses, like graphene and transition metal dichalcogenides, have attracted much interest. Nevertheless, the accurate transfer of these atomically thin materials is still a laborious, manual procedure, which restricts their broad application.

Building a system aims to provide a user-friendly interface for researchers. In addition, we hope this system can reduce the transformation time in the process of the 2D transfer of Quantum materials. Because most 2D transformations take much time to exfoliate materials to get the desired thickness and transfer them to the substrate (Eg, silicon), this system can make the transfer process more time-saving and enhance the experiment's efficiency.

To improve control and lower the danger of contamination, the project also incorporates real-time monitoring and sensor input, which makes the research workflow more efficient. Not only would automation of 2D quantum material transfers speed up experiments, but it will also encourage the creation of new quantum devices and applications.

Our project aims to create a future where 2D quantum materials will be commonplace and dependable, promoting innovation in energy technology and quantum information science. Our goal is to enable researchers, encourage teamwork, and enable discoveries in quantum materials research by automating this vital procedure. To fully utilize these extraordinary materials for advancing science and technology, the "Automation of Quantum Materials 2D Transferring" project looks to be a significant step forward.

Keywords: Quantum Materials, 2D Materials, Semiconductor, Graphene, 2D Transfer

Mentor(s):

Pramey Upadhyaya (Engineering); Abhishek Solanki (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1036
Presentation Time: Session 1: 9:00am-10:00am

Promoting Diversity at Purdue

Social Sciences/Humanities/Education

Author(s):

Nathaniel Mathew† (Science)

Abstract:

Diversity is a selling point for many colleges. It appeals to many high school graduates looking to find others like themselves, or feel at home while attending college. This paper uncovers the programs and strategies used by Purdue, and compares them to similar colleges, in order to find systems that could be implemented, or improved, at Purdue. Purdue's programs will be researched and compared to colleges such as Indiana University, Virginia Tech, and Rose Hulman. Each school's demographics will be compared, and their most prominent programs that support diversity will be presented. Diversity programs will include anything that supports students' races, genders, sexualities, economic classes, or culture. Data will be collected from each college's official websites, and organizations that have found schools' demographics.

Keywords: Diversity

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1037
Presentation Time: Session 1: 9:00am-10:00am

Development of inhibitors for GRK2 Activity

Life Sciences

Author(s):

Kathryn McCauley† (Science)

Abstract:

G-protein coupled receptor kinases (GRKs) desensitize activated GPCRs by phosphorylating them. There are seven human GRKs (GRK1-7). GRK2 and GRK5 are abundantly expressed in cardiovascular tissue, which implicates them in cardiovascular diseases. Here we focus on GRK2. Increased activity of GRK2 has been shown to increase the risk of cardiovascular diseases. Furthermore, recent studies show chronic heart failure and failing cardiovascular muscle tissue due to increased GRK2 activity. Inhibitor βARKct improves failing tissue function by inhibiting GRK2 binding to the βγ G-protein subunits to prevent internalization of the receptor. Other studies show by promoting GRK2 ubiquitination and degradation, regulates GRK2 stability, increasing the metastatic ability of gastric cancer cells making GRK2 an attractive target for chemotherapy as well. In this study we tested GRK2 inhibitors derived from paroxetine scaffold. We used kinase assays using radioactive phosphate isotope (P-32) to test the potency of seven inhibitors. We tested thermostability of GRK2 when bound to inhibitors using a Thermofluor assay. We identified three compounds GRL-029, GRL-032, and GRL-033 with IC50 values of 1.4µM, 1.7µM, and 0.9µM respectively. These inhibitors showed a melting temperature (Tm) of around 55℃ when bound to GRK2, which is an increase from 47℃ with no ligand, indicating increased thermostability. In future we aim to obtain the structure of GRK2 bound to these inhibitors using cryo-electron microscopy to better understand their interactions. This study will aid rational based drug design for cardiovascular diseases and cancer, widening the scope of our understanding of the mode of inhibition of these inhibitors.

Keywords: GRK2, Cardiovascular, Kinase, Inhibitors

Mentor(s):

John Tesmer (Science); Priyanka Naik (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1038
Presentation Time: Session 1: 9:00am-10:00am

Adaptive Perfectionism vs. Maladaptive Perfectionism

Social Sciences/Humanities/Education

Author(s):

Mikey Paulson† (Science)

Abstract:

Perfectionism is consuming the minds of college students around the world. Through parental and peer expectations and pressures, this idea of perfectionism has become the most accepted way to get through academics. These pressures have morphed the minds of college students to conform to this idealogy which in turn has created negative mental health effects. Not only that, but this idealogy is an ineffective way to approach academic success in the college setting. Purdue University is a prime example of this, Purdue's extreme pressure to do well inside and out of the classroom with the plethora of jobs, internship, and other opportunities has given Purdue students an immense pressure to live up to the standards of Purdue. For many of the courses at Purdue they have been designed as weed-out classes. An idea used to weed out many of the students that can't keep up with the coursework. However, this has instead weeded out the students that haven't been able to adjust and adopt the perfectionist mind set in which they expect. Purdue University is known for struggles with mental health on their campus's, we will delve deeper into the connection to this and perfectionism later on. Now the question we are left with is whether or not the academic advantages of being a perfectionist in a college setting is overall worth it when considering mental health and academic performance.

Keywords: Adaptive Perfectionism, Academic Pressure, Academic Expectations, Overworking, Maladaptive Perfectionism

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1039

Presentation Time: Session 1: 9:00am-10:00am

Proximity and Efficacy Perceptions on Consumer Hand Hygiene Compliance in Restaurants

Social Sciences/Humanities/Education

Author(s):

Quinn Phillips† (HHS)

Abstract:

Instant hand hygiene (i.e., hand sanitizer) products have been considered alternatives to handwashing to prevent foodborne illness when access to running water is limited. However, current investigations have limited results on restaurant consumers’ hand sanitizer product usage. Therefore, this study investigated the impact of hand sanitizer product proximity and restaurant consumers’ response efficacy of hand sanitization on their hand sanitizer usage. A between-subject quasi-experiment design using 2 modes of accessibility (entrance-area stationary sanitizer, tabletop sanitizer) was employed to test the research question. The study was conducted in a full-service restaurant over a 1-month period. Results of the independent samples t-tests showed there was a significant difference in consumers’ hand sanitizer usage between different accessibility modes (t(189) = -4.89, p < .001). Specifically, 11% of consumers in the stationary hand sanitizer group complied with hand hygiene, while 41% of participants in the table-side sanitizer group complied with hand hygiene. There was no significant difference in hand sanitizer usage between participants with high and low response efficacy of hand hygiene products (t(189) = -.485, p = .335). The implications of these results suggest that the proximity of hand hygiene products can nudge restaurant consumers toward increased hand hygiene compliance. Placing hand sanitizing products on the tabletop increases consumer hand hygiene compliance.

Keywords: Hand Hygiene, Proximity and Compliance, Response Efficacy, Restaurant Consumer Hand Hygiene

Mentor(s):

Karen Byrd (HHS); Lucheng Wang (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1040
Presentation Time: Session 1: 9:00am-10:00am

Field evaluation of IEQ and Energy usage patterns of a compact living space

Physical Sciences

Author(s):

Ariane Rednour† (Engineering)

Abstract:

Understanding occupant comfort in compact residential spaces is prominent, given that people spend approximately 90% of their time indoors. This study incorporates objective measurements and subjective surveys to investigate both the perception assessment and actual parameters of the indoor environment of compact residential spaces. The mechanistic assessment includes: energy and water consumption, along with various Indoor Environmental Quality (IEQ) parameters such as temperature, relative humidity, sound level, lighting intensity, and indoor air quality. The current phase has successfully combined objective data with occupants' subjective comfort evaluations. Ultimately, the results will present patterns related to IEQ, energy, and water consumption, thereby contributing to the enhancement of indoor living conditions in compact residential spaces.

Keywords: Indoor Environmental Quality, Compact Living Space, Field Evaluation, Energy Usage

Mentor(s):

Nusrat Jung (Engineering); Hongbo Lu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1041
Presentation Time: Session 1: 9:00am-10:00am

The effects of the COVID-19 vaccine on hormone levels in adolescents and potential sex differences

Social Sciences/Humanities/Education

Author(s):

Prudence Regacho† (Science, JMHC)

Abstract:

Immunization is one of the most effective ways to prevent the contraction of the novel coronavirus disease (COVID-19), however, there is a lack of evidence on the potential effects of the COVID-19 vaccine on stress and reproductive hormones in boys and girls during puberty.

To fill this gap, we leveraged data from 52 adolescents (Pre-test Mage=14.27, ~38% female) from the Early Growth and Development Study (EGDS; Leve et al., 2019) who provided hair samples in Spring 2020 (pre-test) and ~9 months later (post-test); 44 received the COVID-19 vaccine, 8 did not. Hair samples were assayed for cortisol (n=47), DHEA (n=25), testosterone (n=37), estradiol (n=32), and progesterone (n=28). The ANCOVA models were used to test the interactions among assessments, vaccination status, and sex, with adolescent's race, family income, and post-test age included as covariates.

No effect was detected for cortisol [F(10)=1.02, partial-eta-squared=.20, p=.44] or DHEA [F(7)=1.47, partial-eta-squared=.63, p=.33]. Both testosterone [F(8)=2.16, partial-eta-squared=.40, p=.066] and estradiol [F(9)=2.36, partial-eta-squared=.54, p=.058] revealed marginal significant results, though no unique contribution of any variable was detected. For progesterone [F(10)=2.93, partial-eta-squared=.68, p=.033], we detected a significant interaction of vaccination status*sex [F(1)=10.67, p=.006], as vaccinated boys showed higher progesterone levels than non-vaccinated boys, whereas vaccinated girls exhibited lower levels than non-vaccinated girls. The results of progesterone suggested potential interference with pubertal development. Our results are preliminary due to the small sample size, and thus larger sample sizes will be beneficial for confirming if COVID-19 vaccination influences the trajectories of hormone level change in boys and girls during puberty.

Keywords: COVID-19, COVID-19 Vaccine, Sex-Based Hormonal Disparities, Adolescents, Immunizations

Mentor(s):

Kristine Marceau (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1042
Presentation Time: Session 1: 9:00am-10:00am

The Intersection of Bobcat Migrations and Public Sentiment in Indiana

Life Sciences

Author(s):

Hannah Reyes† (Agriculture, JMHC); Abigail Seybert* (Agriculture, JMHC); Anthony Tan* (Science, JMHC); Luca Iacobucci* (Agriculture, JMHC); Sierra Hunnicutt* (Science, JMHC)

Abstract:

In recent years, migrating species, such as the bobcat (Lynx rufus), have been observed across the state of Indiana. Habitat corridors are essential for these migrations by combating habitat fragmentation and maintaining biodiversity despite environmental stressors. With private land ownership encompassing approximately 98.2% of the state, per the Indiana Department of Administration, it is important to consider the public perception of coexisting with bobcats. Our research aims to assess public perception concerning bobcats, with the objective of tailoring corridor development strategies along the Wabash River in alignment with these insights. Our survey-based approach targets landowners and visitors of locations like state and county parks, the Niches Land Trust properties, and conservation easement properties near the Wabash River valley. We will initiate our analysis from prior questionnaires conducted in Indiana about people's emotions when encountering white-tailed deer (Odocoileus virginianus) in public and privately owned properties. The studies involve the perspective of rural and urban residents, classifying them further into licensed hunters, farmers, ranchers, and individuals not involved in these practices (Stinchcomb et al., 2023; Stinchcomb et al., 2022; Stinchcomb et al., 2022). Our overarching mission is not just to pave the way for more conservation initiatives centered on corridor development, but also to heighten public awareness in regions where bobcats and humans cohabit. It is crucial for mitigating bobcat-human conflicts as human communities expand. Encountering these felines and other wildlife navigating public roads and neighborhoods as they journey northward, defines the urgent need to advance our conservation efforts.

Keywords: Bobcats, Migrating Species, Corridors, Survey, Questionnaire, Public Awareness Surrounding Wildlife, Wabash River

Mentor(s):

Kristen Bellisario (JMHC)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1043
Presentation Time: Session 1: 9:00am-10:00am

Tumor-associated antigen surface density in mechanisms of CAR T cell threshold setting

Life Sciences

Author(s):

Kenneth Rodriguez-Lopez† (Science)

Abstract:

Chimeric antigen receptor (CAR) T cells are an engineered cell-based therapy that has been successful in treating blood cancers. So far these have had limited impacts on eliminating solid tumors, but success has resulted from high specificity in targeting tumor-associated antigens (TAAs) that are tumor exclusive. Solid tumors usually present a heterogeneous distribution of TAAs that can vary during tumor progression and therefore may be indistinguishable from healthy cells. Furthermore, there is heterogeneity present within a tumor at any given time. One possible reason for this is the 3-dimensional complexity of solid tumors. The density and accessibility of TAAs throughout the tumor volume may modulate CAR T cell activation and, therefore, efficacy. To interrogate the importance of TAA expression level for CAR T cell activation, we have generated clonal populations of the metastatic breast cancer cell line MDA-MB-231 with narrower distributions of folate receptor (FOLR1) expression as a model TAA. The expression of FOLR1 has been quantified using fluorescent microscopy techniques like epifluorescence (EPI) and total internal reflection fluorescence microscopy (TIRF), and cross-validated with flow cytometry. We are also developing 3-D cancer cultures (spheroids) to quantify the differences between TAA expression of traditional 2-D cell cultures and the 3-D spheroids. Finally, we have run killing assays with MDA-MB-231 subpopulations and CARs to determine differences in killing efficiency as a function of FOLR1 density and plan to run similar killing assays with the spheroids in the near future to move into a more therapeutic context, paired with the development of machine learning efforts to streamline large data set cataloging and analysis. Our overall goal is to define the mechanisms for threshold setting in CAR T cells to provide actionable therapeutic insights for treatment regiments and more successful outcomes.

Keywords: Car T Cell, Tumor Associated Antigen, Density Distribution, Killing Assay

Mentor(s):

Shalini Low-Nam (Science); Kevin Scrudders (Science); Suriya Selvarajan (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1044
Presentation Time: Session 1: 9:00am-10:00am

Impacts of a plant-based diet on human health and physiology

Life Sciences

Author(s):

Miray Simsek† (Agriculture)

Abstract:

Plants are prodigious reservoirs of phytonutrients, endowing nutraceutical attributes. Consumption of these foods has nowadays become a burgeoning trend. Plant-derived foods are consumed globally owing to their substantial energy intensity and dietetic worth. They comprehend numerous bioactive components that have been recognized to exhibit manifold health-promoting assets. Comprehension of the synthesis of these compounds by plants and their method of action against several chronic illnesses is a vital requisite. Furthermore, the association of biologically active complexes with plants, humans, disease, and medicine, along with the respective underlying mechanisms, is unexplored. This study investigates various bioactive components derived from plant sources associated with health-promoting traits, along with their action mechanisms. Moreover, this study predominantly assembles given plant-derived bioactive compounds, proposing hypotheses for upcoming studies including selecting bioactive components to formulate diets which effectively combat several chronic health conditions. This information may serve as the basis for advanced preemptive and therapeutic treatment methods to improve human health. Hence, creating opportunities for people to explore the profitable use of plant-based remedies, develop innovative products, and access new marketplaces.

Keywords: Plant, Human Health, Bioactive Compounds, Chronic Diseases

Mentor(s):

Kristin Whitney (Agriculture); Kalpana Bhatt (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1045
Presentation Time: Session 1: 9:00am-10:00am

Wearable sensors for performance enhancement and recovery tracking

Innovative Technology/Entrepreneurship/Design

Author(s):

Diya Singh† (Science)

Abstract:

Long-distance runners are highly impacted by their running indicators, such as stride length and feet vertical forces. While wearable sensors can provide a real-time performance evaluation tool, most of the current devices rely on accelerometers and body mass data, which may introduce errors in estimating kinetics and ground reaction forces. On the other hand, skin-interfaced triboelectric pressure sensing insoles may provide a pathway for seamless force mapping. Additionally, matching biomechanical loads with physiological recovery is key for long-term performance enhancement. By deploying bio-derived electrochemical sensors into the insoles to track biomarkers related to inflammation, and monitoring gait changes, our device can also track athlete's recovery, providing reliable information for data-driven training plans. In this project, bio-derived biochemical sensors and smart pressure sensing insoles will be manufactured through a scalable automatized approach. By combining pressure mapping within the insoles and employing machine learning and reverse kinematics, we aim to precisely measure and analyse key running parameters. Moreover, through sweat electrochemical sensing, bio-chemical information on ongoing inflammation and glycolysis will be collected. Combined, this data can be used to assess both real-time athlete's performance and physiological adaptation to training routines, enabling a reliable data-driven athletic improvement.

Keywords: Wearable Sensors, Biochemical Sensors, Triboelectric Material, Reverse Kinematics, Machine Learning

Mentor(s):

Wenzhuo Wu (Engineering); Pedro Henrique de Souza Barbosa (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1046
Presentation Time: Session 1: 9:00am-10:00am

Motor cortical representation of tactile space is controlled by feedforward somatosensory cortex.

Life Sciences

Author(s):

Sydney Sneed† (Science)

Abstract:

The primary somatosensory cortex (S1) is necessary for performing movements guided by tactile stimuli. Nonetheless, the circuits downstream from S1 that control the flow of tactile information and guide behavior are unknown. One strong possibility is the prominent and direct circuit connection between S1 and the whisker motor cortex (wMC). To causally examine its impact on sensorimotor processing and behavior, we optogenetically silenced S1 axons in wMC during active tactile discrimination of bilateral space. We discovered stimulus-specific representations of bilateral space in wMC neurons that were strongly correlated to task variables. Optogenetically silencing S1 axons in wMC reduced task performance and weakened bilaterally coordination. Stimulus information in wMC neurons greatly decreased. Some neurons completely lost their tactile responses while other neurons gained responsiveness but lost their stimulus preference. Thus, the direct feedforward flow of tactile information from S1 to motor cortex is critical to goal-directed sensorimotor processing and behavior.

Keywords: Bilateral Integration, Motor Cortex, Optogenetics, Somatosensation, Goal-Directed Behavior

Mentor(s):

Scott Pluta (Science); Hayagreev Keri (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1047
Presentation Time: Session 1: 9:00am-10:00am

Numerical modeling and experimental visualization flow behaviors of impingement jet cooling and Tesla channel cooling

Physical Sciences

Author(s):

Yubo Song† (Engineering, JMHC)

Abstract:

The ongoing quest for enhancing cooling efficiency in various industrial sectors fuels our research, as we delve into the flow dynamics of two unique cooling methodologies: Impingement Jet Cooling and Tesla Channel Cooling. We seek to unveil the operational mysteries of these systems, where the former employs high-velocity jets to cool heated surfaces, and the latter leverages the diodic flow properties of Tesla valves. We adopt a dual-pronged approach combining numerical modeling and experimental visualization to thoroughly dissect the fluid behaviors in these systems. Our methodology involves experiments using Particle Image Velocimetry for flow visualization of the water inside the jet cooler and ANSYS software simulations for a deeper interpretation of flow resistances and diodicity in Tesla valves. These comprehensive tools help us unravel the complexities of the fluid dynamics associated with these cooling methods. Initial findings suggest a substantial difference in forward and reverse flow resistances of the Tesla valves, highlighted by a significant diodicity index. Visual representation of the pressure fields using ANSYS provides a clearer image of the dynamics at play. The forthcoming conclusion from our study is anticipated to enrich the current understanding of these cooling systems. By demonstrating the unique unidirectional flow characteristics of the Tesla valve and the potential efficiency of Impingement Jet Cooling, we aim to spur future research and development efforts in the realm of advanced cooling technologies.

Keywords: Fluid Dynamics, Semiconductor Cooling, Thermal Management, Heat Transfer, Numerical Modeling

Mentor(s):

Tiwei Wei (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1048
Presentation Time: Session 1: 9:00am-10:00am

Measuring new cotton fiber phenotypes throughout fiber development

Life Sciences

Author(s):

Anika Sood† (Science)

Abstract:

Gossipyum hirsutum, also known as upland cotton, is a major source of cotton fibers for the global textile industry boasting a multi-billion-dollar market. Fibers grown by G. hirsutum begin developing as a unicellular trichoblast emerging from the seed coat epidermis. Following initiation, fibers enter a developmental programme that consists of tapering, elongation, secondary cell wall synthesis, and finally maturation. The shape, length, and strength of cotton fibers is determined in large part by the material properties of the cell wall, most importantly those linked to cellulose microfibrils. The objective of this project is to deeply and quantitatively analyze material properties of the cell wall throughout fiber development, with the goal of determining the nano- and micro-scale properties of the fiber cell wall. Subsequently, this phenotyping data will be correlated with multiple types of genomic-level measurements of mRNA, protein, and cell wall composition. The first phenotype investigated was the changes in cell wall thickness over time that were measured from published electron micrographs throughout fiber development. This prompted a closer analysis of cotton fiber growth rates to correlate the changing cell wall thickness with the elongation of fibers. Furthermore, a new confocal microscopy-based image analysis pipeline was developed to quantify important aspects of the cellulose microfibril network and how they relate to fiber development. These measurements are important to understand the type and timing of cell wall changes that dictate the final fiber anatomy and will have a practical importance for the genetic improvement of cotton fiber traits.

Keywords: Cotton Fiber, Phenotype, Cellulose, Microscopy, Development

Mentor(s):

Daniel Szymanski (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1049
Presentation Time: Session 1: 9:00am-10:00am

Evaluative and Research Data Collection Research Design

Social Sciences/Humanities/Education

Author(s):

Alexa Striebeck† (HHS)

Abstract:

The purpose of this study was to create a research design framework that collects both evaluative and research data in an educational workshop series. The study focuses on the decision-making process for the development of the research design and an analysis of specific instruments and survey measures. Since this study was based on data collected in the context of the educational workshop series, we implemented the learning objectives from the series to develop an assessment of the participants' extended reality (XR) knowledge for the survey questions. Several considerations guided our survey development including: (a) the characteristics of our anticipated participants (university staff, professors, faculty members, and TAs); (b) appropriate timing for administering the survey; and (c) survey length. To avoid survey fatigue, maintain our participants' engagement, and control attrition, we created a survey timeline. We searched for validated instruments that align with our evaluation and research objectives and modified instruments as needed such as surveys, focus groups, and interviews. For this study, the design process used an evaluation framework that focused on structure, learning processes, and outcomes. We collected data on motivation, self-determination, and self-efficacy using pre- and post-workshop surveys. Our measures included the Autonomy and Competence in Technology Adoption (ACTA) and the Technology Acceptance Model (TAM), as well as implementing an Adoption Stage. Our goal is to create an effective research design to collect evaluative and research data for further researchers to use.

Keywords: Evaluative Data, Research Data, Evaluation Framework, Research Design, Surveys

Mentor(s):

Victoria Lowell (Education); Youli Mantzicopoulos-James (Education); Hannah Kim (Education)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1050
Presentation Time: Session 1: 9:00am-10:00am

Beyond5G

Innovative Technology/Entrepreneurship/Design

Author(s):

Daanish Suhail† (Science); Benjamin Hodonicky† (Engineering); Phone Paing† (Engineering); Kshitij Shah† (Engineering); Zafeer Reza† (Engineering); Shao-Yuan Chang† (Engineering)

Abstract:

Communications technologies have seen improvements in the modern day as evidenced by the 5G standards. The Beyond5G team intends to evaluate and understand these new technologies. This was accomplished by splitting the team into various subteams which would evaluate an area of communications. These include error-correcting codes, carrier synchronization, and the testing of communications techniques with a USRP device.

For error-correcting codes the intent is to implement various mathematical methods on digital transmissions to fix errors which may occur due to corruption. This will mainly involve the use and understanding of Reed-Muller codes, Hamming codes, and convolution codes to detect errors within a signal and to decode the original data.

Carrier synchronization involves ensuring that the local oscillator of the receiver has the correct phase relative to the incoming carrier wave. We will evaluate different methods of carrier synchronization for modulation techniques such as FM, BPSK, and OFDM.

USRP focuses on implementing a MIMO system using an Alamouti code. This involves using two transmitter antennas and one receiver antenna to improve spatial diversity. This system will utilize Ettus Research USRPs and be programmed using GNU radio. Implementation will involve creating a signal transmitter then a receiver for a complete communication system.

The necessity of this work is great due to the need for quality communications for modern day devices like cell phones. Therefore, the evaluation of these technologies is imperative for enabling greater quality communications and to build the foundations for future improvements.

Keywords: 5G, Communications, Electrical Engineering, Signals, Transmission

Mentor(s):

Chih-Chun Wang (Engineering); David Love (Engineering); James Krogmeier (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1051
Presentation Time: Session 1: 9:00am-10:00am

Integrating Open AI into An R Shiny App: A Tool to Generate Pictures from Stories

Innovative Technology/Entrepreneurship/Design

Author(s):

Yunlei Tang† (DSB); Danhe Tang† (DSB)

Abstract:

We develop and test a ‘Story Picture Generator' application using Open Artificial Intelligence (AI). The tool provides the user a R Shiny Graphical User Interface (GUI), that easily interfaces with OpenAI which provides text comprehension and drawing capabilities. By leveraging OpenAI's capabilities, the application generates relevant images based on the context and themes of the user's story.

The motivation for this research is that there exist diverse audiences who seek custom images to support their stories and presentations. Presenters are often tasked with trying to source something “close” to what they are seeking by searching the internet, which is often not exactly what they want, and can be time-consuming. By using this picture generator, users can visualize their text content to amplify the message, aid in comprehension, and make the content more memorable. The Open AI Story Picture Generator aims to bridge this gap, offering an automated solution to provide visual augmentations tailored to the narrative's context.

The application utilizes an R Shiny interactive interface where users can input their textual content to generate a corresponding custom image. By submitting the content, the app processes the text, extracting keywords and themes by connecting and using OpenAI’s Large Language Models (LLMs). These are then sent to drawing OpenAI to return appropriate images. The Shiny app then displays these images alongside the story. The app is built to be intuitive, requiring no technical expertise from the user, but offers options for image customization and refinement as necessary.

Keywords: Text Visualization, R Shiny, Open AI, Storytelling Augmentation

Mentor(s):

Matthew Lanham (DSB)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1052
Presentation Time: Session 1: 9:00am-10:00am

RoboMasters Launcher Optimization

Innovative Technology/Entrepreneurship/Design

Author(s):

Dhanush Tipparaju† (Engineering); Alex Nishio† (Science); Alex Lai‡ (Engineering); Miles Flippin‡ (Engineering); Zihan Lin‡ (Polytechnic); Jayson Stansbury* (Engineering); Ruoyi Li* (Engineering)

Abstract:

Using the available parts on McMaster Carr, we will calculate and find the most optimal spring for a spring-based launcher for the RoboMasters Hero Robot. The spring launcher needs to meet the game constraints while also meeting the following criteria: high accuracy, high consistency, ease of manufacturing and design, low weight, small size, adjustable angles, and high resilience. The goal of the optimized launcher is to replace the current design for the robot to help integrate other mechanical subsystems.

Keywords: Launching, Robotics, Optimization

Mentor(s):

Abolfazl Hashemi (Engineering); Zijian He (Engineering); Shivam Bhat (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1053
Presentation Time: Session 1: 9:00am-10:00am

Reconstruction Efficiency of the CMS Experiment

Physical Sciences

Author(s):

Aditya Tiwari† (Science); Jason Becker† (Science); Rezza Hadian† (Science); Gino Daniels† (Science)

Abstract:

We will be using simulated data from the Large Hardon Colliders CMS detector. Specifically, relating to the production of top quark and anti-top quark pairs. We will be studying the efficiency of the top quark reconstruction process, and we will discuss the results. These results will be used to help improve the reconstruction process, allowing for the discovery of new physics.

Keywords: Top Quark Physics, Large Hadron Collider, Compact Muon Solenoid

Mentor(s):

Andreas Jung (Science); Lingqiang He (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1054
Presentation Time: Session 1: 9:00am-10:00am

Pattern of long-term binge-like alcohol consumption in crossed high alcohol-preferring mice

Life Sciences

Author(s):

Griffin Tresse† (HHS)

Abstract:

Ninety percent of alcohol consumption by adolescents is through binge drinking. Studies suggest that adolescent binge drinking increases the likelihood of developing alcohol use disorder during adulthood. High levels of alcohol consumption during adolescence are particularly detrimental because adolescence is a critical development phase. The purpose of the current study was to examine the pattern of long-term alcohol consumption from adolescence to early adulthood in crossed high alcohol-preferring (cHAP) mice, a mouse model selectively bred for high alcohol preference. Adolescent (PND 32-36) male and female cHAP mice were exposed to a drinking in the dark (DID) paradigm for 4 days a week for 4 weeks to model binge drinking. Mice were administered either 20% ethanol solution or water for 2 hours on days 1-3 and for 4 hours on day 4. Results revealed a significant increase in g/kg alcohol intake in the first two hours of consumption of all 4 days across the four weeks. Females tended towards a higher g/kg alcohol intake than males, consistent with the rodent literature. We also observed a significant increase in overall ethanol intake across the 4 days within Week 3. Interestingly, there was a significant increase in ethanol intake in females compared to males across the 4 days in Week 3. When assessing alcohol intake on Day 4 only of each week, there was significant increase in consumption as the weeks increased. Future directions will include understanding the influence of binge drinking on cognitive processing and immune responses in the hippocampus and PFC.

Keywords: Alcohol, Binge Drinking, Adolescence

Mentor(s):

Julia Chester (HHS); Alisha Aroor (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1055
Presentation Time: Session 1: 9:00am-10:00am

Rapid Identification of Transients from the Zwicky Transient Facility Using a Convolutional Variational Autoencoder

Physical Sciences

Author(s):

Ariadin Vest† (Science); Thomas Slamecka† (Science); Cade Rigg† (Science); Parvesh Venugopallavanya† (Science); Braden Garretson‡ (Science)

Abstract:

Upcoming all-sky surveys such as the Vera Rubin Observatory are set to provide an order of magnitude more data than current surveys such as the Zwicky Transient Facility (ZTF). This increase in data necessitates the need for more efficient methods for the rapid classification of transients. Current methods require time-consuming manual review of images, or light curve classification, which is unreliable at early epochs. To combat this, we train a convolutional variational autoencoder on observation stamps of transients from the ZTF to learn a latent representation that is capable of distinguishing between supernovae, active galactic nuclei, and variable stars. Our methodology will allow for the rapid classification of transients from a single image alone, thereby enabling rapid follow-up observations that better characterize the evolution of the transients' light curves.

Keywords: Machine Learning, Astronomy, Supernovae

Mentor(s):

Danny Milisavljevic (Science); Braden Garretson (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1056

Presentation Time: Session 1: 9:00am-10:00am

Design of a Phase Locked Loop

Innovative Technology/Entrepreneurship/Design

Author(s):

Nicole Wang† (Engineering); Asav Gandhi† (Engineering); Stephen Fetterman† (Engineering)

Abstract:

A phase locked loop (PLL) is a control system with the ability to adjust frequency to match the input signal. If the phase difference between the reference and the output is zero, the system is considered locked. A basic PLL consists of four circuit components: the phase comparator, loop filter, oscillator, and a divider. Digital PLLs indicate that both inputs are digital. Therefore, each component specifically is a time-to-digital converter (TDC), digital loop filter, a digitally controlled oscillator (DCO), and a divider. The team will accomplish this using Cadence Virtuoso for design, testing, and layout. The overall goal is to design a digital PLL for the AFTx08 chip within the SoCET team.

Keywords: Phase Locked Loop, Analog Design, Digital Design, Cadence Virtuoso, Digital Phase Locked Loop

Mentor(s):

Mark Johnson (Engineering); Sutton Hathorn (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1057
Presentation Time: Session 1: 9:00am-10:00am

The Reduction of Noise Reduction Within the XENON NT Dark Matter Detector

Physical Sciences

Author(s):

Christian (Casey) Ward† (Science); James Strayhorn† (Science); Liam Gallegher† (Science); Richie Tan† (Science)

Abstract:

Currently, Weakly Interacting Massive Particles (WIMPs) are one of the leading candidates for dark matter particles. Liquid Xenon scintillation using the XENONnT detector promises a different perspective on the problem over traditional Sodium Iodine lattice scintillation. However, the presence of noise within the XENONnT detector due to radioactive decay in the nearby reaches of the detector along with radioactive decay occurring within the convection field of the liquid Xenon itself prove themselves to be a major obstacle in detecting WIMPs. Among these signals, the radioactive decay of 222Rn into 214Pb via successive alpha decays proves to be (at current) the most problematic. The goal of our team's work is to reduce the false detection of WIMPs that are associated with the signals associated with photoelectrons of similar energies of the 214Pb decay chain starting with 214Po using convection fields. Ideally, our estimated convection field will be able to accurately predict where in our detector the daughter particles of this decay chain will be at any point in time, allowing us to trace false detections to their source.

Keywords: Weakly Interacting Massive Particles, Xenon, Xenon NT

Mentor(s):

Husheng Guan (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1058
Presentation Time: Session 1: 9:00am-10:00am

Observation of human-animal interaction for research (OHAIRE) behavior coding in a randomized clinical trial of children with attention-deficit hyperactivity disorder (ADHD) in a canine-assisted intervention

Social Sciences/Humanities/Education

Author(s):

Katherine Yi† (Science)

Abstract:

Characterized by inattention, impulsive behavior, and restlessness, attention-deficit hyperactivity disorder (ADHD), presents a rapidly rising prevalence of approximately 10% of children in the United States. Current treatments include conventional pharmacological and psychological interventions which are frequently supplemented with integrative methods such as animal-assisted intervention (AAI). This study explores the effects of AAI for children with ADHD by combining AAI (live therapy dog or control stuffed dog) with cognitive behavioral therapy as part of a larger randomized clinical trial. Previous published primary outcomes of this clinical trial suggest improvements to psychosocial outcomes based upon clinically validated survey measures. The current project furthers investigation from this clinical trial data exploring 322 minutes of video-captured behavior observations for analysis. The data is processed using the Observation of Human-Animal Interaction Research (OHAIRE) Coding System to categorize behaviors such as animal social interaction and human social interaction. Data is analyzed utilizing mixed models in GLIMMIX in SAS. Results indicate no statistically significant findings on animal social interaction, regardless of the use of live therapy dogs or stuffed animals. However, there are significant findings within human social interactions over time, as evidenced by a group by time interaction ($p = .020$). Future studies should incorporate behavior coding adapted for structured interventions to further explore these interactions as a mechanism for psychosocial outcomes.

Keywords: Animal-Assisted Intervention, Therapy Dog, Attention-Deficit Hyperactivity Disorder, Complementary Intervention, Human-Animal Interaction

Mentor(s):

Leanne Nieforth (Veterinary Medicine)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1059
Presentation Time: Session 1: 9:00am-10:00am

Retrieval-Based Learning: Is It Effective in Both High School and College Students

Social Sciences/Humanities/Education

Author(s):

Xinmeng Zhou† (Education, HHS)

Abstract:

Transitioning from high school to college is a common stressor for students. One of the challenges facing incoming freshmen is the drastic difference in academic expectations. In college, students are usually asked to absorb more material within a shorter timeframe. To be successful, students must employ effective learning strategies, like retrieval-based learning (RBL), that promote both meaningful learning and effective recall of complex information. It is argued that in addition to encoding new learning in meaningful ways, RBL is critical to knowledge reconstruction and effective storage. Importantly, retrieval in the initial phases of learning is key to helping students in future retrieval and knowledge use. However, the reality is that incoming freshmen often lack this skill, which makes the transition challenging. Can this strategy be effectively used by both high school and college students? A literature review was conducted through PsycInfo & ERIC databases to document the use and effectiveness of RBL in both high school and college. The keywords to search for the literature included: retrieval-based learning, learning strategies, high school students, and undergraduate students. This literature would have important implications for both educational practitioners and researchers and intends to address two important goals. First, to provide educators with strategies that would support them in helping students develop RBL skills prior to the college transition. And second, to generate research on best practices in the use of RBL as students transition from high school to college.

Keywords: Retrieval-Based Learning, High School Students, Undergraduate Students, Learning Strategies

Mentor(s):

Youli Mantzicopoulos-James (Education)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1200
Presentation Time: Session 2: 10:30am-11:30am

The Effect of Cover Crop Inclusion on Soil Nitrogen Bioavailability

Life Sciences

Author(s):

Rebeca Appelmann† (Agriculture)

Abstract:

Planting cover crops in-between cash crops can help retain nutrients in the soil from the previous cash crop season to provide for the next season. Recent studies have concluded that certain cover crop species may be more effective than others at nutrient retention. The objectives for this study were to: 1) compare the ability of different cover crop species to enhance soil N levels; and 2) simulate the growth stages of corn and evaluate the concentrations of soil ammonium (NH4+-N) and nitrate (NO3--N) in the growing season. In this incubation study, the cover crops used were cereal rye (Secale cereal L.) and balansa clover (Trifolium michelianum). The control consisted of soils without cover crops. The soil samples were collected from the Southeastern Purdue Agronomy Center (SEPAC), in Butlerville, IN. Results observed from a prior incubation conducted in 2022 showed that balansa clover had the potential to reduce nitrogen fertilizer application rates and produced a larger biomass than cereal rye. The balansa clover was also found to have greater levels of ammonium at emergence because it has a low C:N ratio, leading to its rapid residue decomposition. Throughout the simulated growing season, NH4+ concentrations decreased from VE to V6, then increased from V6 to R6. Increases of ammonium concentration can be attributed from a second wave of microbial activity mineralizing organic matter. Similarly, nitrate concentrations throughout the simulation were significantly greater in the balansa clover treatments at each growth stage compared to cereal rye treatments. Future research should investigate how different cover crop species and other conservative practices can help reduce nutrient losses and fertilizer inputs while maintaining or increasing cash crop yields.

Keywords: Soil, Nitrogen, Cover Crop, Nitrate, Ammonium

Mentor(s):

Shalamar Armstrong (Agriculture); Frank Johnson (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1201
Presentation Time: Session 2: 10:30am-11:30am

Embedded application of AFtx07 chip

Innovative Technology/Entrepreneurship/Design

Author(s):

Ilan Benschikovski† (Engineering); Ishaan Rath† (Engineering)

Abstract:

The purpose of this project is to implement a PID algorithm using the AFTx07 microcontroller chip developed by the SOCET team. The PID algorithm will be used to control and maintain the water level in a system according to the user's needs. There will be a water pump adding water to the system and a pipe at the bottom facilitating the outflow of water from the system at a steady rate. The user will have the option to specify the water level they want to maintain and the AFTx07 will control the water pump to maintain the specified water level using the PID algorithm. We will be implementing sensors to detect the height of water in the system and monitor this value to decide whether to increase or decrease the water flow rate to the system to reach the target level. Data recorded during preliminary trials will include the input water flow rate and the tank water level. Both will be recorded as a function of time and will be used for parameter tuning. Stability will be reached when the water level oscillates around the desired water level, with a small amplitude. The time it takes to reach stability, and the accuracy at stability, will both be used to evaluate the success of this device. This design can be implemented to maintain water levels in water reservoirs, wastewater management systems, swimming pools, and various other industries. The PID algorithm can be used in areas other than water level systems such as temperature regulation, automotive control, pressure control, and motor control amongst other applications. The success of this project will establish a proof of concept for the AFTx07 chip fulfilling the primary project objective.

Keywords: Embedded Application, PID Algorithm, Microcontroller, Water Level Regulation, AFTx07 Chip

Mentor(s):

Mark Johnson (Engineering); Cole Nelson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1202
Presentation Time: Session 2: 10:30am-11:30am

Strangeness Enhancement in Hadronic Event Generators

Physical Sciences

Author(s):

Amelia Binau† (Science, JMHC)

Abstract:

Cosmic ray air showers and their associated cascades of baryonic daughter particles are often studied using Monte Carlo simulations of hadronic collisions. However, these simulations often fail to account for high muon fluxes observed in data collected from cosmic ray observatories (such as the Pierre Auger Observatory), a problem known as the Muon Puzzle. In this work, I study how such event generators (namely Pythia 8.308, EPOS-LHC, and Sibyll-2.3) account for strangeness enhancement (increased production of strange hadrons), a possible physical explanation for the Muon Puzzle at TeV energies. By simulating up to 100,000 proton-proton collisions at both 7 TeV and 13 TeV energies in all three event generators, I computed charged particle multiplicity classes based on definitions used in experimental analyses conducted by the ALICE collaboration (2017). I used these multiplicity classes to compute yields ratios of strange particle counts for all three event generators at both energy levels. From the multiplicity class dependent yield ratios (pT-integrated yields), it was concluded that strangeness enhancement was characterized as expected in all three simulations, with strangeness enhancement observed in EPOS-LHC and not observed in Pythia 8.308 and Sibyll-2.3. These results affirm that the encoded physics of these collision simulations (well-used by physicists at LHCb and similar collider experiments) are functioning as intended and confirming the extent to which these phenomena are present in simulated data enforces whether these models are accurate representations of real-life hadron collision physics.

Keywords: High Energy Particle Physics, Cosmic Rays, Large Hadron Collider, Computational Physics, Simulation

Mentor(s):

Andreas Jung (Science); Hans Dembinski (Technische Universität Dortmund)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1203
Presentation Time: Session 2: 10:30am-11:30am

Decentralized Wireless Microchip Array For Large-Scale Neural Spike Recording

Innovative Technology/Entrepreneurship/Design

Author(s):

Lorenzo Cacciapuoti† (Engineering)

Abstract:

The vast majority of current neural recording technology follows the model of a central implanted chip equipped with an array of electrodes. While this model has been the standard for many years and used in many successful studies, its implantation and recording methods make it unsuitable for long-term studies and simply too invasive for most human applications. The complex surgical procedure for implanting these devices makes it hard to replicate on a large scale (especially for human trials), and the devices can become relatively bulky depending on the application. To attempt to solve these problems, we propose a new neural recording device, the Neural Microchip Array. The device consists of an array of microchips where each chip is responsible for recording spikes in a single neuron. These chips then communicate wirelessly with a receiver stationed outside the body whenever they sense a spike so that it can be tracked. Due to their small size, these microchips can be implanted into the brain without the need for a complex surgical procedure. While this work is still in the proof of concept stage, we anticipate that this technology could allow for rapid advances in the understanding of the nervous system thanks to its unique capability of monitoring very wide areas of the neural cortex.

Keywords: Neural Recording, Microtechnology, Neural Spike Detection, Neuroscience, Integrated Circuit

Mentor(s):

Mark Johnson (Engineering); John Peterson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1204
Presentation Time: Session 2: 10:30am-11:30am

Network Communication Enhancement for AFT-x06 Chip

Innovative Technology/Entrepreneurship/Design

Author(s):

Indrayudh Chowdhury† (Engineering)

Abstract:

This project designed an Ethernet PCB Shield to enhance the communication capabilities of the AFT-x06 microcontroller chip from Purdue System on Chip Extension Technologies (SoCET). It incorporated the high-speed and stable W5500 Ethernet Controller chip seamlessly with the microcontroller's peripherals, addressing power regulation and noise considerations. The PCB layout was optimized for space usage, implementing efficient grounding and routing for signal integrity and data transmission. The Ethernet Shield opens new applications requiring efficient network communication, such as the Internet of Things (IoT).

Keywords: Ethernet PCB Shield, AFT-x06 Microcontroller Chip, W5500 Ethernet Controller, Network Communication, Internet of Things (IoT)

Mentor(s):

Mark Johnson (Engineering); Rauf Erkiletlioglu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1206
Presentation Time: Session 2: 10:30am-11:30am

Determining the anti-cancer actions of Lippia Origanoides on African American Triple-Negative Breast Cancer

Life Sciences

Author(s):

Aya Elsawy† (Science)

Abstract:

Breast cancer remains a concern as it is the most diagnosed cancer and is a leading cause of cancer death (Wilkinson et al., 2022). Tripple-negative breast Cance (TNBC) is responsible for 12% of breast cancer diagnoses, with a 4.2% risk in women under 40 (Almansour, 2022). TNBC affects 13 in every 100,000 females in the U.S. (NCI, 2022). It lacks estrogen receptor (ER), progesterone receptor (PR), and human epidermal growth factor (HER2), making it more challenging to treat. Those with African American women are at higher risk of TNBC, associated with higher mortality and worse prognosis (Dietze et al., 2015). Given the lack of effective therapeutics, efforts to better understand the mechanisms of TNBC's aggressiveness are critical. Towards identifying novel TNBC targets, the extract of the South American plant Lippia Origanoides (LO) has previously been studied for its anti-inflammatory and antiproliferative components, suppressing cell viability and inducing apoptosis in breast cancer cells. Our current goal is to determine the effect of LO on the viability of MDA-MB-468 cells, a cell line derived from African-American patients. Viability will be quantified using 4 Succinate dehydrogenase activity (MTT assay) to measure cellular metabolic activity. Based on previous studies revealing the impact of LO on mitochondrial activity, we anticipate it will be effective in promoting apoptosis and suppressing proliferation in the MDA-MB-468 cells. Further research on the mechanisms of LO may lead to the development of therapeutics to better African American TNBC outcomes.

Keywords: Triple-Negative Breast Cancer, Lippia origanoides, MDA-MB-468 Cells, MTT Assay, Cellular Metabolic Activity

Mentor(s):

Ignacio Camarillo (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1207
Presentation Time: Session 2: 10:30am-11:30am

Evaluation of Cell Viability and Inflammatory Response in Human Primary Gingival Keratinocyte Cells Exposed to Oral Nicotine Pouches

Life Sciences

Author(s):

Jacob Eyster† (HHS, JMHC)

Abstract:

Among adolescents and young adults, oral nicotine pouches (ONPs) have become the second most prevalent nicotine product in the US, prompting concerns about potential adverse oral health effects as the pouch distributes its contents into the bloodstream via the oral mucosa. While ONPs are considered less harmful compared to traditional tobacco products, the associated risks related to toxicity remain unknown. We hypothesize that ONPs induce oral toxicity dependent on concentration and flavor, tested through an assessment of ONPs of five different flavors at nicotine concentrations of 3 or 6 mg. The ONPs were incubated in artificial human saliva or cell culture media for 1 hour and extracted components were characterized. Nicotine levels were quantified utilizing a targeted mass spectrometry approach, while other components were quantified relatively using a metabolite profiling approach; this confirmed nicotine concentrations and determined unique components based on flavors/extraction media. Human primary gingival keratinocytes (PGK), representative of cells lining the oral mucosa, were exposed to extracts from flavored ONPs generated from incubation in cell culture media at 0% (controls), 50%, or 100% for 3 or 24 hours. Dose- and time-dependent alterations in cell death were observed via MTT assay. Cellular uptake of nicotine was quantified at 3 hours post-exposure utilizing targeted mass spectrometry methods for nicotine and its primary metabolite cotinine. Expression of genes related to inflammation was measured 3 hours after exposure to 0% or 50% extracts; assessment of these inflammatory pathways is ongoing. Overall, our preliminary results demonstrate cellular toxicity associated with ONP exposure.

Keywords: Toxicology, Nicotine Pouch, Gingival Keratinocyte, Cell Culture, Inflammatory Signaling

Mentor(s):

Jonathan Shannahan (HHS); Arjun Pitchai (HHS); Li Xia (HHS); Amber Jannasch (Discovery Park); Bruce Cooper (Discovery Park)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1208
Presentation Time: Session 2: 10:30am-11:30am

Intercultural Competence on a Pendulum Model

Social Sciences/Humanities/Education

Author(s):

Paige Fulkerson† (Education)

Abstract:

In an increasingly globalized world, Intercultural Competence (ICC) is becoming an important trait for people to understand and measure. Many current measures that assess ICC, such as the Intercultural Development Inventory (IDI), implement a continuum model of ICC where individuals move through steps or stages in a linear journey. As an alternative to this simplistic unidirectional developmental model, my research mentor, Kris Acheson-Clair, and Sundae Schneider-Bean (2019) propose a pendulum model for intercultural development and maintenance that is inclusive of “swings” between cultural similarity and difference, as well as “magnets” that pull us to either side, or “anchor” us towards a state of adaptation. The purpose of this project and continued research is to prioritize a nonjudgmental approach that better aligns with people’s lived intercultural experiences.

As this research has continued, connections have been drawn to the Purdue community through questionnaires given to study abroad participants before and after their departure. The resulting qualitative dataset were thematically coded to understand how the pendulum model maps onto study abroad experiences. Further, I compare this dataset with my own experiences abroad, to provide an anecdotal supplement to the analyzed data. Moving forward, we must consider how we can apply this model to creating curriculum that helps people understand their current ICC, and how they can develop it. For example, this research can provide resources for people to understand how to cope strategically with the adjustments they will face in an intercultural context.

Keywords: Intercultural Competence (ICC), Intercultural Development Inventory (IDI), Adaptation, Culture, Training

Mentor(s):

Kris Acheson-Clair (Ofc of Corp and Glbl Partnersh); Phuong Tran (Univeristy of Toronto); Alankrita Chhikara (Education)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1209
Presentation Time: Session 2: 10:30am-11:30am

Monitoring de novo Biosynthesis of Amino Acids with 13C-labeled Glucose

Life Sciences

Author(s):

Eric George† (Science, JMHC)

Abstract:

As weeds develop resistance to current herbicides, novel chemistries and modes of action must be discovered and developed. The effect of an herbicide designed to inhibit a particular metabolic pathway can be measured by tracking the levels of metabolites derived from the targeted pathway. A decrease in metabolite levels would indicate the mode of action of the herbicide. However, metabolic pools present in the plant prior to herbicide application may confound the identification of changes in metabolism due to the inhibitor. One way to overcome the challenge pre-existing metabolic pools present is to track changes in de novo metabolic biosynthesis through isotopic labeling, such as with carbon-13 (13C).

We tested this method by tracking amino acid biosynthesis in duckweed plants with U-13C6-glucose following the application of two herbicides—glyphosate and chlorsulfuron—which inhibit the biosynthesis of aromatic and branched-chain amino acids, respectively. After treatment, plants were allowed to grow for one to two more days, and metabolites were subsequently extracted and analyzed via HPLC/MS. Plants fed U-13C6-glucose contained multiple heavier, “labeled” species of amino acids not appreciably present in unfed plants. Furthermore, plants simultaneously fed U-13C6-glucose and treated with an inhibitor show a drastic reduction in levels of those labeled species targeted by the inhibitor, even with little change in levels of the monoisotopic species. This precursor labeling process could be applied to the development of new herbicides to determine the effectiveness of a newly-developed compound quickly and reliably, and expedite the process of discovering viable replacements for current herbicides.

Keywords: Amino Acid Biosynthesis, Mass Spectroscopy, Herbicide Discovery, Stable Isotope Labeling

Mentor(s):

Jeffrey Simpson (Corteva Agriscience); Suresh Annangudi (Corteva Agriscience)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1210
Presentation Time: Session 2: 10:30am-11:30am

A Meteorological Investigation of a Tornado-Producing, 'Hybrid' Supercell-Multicell Storm near Delphi, Indiana on 8 May 2023

Physical Sciences

Author(s):

Evelyn Girardi† (Science)

Abstract:

Supercells, storms which contain a rotating updraft called a mesocyclone, are a particularly potent storm type responsible for a vast majority of severe weather, including tornadoes, in the United States. The definition and identification of supercells has long remained ambiguous, with contradictory or rigid requirements that often overlook the highly variable nature of storm systems. Most tornadoes are produced by supercells, but a different storm type (multicell) occasionally produces tornadoes called "landspouts" or non-mesocyclonic tornadoes. In the case of the Delphi, Indiana "landspout" tornado on 8 May 2023, the general lack of consensus on many aspects of supercell identification has led to an uncertainty regarding whether this unusual tornado was mesocyclonic or non-mesocyclonic in origin. We review identifying characteristics of supercells, and apply them to investigate the nature of the Delphi landspout tornado. One of the hypotheses we explored for the purpose of categorizing the Delphi tornado was that the radar belonging to Dr. Tanamachi (XTRRA) of Purdue University detected greater azimuthal shear than KIND before, during, and after the tornado. This investigation serves to not only advance the understanding of supercell identification criteria, but it also provides crucial insights into the unique characteristics of the Delphi landspout tornado, ultimately enhancing our ability to accurately classify and predict tornado events in the future.

Keywords: Supercell, Landspout, Tornado, Multicell, Azimuthal Shear

Mentor(s):

Robin Tanamachi (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1211
Presentation Time: Session 2: 10:30am-11:30am

Analysis of Bacteriophage Derived HIT-like proteins to Human Tumor Suppressor FHIT

Life Sciences

Author(s):

Morgan Gyger† (Engineering); Brandon Mar† (Engineering)

Abstract:

Bacteriophage-derived therapies have become increasingly popular spaces for research and developmental efforts covering vast application areas. Many investigations into creating these therapies start with a comparative analysis between prokaryotic genes and eukaryotic genes products. A specific gene of interest is the fragile histidine triad diadenosine triphosphatase (FHIT), a tumor suppressor. FHIT falls within the HIT family of genes; FHIT plays a multifaceted role in cancer immunobiology by repairing damaged DNA, inducing apoptosis in aberrant cells, and cell cycle regulation. Identified in prior research, PurduePete, a bacteriophage discovered in 2022 at Purdue University, was found to code for a putative HIT-like protein. The establishment of conservation between prokaryotic and eukaryotic gene products for cellular regulation supports a drive to expand the understanding of specific topics like FHIT pathways. To investigate similarities and potential homology between the HIT proteins from PurduePete and human FHIT, bioinformatic analysis was completed on three experimentally derived human FHIT isoforms and the putative PurduePete HIT protein. The programs utilize fasta sequences and operate using BLAST-like algorithms to check for alignment between the amino acid sequences, functional similarity, and domain conservation. From the computational work completed, the results suggest conservation of domains, as well as similar tertiary structures. Additionally, numerous programs show in-silico functional alignment. This investigation lays the groundwork to further characterize the HIT protein present PurduePete and develop a screening methodology for more phage derived proteins. Furthermore, these bacteriophage proteins could offer therapeutic opportunities within the cancer immunology space, expanding the possibilities of uncovering new biologics.

Keywords: Bacteriophage, Phage-Encoded Proteins, FHIT, Protein Structure Prediction, Protein Functional Analysis

Mentor(s):

Kari Clase (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1212
Presentation Time: Session 2: 10:30am-11:30am

Early Prediction of Cardiac Arrest Using Neural Networks

Life Sciences

Author(s):

Joshua Harp† (HHS); Jason Cachur† (HHS); Olivia Phillips† (HHS, JMHC); Ashley Lund† (HHS); Annabelle Nelson† (HHS); Kirsten Strout‡ (HHS); Hannah Negash‡ (HHS); Kellyn Bucceri‡ (HHS); Reagan Fahey‡ (Science, JMHC); Chris Parrett‡ (HHS)

Abstract:

Background: Cardiac arrests occurring in emergency departments (ED) constitute a significant proportion, ranging from 10% to 20% of all in-hospital cardiac arrests (IHCA), and are recognized as preventable sentinel events. However, healthcare professionals in these settings often contend with challenges such as overcrowding and alarm fatigue while tending to patient needs. The modified early warning system (MEWS), developed in the late 1990s, was designed as a weighted track-and-trigger system to identify clinical deterioration and facilitate intensive care unit transfers. Over time, MEWS has been used to detect critically ill patients, including those at risk of IHCA. Nevertheless, its effectiveness is limited due to wide scoring ranges and a tendency for high false positives. Machine learning models, a subset of artificial intelligence, offer promising potential for more precise IHCA prediction. Integrating machine learning models into EDs can enable early intervention and potentially reduce IHCA rates.

Objective: This research aims to develop a machine learning model that offers improved accuracy in predicting IHCA compared to the conventional MEWS.

Methods: This study constitutes a retrospective secondary analysis of data from the Medical Information Mart for Intensive Care (MIMIC) IV-ED dataset, encompassing ED patient encounters at Beth Israel Deaconess Medical Center spanning from 2011 to 2019. The primary objective is to predict in-hospital cardiac arrest (IHCA). Feature variables, including age, gender, and dynamic changes in vital signs, will be incorporated into a long short-term memory model (LSTM). Model performance will be evaluated using the area under the receiver operating characteristic curve (AUROC) and the area under the precision-recall curve (AUPRC). The results will be compared with those of the MEWS.

Significance: This study endeavors to enhance the accuracy of early cardiac arrest detection in EDs, thereby potentially reducing morbidity and mortality rates among these patients.

Keywords: Machine Learning, MEWS, Cardiac Arrest, Hospital, Health

Mentor(s):

Laura Moffat (HHS); Katharine Czech (HHS); Alec Pannunzio (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1213
Presentation Time: Session 2: 10:30am-11:30am

Experimental and Theoretical Insights into the structures of Viologen-based Host-Guest Complexes in the Gas Phase

Physical Sciences

Author(s):

Daniel Hristov† (Science, JMHC)

Abstract:

Mass spectrometry (MS) is a versatile technique for identifying chemical species in a sample based on their mass-to-charge ratio. One of the major challenges is that MS provides minimal structural information about the species. To address this challenge, ion mobility spectrometry (IMS) has been coupled to MS. In IMS, analytes travel through a drift tube of carrier gas. Upon collisions with carrier gas, ions are separated based on their size. Isomeric compounds may be differentiated based on their arrival times to the detector. Further structural insights are typically obtained by comparing the values with those predicted, using the electronic structure calculations combined with modeling of CCS. Viologens are chemical species used in electrochromic devices, but their poor solubility in common solvents limits their performance. The incorporation of viologens into a host molecule is often used to increase their solubility. Cucurbiturils or cyclodextrins are often used as hosts in these studies. Herein, we use IMS-MS to provide insights into structures of viologen-based host guest complexes and their relative stabilities towards fragmentation in the gas phase. We provide a systematical comparison of the measured CCS values with those obtained using theoretical calculations. Our results suggest the retention of inclusion complexes of viologens and their host molecules in the gas phase. Overall, IMS data provides a unique advantage to confirming structural information of ions in the gas phase based on their geometric span.

Keywords: Ion Mobility Spectrometry (IMS), Mass Spectrometry (MS), Collision Cross Section (CCS), Host-Guest Complexes, Inclusion/Exclusion Complexes

Mentor(s):

Julia Laskin (Science); Hugo Samayoa-Oviedo (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1214
Presentation Time: Session 2: 10:30am-11:30am

SoCET GPU Tape-out

Innovative Technology/Entrepreneurship/Design

Author(s):

Guillaume Hu† (Engineering); Ronit Nallagatla† (Engineering); Ansh Patel† (Engineering); Zachary Lagpacan† (Engineering, JMHC)

Abstract:

The goal of the Purdue SoCET (System-on-Chip Extension Technologies) team is to design a family of microcontrollers and manufacture it on custom silicon. The aim of the GPU (Graphics Processing Unit) tape-out project is to integrate components of an open source RISC-V based GPU with SoCET's System-on-Chip and tape-out the combined chip. This chip will be optimized for data-parallel applications such as graphics rendering and machine learning, where GPUs excel. Analyzing the effectiveness of this integration will involve measuring the chip's performance on data-parallel workloads.

We put forward an integrated chip design with a graphics core as part of the System-on-Chip package. The functional correctness of this design will be verified through hardware simulation. A physical layout will be created through the design flow process, utilizing Skywater's silicon manufacturing process. The quality of the layout produced will be based on the increase in performance, and the tradeoff factors of area and power consumption. Finally, we develop software to offload parallel programs to the GPU, enabling a programming interface for the end-user.

Keywords: Graphics Processing Unit, Parallel Programming, RISC-V, RTL, Tapeout

Mentor(s):

Mark Johnson (Engineering); Tim Rogers (Engineering); Abinands Ramshanker (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1215
Presentation Time: Session 2: 10:30am-11:30am

Development of a Tilt-Rotor VTOL Aircraft for a Payload Drop Mission

Innovative Technology/Entrepreneurship/Design

Author(s):

Joshua Hyatt† (Engineering); Atharv Bhatter† (Engineering); Ethan Farkas† (Engineering); Austin Lee† (Engineering); Stephen Widjaja† (Engineering); Evan Cahoon† (Engineering); Alejandro Diaz Contreras† (Engineering); Mahineer Ghosh† (Engineering); Parth Karande† (Engineering)

Abstract:

Traditional aircraft have been optimized for point-to-point flight, but with the advancement of technology, aircraft have gained a number of different uses where this design is no longer optimal. One such mission is a payload drop, which can be used in search and rescue, delivery services, urban air mobility, and military package drops. There are many difficulties associated with payload drops, such as having to account for the initial horizontal velocity and the inherent reduced accuracy of needing to use calculations when dropping the payload. There are also risks involved with take-off and landing due to the nature of high-speed landing. To solve these issues, we decided to design a VTOL (vertical take-off and landing) system. Such a system, however, has its own challenges. We designed tilt rotors to allow mid-flight transition and tested different configurations to maximize control and minimize dead weight. Furthermore, Ardupilot software was chosen to handle the transition autonomously, increasing the reliability of the process. Finally, the challenge of drag in both vertical and horizontal flight was addressed by designing an airframe that was aerodynamic for both forms of flight. Our intent in utilizing tilt-rotor technology is to showcase the flexibility in where an aircraft can take off and land and the ability to provide more accurate payload drops, all while matching the cruise efficiency of a fixed-wing setup. A successful demonstration of VTOL technology at a smaller scale will serve as proof of concept for its potential in large-scale integration.

Keywords: Unmanned Aerial Vehicle, Drone, Vertical Take-Off, Tilt Rotor

Mentor(s):

Charles D'Onofrio (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1216
Presentation Time: Session 2: 10:30am-11:30am

Curing Properties of Plant-Based Adhesives Made for Dental and Oral Applications

Life Sciences

Author(s):

Future Jani† (Science); Emma Jeffries‡ (Science)

Abstract:

We have discovered adhesives made from plant polymers that work well in wet environments and that grow stronger when left underwater for some time. Adhesive formulations presented here were made from zein corn protein, tannic acid and some compositions had added calcium carbonate. Because several compositions stick well to substrates such as hydroxyapatite and collagen in the presence of artificial saliva, we are evaluating their potential for use in dental and oral adhesives. To do so we determine curing times and properties that influence curing. Before curing, the color of the zein protein - tannic acid adhesives is amber translucent. Our preliminary studies found that, once the amber colored zein – tannic acid adhesive was placed underwater or in solution, a skin or outer layer formed on the exterior within seconds. Initially this coating was grey yellow and opaque and harder than the inside liquid adhesive. The zein protein within the glue is not soluble in water and immediately phase separates when in contact with aqueous solutions, thereby explaining the formation of the skin. Inside the exterior layer resides the amber adhesive temporarily protected from the aqueous surrounding. When an adhesive drop is sandwiched between microscopy glass slides, the formation and growth of the exterior layer around the drop can be visualized as a ring becoming thicker. Growth of the exterior layer and the resulting color changes can be correlated with adhesive hardening and curing times. This study will measure how fast the adhesives cure when completely submersed in different solutions and at different temperatures. This undergraduate research study is part of a larger collaborative project.

Keywords: Plant-Based Adhesives, Curing Properties, Dental and Oral Applications, Artificial Saliva, Different Temperatures

Mentor(s):

Gudrun Schmidt (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1217
Presentation Time: Session 2: 10:30am-11:30am

Artificial Intelligence Technology for Future Music Performers "Companion"

Innovative Technology/Entrepreneurship/Design

Author(s):

Temirlan Karataev† (Engineering); Tim Nadolsky‡ (Science); Shrish Senthilkumar‡ (Engineering); Caasi Boakye* (Science); Tanin Padungkirtsakul* (Engineering); Guanxi Zhou* (Engineering)

Abstract:

In recent times, Artificial Intelligence (AI) technology has expanded into artistic and creative fields such as music. AI has been used for music creation but has not yet had much impact on the practices and training of professional music performers. We are developing an AI-embedded tool, Companion, for assisting string players’ ensemble practice. Musicians often struggle to find common meeting times to practice due to schedule and place conflicts. The Companion can play the one to four missing parts to replace absent musicians. It follows the tempo and style of the human musicians through audio analysis of their performance while responding in real-time to verbal instructions, such as "start," "slow down," or "play softly." So far, our current research focuses on adapting core technical components needed to produce an accompaniment. These technologies include beat/tempo detection methods which filter out onsets of musical events within a signal and recognize these as beats, state-of-the-art audio time-stretching methods which align the beats of the accompaniment to the player’s audio, and lexical analysis tools such as syntax trees which allow natural language input as commands to the application.

Further development is needed to expand the range of voice commands and increase the variability of how Companion plays. This research represents an important first step in using AI to enhance the ensemble rehearsal experience and improve productivity in musicians' ensemble practice sessions.

Keywords: AI-Embedded Tool, String Players' Ensemble Practice, Real-Time Accompaniment, Audio Analysis, Natural Language Input

Mentor(s):

Yung-Hsiang Lu (Engineering); Kristen Yeon-Ji Yun (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1218
Presentation Time: Session 2: 10:30am-11:30am

Examining the Efficacy of Mobile Units for Substance Use Treatment and Provision of Medication for Substance Use Disorders

Social Sciences/Humanities/Education

Author(s):

Claire Keirn† (HHS, JMHC)

Abstract:

Introduction: Many people experiencing a substance use disorder face logistical barriers that can be addressed though treatment interventions. Mobile units have the capability to reach populations of individuals that are more prevalently impacted by substance use disorders. This research will inform future projects to develop more efficacious interventions for treatment of substance use disorders.

Objective: The objective is to conduct a review of studies on the efficacy and feasibility of the use of mobile units for the provision of substance use treatment.

Methods: Included studies explained the use of mobile units for substance use treatment provision, especially implementing evidence-based interventions such as medication for opioid use disorder. Electronic databases were searched with various combinations of key words such as mobile units, substance use treatment, substance use, buprenorphine, methadone, and naltrexone. The review included 5 studies from 1996 to 2022.

Results: These studies focused on patient characteristics, engagement, and retention factors. Some studies also performed a comparison with another fixed-site substance use treatment location, and analyzed factors associated with engagement and retention in treatment. The literature has found use of mobile units for substance use treatment feasible, and one study found that mobile units had greater patient retention in comparison to fixed-site treatment.

Discussion: While there were a limited number of studies examining the efficacy of mobile units for substance use treatment provision, these studies provided evidence for the benefits of this intervention method. These findings can inform future research on interventions that navigate barriers to access of substance use treatment.

Keywords: Mobile Units, Substance Use Treatment, Medications for Substance Use

Mentor(s):

Jennifer Brown (HHS); Stephen Beegle (HHS); Sofia Rubi (HHS); Luis Gomez (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1219
Presentation Time: Session 2: 10:30am-11:30am

Integration of Physics-based Framework for Shape Change Compensation of Composite Printed Tooling

Mathematical/Computation Sciences

Author(s):

Junhyeok Kil† (Science)

Abstract:

Extrusion Deposition Additive Manufacturing (EDAM) has revolutionized the field of additive manufacturing, particularly in producing large-scale geometries. With the integration of fibers, the Coefficient of Thermal Expansion (CTE) of printed materials witnesses significant enhancement, notably in the printed direction where fibers predominantly orient. This advancement, while beneficial in certain applications such as tooling or molds, complicates predicting shape change upon heating. Stemming from the intersection of Computer Science and Material Science Engineering, this research integrates a physics-based framework that automates the prediction and shape compensation for tooling printed with composite materials. This simulation framework integrates various inputs, including the manufacturing effects predicted through ADDITIVE3D, the process conditions for the tooling application, material properties, the machine code (G-code), and a finite element mesh to produce a set of input files required to carry out a thermomechanical analysis in the finite element software ABAQUS. The accompanying Graphical User Interface (GUI) prioritizes user experience, streamlining the integration of varied inputs. The GUI also provides detailed logging of computations and interactive visualization, emphasizing user engagement and clarity throughout the workflow. Lastly, a set of post-processing scripts is automatically generated to offer actionable insights for tool geometry compensation. Accurate prediction and compensation in large-scale additive manufacturing are paramount to the successful application of this technology in tooling. By effectively predicting shape changes, manufacturers can reduce waste, improve product performance, and accelerate the prototyping-to-production cycle. This research merges software development and material science, ushering in a new era of more efficient and sustainable additive manufacturing.

Keywords: Extrusion Deposition Additive Manufacturing (EDAM), Coefficient of Thermal Expansion (CTE), Finite Element-based Framework, Tool Geometry Compensation, Graphical User Interface (GUI)

Mentor(s):

Eduardo Barocio (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1220
Presentation Time: Session 2: 10:30am-11:30am

Developing the Tissue-Specific Chemogenetic Tool DREADD in the Zebrafish Model

Life Sciences

Author(s):

Carolina Kim† (Pharmacy)

Abstract:

Bioelectricity governs fundamental physiological activities that maintain homeostasis, including communication among neuronal and somatic cells. Its significance is most pronounced during embryonic development, contributing to the structural organization of diverse organisms. An emerging research focus lies in manipulating membrane potential to interrupt bioelectrical signaling for biological research and potential targeted applications. The chemogenetic tool Designer Receptors Exclusively Activated by Designer Drugs (DREADD) is a recently developed tool executed successfully in various models, including fruit flies, mice, and primates. However, the effectiveness of DREADD remains unexplored in zebrafish, as it was indicated unfunctional in a previous study. In this study, using already established transgenic zebrafish lines expressing several DREADDs and GEVIs (genetically encoded voltage indicators), we will reinvestigate the functionality of DREADD in zebrafish. Our primary focus is to evaluate the efficacy of DREADD in a few biological systems such as pigment cells. Successfully finishing this project will yield a genetic tool for manipulating membrane potential in zebrafish.

Keywords: Biological Characterization & Imaging, Cellular Biology, Genetics, Bioelectricity, DREADD

Mentor(s):

GuangJun Zhang (Veterinary Medicine); Ziyu Dong (Veterinary Medicine)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1221
Presentation Time: Session 2: 10:30am-11:30am

Influence of heat treatment of 3D printed fiber reinforced composite tooling on the tool shape change during the composite part production cycles.

Innovative Technology/Entrepreneurship/Design

Author(s):

Seongyun Kim† (Polytechnic)

Abstract:

3D printed fiber reinforced composite technology is widely used for composite part manufacturing tooling. The intrinsic characteristics of 3D printing with composite materials, wherein layers of molten composite beads are deposited, cause potential thermal stresses during the tool fabrication process. During the composite part production at elevated temperatures, the internal residual stresses within the tooling release and it may lead to consequential change in its geometric integrity. To address this challenge, the authors recommended to conduct a heat treatment of the tool by annealing process on the printed tool before it undergoes post-machining. This strategic approach serves to proactively mitigate the residual stress before the tool is subjected to thermal cycling. In this study, the influence of post-printing heat treatment on tool shape stability and dimensional accuracy was investigated. Two distinct tooling approaches are examined: one involving the printing, annealing, and subsequent post-machining of the tool, and the other comprising direct post-machining of the printed tool without annealing. An aircraft intake duct autoclave tool is used as the tool geometry. The tools were 3D printed using Polyethersulfone (PESU) reinforced with 25% by weight of carbon fiber. Ten autoclave composite part production runs, each conducted at 180°C, were performed. Following each cycle, a comprehensive evaluation of the tool's geometry was performed. The shape of the tool was measured and analyzed in relation to the original design specifications using topography 3D laser scanning.

Keywords: 3D Printing, Composite Tooling, Dimensional Stability, Annealing, Production Cycle

Mentor(s):

Garam Kim (Polytechnic); Sungjun Choi (Polytechnic)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1222
Presentation Time: Session 2: 10:30am-11:30am

Origins of Art: Demystifying Purdue's Scheuring Icon Collection

Social Sciences/Humanities/Education

Author(s):

Mikayla Klemp† (Liberal Arts)

Abstract:

Upon its donation to Purdue Galleries' permanent collection in 2005, the Scheuring Icon Collection was described as containing "132 Russian and Ethiopian [and Greek] religious icons ranging from the 16th century to the 21st century." After its display as the Sprit Made Tangible exhibit in 2006, little work was done on the art associated with this collection. In the spring of 2023, a revitalized effort was made to re-examine the Eurasian portion of the Scheuring Icon Collection. This presentation will showcase these updated research developments including the existence of Ukrainian, Polish, Moldovan, and Bulgarian art within the collection, the work of "Old Believer" Russian artists, and an assortment of pieces with rare print and dating details.

These developments serve as an introduction to what will become a multidisciplinary research effort involving students and faculty from Purdue Galleries, the College of Engineering, the Aston Laboratories for Mass Spectrometry, and the College of Liberal Arts. Plans for developing tests for the artwork hope to reveal further information on the methods, materials, and technologies used in the creation of these icons. We hope this unprecedented inclusion of science and engineering resources to historical art research will make the Scheuring Icon Collection a truly invaluable resource for Orthodox iconography research for the larger academic and private collectors' communities.

Keywords: Eastern Orthodox Iconography, Eurasian Studies, Art History, Museum Studies, Conservation Sciences

Mentor(s):

Kirstin Gotway (Liberal Arts); Lana Newhart-Kellen (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1223
Presentation Time: Session 2: 10:30am-11:30am

Using Single-Cell RNA Sequencing to Identify Leukocyte Subsets Present in Benign Prostatic Hyperplasia

Mathematical/Computation Sciences

Author(s):

Andree Kolliegbo† (Science)

Abstract:

Benign Prostate Hyperplasia (BPH) is characterized by the non-cancerous enlargement of the prostate. BPH and the associated lower urinary tract symptoms result in significant morbidity and $3.9 billion in annual medical expenses in the US. The current medications for BPH are often ineffective, with undesirable side effects and high rates of patient non-compliance. Using single cell RNA sequencing (scRNA-seq), our goal is to identify and characterize subsets of leukocytes in normal and enlarged human prostate to better understand the association between BPH and inflammation. ScRNA-seq data was generated from 20 patient samples. We sequenced 5.000 cells from 10 small (<40g) and 10 large (>90g) BPH prostate tissue samples to determine the composition of individual leukocyte populations in the patient samples, using size to determine the progression of the disease. The resulting data were aligned to the human reference genome using Cell Ranger followed by downstream analysis using the package Seurat to identify distinct clusters of cells from both large and small samples. Notably, we have determined that BPH tissues exhibit elevated levels of T cells, B cells, and macrophages, similar to autoimmune and inflammatory disease environments. Moving forward, subsets of T cells and macrophages will be compared with publicly available scRNA-seq datasets generated from diagnosed autoimmune patients to identify and characterize the subsets of immune cells using similar alignment methods. Understanding the subsets of immune cells present in BPH compared with the population will provide potential therapeutic targets with the potential for personalized treatment approaches.

Keywords: Single-Cell RNA Sequencing, Transcriptomics, Benign Prostatic Hyperplasia (BPHh), Immune Cells

Mentor(s):

Nadia Lanman (Veterinary Medicine)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1224
Presentation Time: Session 2: 10:30am-11:30am

Classifier Selection for Motion Predicates in American Sign Language

Social Sciences/Humanities/Education

Author(s):

Dominic LaRouche† (Liberal Arts, Science, JMHC)

Abstract:

The purpose of this research is to examine the classifier selection of native signers of American Sign Language (ASL) for transitive and intransitive motion predicates. This study includes the data of three native ASL signers. The data records the participants renditions of various videos, all featuring motion predicates, including the manifestation of manner-of-motion (e.g., flying) and path-of-motion (ie., go/come, ascend/descend, …). The preliminary results show that classifier selection is not prompt driven, meaning that the specific prompt doesn't influence participants into a common classifier choice. Furthermore, it is not signer restrictive, meaning their personal grammars do not rule out personal classifier choices or combinatorial patterns (i.e., manner- and path- related classifiers). All signers show differences in classifier strategy pattern (e.g. path-manner-path vs. manner-path), and classifier type (e.g. CL-1 vs. CL-ILY). There is questioning surrounding the intentionality behind specific classifier choices for a given motion event and what that implies for linguistic analysis of signed languages. The preliminary data implies that personal preference is the strongest variable in classifier choice, and that multiple classifier choices and pattern strategies can be applied to the same motion predicate, seemingly interchangeably.

Keywords: American Sign Language, Linguistics, Classifiers, Motion Predicates

Mentor(s):

Elena Benedicto (Liberal Arts); Kathleen Wagner (VP Diversity and Inclusion)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1225
Presentation Time: Session 2: 10:30am-11:30am

Tellurene-Based Wearable Sweat Sensor for Glucose Monitoring

Life Sciences

Author(s):

Ju Na Lee† (Engineering)

Abstract:

As opposed to blood glucose monitoring through finger-prick samples via disposable test strips, wearable biosensors offer a non-invasive method for real-time and longitudinal monitoring of sweat glucose levels at lower costs. The multitude of sampling sites across the body as well as consistent access makes sweat a promising biofluid for such non-invasive testing methods. However, various challenges of designing an enzymatic glucose sensor such as GOx immobilization, stable glucose reaction, and optimal layer-by-layer material selection for improved performance have resulted in biosensors with low sensitivity, high LoD (limit of detection), and narrow linear range. Here, a Tellurene based electrochemical biosensor is proposed with a chitosan mediator layer, which is decorated with chloroauric acid (HAuCl4) nanoparticles. Derived from the element Tellurium, Tellurene is an emerging 2D material with structural anisotropy arranged in a honeycomb lattice structure, where its properties have shown great potential in applications of wearable technologies. By integrating such advantages offered by Tellurene, this research project aims to nano manufacture wearable biosensors for more accurate and reliable non-invasive glucose monitoring.

Keywords: Wearable Technology, Biosensors, Glucose Monitoring, Electrochemical Sensors

Mentor(s):

Wenzhuo Wu (Engineering); Ruifang Zhang (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1226
Presentation Time: Session 2: 10:30am-11:30am

Investigation on the Impact of Target Surfaces in Relation to Rotorcraft Fuel Tank Drop Test Certification Processes

Innovative Technology/Entrepreneurship/Design

Author(s):

Simon Lin† (Polytechnic); Ryan Seller† (Polytechnic); Matt Elliott† (Polytechnic)

Abstract:

The Federal Aviation Administration (FAA) requires original equipment manufacturers (OEMs) to certify their rotorcraft fuel tanks to reach the required safety standards. The FAAs' rigorous safety standards must be met by OEMs before the fuel tank can be incorporated into the rotorcraft. OEMs are required to perform free-fall drop tests from 50 feet without rupture or leakage of the fuel tank to be completely certified by the FAA. This study focuses on the ever-growing issue in variation of testing methods between the various OEMs. Right now, OEMs are using several different types of target surfaces including plywood, steel plates, grass patches, or concrete slabs. As a result, this research was focused on the amount of energy that was absorbed during the drop test depending on the chosen target surface. As a result, wood, steel, concrete, and a dirt pad were chosen as target surfaces to investigate the resulting impact forces produced by each material. To evaluate the energy dispersion, the contact time between the testing unit and target surface along with the total force was used to provide data on the effect of varying target surfaces. Conclusions were drawn that as the material got softer, the impact time increased, therefore significantly reducing the resulting force exerted on the testing device. For the most accurate rotorcraft fuel tank drop tests for certification with the FAA, based on the results, steel is the recommended target surface.

Keywords: Target Surface, FAA, OEM, Drop Test, Rotorcraft Fuel Tank

Mentor(s):

Garam Kim (Polytechnic); Jacob Montrose (Polytechnic); Timothy Ropp (Polytechnic)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1227
Presentation Time: Session 2: 10:30am-11:30am

Drone Video/Auto Drone

Innovative Technology/Entrepreneurship/Design

Author(s):

Ethan Lu† (Engineering); Colby Acton† (Engineering); Vinay Jagan† (Engineering); Marvin Lim† (Engineering); Ruth Sugiarto† (Engineering, JMHC); Weicheng Lee† (Engineering); K Annapoorna Prabhu† (Engineering); Yi-Ruei Weng† (Engineering); Suraj Kadajji* (Engineering); Alex Beuerle* (Engineering)

Abstract:

Advances in autonomous drone technology have facilitated human-machine collaboration in various fields including search and rescue, structural analysis, and disaster relief. Our team aims to explore and evaluate training approaches on a suite of tools designed to simulate vision-based autonomous drone systems in a real-world scenario, having the drone following a moving object. Our work proposes to improve in the following directions: hybrid object detection and tracking for quicker inferencing, and refined path planning. We conduct object tracking with onboard depth and RGB sensors to approximate the 3D position of the target object, after which flight logic is employed to follow it. We propose a novel data collection pipeline that allows the immediate tagging of objects in 3D bounding boxes from our RGB+D camera. The training data from this procedure is used to train a modified YOLOv3 tracking model that works with depth data and outputs 3D bounding boxes. These bounding boxes give way for immediate tracking in 3D space using path planning algorithms such as bézier curve trajectories. The YOLO tracking model is further made efficient through quantization and GPU acceleration via the Intel Neural Compute Stick.

Keywords: Autonomous Drone, Object Detection, YOLO, Intel Neural Compute Stick

Mentor(s):

Qiang Qiu (Engineering); Wei Zakharov (Libraries); Zichen Miao (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1228
Presentation Time: Session 2: 10:30am-11:30am

Educator Perspectives on Creativity in Early Childhood Education

Social Sciences/Humanities/Education

Author(s):

Avery Mann† (Education, JMHC)

Abstract:

The purpose of this research is to analyze teacher perspectives on creative skill development in early childhood education curriculum. In early childhood education, children have the opportunity for foundational learning not only in academic subjects, but also in critical thinking and abstract skills. Educators have valuable first-hand knowledge from observing students' development of these creative skills. This study focused on the experiences of six early childhood educators in Indiana. Qualitative data was collected through interviews where educators were asked about how they conceptualize and develop creativity skills in their classrooms. Analysis shows that teachers define creativity as a skill that is unique to each individual student. The educators interviewed identified imagination and problem solving as underlying components of creativity. In addition, they described using dramatic play in their classrooms to facilitate creative skills development. Overall, the study demonstrated that educators correlated high creativity with future success in academics, particularly literacy. This study demonstrates that early educators can be attuned to how and why to support creativity. Future research could examine how teachers' level of creative skill focus in early childhood curriculum affects student development and success.

Keywords: Creativity, Early Childhood, Educators, Imagination, Play

Mentor(s):

Sarah Eason (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1229
Presentation Time: Session 2: 10:30am-11:30am

Path Verbs in Akan

Social Sciences/Humanities/Education

Author(s):

Shamiso Marondera† (Liberal Arts); Brynne Mills† (Education, Liberal Arts)

Abstract:

The purpose of this study is to analyze how the core component of motion, Path, is linguistically encoded in Akan, an indigenous language commonly spoken in Ghana, to provide a better understanding of cross-linguistic expression of motion. In this study we look at the combination of Path verbs in Akan and how they interact with locatives.

The study uses a set of video prompts displaying items moving from one point to another as a data collection tool. Four native speakers were recorded responding to these prompts to determine the linguistic presence or omission of motion vectors in their speech. Their responses are transcribed and coded for the linguistic expression of the three planes of space involved in motion. Instances of motion vectors are marked and analyzed with regard to the nature of the prompt, specific words, telicity, and other linguistic features. Preliminary findings indicate that horizontal and vertical Path verbs in Akan do not occur together but can individually occur with the deictic. We observed that no more than two different axes in a vector occur in the same utterance. Additionally, locatives follow Path verbs and act as complements indicating the region of the entity in motion.

Out of the prompts with all three axes encoded, zero of the corresponding utterances mention three axes, twenty-one mention two axes, and twenty-eight mention one axis

This study's results reveal the structure of Akan, how native speakers perceive and describe motion, and how Akan differs from other languages in its expression of motion.

Keywords: Linguistics, Akan, Motion, Vector, Locative

Mentor(s):

Elena Benedicto (Liberal Arts); Eunice Opoku (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1230
Presentation Time: Session 2: 10:30am-11:30am

The role of racial composition of peer groups on the cultural socialization of transracial adoptees

Social Sciences/Humanities/Education

Author(s):

Audrey Middaugh† (HHS)

Abstract:

Previous research has been conducted on how parents socialize their children about their culture and race (racial-ethnic socialization, or RES), but little research has been conducted on how peers also influence this process. Transracial adoptees (TRAs) are children adopted by parents of a different race, and their experiences may be different from those of same-race adoptees because parents have different lived racialized experiences than their children. Previous studies have found positive associations with the combination of parental and peer cultural socialization and socioemotional well-being (Wang & Benner, 2016). Peers, both same-race and cross-race, can contribute to TRAs' well-being. However, more research is needed to understand the relationship between peer RES and the well-being of transracial adoptees.

Researchers have identified studying the effect of racial composition in peer groups is the next step in the research of peer socialization of TRAs since this population tends to live in racially homogenous areas (Hu et al., 2017). For that reason, this study will investigate the role of racial composition of peer groups as a moderator in the relationship between peer cultural socialization of Korean American TRAs and their well-being. I hypothesize that TRAs having more peers of color than white friends would exhibit a stronger relationship between peer cultural socialization and well-being than TRAs who have more white friends than peers of color. Understanding the link between peer cultural socialization and TRA well-being can help inform the development of interventions with TRA families to better support TRA mental health.

Keywords: Peer Socialization, Cultural Socialization, Racial Composition, Transracial Adoptees, Well-Being

Mentor(s):

Annabelle Atkin (HHS); Nathan Lieng (HHS); Rich Lee (University of Minnesota); Amelia Blankenau (University of Minnesota)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1231
Presentation Time: Session 2: 10:30am-11:30am

Prime Factorization with Quantum Annealing

Mathematical/Computation Sciences

Author(s):

Cole Murphy† (Science); Sean Wall† (Science); Bornik Nag† (Science); Fabiana Correa† (Science)

Abstract:

Quantum Computing leverages principles of quantum mechanics to solve certain problems much quicker than classical computers: Shor's algorithm, for example, is able to threaten RSA encryption through its potential to quickly factor large biprimes. With a similar intention, we utilize DWave's hybrid solver—a cloud-based quantum computing system—to replicate biprime factorization methods found in other papers. The DWave solver uses quantum annealing—a specialized form of quantum computing that relies on the quantum system's tendency toward minimal energy states as different combinations of qubits are explored. Annealing is useful for finding optimal solutions to quadratic binary models: a form of problem in which an objective function and constraints are embedded onto a quantum system to solve for the optimized value. In this way, the factors of a large biprime N can be considered to have prime factors p and q, such that N = pq. In order to formulate a problem such that the energy is minimized when N = pq, the problem can be defined as minimizing (N - pq)2, where p and q are both composed of quantum bits representing their integer values. However, considering this objective function yields higher-order (non-quadratic) terms, we use methods for reducing the dimensions into quadratic form through identities which require adding additional binary variables (in the form of qubits). After processing, DWave's solver can be embedded, yielding the minimal energy state and solving for the bits of the prime factors.

Keywords: Quantum Computing, Quantum Annealing, Prime Factorization, RSA Encryption

Mentor(s):

Robin Carpenter (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1232
Presentation Time: Session 2: 10:30am-11:30am

User Studies on the Visualization of Music using Generative Models of Artificial Intelligence

Innovative Technology/Entrepreneurship/Design

Author(s):

Brian Ng† (Engineering); Haichang Li† (Polytechnic); Samantha Sudhoff† (Science); Tim Nadolsky* (Science); Joshua Kamphuis* (Engineering)

Abstract:

Playing and listening to music is one of the most universal forms of communication and entertainment across cultures. Unfortunately, nearly 20% of the population are hearing-impaired and they cannot enjoy music. This project has taken a machine learning approach in developing a software stack that visualizes music for entertainment, of which the process consists of the following steps: (a) Music analysis and classification into multiple dimensions, including instrumentation, emotion, tempo, pitch range, harmony, dynamics, and more, yield textual descriptions. (b) The descriptions form a feature matrix that are inputs to machine learning models for classification. (c) These models predict the genre of the input audio and its associated emotions as text prompts. (d) The prompts are fed into generative machine models (e.g., DALL-E-2, Stable Diffusion, and Midjourney) to create visual representations, such as images or videos. (e) The visual representations are continuously updated as the music plays, ensuring that the visual effects aptly mirror the musical changes. Notably, these images and videos are generated without human intervention, significantly reducing costs and time producing visual representations tailored to the specific piece of music, and they expand beyond video recordings of musical performances that only provide a passive viewing experience. The proposed solution has the advantage of creating personalized and interactive entertainment experiences, upon which this project will conduct extensive user studies to evaluate whether artificial intelligence's generative models can effectively produce visual representations of rich musical expression, heralding a novel form of entertainment.

Keywords: Music Entertainment Solution, Hearing-Impaired, Machine Learning Approach

Mentor(s):

Kristen Yeon-Ji Yun (Liberal Arts); Yung-Hsiang Lu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1233
Presentation Time: Session 2: 10:30am-11:30am

Role of NGLY1 expression in the propagation of Parkinson's disease neuropathology

Life Sciences

Author(s):

Haley Oliver† (Science)

Abstract:

Nuclear factor erythroid 2-like 1 (NFE2L1) is a transcription factor responsible for the “bounce-back effect,” a protein homeostasis (or ‘proteostasis’) mechanism involving the up-regulation of proteasome subunit expression in response to proteasome dysfunction. Under normal conditions, NFE2L1 is degraded by the endoplasmic reticulum-associated protein degradation (ERAD) pathway. When the proteasome is impaired, NFE2L1 escapes ERAD-mediated clearance and is instead translocated to the nucleus, where it binds to the promoter region of proteasome subunit genes. For nuclear translocation to occur, NFE2L1 must be deglycosylated by N-glycanase 1 (NGLY1). NGLY1 is an enzyme that removes N-linked glycans from misfolded N-glycoproteins and is also a part of the ERAD pathway. Symptoms and pathology associated with NGLY1 deficiency suggest that disruption of the NFE2L1-NGLY1 axis can cause protein aggregation in the brain. We hypothesize that NGLY1 knockout increases proteasome inhibitor sensitivity, leading to a buildup of alpha-synuclein (aSyn), a presynaptic protein that forms aggregates in the brains of Parkinson’s disease patients. To test this hypothesis, we are investigating the efficiency of seeded aSyn aggregation in induced pluripotent stem cell (iPSC)-derived neurons from NGLY1-deficient patients. Parallel studies are being carried out using an HEK293 biosensor cell line that reports on seeded aSyn aggregation. Understanding the effects of NGLY1 knockout on aSyn aggregation will provide insights into mechanisms by which dysregulation of proteostasis contributes to protein aggregation in neurons.

Keywords: NFE2L1, NGLY1

Mentor(s):

Chris Rochet (Pharmacy); Bryce Colon (Pharmacy); Aswathy Chandran (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1234
Presentation Time: Session 2: 10:30am-11:30am

Evaluating the ways in which Purdue University can help its students explore the field of synthetic biology.

Life Sciences

Author(s):

Aditya Pillai† (Science)

Abstract:

Synthetic biology is a contemporary branch of the biology field that combines both the principles of engineering as well as the techniques and processes of molecular biology. Unlike other, older fields of biology, synthetic biology, or synbio is not restricted to one industry. Due to its interdisciplinary nature synbio is a valuable tool in the arsenal for fields such as agriculture, pharmacy and food regulation amongst others. Biotechnology and other similar biological fields are some of the most rapidly growing facets of industry in the current age and synbio will follow a similar trend in the near future, allowing their students to explore these fields will not only benefit the students of Purdue University but also help future-proof the University.

The University can implement small changes to their course offring, curriculum and other aspects of their students' lives that could give them the freedom to explore this field. Even non-academic aspects of a student's time can be a potential avenue for the University to invest their resources into, student clubs and organisations are another way to drum up interest and bring together like minded, curious students and allow them to delve deeper into the topic.

For this paper I will be conducting secondary research in order to find the best ways to create student engagements and look at possible alterations the University can make to help prepare their students to live and work in a world where synthetic biology and other similar fields are paramount to industry.

Keywords: Synthetic Biology, Biotechnology Revolution, Cutting Edge, Rapid Growth, Purdue Students

Mentor(s):

Sidney Ducleroir (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1235
Presentation Time: Session 2: 10:30am-11:30am

Title: "There's nothing they could do for me": Patient experiences with miscarriage in Indiana

Social Sciences/Humanities/Education

Author(s):

Alana Powell† (HHS, JMHC); Oluwapamimo J. Fafowora‡ (HHS); Anayra Maldonado‡ (HHS)

Abstract:

Background: Miscarriage is a common reproductive health experience; approximately 20% of pregnancies in the United States end in miscarriage each year. However, this is a dearth of research in the US context that centers on patients' experiences with pregnancy loss and the health care system, and how they think that care can be improved. This study aims to address that gap.

Methods: We used a multi-modal strategy to recruit people living in Indiana who have experienced a miscarriage since 2018 and sought related medical care. Using a guide developed specifically for this study, we conducted 21 in-depth interviews; interviews lasted an average of 60 minutes. We carried out content and thematic analysis.

Results: The vast majority of participants reflected negatively on the care they received during their miscarriage; many participants were sent to the emergency department (ED) when they began to experience bleeding, even if it was not medically necessary. Inconsistent with standards of practice, participants were given few choices and options to manage their care. Most described their experiences at the ED as traumatic, unnecessary, and expensive. Consistently, participants wanted additional information about pain and pain management, the physical process of miscarriage, and how to access emotional support and resources.

Discussion: Identifying options for miscarriage care and support outside of emergency departments appears warranted, as does working with clinicians who regularly interact with pregnant people to give patients and providers up-to-date, evidence-based information. Normalizing conversations about pregnancy loss in health care settings could be helpful.

Keywords: Miscarriage Care, Womens Health, Health Care Experiences, Reproductive Health

Mentor(s):

Kathryn LaRoche (HHS); Sophie Shank (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1236
Presentation Time: Session 2: 10:30am-11:30am

Project Sigstore Rekor

Innovative Technology/Entrepreneurship/Design

Author(s):

Adithi Praveenkumar† (Engineering); Ishaan Bajpai† (Engineering); Julia Dolpies† (Unknown); Brian Qi† (Science)

Abstract:

Sigstore is an open source software application to handle the signing and provenance checks for the purpose of software security. Sigstore Rekor was created to monitor patterns in software usage through auditing data in logs, which acts as a way to trace back activity to certain timestamps. The research will focus mainly on how policies can be created in the context of logging actions.

To address this question, we will develop a set of policies that can be implemented in Sigstore Rekor to require saving alerts to the log and releasing email notification for severe alerts. These alerts will be triggered by a high number of the same action, or an outlier action in a continuous repetition of a certain action. In terms of actions itself, the address could be paused in order to prevent further suspicious or unnatural activity.

To store logs, we will use Purdue University's cloud storage options, such as PURR, box etc., which would be a sufficient choice for storing the logs for reference.

We believe that this research will help to improve the security of the software supply chain by making it more difficult for attackers to successfully poison software delivery pipelines.

Keywords: Sigstore, Security, Supply-Chain

Mentor(s):

Santiago Arias (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1237
Presentation Time: Session 2: 10:30am-11:30am

Healthcare Monitoring through Self-Powered Bionanomaterial-Based Wearable Sensors.

Innovative Technology/Entrepreneurship/Design

Author(s):

Santosh Ramesh† (Science)

Abstract:

The project aim is to optimize wearable sensors composed of biomaterials by utilizing their sustainability and harnessing TENG properties. TENG (Triboelectric nanogenerators) are small devices that apply in micro–nano energy harvesting, self-powered sensing, blue energy, high voltage sources, etc. It is possible to harness the self-powered sensing and energy harvesting by utilizing the electrostatic induction effect, or when mechanical energy causes charges to move around and creates a flow of electricity that can power devices. In the context of cardiovascular sensors, this technology could be used to detect mechanical movements associated with heartbeats and blood flow. The project encompasses several stages including biomaterial selection and optimization, sensor design and fabrication, extensive testing, and eventual healthcare application integration. Through extensive studies, we selected different types of lignin biopolymers as our biomaterials. We first fabricate thin films of lignin on aluminum substrate and silver nanowires, then the testing begins. By testing the current and voltage output generated by the lignin films, we can cross compare them to the current and voltage output of other other bio and synthetic materials. With the extensive testing, we can optimize our wearable sensors to maximize energy output and sustainability. With the findings from the research, advanced sensors could be developed that can outperform synthetic materials while still being designed to continually monitor various health parameters, providing real-time data to both patients and healthcare providers. By leveraging the unique properties of biomaterials, these sensors will offer superior comfort, biocompatibility, and accuracy.

Keywords: Triboelectric Nanogenerators, Wearable Sensors, Biomaterials

Mentor(s):

Wenzhuo Wu (Engineering); Robert Ccorahua (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1238
Presentation Time: Session 2: 10:30am-11:30am

Longitudinal and Burst Noise Disturbances and Their Effect on Biodiversity Along the Wabash

Life Sciences

Author(s):

Jared Robbins† (Pharmacy, JMHC); Taylor Clark‡ (Agriculture, JMHC); Sarah Keller‡ (Agriculture, JMHC); Liam Robinson‡ (Engineering, JMHC); Lukas Hecht* (Engineering, JMHC)

Abstract:

Anthropogenic noise can negatively impact wildlife and has been shown to reduce biodiversity. Recent research in soundscape ecology has shown that acoustic indices may serve as a proxy for biodiversity measurements. To evaluate the effect of anthropogenic noise in the environment, we investigated biodiversity and species richness in six sites of a nature trail system along the Wabash River in Tippecanoe County, Indiana with two treatments, one near an active road and one near a closed road. We used a non-invasive acoustic recording unit and microhabitat data logger with a duty cycle of 1-minute every thirty minutes for a four-week period, from September 16th to October 21st. We calculated common acoustic indexes (ACI, ADI, and BI) using combinations of acoustic features (ie., frequency, amplitude, bandwidth ratios) and AI-calculated bird species richness (using an open-source tool called CNN BirdNet). Each acoustic index is designed with an explanatory value for anthropogenic to biological noise, species richness, and presence of biological activity. One hypothesis is that biodiversity measures will be higher in the north corridor, validated with bird species' richness, due to less road activity. This study helps illuminate the need for minimizing human alterations of some parks and shared forest areas which can be accomplished by establishing noise reduction strategies and assisting conservation and park managers in park planning. Further studies are needed about vulnerable types of environments impacted the most by noise and the potential benefits that managed soundscapes have for improving wildlife and human health.

Keywords: Noise, Biodiversity, Longitudinal/Burst, Wabash River

Mentor(s):

Kristen Bellisario (JMHC)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1239
Presentation Time: Session 2: 10:30am-11:30am

Does the C-terminus of Bordetella's Fic protein influence GMPylation-mediated signal transduction?

Life Sciences

Author(s):

Rahul Saproo† (Agriculture); Rohan Aryan† (Science)

Abstract:

Fic (Filamentation induced by cAMP) proteins are an emerging family of enzymes that regulate cell signaling in bacteria and eukaryotes via post-translational modifications (PTMs). Predominant among these PTMs is AMPylation/adenylylation, whereby the Fic protein catalyzes ATP to add an AMP moiety to its target. We have discovered a highly conserved Fic protein in the Gram-negative Bordetella sp., members of which cause respiratory diseases including Whooping Cough in humans. Our studies with the Bordetella bronchiseptica Fic protein, called BbFic, revealed that this clade of Fic proteins carries out a previously unseen PTM. Specifically, BbFic functions as a guanlylyltransferase, catalyzing GTP to add a GMP on itself and its putative target(s). We term this novel PTM GMPylation.

We solved the crystal structure of apo BbFic at 3.1 Å, which validated our biochemical characterization of BbFic as a GMPylating enzyme. Further, using AlphaFold (albeit with a weak confidence prediction score), we identified the C-terminus of BbFic as a putative helix-turn-helix (HTH) domain, typically involved in DNA binding. Accordingly, using DNA supercoiling assays and transfection of mammalian cells, we observed that BbFic binds DNA and translocates to the nucleus, respectively. Here, we describe the cloning and purification of just the C-terminal domain of BbFic (BbFic-Cterm) to 1) determine the X-ray crystallographic structure of BbFic-Cterm's putative HTH domain, and 2) use BbFic-Cterm as a bait to capture BbFic's interacting partners. Our preliminary data are presented, which give us important insights into BbFic's physiological function.

Keywords: Bordetella, Fic Protein, GMPylation, Helix Turn Helix

Mentor(s):

Seema Mattoo (Science); Sherlene Brown (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1240
Presentation Time: Session 2: 10:30am-11:30am

Baroque Era in Germany - Musik and Architecture

Fine Arts

Author(s):

Roxanne Schwab† (HHS)

Abstract:

The Baroque Era in Germany had many different aspects to it, and these aspects have been a very important part of keeping the culture from the past alive today. There was a new style of music, known as the Fugue, which had each different part equally as important as the others. Fugues were created by Johann Sebastian Bach, and were a polyphony, which is where there are many different parts of music simultaneously playing at the same time. A fugue has the left and right hands equally important in a piano piece, and every voice part important in a choir arrangement. The Baroque Era also gave rise to different architecture styles, especially within castles and churches having lots of gold and domed surfaces on the outside. The inside would be filled with gold embellishments and there would be lots of artwork.

Keywords: Music, Bach, Baroque Era, Architecture, Fugue

Mentor(s):

Beate Allert (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1241
Presentation Time: Session 2: 10:30am-11:30am

Investigation of Fiber Orientation and Mechanical Properties of Pyrolysis Recycled Carbon-Fiber Reinforced Thermoset Composite

Innovative Technology/Entrepreneurship/Design

Author(s):

Reva Simmons† (Engineering); Harry Lee‡ (Engineering, JMHC)

Abstract:

With increasing demand of carbon fiber reinforced fiber thermoset composites, establishing a sustainable cycle for these materials becomes crucial. Pyrolysis is a process of reclaiming carbon fiber from thermoset composites by thermally degrading the polymer at high temperatures allowing the fibers to be extracted. Carbon fiber reclaimed through current pyrolysis processes for thermoset composites typically loses its original shape and orientation, making it difficult to reorganize the fibers. This study investigated the feasibility of maintaining the fiber orientations for continuous fiber reinforced thermoset composite during pyrolysis by stitching the carbon fiber layup to a conformable copper mesh during the manufacturing process. By maintaining the carbon fiber lengths and orientation through pyrolysis, an identical part or similar part can be reproduced and significantly mitigate the fiber reorganizing process. This study used the two-step pyrolysis-oxidation process to reclaim the fibers and vacuum assisted resin transfer molding (VARTM) for sample manufacturing. The changes in fiber orientations were monitored over multiple VARTM-pyrolysis iterations using microscopy for plain weave samples, both with and without the copper mesh. The potential contamination within the plies during the pyrolysis process was thoroughly investigated, and approaches to remove it before the next VARTM process were developed. Additionally, the tensile strength and stiffness of both the control and copper mesh samples were measured at each iteration to assess the decrease in structural performance over multiple iterations.

Keywords: Carbon Fiber Pyrolysis, VARTM, Two-Step Pyrolysis-Oxidation, Copper Mesh

Mentor(s):

Garam Kim (Polytechnic)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1242
Presentation Time: Session 2: 10:30am-11:30am

Employing TinyML and Data Visualisation for fingerprinting manufactured parts

Innovative Technology/Entrepreneurship/Design

Author(s):

Prisha Singhal† (Engineering); Mahad Faruqi† (Science); Nathon Tubbs* (Engineering)

Abstract:

Our research aims to develop a real-time recognition system for parts manufactured by CNC machines in a manufacturing shop, employing data engineering and machine learning techniques. Specifically, we are focused on processing time-series data generated by the CNC machine, which records current values in amps during the part fabrication process. Our objective is to use this data to construct a model capable of accurately identifying the specific part being manufactured by the machine. Machine learning models are typically generated with large datasets, often needing cloud platforms for data management. However, we need to execute these tasks at the edge, without relying on cloud resources. To address this challenge, we leverage the power of TinyML and the Edge Impulse platform.

To present this data efficiently, we are developing a user-friendly visual dashboard that graphs real-time sensor data and showcases the performance of our machine learning models using Grafana, an observatory platform. The data will be written to InfluxDB, an open-source time series database using Python. This ensures that large amounts of data can be analyzed in a timely manner and the results can be communicated effectively with our stakeholders.

Keywords: Machine Learning, Data Visualisation, Time-Series Data, Edge Impulse, Grafana

Mentor(s):

Ali Shakouri (Engineering); Jabir Jahangir (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1243
Presentation Time: Session 2: 10:30am-11:30am

Applying Lean Six Sigma in Semiconductor Industry

Innovative Technology/Entrepreneurship/Design

Author(s):

Jack Snelling† (Engineering); Paraj Goyal† (Science)

Abstract:

The semiconductor supply chain is extremely complex, with different processes conducted by numerous companies across the world. As a result, uncertainty surrounding the semiconductor supply chain has had a significant global impact, including a lack of availability of chips that drive the economy in the United States, as well as the rest of the world. To address this, it is important to understand and implement known strategies for reducing waste, minimizing resource use, and improving efficiency at each level of the semiconductor supply chain. Lean Six Sigma is a methodology that combines both Lean and Six Sigma, which reduce waste and defects from variations, respectively, throughout supply chains and industries.

This research reviews Lean and Six Sigma methodologies that have been applied to significantly enhance the efficiency of semiconductor manufacturing. Aspects of these approaches, such as systematically identifying and eliminating waste (i.e., DOWNTIME), reducing defects, and optimizing processes (e.g., DMAIC), have proven to be highly impactful when properly implemented in each phase of the semiconductor supply chain. Implementing Lean Six Sigma methods in semiconductor manufacturing could lead to effective solutions in developing a reliable and sustainable semiconductor industry.

Keywords: Lean Six Sigma, Semiconductor Industry, Semiconductor Supply Chain

Mentor(s):

Tho Le (Polytechnic)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1244
Presentation Time: Session 2: 10:30am-11:30am

Chi-Squared Test on Fit Functions for LHC data

Physical Sciences

Author(s):

Jacob Strietelmeier† (Science); Alex Carroll† (Engineering); Akshith Karri† (Science)

Abstract:

The Large Hadron Collider produces copious amounts of data regarding the fundamental laws of the universe, given accurate modeling and analysis. In this research project, we present a study regarding the effectiveness of different functions at modeling physical aspects of toponium, the pair between top and anti-top quarks, using the Chi-Squared goodness of fit test.

Our study delves into the mathematical analysis of these fit functions, including the Gaussian, polynomial expressions, and skewed gaussians. Using python libraries and statistical analysis, we investigate which functions provide the best description of the experimental data. We are then able to draw conclusions and offer insight in modeling physical aspects of toponium, which may prove useful in further research.

Keywords: CMS Collaboration, Curve-Fitting for Histograms

Mentor(s):

Andreas Jung (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1245
Presentation Time: Session 2: 10:30am-11:30am

Racial and Ethnic Identity Awareness: Impact of Student Researchers Studying Asian and Asian American Adolescents in the Midwest

Social Sciences/Humanities/Education

Author(s):

Maia Talbert† (Science, JMHC); Ana Rojas† (HHS)

Abstract:

This presentation discusses how studying Asian and Asian American adolescents in the Midwest prompted student researchers to reflect on their own racial and ethnic identity. We are a team of undergraduate student researchers working in a collaborative project between the Health Disparities Research Lab and the AAARCC Research Lab. As we examined the experiences of Asian and Asian American adolescents in the Midwest, we were able to explore not only their identity journeys, but our own as well. Through numerous interactions with teens of various ethnic and (multi)racial Asian backgrounds, we developed a better grasp on defining our own identities, distinguishing (just as we prompted the teens we spoke with to) between when we ourselves first recognized our identity versus when we genuinely identified as such. This in turn begged the question: How can we stay informed and educated on the nomenclature surrounding topics of race and ethnic identities? We reflected on our comfort levels in regards to discussing self-identity, community, inclusion, and belonging before and after the research — in other words, how involvement in the research impacted our sense of identity. Building both from a professional standpoint and the topic of multiracial identities, we attest that interacting with Asian and Asian American teens through research normalizes a growing expectation of seeing more widespread diversity in the workplace, among colleagues and social circles, and ultimately the hope that this diversity will be accompanied by a greater sense of belonging.

Keywords: Music Therapy, Self-Identity, Asian American / Asian, Mental Health, Inclusion

Mentor(s):

Pamela Sari (VP Diversity and Inclusion); Manabu Taketani (VP Diversity and Inclusion); Stewart Chang Alexander (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1246
Presentation Time: Session 2: 10:30am-11:30am

Immunoglobulins, Cytokines, and Chemokines Response to Prolonged Progesterone in Uterine and Vaginal Tissues

Life Sciences

Author(s):

Summer Thomlison† (Agriculture)

Abstract:

The objective of this study is to understand the role of progesterone and estrogen in modulating immune function within the upper and lower reproductive tract and distal mucosal sites. The animal trial consisted of N=24 rabbits with half receiving 2 injections of hCG at 14-day intervals and tissue samples collected at day 28. Tissue samples were collected from the uterine horn (upper reproductive tract), vagina (lower reproductive tract), and lung (distal mucosal tissue) 35 days after the initial treatment. Total RNA was extracted, reverse transcribed, and the resulting cDNA was used to evaluate gene expression via real-time quantitative polymerase chain reaction (qPCR). Foremost, three reference genes were quantified and evaluated for stability in each tissue. SDHA, HPRT1, and HMBS were all found to be stable across treatment in the lung, while only the latter two genes were found to be stable in uterine and vaginal tissue. Once the reference genes were established, the first two target genes were the epithelial antibody transporters FCGRT (IgG transporter) and PIGR (IgA transporter). The data generated indicates that FCGRT was downregulated while PIGR was upregulated in the uterine tissue of the hCG (high progesterone) rabbits while the vaginal tissue remained stable. These results suggest that steroid hormones differentially alter epithelial transport of IgG and IgA in a tissue-specific manner. The next step of this experiment is to understand the impact of the hormonal state on cytokines and chemokines including CSF1 and CXCL8.

Keywords: Reproduction, Immunology, Gene Expression

Mentor(s):

Alex Pasternak (Agriculture); Alyssa Smith (Agriculture); Devon Anderson (Veterinary Medicine)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1247
Presentation Time: Session 2: 10:30am-11:30am

Sustainability Amongst the Big 3 Hoosier Multinational Automobile Organizations: A Consideration of Whole Life Carbon Emissions Records

Social Sciences/Humanities/Education

Author(s):

Benjamin Traylor† (Polytechnic); Joel Jarrett† (Polytechnic); Joon Kang† (Polytechnic)

Abstract:

This research is focused on quantifying the carbon emissions of multinational automobile organizations in Indiana. With the automotive industry being a disproportionate employer amongst Hoosiers and one of the main contributors to carbon emissions in the state, it is vital for researchers to gain insights into sustainability practices on behalf of these manufacturers. Specifically, this project will review data associated with vehicle use from 'birth to grave.' Our research is bounded by analyzing emissions data associated with the production of automobiles between 2010-2022 for the 3 multinational automobile firms that operate in Indiana: Honda, Subaru, and Toyota. This report will be broken down into three main categories: description of whole life carbon emissions, environmental regulations and consequences, and a carbon emission data analysis. This structure is designed to confront the relatively new science of measuring whole life carbon emissions. This research seeks to outline the standards and practical consequences of emission trends along supported by figures over the last 12 years. The team is currently processing total on off-site release data of chemicals (in pounds) from the Toxic Release Inventory (TRI) database. As the automotive market continues to evolve, it is important to analyze the full carbon emissions produced by the vehicle, rather than just what comes out of the tailpipe, given the absence of in-depth existing research on the subject.

Keywords: Whole Life Carbon Emissions, Auto Manufacturing, Multinational Automobile Organizations, Toxic Release Inventory

Mentor(s):

Jim Tanoos (Polytechnic)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1248
Presentation Time: Session 2: 10:30am-11:30am

Predicting NBA Game Outcomes with Optimized Player Lineups Using Quantum Annealing

Mathematical/Computation Sciences

Author(s):

Caelan Tucker-Camou† (Science); Tayden White† (Science); Anirudh Emani† (Science); Aryan Jumani† (Science)

Abstract:

The purpose of this project is to use quantum annealing to predict the winner of an NBA basketball game based on the statistics of the players on each roster. Data will be pulled from the ESPN website, primarily focusing on the offensive and defensive capabilities on the players from each team. This data will then be used in a quantum annealing program in D-Wave using quantum circuits. These quantum circuits use qubits to find different combinations of player lineups based on past performances and are used to output the optimal lineup for each team. These lineups will be compared against each other using a traditional prediction model in order to find the better team and likely winner. Given two teams, the model will output an optimized team lineup for both teams and predict the probability of a certain team winning.

Keywords: Quantum Annealing, Optimization, Quantum Circuits, Prediction Model, Data Scraping

Mentor(s):

Andreas Jung (Science); Robin Carpenter (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1249
Presentation Time: Session 2: 10:30am-11:30am

Tradespace Exploration of Aircraft Performance for Humanitarian Aid and Disaster Relief

Innovative Technology/Entrepreneurship/Design

Author(s):

Jacob Valdez† (Engineering, JMHC); Sayantan Mukhuti† (Engineering, JMHC); Swami Karunakaran† (Engineering, JMHC)

Abstract:

Existing Humanitarian Aid and Disaster Relief (HADR) aircraft often conduct missions in remote and adverse conditions. These systems are not specifically targeted towards carrying out various relief missions, resulting in scenarios where governments and agencies often rely on HADR aircraft that have been retrofitted from existing models (such as the Boeing 747 Supertanker). A tradespace analysis serves to converge on one or more clean-sheet aircraft designs which can meet mission requirements and perform multiple HADR aircraft missions, thereby providing an alternative, mission driven concept compared to existing aircraft. We explore the aircraft performance design space to determine optimal configurations effective for a range of HADR missions. In addition, it explores the tradeoffs in mission performance based on aircraft design decisions.

We used traditional aerospace systems engineering and design tools to identify key aircraft performance parameters. The tools include X-Plane 11, a non-commercial flight simulator, and Piano-X, an aircraft analysis tool. This leads us to obtain relationships between aircraft performance parameters relevant to specifically designed HADR missions. These relationships will be examined against each other to create a tradespace of aircraft configurations, where one or more optimums can be determined.

In the near future, we will use Cotter's Method to conduct a more thorough sensitivity analysis on the various parameters in our current study. This will allow us to further examine the relative impacts that these characteristics have on overall aircraft design and operating costs.

Keywords: Aerospace, Tradespace Analysis, Humanitarian Aid and Disaster Relief, Aircraft Design, Aircraft Performance

Mentor(s):

Karen Marais (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1250
Presentation Time: Session 2: 10:30am-11:30am

Elucidating the Neural Mechanisms of Social Familiarity-induced Anxiolysis in Rats

Life Sciences

Author(s):

Katherine Veth† (Science, JMHC)

Abstract:

Familiar social support attenuates anxiety and facilitates exposure-based therapy for anxiety disorders. We explore neurobehavioral mechanisms of this phenomenon using the Social Interaction Habituation (SI-Hab) protocol to investigate Social Familiarity-induced Anxiolysis (SoFiA). SoFiA is a learned suppression of anxiety facilitated by familiar social cues that serve as safety signals. Exposing male rats to repeated daily social interaction (SI) tests with the same conspecific rat in the presence of an anxiogenic stimulus results in a reduction of anxiety after about five SI sessions, demonstrating SoFiA. The inputs of social memory and anxiety are both required for safety learning to occur, allowing for anxiolysis. Previous studies implicate the infralimbic cortex (IL) in the expression of SoFiA, and this experiment demonstrates the IL's role in SoFiA acquisition. Chemogenetic inhibition of the IL blocks acquisition of SoFiA, suggesting a critical role in social safety learning. These data represent a first step towards identifying the critical neural circuitry of SoFiA acquisition, which will help provide novel therapeutic targets for the treatment of anxiety disorders.

Keywords: Social Familiarity, Anxiolysis, Neuroscience, Rats

Mentor(s):

Bill Truitt (Indiana University); Andrew Burke (Indiana University)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1251
Presentation Time: Session 2: 10:30am-11:30am

Experiment Management Improvements for the FEMTA Suborbital Flight Experiment

Innovative Technology/Entrepreneurship/Design

Author(s):

Vincent Wang† (Science); Jacob Valdez‡ (Engineering); Gabriel Oliviera‡ (Engineering); Josh Mansky‡ (Engineering); Max Lantz‡ (Engineering); Katie Kneeland‡ (Engineering)

Abstract:

FEMTA (Film Evaporation Micro-Electro-Mechanical Systems Tunable Array) is a water-based micropropulsion system being developed at Purdue University for small satellite attitude control. The FEMTA Suborbital Flight Experiment aims to test the propellant management system developed for the FEMTA microthruster, which uses an expanding hydrofluoroether diaphragm to provide steady water flow through the system.

We present multiple significant improvements to the design of the propellant management experiment in order to increase the reliability and accuracy of the test. The logic used to control the state of the experiment was largely overhauled, and now uses a simpler, more robust approach based on accelerometer readings to determine experiment start time. The firmware used to run the experiment also now supports reading an array of multiple pressure sensors in addition to a flow meter, ensuring more accurate data collection. Additionally, we developed a testing approach using simulated flight profiles and sensor data to ensure that the software will function as expected during suborbital flight.

This series of improvements greatly increases our confidence in the successful operation of the FEMTA Suborbital Flight Experiment.

Keywords: Suborbital, Software-Testing, Microthruster

Mentor(s):

Alina Alexeenko (Engineering); Tony Cofer (Engineering); Steven Pugia (Engineering); Jesus Meza-Galvan (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1252
Presentation Time: Session 2: 10:30am-11:30am

The Impact of Early Prediction of Cardiac Arrest on Healthcare Finance

Life Sciences

Author(s):

Elena Warble† (HHS); Anaelle Gackiere† (HHS); Mattia Moran† (HHS); Elainna Papandrea† (HHS); Marissa Santia† (HHS); Abigail Rosborough† (HHS); Jack Bonnell† (Engineering); Aneesh Poddutur† (Engineering); Subbi Sathya† (HHS); Katharine Czech‡ (HHS)

Abstract:

Introduction: Cardiac arrest is a medical emergency that occurs when an abrupt cessation of the heart's normal rhythm occurs; preventing effective pumping to vital organs and tissues. Over 300,000 in-hospital cardiac arrests (IHCA) occur each year in the U.S. with a 28.7% survival rate. Estimated financial cost of post-cardiac arrest care within the U.S. is valued at 33 billion USD per year, with 6 billion USD attributed to index hospitalization. Research shows that Patients display shifts in vital signs, indicating cardiac arrest up to 12 hours in advance. The subtle nature of these changes makes it difficult for medical personnel to detect impending cardiac arrests and intervene in a timely manner. Deep learning offers an opportunity to develop more accurate and timely predictive models leading to improved IHCA predictions

Purpose: This research aims to develop a machine learning model capable of recognizing clinical decline leading up to cardiac arrest and, in doing so, improving the cost-effectiveness of patient care.

Methods: This is a retrospective secondary analysis of the Medical Information Mart for Intensive Care (MIMIC) IV-ED dataset. This dataset comprises ED patient encounters from Beth Israel Deaconess Medical Center from 2011 to 2019. The primary outcome is the prediction of in-hospital cardiac arrest IHCA. Feature variables, including age, sex, and changes in vital signs, will be incorporated into a Long Short-Term Memory Model (LSTM). LSTM performance will be measured by the area under the receiver operating characteristics curve (AUROC) and the area under the precision-recall curve (AUPRC). Results will then be compared to a logistic regression.

Impact: Implementing a deep learning-based IHCA prediction model can reduce the financial burdens associated with in-hospital cardiac arrests. Accurate identification of at-risk patients allows health care providers to implement timely interventions, thereby, minimizing expenses associated with post-arrest care.

Keywords: Machine Learning, Cardiac Arrest, Healthcare Finance, Vital Signs, LSTM

Mentor(s):

Laura Moffat (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1253
Presentation Time: Session 2: 10:30am-11:30am

The Effect of Regional Variations on Territorial Defense in Chickadees of Indiana

Life Sciences

Author(s):

Bruce Ward† (Exploratory Studies)

Abstract:

Chickadee populations in central Indiana have become fragmented due to the impact of agriculture on forested habitats. This has led to the creation of a variety of song dialects throughout the partially connected system of habitats. We are studying how the adoption of regional dialects affects territorial defense of male chickadees.

Since 2022, our team has gone to nineteen different locations throughout Central Indiana and played recordings of different chickadee songs to evoke responses from the chickadees there. Over different sessions, we change the recording the birds hear; sometimes they get a song from a native bird, other times they get that of an outsider. Using a software called Praat, we look at a spectrogram of our recording and evaluate the type of song the responder gives. We look for signs of aggression and whether the responder's dialect has similarities with the playback.

Male chickadees respond to unfamiliar songs with more aggression than they do to songs in the local dialect. Indeed, we have discovered that over repeated recording sessions, the overall number of aggressive responses decreases. We want to further explore whether this decrease is due to habituation to recorded playback or whether the chickadees are becoming familiar with this foreign song. We discovered several instances where chickadees started expressing seemingly foreign songs acquired from a nearby location. By looking at these instances, we hope to better understand the impact of foreign dialects on aggressiveness and how it changes as birds become familiar with newly introduced songs.

Keywords: Chickadee, Regional Dialect, Territory, Aggression

Mentor(s):

Jeff Lucas (Science); Jonathan Jenkins (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1254
Presentation Time: Session 2: 10:30am-11:30am

The Future of AI in Classrooms at Purdue

Innovative Technology/Entrepreneurship/Design

Author(s):

Tayden White† (Science)

Abstract:

This research essay will explore the future of Artificial Intelligence (AI) in university classrooms, specifically as it relates to Purdue University. In an era of exponential technological growth, AI is a field which holds the potential to transform the world. This technology has already shown a propensity for being both used and abused in the educational world, however an optimistic view of the future implies a complete transformation in modern education. By examining the current landscape of Purdue, its stances on the utilization of AI, and cross-referencing with the changes that AI is expected to make, I will analyze the most likely implementations of AI at Purdue and its educational programs. Additionally, I will explore the dynamics between AI educational tools and human students/educators, trying to predict the social impact of this evolved education here at Purdue. I plan to employ research from various scholarly sources and Purdue's web pages to assess the most likely outcome of AI tools in Purdue classrooms.

Keywords: Artificial Intelligence, Educational Tools, Social Development, Purdue, Regulations

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1255
Presentation Time: Session 2: 10:30am-11:30am

Earth Remote Sensing, Signals of Opportunity (SoOp)

Innovative Technology/Entrepreneurship/Design

Author(s):

Cecilie Wiuff† (Engineering); Dhruv Sharma† (Engineering); Castor Yuan† (Engineering)

Abstract:

Signals of Opportunity (SoOp) is a type of microwave remote sensing. SoOp can be used to make remote sensing measurements for different science applications such as soil moisture, ocean wind speed, and ocean altimetry. One of the most revolutionary advancements of SoOp is the capability of making remote sensing measurements outside of spectral bands normally used for science applications, and the frequencies used for SoOp span from the P-band to the Ka-band. Depending on the frequency of the signal remote sensing becomes useful for different applications. When using SoOp for remote sensing of soil moisture at the root level P-band SoOp can be used. P-band SoOp can penetrate through for example heavy vegetation and snow which is relevant when analyzing root-level soil moisture. However, when analyzing the top layers of soil moisture, L-band SoOp is used more but L-band SoOp is only able to penetrate through the top 0-2 cm layer. Analysis of soil moisture done by using SoOp is relevant when it comes to understanding the water cycle, agricultural management, and forecasting of floods and droughts.

Keywords: Signal Acquisition for GPS, Earth Remote Sensing, Signals of Opportunity

Mentor(s):

James Garrison (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1256
Presentation Time: Session 2: 10:30am-11:30am

Molecular Cages as Artificial Antibodies and Enzymes

Life Sciences

Author(s):

Daniel Zou† (Science)

Abstract:

Redacted

Keywords: Molecular Cages, Sequencing, Stability, Selective Recognition, Synthetic Catalysts

Mentor(s):

Severin Schneebeli (Pharmacy); Anthony Mena (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1400
Presentation Time: Session 3: 12:00pm-1:00pm

AI For Musicians Evaluator Tool

Innovative Technology/Entrepreneurship/Design

Author(s):

Mukul Agarwal† (Science); Mayank Hothur† (Engineering); Kodiak Ortiz† (Engineering); Isaac Mei† (Engineering); Branden Cho† (Engineering); William White† (Engineering); Daniel Yang† (Engineering); Sanya Dod‡ (Engineering); Joshua Kamphuis‡ (Engineering)

Abstract:

Musicians’ challenges include the need to learn music quickly and possible injury from long practice. We aim to create an AI-embedded application that will enable string musicians to practice more efficiently by analyzing sound to detect deviations in intonation, dynamic, and rhythm, and by using computer vision to detect incorrect posture to prevent injury.

To evaluate the accuracy of a musician’s playing, we aim to accurately quantify notes, dynamics, tempo, and other aspects of input audio and compare the musician’s playing to a digitized version of the score (sheet music) they play from in real time.

Existing research in computer vision for pose detection attempts to create node-based pose estimations of different parts of the body. However, current models each have certain flaws, like difficulty with video, inability to detect partially obscured objects, and low precision in pose detection, which make any single model inappropriate for our work. This research will instead combine a variety of pre-existing machine learning models for pose detection. As a anticipated result of this work, we will create a multi-model approach to achieving complex pose detection of a musician in performance.

These three forms of input – score, audio, and video – will serve as input to a transformer, a cutting-edge deep learning model, trained on video and audio of string music performances. This transformer will detect inaccuracies in the musician’s sound and posture and report them to the user.

Keywords: Music, Machine Learning, Computer Vision, Artificial Intelligence

Mentor(s):

Yung-Hsiang Lu (Engineering); Kristen Yeon-Ji Yun (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1401
Presentation Time: Session 3: 12:00pm-1:00pm

The Development of Fetal Porcine Intestine in Mid-to-Late Gestation

Life Sciences

Author(s):

Lillian Andis† (Agriculture)

Abstract:

While the structure of the postnatal intestine is well understood, little is known regarding the fetal ontogeny of this critical organ. Thus, our objective is to characterize the developmental timeline and determine the role of fetal thyroid hormone in regulating this process. We hypothesize that secondary intestinal structures such as crypts and villi will progressively develop from mid-to-late gestation, while the population of specialized goblet cells will expand. We further hypothesize that endocrine disruption, in the form of fetal hypothyroidism, will alter this normal developmental trajectory. To investigate this, intestinal samples were collected from N=24 fetuses each at days 55, 66, 76 and 86 of gestation. Half of the samples at each time point were derived from gilts treated with methimazole for 21 days prior to sampling to induce fetal hypothyroidism. All N=96 samples were formalin-fixed, paraffin-embedded in triplicate, and histologically sectioned using a microtome. Tissue sections were then mounted on slides, deparaffinized, and stained with a combination of alcian blue and nuclear fast red. The resulting slides were examined microscopically, and a minimum of 4 images captured per sample for subsequent analysis. Intestinal villi were observed in the fetal intestine at all gestational ages; however, stereotypical intestinal crypts were largely absent during the examined time-period. Alcian blue staining successfully detected goblet cells within the luminal epithelium as early as day 55. Ongoing work will quantify the growth of intestinal villi and the number of goblet cells over time, as well as evaluate the impact of fetal hypothyroidism on these metrics.

Keywords: Fetal, Porcine, Ontogeny, Hypothyroidism, Mid-to-Late Gestation

Mentor(s):

Alex Pasternak (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1402
Presentation Time: Session 3: 12:00pm-1:00pm

Biomedical Drone for Narcan Delivery

Innovative Technology/Entrepreneurship/Design

Author(s):

Nathan Arnold† (Engineering); Jatin Soni† (Engineering); Alexander Eiguren† (Engineering); Alan Chao† (Engineering); Grant Sims† (Engineering); Om Muthyala† (Science)

Abstract:

Opioid overdose is a growing public health crisis in Indiana with a 50% increase in opioid overdose deaths from 2019 to 2020, and an additional 16% by 2021. Fortunately, Narcan is an easily administered drug that can reverse an overdose. However, oxygen deprivation from an overdose can cause brain damage within 6 minutes, whereas some rural Indiana counties have an emergency medical service (EMS) response time of 17 minutes. This project seeks to design an Unmanned Aerial Vehicle (UAV) that autonomously delivers Narcan and instructs bystanders to administer the treatment ahead of EMS arrival.

We derived vehicle flight performance requirements modeling current EMS infrastructure and the impact of cooperatively deployed UAVs. Using physics simulations, we designed and built a UAV capable of meeting these requirements. The design process also included an evaluation of various path-planning methods given various speeds. This UAV would double the EMS coverage area of Indiana in a six-minute window. The vehicle would navigate to a victim using a planned flight path with forward and downward collision sensors to prevent accidents, as well as a 4G-enabled companion computer for added reliability. A bystander could retrieve Narcan from the payload dispenser and follow video and audio instructions played by the vehicle. With the ability to rapidly reach far distances, autonomously land, and provide lifesaving drugs and instructions to bystanders, a fleet of Narcan delivery UAVs would provide EMS responses to areas where ambulances cannot reach in time, improving the medical outcomes of overdose victims.

Keywords: Narcan Delivery, EMS Collaboration, Biomedical UAV, Lifesaving Treatment, Autonomous

Mentor(s):

James Goppert (Engineering); Nicole Adams (HHS); Kong (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1403
Presentation Time: Session 3: 12:00pm-1:00pm

Fabrication of biodegradable packaging alternatives using plant-based protein

Physical Sciences

Author(s):

Kara Benbow† (Agriculture); Gabriela Surdyka† (Engineering)

Abstract:

Single-use plastics, like Saran WrapTM , are used in the food industry to protect products from oxygen, light, and physical hazards, and plastics have accumulated into large amounts of waste and pollution. This leads researchers to develop biodegradable alternatives made from carbohydrate and protein-based sources. Pea protein offers an affordable opportunity to create alternative packaging but often exhibits inferior mechanical strength, oxygen or water permeability, and flexibility. Research targeting flexibility and elongation is largely absent in food science literature, therefore, this study aims to replicate the mechanical properties of plastic packaging, with an emphasis on flexibility and elongation, to reduce the environmental impact of single-use plastics. Films were fabricated using solutions of 10% (w/v) pea protein adjusted to pH 3, 4.5, or 8 . The protein solutions were mixed with glycerol at ratios of 70%/30%, 80%/20%, and 90%/10% (pea protein/ glycerol, w/w), and a constant weight (8g) was poured into petri dishes. The film solutions were baked for 15 minutes at 180℃, 200℃, and 220℃. After baking, the films were peeled, and characterized for thickness, moisture, mechanical strength, and elongation. The films were also dried in a vacuum oven, and subsequently characterized again for thickness, moisture, and mechanical properties. Results show that the film made at pH 3, at a concentration of 90%/10%, and baked at 220℃ was the closest match to saran wrap regarding elongation and strength. These results suggest pea protein could be used in packaging alternatives in lieu of single-use plastics in terms of their mechanical properties.

Keywords: Biodegradable Packaging, Plant-Based, Mechanical Properties, Elongation

Mentor(s):

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Poster Presentation Abstract Number: 1404
Presentation Time: Session 3: 12:00pm-1:00pm

The Impact of Binge-Like Alcohol Consumption on Recognition Memory and Compulsive-Like Behavior in Aged Mice

Social Sciences/Humanities/Education

Author(s):

Tori Burke† (HHS, Liberal Arts, JMHC); Roma Kamat‡ (HHS)

Abstract:

Alcohol consumption in aging humans is a risk factor for memory impairment. This experiment assesses the effects of binge-like alcohol drinking in aged mice on memory [object recognition (ORM) and location (OLM) tasks] and compulsive-like behavior (marble-burying task). Subjects will be 14–15 months old, 8 female and 10 male mice selectively bred for low alcohol preference (LAP). Mice will consume either tap water or a 20% alcohol solution in tap water (v/v) by a drinking in the dark (DID) procedure for 4 consecutive days a week, for 3 consecutive weeks. The DID procedure induces relatively high levels of alcohol consumption in LAP mice. Mice will complete the marble-burying task 24 hours after the last binge-drinking session and 11 days later. The day after the 2nd marble-burying test mice will undergo ORM and OLM tasks that test recognition memory. Mice will explore two identical objects during the training phase. Mice will then be tested for ORM in which they will explore one familiar vs. one novel object. OLM, a spatial version of ORM, tests recognition of a displaced vs non-displaced object. If their memory is not impaired, they will explore the novel object/location more than the familiar object/location. Alcohol-exposed mice are expected to show greater marble-burying activity as well as impaired ORM and OLM, indicating greater compulsive-like behavior and cognitive impairment, respectively. Female mice are expected to drink more alcohol and display greater alcohol-induced cognitive impairment than male mice.

Keywords: Alcohol, Aging, Memory Impairment, Mice

Mentor(s):

Julia Chester (HHS); Soyol Enkh-Amgalan (HHS)

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Poster Presentation Abstract Number: 1405
Presentation Time: Session 3: 12:00pm-1:00pm

Headphones and Colleges Students: Factors which Increase Consumer Preference for Sustainable Products

Innovative Technology/Entrepreneurship/Design

Author(s):

Adrian Calderon† (Polytechnic)

Abstract:

Sustainability and environmental awareness continue to become a major facet of today’s society. Despite increased awareness, consumers continue to hesitate when purchasing sustainable products over environmentally harmful ones (Luchs, Brower, Chitturi, 2012). Previous studies indicate three primary factors affect this choice specifically with regards to food products - confidence in product functionality, cost to self, and social responsibility or guilt (Goldsmith, Roux, and Wilson 2019). The following study seeks to determine the extent of environmental responsibility undergraduate students have by confirming that functionality, cost to self, and social responsibility significantly affect their consumer product preference in regards to electronic products, specifically headphones, rather than food products. A survey is provided to undergraduate students at Purdue University. The survey includes a description of conceptual products along with different thresholds of functionality, price, and environmental impact. Students can rate on a scale of 1 to 5 how likely they are to purchase the product. The study seeks to determine which specific, numeric thresholds of these factors lead to highest consumer preference for conceptual electronic products.

Keywords: Sustainability, Consumer Preference, Natural Language Processing, Headphones

Mentor(s):

Gaurav Nanda (Polytechnic)

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Poster Presentation Abstract Number: 1406
Presentation Time: Session 3: 12:00pm-1:00pm

QDILink

Innovative Technology/Entrepreneurship/Design

Author(s):

Jacob Chappell† (Engineering)

Abstract:

One of the methods for continuing scaling post-Moore's Law is by combining multiple silicon chiplets into one unit. QDILink is intended to serve as a communication pathway between these dies. Most of the current solutions that are used employ a synchronous communication protocol, however QDILink has a quasi-delay insensitive protocol that is not effected by timing differences across the link.

By using a QDI protocol, there is no need for any analog circuit design for the link to function, which is important as analog circuits are very process dependent, potentially requiring a significant amount of design work for each different chiplet that is connected to the system. QDILink can also perform processing while the data is in transit by adding calculation stages into its internal pipeline. This moves part of the routing and data transmission logic into the link itself, increasing the flexibility of implementations to have different data transmission requirements. Beyond this, QDILink does not require either chiplet to be a synchronous system, enabling the use of a wider set of chiplets compared to the synchronous protocols. The lack of complex logic needed to decode and manage the link is also advantageous towards interfacing with as many systems as possible.

This project is still early in development, but will eventually be integrated into a version of the SoCET Team's AFTx line of system on chips along with other projects that require a simple, reliable, and flexible communication protocol.

Keywords: Advanced Packaging, Quasi-Delay Insensitive Circuits

Mentor(s):

Mark Johnson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1407
Presentation Time: Session 3: 12:00pm-1:00pm

Machine Learning in Motion

Innovative Technology/Entrepreneurship/Design

Author(s):

Arunima Chowdhury† (Science); Esharaqa Jahid† (Engineering); Sami Zagha† (Engineering); Mert Ryan Kiroglu† (Science)

Abstract:

The VIP (Vertically Integrated Projects) project Machine Learning in Motion consists of the development of motion analyzing software to help dance choreographers gather data on their rehearsals and performances, such as distance, speed, and position of the dancers. The project's goal is to provide open-source software for individuals to learn how technology may be utilized to assist artists from a variety of disciplines in using the physical world to impact the electrical and hardware realms. This data can be used in the dance making process and/or performances through the interaction of design elements such as lighting, sound, and projection. The project consists of two components; a “backend” that tracks the motion of multiple figures with a relatively high degree of accuracy using TensorFlow, and an intuitive user interface which allows the user to directly interact with the project’s deliverables. This allows users with minimal exposure to the project's technical components to utilize its deliverables effectively. Due to the scope of the project, many hurdles have been encountered, especially with regards to maintaining “smooth” tracking of the figures detected, and distinguishing distinct figures from each other as the current implementation of the project is effectively “memoryless”. Furthermore, the project aims to detect more than six figures at the same time, something currently not possible due to the technical limitations imposed by TensorFlow. With further development, this software can be a valuable contribution to the field of performing arts.

Keywords: Tensorflow, Intuitive User-Interface, Dance Choreographers, Open-Source Software, Motion Analysis Software

Mentor(s):

Renee Murray (Liberal Arts); Frederick Berry (Polytechnic)

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Poster Presentation Abstract Number: 1408
Presentation Time: Session 3: 12:00pm-1:00pm

A review of Math Interventions for ASD Students

Social Sciences/Humanities/Education

Author(s):

Nicholas Cline† (HHS)

Abstract:

From 2000 to 2020, the prevalence of autism spectrum disorder (ASD) has risen dramatically from 1 in 150 to 1 in 36 (Centers for Disease Control and Prevention, 2021). This has fueled the development of new educational interventions for ASD students, with a primary focus on noticeably impacted skills like communication and language. However, ASD students, similar to their typical development (TD), peers also struggle with math skills. Yet, unlike TD students, ASD students are stereotypically portrayed as mathematically gifted. Consequently, fewer interventions target math learning for ASD students. Interestingly, of the existing math interventions for ASD students, even fewer address the intersection of mathematics understanding and language comprehension, i.e., word problem solving. Word problems call for the application of mathematical knowledge to real-world situations. Thus, math interventions for students with ASD must focus on word problem comprehension to bridge the gap between language and mathematics skills.

A comprehensive literature review was conducted to identify current math interventions for ASD students with particular attention to problem solving. Studies were included in the review if they met the following criteria: be published within the last 20 years of a peer reviewed journal; include students ranging from elementary to high school age; include participants with an ASD diagnosis; target mathematics skills (if possible, word problem comprehension); and be conducted in any educational or clinical setting. This review will serve as the basis for the development of research that examines the effectiveness of a mathematics invention for problem solving with ASD students.

Keywords: Autism Spectrum Disorder, Problem Solving, Mathematical Problems, Word Problems (Mathematics), Education & Educational Research

Mentor(s):

Yan Xin (Education)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1409
Presentation Time: Session 3: 12:00pm-1:00pm

The Necessity for Sleep among Undergraduate Students at Purdue University

Life Sciences

Author(s):

Peyton Dow† (DSB, JMHC)

Abstract:

Sleep is a necessity of life and is thought to be necessary for success. It is an especially common thought that sleep is necessary for academic success. Undergraduate college students balance sleep with academics, but to what result? A relationship between sleep and academic performance is studied. Sleep data is gathered from multiple universities. This is done through various means, such as wearable sleep trackers or surveys. Sleep data is compared to academic performance. Variables are quantified; GPA is used as a measure of academic performance. Data on GPA is gathered directly from university databases, or by student surveys. Then, statistics are run on this data. A significant relationship between sleep and GPA is found; there is a positive relationship between sleep and academic performance. Undergraduate students who get good sleep are found to tend to get good grades, and vice-versa. Much data points towards this, and researchers conclude that sleep has a strong positive effect on undergraduate academic performance. So, undergraduate students at Purdue University should be sure to get adequate sleep in order to have academic success.

Keywords: Sleep, Academic, Undergraduate, Student, Grades

Mentor(s):

Sidney Ducleroir (Liberal Arts)

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Poster Presentation Abstract Number: 1410
Presentation Time: Session 3: 12:00pm-1:00pm

SWARMS: Multi-Agent Control Simulation Platform

Innovative Technology/Entrepreneurship/Design

Author(s):

Avi Dube† (Engineering); Isaac Fuksman† (Science, JMHC); Peter Zakariya† (Science); Sully Cisco‡ (Engineering); Rishabh Agarwal‡ (Engineering); Justin Gan‡ (Engineering); Derek Matthei‡ (Engineering); Annie Mitten‡ (Engineering); Renee Patton‡ (DSB); Dinesh Ruben‡ (Engineering)

Abstract:

The SWARM Simulation platform is a user-friendly cloud-based application designed to advance drone development and autonomous research. By utilizing Unreal Engine's high-fidelity graphics in combination with AWS cloud services, it offers scalability and realism while significantly reducing computational demands. Researchers can efficiently design, implement, and evaluate multi-agent flight control algorithms using this platform. SWARM provides accessible data log files and visualizations for in-depth analysis of simulation results, including drone positions over time. The platform also offers realistic benchmarks and built-in libraries for common swarm functions, such as task allocation and obstacle avoidance utilizing LiDAR sensor data. SWARM RDS UI utilizes a native user interface application to simplify the simulation and system setup, which is particularly useful for testing custom algorithms. Current efforts are focused on developing and testing custom algorithms as well as building automation tools for comprehensive simulation analysis. Future plans include simulating realistic scenarios, such as search and rescue missions and forest fire response.

Keywords: Autonomous Systems, Obstacle Avoidance, Simulation, Robotics Research, Drone UAV

Mentor(s):

Shreyas Sundaram (Engineering); Younggil Chang (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1411
Presentation Time: Session 3: 12:00pm-1:00pm

Design and Evaluation of an Izumo-Based Wildlife Contraceptive Vaccine

Life Sciences

Author(s):

Delilah Flora† (Science, JMHC)

Abstract:

Contraceptive immunization is a non-lethal solution to the ongoing problem of overabundance in wildlife animal populations such as horses, deer, and burros. The current vaccine formulations utilize native porcine zona pellucida proteins (PZP) derived from pig ovaries along with Modified Freund's Complete Adjuvant (FMA). The use of current vaccines is limited by the infection risk and limited supply of PZP as well as the preparation difficulty, injection site reaction, and overall hazardous nature of FMA. The purpose of this study is to develop a new immunocontraceptive vaccine to overcome these limitations. IZUMO1, a protein from the acrosomal region of sperm, is known to induce infertility in mice via immunization. We used recombinant equine IZUMO1 (reIZUMO1) as well as AddaSO3, a safe, effective, and stable adjuvant, to immunize mice with the goal of inducing infertility. The reIZUMO1 plasmid was synthesized and underwent selection and amplification via bacterial transformation. The plasmid was expressed in Chinese Hamster Ovary (CHO) cells. The protein was extracted and purified via chromatography and confirmed using an SDS-PAGE and Western Blot. Female mice were immunized with either a control vaccine (native PZP + FMA) or with reIZUMO1 combined with AddaSO3 and then allowed to mate with male mice. Immunoassay results showed significant elevation in the antibody levels in the serum samples of each vaccinated group. However, the mice group immunized with reIZUMO did not show infertility. This elevated immune response demonstrates potential for the use of IZUMO1 in immunocontraceptive vaccines, however, a species-specific approach may yield better results for inducing infertility.

Keywords: Vaccines, Immunocontraception, IZUMO1

Mentor(s):

Harm HogenEsch (Veterinary Medicine); Ahmed Hassan (Veterinary Medicine); Raluca Ostafe (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1412
Presentation Time: Session 3: 12:00pm-1:00pm

The Function of Gamete Expressed-Endopeptidases in Double Fertilization

Life Sciences

Author(s):

Alaina Gartner† (Agriculture, Engineering); Keila Jellings‡ (Agriculture, Science)

Abstract:

The interaction between male and female gametes during double fertilization is critical for successful seed development. Recently, two egg cell secreted endopeptidases in Arabidopsis thaliana, ECS1/ECS2, were found to be involved in the regulation of pollen tube reception and gamete fusion. We hypothesized that other endopeptidase members may have additional functions in regulating localization, activation, or elimination of proteins at the surface of gametes. To test this hypothesis, we examined transcriptomic profiles of sperm and egg cells and identified several candidates for different endopeptidase families. To identify their specific roles in recognition and fusion of gametes, we examined single mutants and generated high-order mutants by crossing homologous gene members. The isolated mutant lines were examined for pollen, embryo sac cellular morphology, and fertility defects. We expect fertility defects to be caused by defects in sperm-egg interactions. This work is expected to contribute to the discovery of new gamete factors controlling double fertilization and seed development or unveiling fertilization anomalies leading to parthenogenesis or polyspermy.

Keywords:

Mentor(s):

Leonor Chagas Boavida (Agriculture)

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Poster Presentation Abstract Number: 1413
Presentation Time: Session 3: 12:00pm-1:00pm

20 Years in the Making: Tracking the Dismantling of Traditional Public Schools through the Proliferation of Charter Schools in Indianapolis

Social Sciences/Humanities/Education

Author(s):

Anjali Gupta† (Science, JMHC)

Abstract:

Over the last two decades, federal and state educational policies have increasingly supported the expansion of school choice. As a result, the assortment of choice options has expanded substantially, particularly in urban areas. For example, within the attendance boundary of Indianapolis Public Schools (IPS), there are currently 81 charter schools and only 27 traditional public schools. This study analyzes the proliferation of charter schools in Indianapolis over the past 20 years and its effects on the enrollment and funding of the public school system. Specifically, the study tracks the number of charter and traditional schools from year to year, analyzes the percentages of IPS's total expenditures paid out to charter and private schools, and follows the enrollment trends of IPS as the number of charters has increased. The findings demonstrate the impact of charter schools on the traditional public school system in Indianapolis and suggest that the growth of charter schools has had a significant impact on the funding of the public school system, which raises important questions about the appropriation of public funds towards the dismantling of traditional public schooling.

Keywords: School Choice, Charter Schools, School Finance, Educational Policy, Critical Policy Analysis

Mentor(s):

Bryan Duarte (Education)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1414
Presentation Time: Session 3: 12:00pm-1:00pm

Understanding Human Social Cues in Robot-mediated Mental Health Intervention Activities

Mathematical/Computation Sciences

Author(s):

Denison Guvenoz† (Polytechnic); Avery Kruppe† (Polytechnic)

Abstract:

Robots have been involved in human lives for a few decades now and, coupled with AI, have been taking on more of a human likeness in their interactions. However, robotic assistants like Alexa or Google Home are not yet capable of holding meaningful, socially normative conversations. This project aims to incorporate some level of “social intelligence” into robots so they can act as more effective companions. Effectiveness here is defined as a robot’s competencies compared to errors, both in terms of performance and socio-affective instances. “Performance” instances include how fast the robot responds and if it understands the user’s words. “Socio-affective” instances are more abstract with categories including how the robot recognizes and responds to the participant’s overall social behavior, including engagement, emotions, and conversational mechanics. To evaluate effectiveness, we are annotating videos of 70 clinical participants’ therapy sessions facilitated by Jibo, a mental health robot. We note its errors and competencies, watching how these affect the user, and consider how Jibo’s interactions can be improved. Although this is our goal, our current conclusions go beyond the participants and robot’s interactions and center around the subjective nature of social contexts. Socio-affective instances can be categorized, but each category is largely subjective. Differing opinions in our annotations support this, and they pose an interesting question on whether robots can be taught the social norms needed to perform effectively. This question, along with further annotations and analyses, will help us understand the potential that robots, including Jibo, have as sympathetic companions.

Keywords: Technology, AI, Social Psychology, Robotics, Video Analysis

Mentor(s):

Sooyeon Jeong (Science); Dong Won Lee (Massachusetts Institute of Technology)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1415
Presentation Time: Session 3: 12:00pm-1:00pm

The Exploration of Autonomous Navigation of Unmanned Aerial Vehicles Within a Maze

Mathematical/Computation Sciences

Author(s):

Jaya Hari† (Engineering, JMHC); Dheepa Hari† (Engineering, JMHC); Alice Dragnea† (Engineering); Junpei Ota† (Engineering); Aryan Srivastava† (Engineering); Natasha Gundapaneni‡ (Engineering); Sarah Sawhney‡ (Engineering)

Abstract:

Unmanned Aerial Vehicles (UAVs) are useful in environments inaccessible to humans or environments where more definitive data collection is desired. The potential applications for UAVs are immense, however as a system, they have limitations especially in regards to memory. The purpose of our research is to explore memory-efficient solutions for path-planning and collision-avoidance by UAVs, specifically for two-dimensional navigation and mapping within unknown environments. We will be creating an open-source sample solution with elements of localization, mapping, navigation, and path-planning alongside programming for basic drone controls to be tested in a simulated environment containing a maze. Simultaneously with programming of a sample solution, a physical maze is built and designed to validate structural integrity for real-world testing of the simulated environment. We will test the current solution for how quickly it is able to solve the maze, determine the maximum memory usage (and more specifically see if we can determine which aspects of our algorithm will be using the most memory), and analyze the algorithm used for maze traversal to determine its time and memory complexity. We are currently developing a UAV maze competition and baseline solution for the Spring 2024 IEEE International Conference on Robotics and Automation (ICRA). This competition provides a stable, controlled environment for understanding the types of constraints drones face for path planning and object detection problems. Our next steps will be to build upon the baseline solution by improving drone memory efficiency, collision avoidance, and speed of maze completion.

Keywords: Unmanned Aerial Vehicles, Memory-Efficient, Path-Planning, Collision-Avoidance, Open-Source

Mentor(s):

Yung-Hsiang Lu (Engineering); Jiwoo Rachel Kim (Engineering); Worawis Sribunma (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1416
Presentation Time: Session 3: 12:00pm-1:00pm

The Effects of Extracurricular Partipcation on Purdue Students

Social Sciences/Humanities/Education

Author(s):

Alden Hartman† (Exploratory Studies)

Abstract:

This article discusses the benefits of extracurricular participation and compares the effects received from participation in sports extracurriculars compared to those received by academic extracurriculars. The research and statistics used in this article come from various observational studies that have previously been conducted by Purdue primarily within the last decade. The goal of this article is to compare the benefits received by these two types of extracurriculars and decide which is more beneficial for a student to join. I used data provided and gathered by Purdue University to support my claims using academic, peer-reviewed sources, and popular sources. I conducted research by comparing the positive and negative impacts of each type of extracurricular and weighing which type on average provided more positive impacts for the student. Using this process I found that academic extracurriculars gave benefits such as higher test scores or better academic performance while sports extracurriculars provided a different set of benefits such as boosted self-esteem or improved social skills. While we can not ultimately conclude that one type of extracurricular is better overall than the other, we can conclude that the type of extracurricular you select leads to different benefits.

Keywords: Academic Extracurriculars, Sports Particpation, Benefits, Purdue University

Mentor(s):

Sidney Ducleroir (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1417
Presentation Time: Session 3: 12:00pm-1:00pm

AFTx07 Post-Layout Simulation

Mathematical/Computation Sciences

Author(s):

Timothy Hein† (Engineering); Miguel Isrrael Teran† (Engineering)

Abstract:

The System-on-Chip Extension Technologies (SoCET) team at Purdue University has been developing the AFTx07, a single core, pipelined, RISC-V microcontroller. Post-layout simulation is the final step in the integrated circuit design flow that verifies the physical layout of the design meets desired performance and functionality metrics. The purpose of our project is to evaluate the physical layout of the AFTx07 by developing a post-layout simulation flow consisting of three phases: logical verification, parasitic extraction, and simulation. The logical verification phase (LVS) checks that the post-layout netlist matches the schematic netlist. The parasitic extraction phase calculates the parasitic effects of components within the design in order to create a more accurate analog model of the chip. In the final stage of our flow, we will generate performance data by simulating our model from the parasitic extraction phase. A successful post-layout flow will pass the testbench and achieve desired power, timing, and area constraints. Our goal is to produce a refined analog model of the AFTx07 and a set of simulations to verify the AFTx07 meets the desired performance and functionality metrics in anticipation of tape-out by the end of the fall semester.

Keywords: Post-Layout Simulation, Microcontroller, LVS, Parasitic Extraction, System on Chip

Mentor(s):

Mark Johnson (Engineering); Conor Green (Engineering); Swapnil Bansal (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1418
Presentation Time: Session 3: 12:00pm-1:00pm

Early Prediction of Cardiac Arrest- AI in Healthcare

Social Sciences/Humanities/Education

Author(s):

Allison Herr† (HHS); Duc Le† (HHS); Vicky Zheng† (HHS); Ethan Lin† (HHS); Devin Reynolds† (HHS); Yen-Hsi Lai† (HHS); Sienna Moon* (HHS); Linda Zou* (Science); Kayla Gaerte* (HHS)

Abstract:

Background:

Over 300,000 in-hospital cardiac arrests (IHCA) occur annually in the U.S., with an estimated 30,000 occurring within the Emergency Department. Survival rates for IHCA have been reported at 22.8%, with roughly 15% of the survivors predicted to sustain permanent life-changing effects. Current research shows that patients have subtle changes in vital signs prior to an IHCA occurring. Early prediction of IHCA is crucial because it allows emergency providers to take necessary preventative action to prevent or intervene prior to its onset.

Purpose:

Our research aims to create a deep-layered neural network capable of leveraging the prediction of IHCA to improve survival rates.

Methods:

This is a retrospective secondary analysis of the Medical Information Mart for Intensive Care (MIMIC) IV-ED dataset. This dataset comprises ED patient encounters from Beth Israel Deaconess Medical Center from 2011 to 2019. The primary outcome is the prediction of in-hospital cardiac arrest IHCA. Feature variables, including age, sex, and changes in vital signs, will be incorporated into a Long Short-Term Memory Model (LSTM). The performance of LSTM will be measured by the area under the receiver operating characteristics curve (AUROC) and the area under the precision-recall curve (AUPRC). The results of each will then be compared to a logistic regression.

Impact:

Early identification significantly impacts patients at risk for IHCA, improving outcomes and reducing overall mortality and morbidity.

Keywords: Cardiac Arrest, Healthcare, AI, Machine Learning, Improving Morbidity and Mortality

Mentor(s):

Laura Moffat (HHS); Katharine Czech (HHS); Alec Pannunzio (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1419
Presentation Time: Session 3: 12:00pm-1:00pm

BINGE-LIKE ALCOHOL DRINKING PATTERNS IN AGED HIGH ALCOHOL PREFERRING MICE

Life Sciences

Author(s):

Cami Howard† (HHS)

Abstract:

The adverse health effects of alcohol could be exacerbated in older populations. Concerningly, the prevalence of alcohol binge drinking in people over the age of 50 has been increasing. In our lab, we use selectively bred High Alcohol Preferring (HAP) mice. These mice model humans with innate tendency to excessively drink alcohol. In this study, we characterized binge drinking patterns in aged male and female HAP mice. Twenty-month-old HAP mice (10 female and 9 male) went through 4 days of drinking in the dark procedure (DID) to induce binge-like drinking. During the DID procedure mice were given 20% alcohol (v/v) or water for 2 – 4 hours during the dark cycle, when the mice have the highest ingestive activity. Overall, mice in the water group drank more fluid than mice in the alcohol group. Drinking patterns were stable across 4 days and there were no sex differences. The lack of sex differences in alcohol intake in aged HAP mice conflicts with previous literature in younger mice. Future work will assess whether binge-like alcohol versus water intake will affect neurobiological changes in these aged HAP mice.

Keywords: Alcohol, Aging, High-Alcohol Preferring Mice

Mentor(s):

Julia Chester (HHS); Soyol Enkh-Amgalan (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1420
Presentation Time: Session 3: 12:00pm-1:00pm

Research and Development in IoT and Edge Processing

Mathematical/Computation Sciences

Author(s):

Kyochul Jang† (Science); Jacob Carroll† (Engineering); Ilhoon Lee† (Science); David Cho† (Science); David Lender† (Engineering)

Abstract:

Our project, based at the Bechtel Innovation and Design Center, is focused on enhancing safety within high-risk environments through the strategic use of Internet of Things (IoT) devices. We're leveraging these devices to collect a diverse range of data from multiple sensors that measure variables such as light intensity, temperature levels, particulate count, and various gas concentrations.

Applying advanced machine learning algorithms to this collected data along with simulated hazard scenarios allows us to create a predictive system. This system is designed to identify potential safety incidents like fires or air contaminants before they actually occur.

The proof of concept for our project involves using unsupervised learning approach which allows the computer to independently identify anomalies within the data stream.

The next phase in our development process involves incorporating predictive models into our system. These models will be trained to anticipate future sensor data values and then check whether these predicted values could indicate an impending safety incident.

Our ultimate objective is not just about improving safety in workplaces with high-risk factors but also about demonstrating how cost-effective IoT systems can be used in this regard. We believe that efficiently collecting and harnessing information through these systems can play a significant role in promoting safer working conditions by enabling preventive measures before any potential hazards turn into real incidents.

Keywords: IoT, Edge Processing, Machine Learning, Bechtel, Anomaly Detection

Mentor(s):

Matthew Swabey (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1421
Presentation Time: Session 3: 12:00pm-1:00pm

A Bayesian Framework for Transfer of Process-Dependent Material Properties

Mathematical/Computation Sciences

Author(s):

Mateusz Jaszczuk† (Engineering)

Abstract:

Extrusion deposition additive manufacturing (EDAM) of short-fiber reinforced polymer (SFRP) composites provides unparalleled design flexibility and has enabled printing tooling in the scale of meters. Virtual twins (VT) of the manufacturing process enable predicting the composite behavior regarding possible deformations and failure that might occur during printing or after the printed part is subjected to external thermal or mechanical loads. Material cards required for VTs require extensive experimental characterization, as the same material printed on different platforms may result in significant changes in the microstructure, which further changes the mechanical and thermal properties of the composite. Hence, this research utilizes a Bayesian framework to transfer material properties from one system to another, accounting for the change in microstructure, using only a few tensile properties. This framework uses the prior information about the composite manufactured in one printing platform to predict the effective thermal conductivity of the same material printed in a different system. Predictions for thermal conductivity made with this framework were experimentally verified. While we concentrate on thermal conductivity in the research, this framework can further transfer different properties, like coefficient of thermal expansion, viscoelastic properties, etc. As a result, our framework – Physics-Guided Transfer Learning – can greatly reduce the characterization efforts required for developing material cards, accelerating the propagation of VT to different EDAM systems.

Keywords: Bayesian Inference, Gaussian Process, Short-Fiber Reinforced Polymers, Additive Manufacturing

Mentor(s):

Akshay Jacob Thomas (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1422
Presentation Time: Session 3: 12:00pm-1:00pm

Exploration of the Extent to which Purdue's Physics Department is Racially Inclusive

Physical Sciences

Author(s):

Yuvraj Jhanwar† (Engineering)

Abstract:

Historically, Physics has been a discipline associated with men, particularly white men. Recent research shows that the field is still dominated by white men (Blue et al., 2018), though efforts are being made to promote racial inclusivity in US colleges (U.S. Department of Education, November 2016). This project aims to explore how Purdue University deals with racial inclusivity in its Physics Department. Specifically, this project will examine the university's acceptance rate of students of color into the College of Physics and investigate how the university supports the academic needs of these students. These analyses will be done through the examination of various initiatives, programs, and support structures that the university has designed to foster diversity and inclusivity. Moreover, comparisons will be made between Purdue University and California Institute of Technology to evaluate how these two top Physics programs compare in terms of supporting racial diversity. Ultimately, the study will contribute to the ongoing dialogue on fostering inclusive educational environments and advancing equitable practices in higher-education Physics courses.

Keywords: Racial Inclusivity, Purdue's Physics Department, Academic Needs, Black Students, Caltech

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1423
Presentation Time: Session 3: 12:00pm-1:00pm

Detecting Nuclear Copies of Mitochondrial DNA Fragments (Numts) in the Gray Whale Genome

Life Sciences

Author(s):

Megan Johnson† (Science); Rafaela Besse† (Science)

Abstract:

Nuclear copies of mitochondrial DNA fragments, or NUMTs, are generated when portions of the mitochondrial DNA (mtDNA) molecule are integrated into the nuclear genome. Nuclear copies of NUMTs can be mistaken for mtDNA and thus act as a potential source of contamination in mtDNA sequence analyses. While the nuclear and mtDNA genomes of gray whales have been successfully characterized in previous studies, studies specifically addressing NUMTs in this species are absent. We employed bioinformatics analysis to identify these sequences and aim to analyze their potential association with transposable elements and chromosomal positions to determine what facilitates NUMTs integration into the nuclear genome. This work not only aims to catalog NUMTs in the gray whale genome but also provides into the dynamics that contribute to NUMT occurrence.

* These authors contributed equally to this job.

Keywords: Numts, Gray Whale

Mentor(s):

Andrew DeWoody (Agriculture); Natalie Allen (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1424
Presentation Time: Session 3: 12:00pm-1:00pm

Climate Change: Combating Desertification using NetLogo

Physical Sciences

Author(s):

Christine Kaylor† (DSB)

Abstract:

The concept of deforestation and its effect on global climate change is widely understood, however, only until recently was the definition of desertification clarified. This definition was amended to describe the process of change, as well as the end result of the change. The resulting definition is described by the UN Environmental Program as “...land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climate variations and human activities” (Sterk, 2020). Now that desertification has been identified, the next step is identifying the process and the means to reverse its effects.

NetLogo is an open-access agent based modeling software that is capable of replicating a simplistic system of desertification and methods of combating it. While there are many models in the NetLogo library, the topic of desertification is overlooked. In this gap in research, we have taken the liberty to create a base model to show a simplistic design of desertification. The main aspect of the model is to show the impact of vegetation on soil degradation. Currently, the model works on a fundamental level, allowing for adjustment of the starting amount of plants. The plants affect the soil moisture and have a chance to reproduce if there is enough moisture. This model explores the race against time to see if the plants will be able to maintain the moisture in the soil before dying out. This can be further adjusted to further portray the complexity behind desertification. Some examples could include environmental changes, different soil moisture retention rates, various vegetation effects, and human interference. This is but the first step in recreating a realistic representation of desertification and its adverse effects on the ecosystem.

Reference:

Sterk, G., & Stoorvogel, J. J. (2020). Desertification–Scientific Versus Political Realities. Land, 9(5), 156. https://doi.org/10.3390/land9050156

Keywords: Desertification, NetLogo, Agent-Based Modeling, Complex System, Climate Change

Mentor(s):

Tugba Karabiyik (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1425
Presentation Time: Session 3: 12:00pm-1:00pm

Addressing Model Architecture Misclassification for open-source Pre-trained Model packages

Mathematical/Computation Sciences

Author(s):

Mingyu Kim† (Engineering); Heesoo Kim† (Engineering)

Abstract:

Deep Neural Network (DNN) techniques serve as preeminent components in modern software systems. However, there is a prevailing trend in creating new DNN models that leans towards incorporating more layers and parameters, particularly as state-of-the-art architectures become increasingly complex. In response, the notion of reusing and fine-tuning pre-trained models (PTMs) has gained prominence. Hugging Face, a renowned open-source PTM platform, has been one of the environments for implementing this concept. However, prior work shows that a new challenge has emerged in the form of model architecture misclassification. As the diversity and intricacy of PTMs increase, there is a risk of misclassification in model architecture, potentially preventing users from selecting the most suitable model for their own purposes. This could also lead to a substantial amount of waste in time and resources without obtaining the desired performance improvements.

In response, we propose a solution aimed at accurately categorizing current PTMs and automatically categorizing incoming PTMs, thereby rectifying existing misclassifications and preventing future ones. Our solution exploits a pre-trained RoBERTa model to convert text embeddings into high-dimensional vector representation, and is fine-tuned through a contrastive learning model, SimCSE. Our approach automates the categorization process to improve PTM selection precision. This addresses challenges related to model architecture misclassification, leading to more efficient utilization of time and resources in software development.

Keywords: Software Reuse, Machine Learning, Deep Learning, Contrastive Learning

Mentor(s):

James Davis (Engineering); Wenxin Jiang (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1426
Presentation Time: Session 3: 12:00pm-1:00pm

Determining the Goodness of a Detector for Top Quark Decay

Physical Sciences

Author(s):

Anna Klupshas† (Science); Emanuel Borror† (Engineering); Timur Uxukbayev† (Engineering); Quinten Sanders† (Engineering)

Abstract:

As data mine students in the physics cohort, under the supervision of Dr. Jung, we seek to use the Monte Carlo simulation generator. Using the High Luminosity Large Hadron Collider fast detector simulation we want to describe the goodness of a detector for top quark decay kinematic variables. We compare reconstructed kinematic variables with theoretical kinematic variables in a 2 dimensional histogram and collect statistics regarding their efficiency. We will find any biases in the design of the simulator's detectors which might lead to false discoveries.

Keywords: Leptons, Top Quark, Decay, Large Hadron Collider, Bias

Mentor(s):

Andreas Jung (Science); Lingqiang He (Science); Amelia Binau (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1427
Presentation Time: Session 3: 12:00pm-1:00pm

Cyber Security Awareness at Big 10 Universities: How Cyber Security Initiatives Can Help Reduce Cyber Crime

Innovative Technology/Entrepreneurship/Design

Author(s):

William Koppin† (Engineering)

Abstract:

This paper describes the results of research conducted on cyber security initiatives in tertiary educational institutions with a focus on Purdue University and other Big 10 universities. To understand this topic, multiple sources of research on cybersecurity awareness were analyzed studying cyber security awareness. Many of these studies made use of surveys in order to test both the knowledgeability and practical application of online security techniques. These tests were done internationally across very different institutions. Another method tested the efficacy of current cyber security programs as compared to those with small modifications through long multi week courses. The survey studies found a major discrepancy between student understanding and practical application. Many students understood what they should do but did not put that into practice. A longer form study found that the efficacy of current cyber security programs could be improved considerably through minor changes. These results bring up the necessity of improving cyber security awareness in students at tertiary educational institutions especially at institutions such as Purdue and several other Big 10 Universities which do not have a formal cyber security requirement. Implementation of an effective program for all students to learn from would greatly benefit the overall student populations at these institutions.

Keywords: Cyber Security, Cyber Security Awareness, Cyber Crime, Cyber Security Programs

Mentor(s):

Sidney Ducleroir (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1428
Presentation Time: Session 3: 12:00pm-1:00pm

How does the pathfinding algorithms' efficiency change according to a particular type of data set?

Mathematical/Computation Sciences

Author(s):

Partth Kulkarni† (Science)

Abstract:

This research paper analyzes and compares the time taken for different pathfinding algorithms to iterate over specific datasets. Pathfinding algorithms are used in multifaceted ways. The kind of data sets they are used to can, however, have a major impact on how well they perform. I investigate the effectiveness of pathfinding algorithms as well as the dynamic interplay between various data sources. My research examines pathfinding algorithms and evaluates how well they perform on a variety of data set classifications, including A*, Dijkstra's, and numerous heuristic-based techniques. To further understand how various categories affect processing needs and execution times, I analyze algorithmic efficacy in structured, unstructured, and dynamic data sources. My study demonstrates how much the characteristics of the data set influence how well the pathfinding algorithm performs. Since unstructured and dynamic data sets lack the homogeneity and certain patterns that tend to provide the best results in structured data sets, they present greater challenges. I give a comparison study that details the advantages and disadvantages of each approach in various data scenarios, offering helpful knowledge to both academics and practitioners. I have used some of the information from Purdue databases and investigated the different algorithms that are being explored by Purdue currently and already explored in the recent past in forms of research paper and articles. In summary, this work contributes to the field of pathfinding by clarifying how data set classifications affect algorithmic performance.

Keywords: Algorithm Performance, Pathfinding Algorithms, Performance in Different Data Classifications

Mentor(s):

Sidney Ducleroir (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1429
Presentation Time: Session 3: 12:00pm-1:00pm

Evaluating the use of Generative AI tools and its effects on productivity levels amongst students within Purdue University.

Innovative Technology/Entrepreneurship/Design

Author(s):

Aditya Kuniyil Kattil† (Polytechnic, JMHC)

Abstract:

With rapid advances being made in the field of AI, especially Generative AI, productivity levels around the world will change forever. Generative AI can automate seemingly “boring” tasks, allowing people to devote more time doing other work. The following article evaluates the uses of Generative AI tools by the students at Purdue University and their general productivity levels. Various studies, involving surveys asking students about their use of AI powered tools, were referenced. Productivity was accounted for by using the concept of opportunity cost. In this case, the opportunity cost was assumed to be work offering the same wages as the dining courts on campus of $13.50 assuming that students value flexibility over higher wages in order to attend their classes. It was found that students, in general, were more productive, completed the same quantity of work in less time, when using AI powered assistance tools leaving them with more time to work. The data leads to the conclusion that encouraging the use of AI assisted tools on campus would lead to greater productivity. However, ethical concerns behind Generative AI especially the fact that students might not acquire the necessary skills is of great concern. Allowing Purdue students to harness the power of generative AI could lead to improvements in their academic performance, efficiency, and industry readiness. This can be achieved by teaching them how to use generative AI as a companion to aid learning, rather than as a tool to complete homework.

Keywords: AI In Education, Generative AI, Educational Technology, Pedagogical Innovation, Classroom Productivity

Mentor(s):

Sidney Ducleroir (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1430
Presentation Time: Session 3: 12:00pm-1:00pm

Flight State Detection and Avionics Control of FEMTA Microthruster Systems

Innovative Technology/Entrepreneurship/Design

Author(s):

Max Lantz† (Engineering); Jacob Valdez† (Engineering, JMHC); Josh Mansky† (Engineering); Gabriel Oliveira† (Engineering); Vincent Wang† (Engineering); Katie Kneeland† (Engineering)

Abstract:

The Film-Evaporation MEMS Tunable Array (FEMTA) is a micro-electromechanical system (MEMS) thruster featuring a small form factor, minimal power requirement, and adjustable thrust. The FEMTA unit expels ultrapure deionized water to control the attitude of a nanosatellite.

Two experiments verifying the operation of the FEMTA technology in a zero-gravity environment will be conducted onboard a Blue Origin New Shepard suborbital launch. A thrust measurement experiment will characterize FEMTA's operation in microgravity, and a propellant management experiment will monitor the performance of a passive vapor pressure-driven pump to ensure continuous propellant flow from propellant storage to the microthruster. Currently, FEMTA and its experiments have seen extensive testing on the ground. The end product of the suborbital launch is a technology demonstration of FEMTA in the space environment.

The FEMTA experiment utilizes a Feather M0 microcontroller and several sensors to gather ambient pressure, ambient temperature, and acceleration data to determine the flight stage of the mission and perform the experiments as designed.

We report significant improvements to the algorithms used to detect and track flight state transitions of the New Shepard launch vehicle, in addition to the integration of an extensive sensor suite with the experiment. Additionally, we present a testing approach that uses simulated flight profiles and sensor data to verify that the control software will function as expected during suborbital flight.

Keywords: FEMTA, Zero Gravity, New Shepard, State Detection, Flight Simulation

Mentor(s):

Jesus Meza-Galvan (Engineering); Steven Pugia (Engineering); Tony Cofer (Engineering); Alina Alexeenko (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1431
Presentation Time: Session 3: 12:00pm-1:00pm

An analysis of the relationship between the rigor of introductory STEM classes at Purdue and student motivation

Social Sciences/Humanities/Education

Author(s):

Felix Li† (Science)

Abstract:

This study aims to investigate the relationship between the rigor of Purdue University's introductory calculus courses and the levels of motivation among students. Motivation can be described as a driving force that compels students to engage in learning, study, and scholarly pursuits. As such, it plays a pivotal role in dedication, persistence, and achievement in the educational endeavors of students. As a result, it becomes crucial for us to be able to discern and understand how the often demanding nature of STEM coursework contributes to motivation for us to effectively assist those who struggle with it.

Purdue University is renowned for its challenging STEM programs, and this research aims to uncover the intricate relationship between academic rigor and motivation. In this study, I aim to define the meaning of rigor in an academic context. This is because rigor can mean different things in different social circles, and will not be sufficient for this study if it is simply defined as ‘difficult’ or ‘hard’. This established baseline allows us to assess the rigorousness of Purdue’s introductory calculus classes, namely Calculus I, as it is one of the most taken introductory STEM classes. This will be done by evaluating the difficulty of Calculus I exams from Purdue University, Massachusetts Institute of Technology, and The University of Notre Dame and comparing them. Using this assessment of rigorousness in the courses, I will be able to make predictions of possible motivation levels among the students. This is aimed to be achieved by linking rigor to increasing or decreasing levels of motivation, namely through using the Self Determination Theory (SDT).

Keywords: Academic Rigor, Procrastination, Motivation, STEM

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1432
Presentation Time: Session 3: 12:00pm-1:00pm

Fab & SPC - Metalization in Birck@semiconductor

Physical Sciences

Author(s):

Jiawe Li† (Engineering)

Abstract:

The basic abstract of our project is about using SPC(Statistical Process Control) to analysis the data which we have gathered from Birck's current metalization tools. During this process, we will be training for PVD, P7 to guide us how to us the tool to do the fabrication, metalization on wafer, and spinning for equilibrium. Our team will be finished the wafer at the end of semester if we could catch up on time. Beside that, we will doing the work to validate the data we have collected and understand how variables -both controlled and uncontrolled- affect the final product with the goal of reducing variation.

Keywords: Statistical Process Control, Wafer, Metallization, Fabrication, Chemical Spinning

Mentor(s):

Zhihong Chen (Discovery Park); Joerg Appenzeller (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1433
Presentation Time: Session 3: 12:00pm-1:00pm

Statistical Process Control in Semiconductor Fabrication

Physical Sciences

Author(s):

Kenneth Liendo† (Engineering); Darbin Oh† (Engineering, JMHC); Benjamin Tofil† (Engineering); Gangsan Lee† (Engineering); Ryan Bailey† (Engineering, JMHC); Ho Jun Lee† (Engineering); Jensen Lee† (Engineering); Jiawei Li† (Engineering); Armaan Kanchan† (Engineering); Joshua Kim‡ (Engineering); Lyu-Jia Su‡ (Engineering); Cheng-En Yeh‡ (Engineering); Brett Chen‡ (Engineering)

Abstract:

Statistical Process Control (SPC) is a methodological approach used to comprehend and regulate variation within fabrication processes through statistical analysis and repeated experimentation. By employing SPC, we will conduct standard processes within Birck's cleanroom and systematically collect performance data, providing invaluable insights for the lab's engineers and researchers.

This research aims to execute multiple iterations of two distinct processes using 4-inch silicon wafers, with data collection at each step of fabrication. The first process entails the deposition of silicon nitride, followed by photoresist patterning, and etching. The second process involves photoresist patterning and aluminum metallization. These standard processes encompass chemical vapor deposition, e-beam metallization, shadow mask lithography and reactive-ion etching, to understand the variation in these commonly-used fabrication methods. Through reflectometry and profilometry, each process step is measured. The data collected will be analyzed using SPC to identify potential assignable causes to variation and measure the processes' performance. The resulting analysis seeks to establish a foundational framework for researchers and cleanroom engineers when using the same cleanroom tools.

Overall, our work aims to bring Brick's semiconductor fabrication to a higher standard by applying industry methodology to our laboratory's fabrication processes, aiming to understand and reduce the variation of commonly utilized techniques. Through this, Birck users can have a solid groundwork on which to conduct their endeavors.

Keywords: Statistical Process Control, Semiconductor Fabrication, Cleanroom Laboratory, Engineering Methodology, Statistical Analysis

Mentor(s):

Zhihong Chen (Discovery Park); Joerg Appenzeller (Engineering); Richard Harlan (Engineering); Ronald Reger (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1434
Presentation Time: Session 3: 12:00pm-1:00pm

Understanding the Impact of Moral Choices on Maximization

Social Sciences/Humanities/Education

Author(s):

Sydney Ludwig† (Science, JMHC); Sophia Vargas* (HHS, JMHC); Jackson Murray* (Polytechnic)

Abstract:

Maximizing is a form of decision making whereby an individual works to make the best choice available. They often do this by putting extensive time and effort into their decision. On the other end of the spectrum is satisficing, whereby an individual chooses the first option that satisfies their needs, even if it is not the best. Past research into maximizing vs satisficing has focused heavily on defining people as maximizers or satisfiers from an individual differences perspective. But, can maximizing also vary across situations, rather than only across people? In this study, we seeked to answer the question: do people maximize more when they see their choices as more related to morality? To answer this question, we are collecting surveys (target N = 250) in downtown West Lafayette from people who just recently bought something. The survey included questions about the morality of their purchase and the extent to which they maximized vs. satisficed. Although analysis of the data has not yet been completed, we predict that if a choice is perceived as related to morality, then a person is more likely to maximize than if the choice was not related to morality. If correct, our prediction would introduce a new perspective on decision making and shift the idea of maximizing vs satisfying from individual differences to the situationally-dependent. We can then suggest that one determinant of whether an individual maximizes or satisfies may be the extent to which they see their choice as related to morality.

Keywords: Choice, Maximizing, Psychology, Satisfying, Morality

Mentor(s):

Nathan Cheek (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1435
Presentation Time: Session 3: 12:00pm-1:00pm

Virtual Investigation of the Effects of Bead Deposition in Large Scale Additive Manufacturing

Innovative Technology/Entrepreneurship/Design

Author(s):

Eric Luscher† (Engineering)

Abstract:

Large scale additive manufacturing provides for manufacturing of geometries in the scale of multiple meters by depositing extrudates of fiber reinforced thermoplastic in a bead-by-bead, and layer-by-layer basis. The different flow mechanisms developed during printing control the orientation of fibers within the printed bead. Such flow mechanisms develop as the material flows through a printing nozzle, exits the nozzle and turns ninety degrees to be deposited on a print surface, and gets consolidated through the action of a compacter. A simulation study was carried out to investigate the effects of compaction through a roller and the lateral bead overlap on the average and local fiber orientation for the bead deposition process used in Large Scale Additive Manufacturing (LSAM). A closer look at this Extrusion Deposition Additive Manufacturing (EDAM) process displays various key findings. The first is that the rolling process consistently does not affect the average fiber orientation in the printing direction before and after compaction for the tested aspect ratio. The next is that the inter-bead void area begins to disappear at 11 percent overlap with its adjacent second bead which is consistent with the LSAM standard used. Further, increasing bead overlap percentage does not affect the average fiber orientation in either bead throughout the extrudate, however, the symmetry in fiber orientation across the bead height and width is disrupted. Furthermore, as the overlap of the second printed bead increases, the local fiber orientation skews to the right with respect to the center of the bead. This virtual investigation was carried out with AddiFlow3D in Abaqus, an anisotropic viscous flow model solved with the smooth particle hydrodynamics method.

Keywords: Composites, Additive Manufacturing

Mentor(s):

Eduardo Barocio (Engineering); Pasita Pibulchinda (Engineering); R Byron Pipes (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1436
Presentation Time: Session 3: 12:00pm-1:00pm

Investigating Connections Between Purdue's Green Spaces and Students' Mental Health

Social Sciences/Humanities/Education

Author(s):

Jenna Ma† (Agriculture)

Abstract:

Stress has adverse effects on everyone and is especially prevalent on college campuses. Purdue University is one of the top academic schools in the United States. It provides a world-class education to students across campus, which causes college students to become stressed by academic pressures and workload. However, research shows that greenery promotes psychological well-being and reduces stress since green spaces provide a way to relieve frustration and promote recovery from the cognitive fatigue arising from daily stressors. Purdue University has many green spaces across campus, including tree trails and outdoor spaces, with many species of trees and plants. Green spaces are generally interpreted as areas containing living and non-living elements that include plants and animals across various degrees of human management. Since mental health is a significant issue at Purdue University, investigating the connection between Purdue's green spaces and students' mental health is crucial to improving mental health services. This paper aims to explore the association between campus green spaces and college students' mental health by investigating the general effects of green spaces and students' overall mental health at Purdue University. I will employ research from various scholarly sources and Purdue's student services web pages to assess the effectiveness of green spaces on mental health.

Keywords: Campus Green Spaces, Mental Health

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1437
Presentation Time: Session 3: 12:00pm-1:00pm

Design, Analysis, and Implementation of a System for Printing with a Hybrid of Continuous and Discontinuous Fibers

Innovative Technology/Entrepreneurship/Design

Author(s):

Camila Andrea Martinez Montes† (Engineering)

Abstract:

Extrusion deposition additive manufacturing (EDAM) opens infinite possibilities for producing complex geometries using fiber-reinforced thermoplastics. The proposed printing by coextruding discontinuous and continuous fiber systems bridges the gap in structural performance, stiffness and strength, across short and long fiber reinforced polymers. This project started with the redesign of a coextrusion nozzle, wherein a transient heat transfer analysis was carried out to drive the location of heaters and the temperature sensor. This was carried out with the objective of 1) ensuring temperature uniformity during operation of the co-extrusion nozzle, and 2) to investigate the response and temperature distribution due to a closed-loop temperature control at different stages of the process. The transient heat transfer analysis was carried out in the finite element software ABAQUS, the closed-loop temperature control was designed with Simulink in Matlab, and the controller was implemented through an amplitude user-defined (UAMP) subroutine in ABAQUS. Through this coextrusion nozzle, multiphase structures can be created at rates similar to the EDAM process but with enhanced stiffness and strength. The second phase of this project involved creating the continuous fiber filament used in the co-extrusion process by impregnating carbon fiber with polycarbonate through a melt impregnation process. Finally, the mechanical properties of the hybrid material system printed by coextruding continuous and discontinuous fiber reinforced polymers will be presented. This coextrusion printing process will opens multiple possibilities in the fast manufacture of complex geometries with structural characteristics that could impact the aerospace, construction, and medical industries

Keywords: Co-Extrusion, Fiber-Reinforced Thermoplastics, Continuous Fibers, Discontinuous Fibers, Impregnation

Mentor(s):

Eduardo Barocio (Engineering); R Byron Pipes (Engineering); Garam Kim (Polytechnic)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1438
Presentation Time: Session 3: 12:00pm-1:00pm

Phenotypic Consequences of Cold Acclimation

Life Sciences

Author(s):

Stephen Mills† (Agriculture)

Abstract:

Exposure to freezing temperatures is one of the most significant plant abiotic stressors in temperate climates. To prepare for freezing events, plants undergo a series of physiological changes known as cold acclimation in order to increase freezing tolerance. This study investigated the phenotypic consequences of cold acclimation in Plantago lanceolata and Conyza canadensis by measuring traits linked to these physiological changes. Plants of both species were grown under conditions representative of late season germination, and then subjected to an extended period of low temperature to induce cold acclimation. During the cold acclimation period tissue was harvested to assay the soluble sugars glucose, sucrose, and raffinose, and growth rates were measured after the cold acclimation period ended and plants had been transferred to a greenhouse to resume active growth. Soluble sugars were found to increase during cold acclimation compared to the control, and growth was greater in the control compared to the cold acclimated group five weeks post treatment. This increase in soluble sugars and decrease in growth associated with cold acclimation suggest that the process is energetically costly, with potentially negative implications in the face of a changing climate marked by disrupted winter weather patterns.

Keywords: Cold Acclimation, Climate Change, Costs, Raffinose

Mentor(s):

Chris Oakley (Agriculture)

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Poster Presentation Abstract Number: 1439
Presentation Time: Session 3: 12:00pm-1:00pm

Enhancing Computer Vision in Low Visibility Environments

Innovative Technology/Entrepreneurship/Design

Author(s):

Areej Mirani† (Engineering); Zihao Ye‡ (Engineering); Brandon Orbach‡ (Engineering); Sejal Kumar‡ (Engineering)

Abstract:

The challenge of computer vision in low visibility environments remains unsolved, with limited solutions such as night vision cameras in smartphones. To address this issue, this research emphasizes the need for expanding computer vision capabilities in conditions such as dust storms, fog, extreme lighting, and darkness. The applications range from enhancing safety for individuals navigating adverse conditions to aiding military operations and supporting Mars rovers and satellites in challenging environments. Current datasets are primarily focused on satisfactory environments, such as traffic in low altitudes, with some using infrared cameras for nighttime pedestrian detection and fog simulation. This research team aims to create a comprehensive dataset using drones in mini cities with varying visibility due to lighting and fog, challenging 3D reconstruction algorithms. The dataset will be continually improved based on background research and real-world findings, with the ultimate goal of developing high-resolution, clear reconstructions in adverse environmental conditions.

Keywords: Computer Vision, Low Visibility, 3D Reconstruction, Adverse Environments

Mentor(s):

Yung-Hsiang Lu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1440
Presentation Time: Session 3: 12:00pm-1:00pm

Race to Zero (R2Z)

Innovative Technology/Entrepreneurship/Design

Author(s):

Andrew Modin† (Engineering); Daniel Wu† (DSB); Mariam Ghoneima† (Engineering, JMHC); Brogan Holt† (DSB, JMHC); Max Cervantes† (Engineering, JMHC); Catherine Mayer† (DSB); Dylan Hall† (Engineering); Zach Tan† (Engineering); Josh Beigel† (DSB); Hey Chuck Lo† (DSB)

Abstract:

Green hydrogen is produced through the electrolysis of water, which splits water into hydrogen and oxygen using renewable energy sources. This hydrogen can be efficiently stored and used to generate power in fuel cells, producing only water as a byproduct, or combusted more cleanly and efficiently than conventional fossil fuels. It thus emerges as a clean and adaptable energy source for various applications like transportation, energy storage, and industrial operations. Widespread adoption of green hydrogen has the potential to significantly reduce greenhouse gas emissions and contribute to a more sustainable energy future. The primary case study explored in this research is Orkney Islands. The “Surf ‘n’ Turf” project in the Orkney Islands represents a pioneering community initiative that has successfully integrated hydrogen into the island’s daily energy usage. The project is supported by multiple companies and organizations, with significant backing from the European Union, which has provided over 12 million Euros in funding. The project harnesses excess electricity generated from the island’s renewable energy sources, including tidal and wind power, converting it into hydrogen. This hydrogen is then transported to Kirkwall, where it can be stored in a fuel cell and converted into useful energy. Our objectives with this project encompass highlighting opportunities for expanding this process to other regions with limited access to wind and tidal energy and conducting a thorough analysis of the technology to identify areas where energy loss reduction and efficiency improvements are possible.

Keywords: Green Hydrogen, Electrolysis, Renewable Energy, Fuel Cell, Surf ‘N' Turf Project

Mentor(s):

John Sheffield (Polytechnic)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1441
Presentation Time: Session 3: 12:00pm-1:00pm

Accelerating a sustainable energy transition through novel locally high concentrated electrolytes

Physical Sciences

Author(s):

Jason Packard† (Engineering)

Abstract:

Despite its poor LT performance attributed to it's high FP, ethlyne carbonate(EC) has remained the primary solvent in commercial electrolytes due to its strong coordination and excellent ability to form a passivating layer on the anode, the solid electrolyte interphase.(SEI) Without a robust SEI that can prevent solvent co-intercalation, our anode will continuously react with our electrolyte under normal cell operation causing rapid capacity degradation over time. Although excellent at room temperature (RT), the EC-derived SEI exhibits large charge transfer resistances which becomes problematic at LT environments. Herein, the key to designing an electrolyte with enhanced LT performance is engineering a tailored non-EC derived SEI from solvents with desirable FP and LT viscosity that has low charge transfer resistances. Recently multiple approaches have shown success in engineering non-EC derived SEI's, namely using high salt concentration electrolytes.(HCE) The high salt concentration allows anion participation in the Li+ solvation structure, consequentially causing an anion derived SEI which has shown superior kinetics to EC-derived SEI's. In this work we expand upon the HCE and develop a novel locally high concentrated electrolyte (LCHE) further tailored with a non-polar diluent creating excellent low temperature performance cells and serving as a key advancement in the progression towards sustainable energy.

Keywords: Sustainability, Electrochemistry, Electric Vehicles, Space Tech, Energy Storage

Mentor(s):

Ethan Adams (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1442
Presentation Time: Session 3: 12:00pm-1:00pm

Locations Depicted in Online Images of Sexual Harassment

Social Sciences/Humanities/Education

Author(s):

Patrick Pannier† (HHS); Sierra Norris† (HHS); Jackson Murray* (Polytechnic); Sydney Ludwig* (HHS, JMHC); Michelle Zhao* (HHS)

Abstract:

People’s understanding of the world originates from what they have previously been exposed to, including what they experience through media. Hence, media representation of different topics affects how people understand and interact with the world. Online media images depicting significant issues, such as sexual harassment, can have a consequential effect on how such issues are perceived. In the present research, we investigated the portrayal of sexual harassment in online media by examining where sexual harassment is shown to take place. To do so, we analyzed the 1,250 images returned by searching“sexual harassment” in Bing and Google image searches and in the stock photo databases Adobe Stock, Getty Images, and Shutterstock (n = 250 images per search). Analyzing where the actions in the image appear to take place, as well as secondarily coding victim and perpetrator portrayals, we found that, the most common workplace depicted was a stereotypical white-collar office place, comprising 53.5% of all coded images. Our results shed light on media representations of sexual harassment, including what images people are likely to see when navigating online. In particular, this finding highlights the difference between biased vs. accurate depictions of harassment, with implications for understanding how the media shapes perception. For example, one possibility is that sexual harassment will be more readily recognized and reported when it occurs in workplaces people often see in online depictions - in this case, stereotypical office places - which could hamper the perception of such acts in less frequently depicted contexts.

Keywords: Sexual Harassment, Media Representation, Workplace, Perception

Mentor(s):

Nathan Cheek (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1443
Presentation Time: Session 3: 12:00pm-1:00pm

How effective are the mental health services at Purdue in preventing criminal behavior on campus?

Social Sciences/Humanities/Education

Author(s):

Sucheta Parthasarathy† (Pharmacy)

Abstract:

This research paper addresses the most prevalent mental illness among violent students at Purdue and how mental health services such as CAPS can utilize this information to improve the prevention of criminal behavior on campus. Other studies have shown that there isn't a direct correlation between mental illness and violence; however, with a combination of other environmental factors, the risk of criminal behavior increases. These conditioning factors include drug usage, family background, location, and access to healthcare systems. For the data collection process, Purdue's Annual Security Report will supply information on commonly committed crimes on campus for the past five years. This will be narrowed down to only severe cases where at least one other individual has been affected physically or mentally. Then, we will analyze related criminal cases to identify the commonalities in mental illness and environmental background. Additionally, the mental health services on campus will be reviewed based on their current capacity and frequent visitors. Both in-person and online resources affiliated with Purdue will be analyzed to check the effectiveness of both avenues. This paper strives to bring awareness to the potential backstory of the perpetrator to speculate the reasoning behind the crime and what we can do to prevent such tragedies from occurring.

Keywords: Mental Illness, Mental Health Services, Criminal Behavior

Mentor(s):

Sidney Ducleroir (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1444
Presentation Time: Session 3: 12:00pm-1:00pm

Artificial Intelligence's Potential Affects on Student Success at Purdue University

Mathematical/Computation Sciences

Author(s):

Rohini Pillai† (Science)

Abstract:

Artificial intelligence is rapidly developing and entering society. With the release of sites such as ChatGPT and Google Bard in the past year, generative artificial intelligence systems have never been more prevalent, both in everyday and academic settings. Generative artificial intelligence can certainly be a valuable tool in academic settings, serving as a more competent and relevant search engine as well as providing reasonable feedback on human work. However, they could also become a crutch and inhibit students from actually learning and retaining new content. This paper aims to find whether there is an association between the restrictions on the use of artificial intelligence in different Purdue classes and the corresponding class average scores. This potential association will be determined by analyzing a dataset of score averages of Purdue classes from Fall 2022 concerning the class's artificial intelligence policy. Class averages were accessed publicly through Purdue Boiler Grades. Artificial intelligence policies were determined through publicly accessible policy changes on different department's websites. This paper intends to help instructors and curriculum developers at Purdue create the most beneficial and effective artificial intelligence policy to maximize student success in class.

Keywords: Artificial Intelligence, Generative Content, Student Academic Success, Purdue University

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1445
Presentation Time: Session 3: 12:00pm-1:00pm

A Scholarship of Teaching and Learning (SoTL) Accelerator for Engineering Educators

Social Sciences/Humanities/Education

Author(s):

Matthew Pung† (Engineering)

Abstract:

According to the 2021 Engineering by the Numbers Report: ASEE Retention and Time-to-Graduation Benchmarks for Undergraduate Engineering Schools, Departments and Programs, the overall average retention rate for obtaining an engineering degree within 6 years was 55.9%. According the 2021 NSF National Survey of College Graduates, only 65% of science and engineering college graduates had an occupation related to their highest degree. Putting this into perspective, if 100 students enrolled in an engineering program, about 55.9% (~56 students) will complete the degree within six years. Of those ~56 students, 65% (~36 graduates) will enter the engineering workforce. In summary about one-third (1/3) of students who enroll in engineering programs will complete the degree within six years AND enter the engineering workforce. What about the other two-thirds (2/3)? Why are they leaving engineering education and/or not entering the engineering workforce? The literature suggests teaching and learning plays a large role in these extreme attrition rates. The overarching goal of this poster is to showcase the findings from a cohort-based engineering faculty professional development experience which has two key components: curriculum development and scholarship of teaching and learning (SoTL) dissemination.

Keywords: ASEE Retention and Time-to-Graduation Benchmarks, The Engineering Workforce, Teaching and Learning, Engineering Faculty Professional Development, Scholarship of Teaching and Learning Dissemination

Mentor(s):

Lisa Bosman (Polytechnic)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1446
Presentation Time: Session 3: 12:00pm-1:00pm

FEMTA Suborbital Spaceflight Test - Manufacturing

Innovative Technology/Entrepreneurship/Design

Author(s):

Paulo Ramirez† (Engineering); Tejas Kamdi† (Engineering); Yahor Lechanka† (Engineering); Benjamin Roeder† (Engineering); Shreya Sandu† (Engineering); Matt Wheeler† (Engineering)

Abstract:

The FEMTA (Film Evaporation MEMS Tunable Array) Suborbital Spaceflight represents an innovative endeavor aimed at advancing CubeSat attitude control and research capabilities through micropropulsion technology. The primary goal of this experiment is to test the FEMTA thruster and its associated propellant management system in zero gravity. Scheduled for launch aboard Blue Origin's New Shepard rocket in 2024, this mission holds great promise for measuring FEMTA micropropulsion system performance. The FEMTA manufacturing team works to design, manufacture, and source the components necessary for the success of the mission. Key components including the propellant tank, collection chamber, avionics assembly, and thrust stand, have been manufactured using aluminum and corrosion-resistant Delrin plastic. Rigorous testing and analysis of these components have played a crucial role in informing design refinements and ensuring their suitability for the challenging environment of space. Currently, the project is in the process of assembling all the flight components and is nearing final testing that will determine the readiness of the flight model for integration into the launch vehicle, marking a significant milestone in the project. The poster presentation will showcase recent manufacturing progress, highlight the purpose of each manufactured part, delve into the methodologies employed for optimizing components, and discuss insights gained from the testing process. Attendees will gain a comprehensive understanding of FEMTA’s capability in advancing micropropulsion technology and its potential impact on the future of space technology and CubeSat research.

Keywords: FEMTA Technology, Microgravity Experiment, Component Manufacturing, CubeSat Research, Micropropulsion

Mentor(s):

Alina Alexeenko (Engineering); Jesus Meza-Galvan (Engineering); Steven Pugia (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1447
Presentation Time: Session 3: 12:00pm-1:00pm

Assessing the Resilience of the Semiconductor Supply Chain

Innovative Technology/Entrepreneurship/Design

Author(s):

Zachary Ramirez† (Engineering, JMHC); Shams Hoque† (Engineering, JMHC)

Abstract:

Resilience has been a growing area of interest within supply chain research. This has been driven by the increasing frequency of disruptive events within the globalized supply chain such as pandemics, geopolitical conflicts, and extreme weather events. Furthermore, rising demand for advanced electronics places semiconductors in a critical position for ensuring global security and promoting innovation.

This study seeks to develop a comprehensive framework for evaluating resilience within the semiconductor supply chain by reviewing literature from the past ten years related to the topic for the purpose of identifying critical bottlenecks and vulnerabilities contributing to supply chain disruptions. The research basis for the literature review is formed by articles with similar search strings including “semiconductor” “resilience OR risk” and “supply chain” as keywords. These articles were then analyzed within the proposed framework to analyze research trends related to supply chain stressors and identify areas for further investigation. The literature review concludes that while there has been increasing interest in assessing the network effects related to disruption transmission, decreasing supply and demand related vulnerabilities, and assessing the influence of geographic factors on risk in supply chain design, there is a notable absence of research related to assessing resilience at the firm level.

Keywords: Semiconductor, Resilience, Supply Chain Management, Literature Review

Mentor(s):

Tho Le (Polytechnic)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1448
Presentation Time: Session 3: 12:00pm-1:00pm

Breathable and self-healing triboelectric sensor for cardiovascular monitoring

Innovative Technology/Entrepreneurship/Design

Author(s):

Sejal Rhodes† (Engineering, JMHC); Paul Ulrich* (Engineering); Sarah Pushparaj* (Science)

Abstract:

Cardiovascular disease deaths increased by 18.7% from 2010 to 2020, adding to 20% of all U.S. deaths, totaling 697,000 casualties only in 2020. Furthermore, risk factors such as a high BMI and physical inactivity have increased dramatically in the last two decades. In response to these risk factors, screenings of asymptomatic heart diseases are done to decrease risk for death. As reports have shown that ambulatory monitoring of physiological and cardiovascular metrics may be more reliable for diagnostics, wearable sensing has emerged as a potential solution for ubiquitous, dependable monitoring. Nevertheless, most wearable solutions are either reliant on batteries or have properties that are unsuitable for skin applications, such as mechanical mismatches and non-breathability. Furthermore, battery dependency requires the wearable devices to be removed for charging or battery removal, which leads to momentaneous loss of relevant physiological information. Skin-interfaced triboelectric sensors rise as a self-powered solution for cardiovascular monitoring. In this work, we manufactured a skin-like, breathable triboelectric sensor composed of a thin self-healing polymer and laser-induced graphene layers, enabling seamless health monitoring of important physiological data, such as heart rate and heart rate variability. Due to the synergy of triboelectric and piezoresistive effect, our device is potentially pressure sensitive, which may also enable blood pressure sensing. Lastly, the manufactured sensor is made of bio-compatible materials, promoting a user-friendly skin-interface for long-term use.

Keywords: Wearable Sensors, Biomaterial-Based, Cardiovascular Disease, Self-Healing, Self-Powered

Mentor(s):

Wenzhuo Wu (Engineering); Pedro Henrique de Souza Barbosa (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1449
Presentation Time: Session 3: 12:00pm-1:00pm

Semiconductor Supply Chain Models: State-of-the-Art and Practical Challenges

Mathematical/Computation Sciences

Author(s):

Nemisa Samanthapudi† (Engineering)

Abstract:

The United States (US) has planned for domestic production of semiconductors to avoid future challenges and disruptions in the supply chain caused by pandemics, wars, natural disasters, heavily relying on overseas manufacturing, etc. To promote domestic semiconductor manufacturing, the US government passed the CHIPS Act of 2022. However, there is a lack of research that provides an understanding of the semiconductor supply chain and the requirements to effectively manufacture the chips and distribute them.

To ensure the efficiency of both the present and future semiconductor supply chain, this research aims to review the eight different stages of the semiconductor supply chain and identifying existing mathematical model usages within the stages: strategic network design, demand management, master planning, inventory management and capacity planning, demand fulfilment and ATP, production planning and scheduling, purchasing and material requirement planning (MRP), and distribution and transport planning. Research on the models includes understanding various factors and strategies to optimize the supply chain to increase efficiency, reduce lead time, and minimize waste. In addition, this research encompasses how models will be incorporated with emerging artificial intelligence, blockchains, and future applications for supply chain management.

Findings from this research suggest for optimization models to develop faster algorithms that can find feasible solutions within a period, understand the foundations of a multiproduct system within each stage of the supply chain, and implement AI and machine learning methods to acquire larger datasets for forecasting and computations.

Keywords: Semiconductor Supply Chain, Semiconductor Optimization, Supply Chain Management, Semiconductor Industry, CHIPS Act of 2022

Mentor(s):

Tho Le (Polytechnic)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1450
Presentation Time: Session 3: 12:00pm-1:00pm

Investigating the Impact of the SCN2A epilepsy-related Mutation L1342P on Neuron Structural Development Through the Analysis of Cortical Organoid Neural Rosettes

Life Sciences

Author(s):

Vinayak Shankar† (Pharmacy, JMHC)

Abstract:

The SCN2A gene encodes for Nav1.2, a voltage-gated sodium channel critical in generating neuronal action potentials. Mutations in the SCN2A gene are linked to various disorders, including autism spectrum disorder and epilepsy1. One example is the Nav1.2-L1342P mutation, found in patients with intractable seizures, epileptic encephalopathy, and cortical brain atrophy2. Previously, our lab established a 2D human induced pluripotent stem cell (hiPSC)-derived cortical neuron monolayer model of the Nav1.2-L1342P mutation and found that diseased neurons have an overall hyperexcitability phenotype3. Our current objective is to explore the impact of the Nav1.2-L1342P mutation on cell morphology and structure, specifically, whether it can recreate the cortical atrophy phenotype in an in vitro model mimicking the human brain. To achieve this goal, we used cortical organoids, 3D aggregates resembling the human cortex4, which exhibit the formation of early developmental neural rosettes, flower-shaped structures that serve as models of early neural tubules and indicate developing neural progenitors5. For experiments, neural rosettes from 30-day-old sliced cortical organoids were imaged using a Nikon Ti-2 Eclipse epifluorescence microscope. We used labeling techniques to visualize SOX2 (SRY-box Transcription Factor 2), Ki67 (Antigen Kiel 67, and nuclear stain DAPI. Our objective is to analyze the morphology of these rosettes. We found that organoids with the Nav1.2-L1342P mutation had compromised neural rosette formation compared to controls, indicating that the presence of the mutation has an impact on organoid development. Taken together, our research aims to shed light on the mechanisms underlying the Nav1.2-L1342P mutation's impact on impaired cortex formation.

Keywords: SCN2A, L1342P, Neural Rosette, Cortical Organoid, Neuron Development

Mentor(s):

Yang Yang (Pharmacy); Maria Olivero-Acosta (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1451
Presentation Time: Session 3: 12:00pm-1:00pm

Impact of Freedom School at Purdue for Students K-5

Social Sciences/Humanities/Education

Author(s):

Lauren Spedale† (Education); Teagan Drumm† (Education)

Abstract:

We examine whether using a culturally diverse, literacy-focused program promotes both students’ literacy and social justice awareness. Data were collected from Purdue’s CDF Freedom School (FS), during a six-week summer program serving 26 students in grades K-5. The FS uses an integrated reading curriculum with the theme of “I Can Make a Difference” (ICMAD). Then, each week, subthemes address ICMAD in myself, my family, my community, my country, my world, and with hope, education, and action. Each week also includes a focus on creative writing, field trips, STEM engagement, and social action activities. Students (1-10 teacher-student ratio), work on literacy activities that include community, local and global social justice topics. Data were collected at the end of the 6-week program, from parents who were given a combination of quantitative and qualitative questions designed to document their children's academic and personal development. The majority of parents (>88%) reported that their children benefited from the curriculum and noted: (a) improvements in their reading skills; (b) greater confidence in reading; (c) efficiency about their ability to effect change; and (d) appreciation of the integration of social justice, history. This pilot study provides strong initial support for the assertion that the implementation of a multi- faceted approach to education that blends traditional academic subjects with lessons on social justice, history, and personal empowerment is both innovative and effective. This approach is essential to the development of academic skills and cultural awareness, as well as critical to students’ success in our interconnected global community.

Keywords: Freedom Schools, Literacy, Diversity, Family Involvement, Social Justice

Mentor(s):

Breanya Hogue (Education)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1452
Presentation Time: Session 3: 12:00pm-1:00pm

Artificial Intelligence and Education

Social Sciences/Humanities/Education

Author(s):

Amogha Tejas Sunkara† (Science)

Abstract:

The evolution of technology over the decades has led to a wide array of transformations and huge developments in almost every field possible. However, Artificial Intelligence is one of the most recent and tendentious breakthroughs to occur. Hardman, D. P. (2023, March 23). A brief history of AI in Education. A Brief History of AI in Education. https://drphilippahardman.substack.com/p/a-brief-history-of-ai-in-education. This paper aims to explore the relationship between Artificial Intelligence and education, specifically the effects of AI on education when adopted into the classroom. This paper also focuses on how AI-inducted classrooms would affect students as a whole and also individually. Another very important aspect of this product is to address a very important concern which is the effect of the absence of human teachers in classrooms on students and future education. Using Drawing on various lines of research within education and AI broadly, this project will summarize current findings and provide data for further research into this topic to dissect the links between the connection of AI and education. This in turn can determine the worth and usefulness of such a collaboration on a large scale in the coming decades.

Keywords: Artificial Intelligence, Education, Effects, Human Teachers, AI Classrooms

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1453
Presentation Time: Session 3: 12:00pm-1:00pm

A high-resolution developmental time course of transcription factor expression in cotton fibers

Life Sciences

Author(s):

Ethan Szajko† (Science); Maria Camila Escobar Herrera† (Agriculture)

Abstract:

Cotton fibers are the foundation of multi-billion dollar textile industry. Thus, understanding the development of these fibers is of utmost importance, with the long-term goal to control processes that determine fiber length, shape, and material properties. Development of fibers begins as unicellular trichoblasts emerge from the seed coat epidermis, followed by poorly understood tapering and elongation phases. After about 16 days, the cells transition to a cell wall thickening phase where the cytoplasm is progressively displaced by cellulose before undergoing programmed cell death. In biological systems, the phenotypes of an organism are determined by genes which code for proteins that function collectively to enable predictable phenotypes to emerge. Transcription factors (TFs) are special proteins that couple DNA-binding activity with either positive or negative effects on the transcription of target genes. Here, transcriptomics and proteomics analyses were performed to characterize the expression and abundance of TFs during the elongation and transition to secondary wall synthesis phases. Expression patterns of all annotated transcription factors were analyzed. Some families had rather uniform expression while others were highly variable over time. Using prior knowledge, we focused on a subset of TFs with cross-species functions in trichoblasts. One, a MYB-bHLH-TTG triad, has highly dynamic expression patterns that do not reflect a single developmental transition to cell wall synthesis. Second, the NAC/VNDs are closely associated with genetic programs that lead to secondary wall synthesis. The most highly expressed NAC/VND TFs were correlated with secondary cell wall synthesis. TF networks and predicted functions will be presented.

Keywords: Cotton Fibers, Development of Fibers, Transcription Factors, Cell Wall Synthesis

Mentor(s):

Daniel Szymanski (Agriculture); Alexander Howell (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1454
Presentation Time: Session 3: 12:00pm-1:00pm

Material and Process Development for Printing with Continuous Fiber reinforced Polymers

Innovative Technology/Entrepreneurship/Design

Author(s):

Daiana Valenzuela† (Engineering, JMHC)

Abstract:

Continuous carbon fiber reinforced polymers (CFRP) provides a high strength to density ratio that makes them a choice for lightweighting structural applications across the automotive, aerospace, and aeronautical industries. Similarly, additive manufacturing with composites provides unparalleled design freedom that is not possible with traditional subtractive manufacturing. Hence, this research project focuses on developing 1) a continuous fiber filament that could be used in additive manufacturing and, 2) the process for printing with a filament reimpregnated with a thermoplastic resin. The continuous fiber filament was produced through a melt impregnation process, thereby providing uniform impregnation of the fibers with polymer. The polymer used was polycarbonate. Additionally, a transient heat transfer that integrates a closed-loop PID temperature controller was carried out to drive the process conditions to operate the impregnation process. The filament produced through the melt impregnation process is then used in a nozzle developed for printing with continuous fiber wherein the filament is heated to the process temperature of the polycarbonate (300 $°C$) through forced internal convection. Preliminary results of the printing process and the printed microstructure will be discussed in this poster along with directions for next steps.

Keywords: Continuous Carbon Fiber Reinforced Polymers, Additive Manufacturing with Composites, Polycarbonate, Melt Impregnation Process, Microstructure

Mentor(s):

Eduardo Barocio (Engineering); R Byron Pipes (Engineering); Garam Kim (Polytechnic)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1455
Presentation Time: Session 3: 12:00pm-1:00pm

Expression of alpha-synuclein truncated variants fused with a fluorescent protein in SH-SY5Y cells.

Life Sciences

Author(s):

Jackson VonBlon† (Science, JMHC)

Abstract:

Alpha-synuclein (aSYN) is a presynaptic protein involved in the development of synucleinopathies such as Parkinson’s disease (PD) upon its aggregation in the brain. While most PD cases are sporadic, some involve mutations of aSYN that increase the protein’s propensity to form aggregates in neurons. aSYN undergoes several post-translational modifications (PTMs), including truncations, that are detected in the brains of healthy individuals and patients. The goal of this study is to determine the effects of these truncations on aSYN aggregation in SH-SY5Y cells, neuroblastoma cells that serve as a model for neurodegenerative disorders. The cells will be transduced with adenoviruses encoding a set of aSYN truncated variants fused with a fluorescent protein, and protein expression will be monitored using confocal microscopy.

Keywords: Alpha-Synuclein, Parkinson's Disease, Aggregates, Post-Translational Modifications, Confocal

Mentor(s):

Chris Rochet (Pharmacy); Magaly Guzman Sosa (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1456
Presentation Time: Session 3: 12:00pm-1:00pm

What is the most Impactful Procrastination Resource at Purdue University?

Social Sciences/Humanities/Education

Author(s):

Alexander Walters† (Science, JMHC)

Abstract:

Studies across the globe, have found that the majority of college students admit to having procrastinated at one point in time during their college experience. This study seeks to discover the most valuable resource at Purdue University that enhances students' academic performance through the strategy of eliminating procrastination. The research question at hand that is being looked into is "What resource at Purdue University serves the most benefit to students' academic performance through the elimination of procrastination?". Furthermore, the research will include future implications of the data found in the study. It will examine the efforts put forth by Purdue to find solutions to student procrastination. Specifically, it looks into what areas of student help services are more common at Purdue University. For example, the study will look into the school's Academic Success Center and its offerings to all students who go to Purdue. The study will also dive into what strategies and activities the Academic Success Center uses to implement new study habits in students that avoid procrastination. Based on the findings, the study looks into why Purdue's preference for commonality of student help services may have reason by comparing it to other well-known universities across the country. Specifically, it will look into whether other colleges around the US have similar help centers and how much these universities put their focus on them.

Keywords: Purdue, Academic Performance, Procrastination, Student

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1457
Presentation Time: Session 3: 12:00pm-1:00pm

A study of ESL students' performance and challenges in oral communication

Social Sciences/Humanities/Education

Author(s):

Qiaoqiao Wang† (Education); Huimin Gai† (HHS)

Abstract:

Increases in globalization and international education have resulted in greater exposure of students to diverse educational environments. This requires a closer look at the challenges that English as a Second Language learner(ESL) encounters, or English as a Foreign Language learner(EFL), particularly in light of data that the number of international students is growing. The literature review will study the mental and academic performance and challenges faced by ESL students in oral communication. Understanding these challenges is important to the development of effective teaching methods for diverse student groups. Insights from this study can help develop inclusive pedagogies that recognize and value diversity, thereby promoting equal learning opportunities for all students and meeting the unique needs of ESL students. For ESL students, attention to language and contextual adaptation in oral communication is critical because both are key contributors to students' educational experiences, mental stability, and success.

Previous studies on this question have shown the oral performance of ESL students in the classroom. They have used quantitative methods and personal reports to investigate relevant samples. The studies show that effective communication depends not only on language skills but also on communicative context and adaptability, all of which pose multiple challenges for ESL students. ESL students face multiple barriers in the classroom, including language difficulties, speaking anxiety, and cultural misunderstandings that affect their academic and mental performance. This study will help improve future surveys dedicated to creating more inclusive and positive learning environments for ESL students.

Keywords: Second Language Learning, Foreign Students, Speaking Challenge, Academic and Mental Performance

Mentor(s):

Youli Mantzicopoulos-James (Education)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1458
Presentation Time: Session 3: 12:00pm-1:00pm

College Mental Health Infrastructure Adaptations Following the Coronavirus Pandemic to Increase Resource Utilization Nationwide and in Purdue

Social Sciences/Humanities/Education

Author(s):

Francesca Werner† (Science)

Abstract:

Mental health has become a topic on the forefront of college administrators' minds as students' symptom rates double within the last decade. Reports show that counselors are facing increasingly overwhelming workloads. This is occurring concurrently with reports that a minority of students experiencing mental health symptoms seek the services available to them. These issues, along with the coronavirus pandemic, have pushed colleges to rethink how they provide mental health services. This report examines how Purdue University follows or deviates from nationwide trends in university mental health over the past two decades, and service adaptations following the coronavirus pandemic. Various scholarly and professional articles found in various databases were drawn from to create a nationwide trend. Archived Purdue-related articles, press releases, and Purdue website information were used to find where the university aligns with that trend. Results from this paper can show where Purdue can improve and take inspiration from others, as well as how far it has come.

Keywords: Mental Health, University, Counseling, Purdue, Coronavirus Pandemic

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1459
Presentation Time: Session 3: 12:00pm-1:00pm

An Application of Machine Learning in Analyzing the Food Delivery Industry

Social Sciences/Humanities/Education

Author(s):

Jiaming Zhang† (Agriculture)

Abstract:

In the aftermath of the COVID-19 pandemic, there has been a significant transformation in the domain of the food delivery industry. This transformation is marked by a noticeable increase in the use of digital platforms for ordering meals, which deviates greatly from previous dining practices. This shift has been driven by the rapid digitalization of services aimed at consumers, resulting in considerable growth in online food delivery platforms. These platforms have amassed large amounts of data that can be used for machine learning analysis. China, with its densely populated urban areas and widespread adoption of digital food delivery systems, particularly through platforms like Ele.me, is a prime example of this evolutionary trend. This investigation outlines three goals: to conduct an extensive literature review and synthesize existing research findings; to interpret the subtle changes in consumer tendencies within the food delivery environment; and to integrate machine learning approaches with Ele.me's expansive dataset, thereby addressing existing research gaps. The investigation strives to offer valuable insights into both the scholarly and the practical aspects of the food delivery industry, equipping businesses with the strategic direction needed to navigate the intricacies of the expanding digital food ordering domain.

Keywords: Food Delivery, Machine Learning, Consumption Behaviors, Online Ordering, Big Data Analytic

Mentor(s):

Holly Wang (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1460
Presentation Time: Session 3: 12:00pm-1:00pm

Video Analytics for Understanding Animal Behavior

Innovative Technology/Entrepreneurship/Design

Author(s):

Brooklynn Fugate† (Engineering); Erin Kramer† (Science); Arpita Rattan† (Engineering)

Abstract:

This project considers the application of automated image processing to study chimpanzee populations in Senegal. Camera traps take images when animals are detected at a camera site. A detector is applied to the images to locate the animals, and then a classifier categorizes each animal into a species. However, the environment can confuse the detector. This can happen when the environment conceals an animal (a miss) or when the detector mistakes environmental objects, such as rocks or foliage, for an animal (a false detection). We aim to explore the effect of computer generated obstructions on the detector's ability to recognize concealed animals. We will also use the location information from each image to identify stationary objects and limit false detections.

To begin, we generate artificial obstructions of variable shape and size onto an image, mimicking different items in the image. Rounder shapes mimic plants, while sharper shapes with fewer edges mimic rocks and land formations. This enables us to measure the impact different kinds of obstructions have on the detector. Additionally, we created a script to identify images from the same camera location. For these images, we can utilize an intersection over union matrix to identify stationary environmental objects across multiple images. We believe this will help reduce false detections caused by mistaking stationary background objects as animals. In future work, we will explore the effects on the detector of animal based occlusions, where an animal partially covers another animal.

Keywords: AI, Detector, Machine Learning, False Detection

Mentor(s):

Amy Reibman (Engineering); Haoyu Chen (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1600
Presentation Time: Session 4: 1:30pm-2:30pm

Design and Implementation of a Super Capacitor Energy Storage System

Innovative Technology/Entrepreneurship/Design

Author(s):

Mohammad Alfaili† (Engineering)

Abstract:

In the ever-evolving landscape of robotics, the demand for efficient and reliable energy storage solutions has become paramount. This project focuses on the design and implementation of a supercapacitor-based energy storage system aimed at enhancing the performance and longevity of robots by reserving power and ensuring a stable power output from the primary battery source. The primary objective of this endeavor is to address the limitations associated with traditional battery systems, which often struggle to provide consistent power delivery, especially in high-demand robotics applications.

The proposed supercapacitor energy storage system leverages the unique characteristics of supercapacitors, including their rapid charge-discharge capabilities, extended cycle life, and ability to operate effectively over a wide temperature range. This innovative energy storage solution offers several key advantages for robotics applications, such as the ability to capture regenerative energy during braking or deceleration, reducing overall energy consumption, and providing an additional source of power when required.

The project encompasses the following key phases:

Design and Component Selection: Detailed analysis and selection of supercapacitors, control electronics, and safety mechanisms to ensure the system's performance, safety, and reliability meet the specific requirements of the robotics club.

Integration with Robotics Platform: The integration of the supercapacitor energy storage system into the existing robotics platform, ensuring compatibility and optimization for real-world use.

Energy Management Algorithms: Development of intelligent energy management algorithms to optimize the charge and discharge processes, efficiently utilizing the supercapacitor's capabilities while extending the life of the primary battery.

Testing and Evaluation: Rigorous testing, validation, and performance evaluation under various operating conditions and scenarios to verify the effectiveness and benefits of the supercapacitor-based system.

Future Applications: Exploring the potential for scalability and adaptability of the technology to diverse robotic systems and applications, with a focus on promoting sustainability and energy efficiency in the field of robotics.

The successful implementation of a supercapacitor energy storage system in robotics has the potential to revolutionize the industry by enhancing the operational capabilities and efficiency of robots across various secto

Keywords: Supercapacitor, Battery Efficiency, Sustainability, Energy Management, Energy Storage

Mentor(s):

Zijian He (Engineering); Shivam Bhat (Science)

Poster Presentation Abstract Number: 1601
Presentation Time: Session 4: 1:30pm-2:30pm

Structural Adaptation of the Porcine Placental from Mid to Late Gestation

Life Sciences

Author(s):

Megan Ashby† (Agriculture)

Abstract:

Porcine Reproductive and Respiratory Syndrome Virus (PRRSV) infection of pregnant gilts has devastating effects on the developing fetuses in late gestation. In early gestation, fetuses are immune to PRRSV infection, but as gestation progresses, they eventually become susceptible. As the gestation progresses, the physical structure of the placenta must change in order to meet the increasing requirements of the developing fetus. We hypothesize that such changes in placental architecture increase placental permeability allowing for vertical transmission of PRRSV. The objective of this study is to evaluate the increase in folding of the porcine placental epithelial bilayer as well as the decrease in width of placental stroma as the gestation progresses. Placental samples were taken from litters of pigs at 10 day intervals between day 55 and day 85 of gestation. Histology sections were cut from formalin fixed paraffin embedded tissue using a microtome, then fluorescently stained with wheat germ agglutinin (WGA) and imaged at 3 discrete locations along the maternal fetal interface. Initial qualitative observations confirm the increasing complexity in of the maternal fetal interface and indicate a dynamic state during this critical window of gestation. A morphometric image analysis will be conducted to quantify the folding of the epithelial bilayer and the width of the placental stroma. The results of this study will provide a better understanding of how the structures of a porcine placenta develop throughout gestation and how this phenomenon relates to PRRSV and fetal immunity or lack thereof.

Keywords: Porcine, Placenta, Microscopy, Gestation, Morphometrics

Mentor(s):

Alex Pasternak (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1602
Presentation Time: Session 4: 1:30pm-2:30pm

Quantifying the ACRE Wetland Water Balance

Life Sciences

Author(s):

Ryland Barton† (Agriculture)

Abstract:

The Indiana Climate Change Impacts Assessment found that winter and spring in Indiana are getting wetter, while the summers are getting hotter and dryer. Drainage water recycling is a conservation practice that can help with both challenges by capturing subsurface drainage water and storing it for use as supplemental irrigation. To estimate the potential of existing depressional wetlands for this practice, it is important to better understand when and how much water leaves the wetland as subsurface flow. The goal of this project was to gain a better understanding of the frequency and magnitude of subsurface outflow from a depressional wetland in the Tipton Till Plain of north central Indiana at Purdue's Agronomy Center for Research and Education (ACRE). This was accomplished by calculating the wetland water balance and using it to find the lateral flow into and out of the wetland. It was hypothesized that groundwater flow would be a main net detractor of water from the wetland throughout the four seasons, specifically subtracting the most amount of water in the summer when it is needed most for irrigation. Using coding and data collection from a variety of sources, the groundwater flow into and out of the wetland was quantified. The results found that there was a net positive inflow of 0.013 m/day into the wetland over the 19 years. There was a positive correlation between precipitation and interflow, which explains why both spring and winter had the highest interflow rates. The inverse being true for autumn and summer.

Keywords: Seepage, Wetland, Interflow, Drainage Water Recycling, Runoff

Mentor(s):

Laura Bowling (Agriculture); Dongseok Yang (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1603
Presentation Time: Session 4: 1:30pm-2:30pm

RoboMasters Video Player Project

Innovative Technology/Entrepreneurship/Design

Author(s):

Andrew Behl† (DSB, JMHC); Benjamin Dravis† (Science, JMHC); Thomas Greer† (Engineering); Matthew Tolla† (Polytechnic)

Abstract:

The Video Player project works directly with ROS 2 nodes to read through a folder and extract, order, and publish all the ".png" images within that folder. The script that will contain the bulk of what we are working on is in C++ and contains many features from ROS 2, like nodes for example. This code will traverse through a folder taking all the files with the extension of ".png" which will then be sorted in sequential order to later be published by our Publisher Node. We're going to make this Publisher Node within the larger body of code, and a Subscriber Node, that we will be creating and modifying, will be implemented alongside it. The overall goal behind this project is to create an efficient and easy way for the club to analyze the performance of our robot by viewing the different frames that the robot is capturing as the match progresses. With this, it will be easier to figure out what is going on, what is potentially going wrong, or even new functionalities which could be improved by the different team leaders and sub-teams to make a more efficient competition robot.

Keywords: Ros2 Node, Publisher, Subscriber, Video, Image Conversion

Mentor(s):

Shivam Bhat (Science); Zijian He (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1604
Presentation Time: Session 4: 1:30pm-2:30pm

A genomic analysis of the global house dust mite allergen diversity

Life Sciences

Author(s):

Sarah Bennett† (Science, JMHC)

Abstract:

Pyroglyphid house dust mites are a prevalent source of indoor allergens and are found globally, affecting about 30% of the world population. Although currently a number of allergens have been discovered in three house dust species, for which genomic data are available, the global diversity of allergen groups is unknown. Our study has sequenced genomes of 52 species of house dust mites to deduce genes encoding thirty-eight allergen groups and analyze global allergen diversity. The DNA samples come from mite colonies collected globally in North America, South America, the Caribbean, Europe, Southeast Asia, Africa, Australia, and New Zealand. DNA was extracted using the ultra-low input DNA methodology; 48 Illumina libraries were generated to get 52 mite species at a coverage of 40-100x for each sample (1-10 mite individuals). To infer allergen encoding genes, the sequence data was mapped using three genomic reference sequences with gene boundaries confirmed by transcriptomic data. One of the references was generated by us using advanced gene prediction frameworks. Our annotated genomes will be deposited into GenBank. Our project provided high-quality gene models confirmed by transcriptomic evidence for the complete set of allergens for 52 species of house dust mites and their relatives. This will allow for better understanding of the allergy sensitization patterns and will improve allergy vaccine therapies, which will account for the

actual diversity of house dust allergens at a global scale.

Keywords: House-Dust Mites, Allergens, Genomic Sequencing

Mentor(s):

Qixin He (Science); Pavel Klimov (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1605
Presentation Time: Session 4: 1:30pm-2:30pm

Utilization of Digital Twins in Facilities Management

Innovative Technology/Entrepreneurship/Design

Author(s):

Veronica Brems† (Polytechnic)

Abstract:

Digital twin is often referred to as a realistic digital replica of any asset. Depending on the level and details of the digital twin, it comprises real-time data and analytics that would be utilized to identify any potential issues in building systems and components. Considering the increasing attention and applications of digital twins in the architecture, engineering, construction, and operations (AECO) industry, this project aims to identify the utilization of digital twins in facility management and building operations/maintenance. The project focuses on current literature to reveal the use, challenges, barriers, and benefits of the digital twin in facilities management with other technologies.

Keywords: Digital Twin, Facilities Management, Building Maintenance

Mentor(s):

Deniz Besiktepe (Polytechnic); Sogand Hasanzadeh (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1606
Presentation Time: Session 4: 1:30pm-2:30pm

Addressing Food Insecurity in Tippecanoe County

Social Sciences/Humanities/Education

Author(s):

Josie Bull† (Liberal Arts); Grace Gilbert† (HHS); Lourdes Bengero* (HHS, JMHC); Samantha Katovich* (Science, JMHC); Catherine Kruger* (Science, JMHC)

Abstract:

In partnership with Food Finders Fresh Market, the purpose of this study is to research the different foods that are (or aren't) taken at a local food pantry and teach people to incorporate less popular food items into their diets. In turn, this will educate people on the food groups they are missing. For this study, we conducted a survey for neighbors (the people who shop at the food pantry) and are organizing a focus group to learn more about some of the information we are missing. The goal is to use the data we collect to create an intervention that addresses shoppers' needs and demonstrates alternative ways to incorporate unconventional food items into their cooking. We are still in the data collection/analysis phase of the project and have strong ideas for what types of interventions we are looking to implement, whether it would be making ingredient bundles with recipes to making small information cards to put next to different food items. The biggest implication for this is making sure the people using the pantry actually make use of the intervention - we want it to be something that will be useful to them.

Keywords: Food Insecurity, Food Pantry, Neighbor, Intervention

Mentor(s):

Jennifer Hall (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1607
Presentation Time: Session 4: 1:30pm-2:30pm

How Technology Impacts University Students' Interpersonal Relationships

Social Sciences/Humanities/Education

Author(s):

Isabella Carpenter† (Engineering)

Abstract:

As technology continually evolves, it has become an integral part of everyday life, affecting the dynamics of face-to-face and virtual connections. This research paper delves into the complex relationship between technology and the ability of students at Purdue University to form and maintain interpersonal relationships. This study employs a multidisciplinary approach, combining literature and observational data to investigate how technology usage influences the quality and quantity of interpersonal relationships among Purdue students. Much of the data collected comes from Purdue students observing their peers' romantic relationships while also commenting on their own platonic and familial relationships. The Purdue Exponent provides deeper insight as to how teenagers view their own interpersonal relationships, while other literature will provide further observational and quantitative data regarding how young adults interact in the digital era. The findings reveal a complex interplay between technology and interpersonal relationships. While technology can provide students with opportunities to facilitate initial connections and help maintain long-distance relationships, it also poses newfound challenges. These challenges include decreased in-person interactions, a reduction in the depth and connections within relationships, and a growing reliance on virtual communication. These findings will offer Purdue students guidance for harnessing technology's benefits while proactively addressing its potential pitfalls. The implications of these findings extend to educators, counselors, and students, highlighting the need for a balanced approach to technology usage to encourage meaningful interpersonal connections and personal well-being in the digital era.

Keywords: Technology, Interpersonal Relationships, Connections

Mentor(s):

Sidney Ducleroir (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1608
Presentation Time: Session 4: 1:30pm-2:30pm

The Impact of Naloxone Distribution in Communities & the Future of Naloxboxes

Social Sciences/Humanities/Education

Author(s):

Hannah Carreon† (HHS, JMHC); Sarah Eyles† (HHS); Anne Gilhooly† (HHS, JMHC); Simran Zaveri† (HHS, JMHC)

Abstract:

Introduction: Despite public health efforts, opioid overdose-related deaths in the United States remain on the rise. Naloxone, an opioid antagonist medication, has been identified as an effective primary treatment for reversing overdoses and can be used by both medical professionals and civilians .

Purpose: We aimed to conduct a literature review examining the outcomes of naloxone distribution approaches within communities to address opioid overdoses.

Methods: Inclusion criteria for this review included (a) examining a community-based naloxone distribution program, (b) examining the effect of the program on communities in the context of opioid overdoses, and (c) were published between 2019 and 2022.

Results: The review included seven articles, all of which are non-randomized control trials. Findings show that community-based naloxone programs are correlated with less stigma towards substance use, increased education and willingness to seek treatement, and expansion of naloxone access to a wider group of patients. Distributing naloxone to family members, friends, bystanders, and those with a history of opioid overdoses is associated with lower opioid overdose death rates.

Discussion: A limited number of studies investigated the impact of naloxone distribution programs within larger communities. Further research is needed in this area; one additional article focused on the NaloxBox, which should be the target of future studies for its feasibility in large-scale naloxone distribution.

Keywords: Naloxone, Naloxbox, Community-Based Distribution, Harm Reduction, Opioid

Mentor(s):

Jennifer Brown (HHS); Stephen Beegle (HHS); Sofia Rubi (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1609
Presentation Time: Session 4: 1:30pm-2:30pm

Large Language Model and Prompt Engineering Application

Innovative Technology/Entrepreneurship/Design

Author(s):

Yen Jung Chen† (Engineering); Seungkeun Oh† (Engineering)

Abstract:

Our project centers on fine-tuning LLM and implementing prompt engineering for specific use cases. The group is divided into two sub-projects.

The first sub-project involves developing an LLM to assist doctors and potentially even patients in determining the appropriate description or treatment method for their symptoms based on uploaded medical records.

The aim of our medical record diagnosis LLM is to assist doctors and inform users about their expected hospital experience. We've opted for Llama as our LLM, utilizing medical data from Hugging Face with a strong emphasis on patient privacy. Our large language model, derived from Meta's LLM, has been finely tuned for medical records, ensuring it comprehends and generates domain-specific text effectively. This model empowers healthcare professionals, augmenting diagnostic decisions and providing patients with fundamental insights. While performance may vary, it forms the basis for ongoing innovations in medical record analysis, potentially enhancing diagnostics and patient outcomes.

The second sub-project focuses on generating human-like text in two steps. We found that AI-generated text predicts word likelihood, often leading to simpler sentences. Our research evaluated text perplexity and burstiness, metrics where AI-written content scored lower. Perplexity measures sentence complexity, while burstiness gauges uniformity. To address this, we fine-tuned the model using human-written essays, aiming to teach it high perplexity and varied burstiness. The fine-tuned Llama 2 model produced more human-like text.

Additionally, employing prompt engineering techniques, our team stabilized the pre-trained model. By clarifying principles like perplexity, burstiness, and human-like texts, we were able to improve our model's outputs.

Keywords: AI Detection, Healthcare Diagnostics, Large Language Model, Fine-Tuning, Llama 2

Mentor(s):

Sam Labi (Engineering); Shreya Ghosh (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1610
Presentation Time: Session 4: 1:30pm-2:30pm

Structural Irregularities Due to Interommatidial Cell Aggregation in Drosophila Retinas

Life Sciences

Author(s):

Annabella Chen† (Science)

Abstract:

The complex structure of the Drosophila fly retina is composed of a carefully constructed lattice of rhabdomeres and interommatidial cells (IOCs) held together by actin stress fibers and numerous structural proteins such as integrin-linked kinase, perlecan, and collagen. This framework is most easily observed by studying the retina's basement membrane, a specialized extracellular matrix (ECM) sheet which lines the basal surface of epithelial cells and serves as an anchor for tissue morphogenesis. Prior research has found that modulations to the network of stress fibers and grommets in the basement membrane via protein knockdown results in the membrane fragmentation. Thus, it is also possible that modulating the number of IOCs via the p35 mutation may also affect the structural integrity of the basement membrane. In an effort to further understand the degree to which increasing the number of IOCs alters retinal morphology, we observed the extent of warping in p35 mutant retinas as compared to normal wild type retinas. Drosophila genetic crosses were performed to build flies with GFP-labeled integrin-linked kinase to examine the grommets. The analysis of the resulting patterns under fluorescent photomicroscopy suggests that altering the number of IOCs introduces some disruption to what would otherwise be a homogeneous lattice, though the structural integrity of the basement membrane itself is still found to be intact. Therefore, the quantity of IOCs influences the formation of basement membranes, and the possible resulting effects of uneven stress fiber tension due to structural irregularities is a noteworthy avenue for further inquiry.

Keywords: Drosophila, Retina, Protein Structure, Basement Membrane

Mentor(s):

Henry Chang (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1611
Presentation Time: Session 4: 1:30pm-2:30pm

Analysing Bias in Quantum Random Number Generator using D-Wave Quantum Annealing

Mathematical/Computation Sciences

Author(s):

Ashish Chenna† (Science); Ayusha Patra† (Science, JMHC); Aarav Kumar† (Science)

Abstract:

D-Wave, a pioneer in quantum computing technology, utilizes a novel approach known as Quantum Annealing to solve complex optimization problems. In the D-wave Systems quantum computers, quantum annealing occurs when the superpositioned qubits are introduced to couplers and biases that allow them to become entangled and open up many more possible states. This abstract introduces a project idea to develop a Quantum Random Number Generator (QRNG) using D-Wave's quantum annealing capabilities and hopes to investigate those biases and how much they truly affect the randomness of the generated numbers.

Randomly generated numbers are widely applicable to the fields of cryptography and cybersecurity. Classical computers should not be used for these cases, however, since the values they produce are pseudorandom, and can always be traced back to their origin. This makes classical computers unreliable for industry and cybersecurity in the near future. Quantum computing can help combat this since its methods of generating numbers may be truly unpredictable due to the inherent randomness of certain physical phenomena, such as superposition and wavefunction collapse. However, systematic bias - one that is different from the bias that occurs in quantum annealing - can be introduced in the process of generating random numbers, which reduces the security of the numbers. This bias comes directly from the hardware of the quantum computers themselves. By exploiting the probabilistic nature of quantum annealing, we plan to create a quantum circuit that, when executed on D-Wave's quantum annealer, will output sequences of genuinely random numbers.

Keywords: Quantum Random Number Generator, Statistical Analysis

Mentor(s):

Andreas Jung (Science); Robin Carpenter (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1612
Presentation Time: Session 4: 1:30pm-2:30pm

Unveiling Quantum Entanglement

Physical Sciences

Author(s):

Piyush Chhallare† (Science); Angela Mao‡ (Science); Michael Wang‡ (Science, JMHC)

Abstract:

Join Piyush, Angela, and Michael at the Purdue Physics Undergraduate Research Expo as we unravel the captivating world of quantum entanglement. In this poster presentation, we will commence by introducing the concept and highlighting its historical significance, including its connection to renowned figures like Einstein, Podolsky, Rosen, and Bell. Our presentation will also provide a comprehensive overview of the various types of entanglements possible in our universe. These diverse manifestations offer us a glimpse into the rich tapestry of quantum systems. Delving deeper into this presentation, we will also unravel the fundamental properties of entanglement, including the non-locality, superposition, and the collapse of the wavefunction. We will explore the profound physical implications of these properties, shedding light on the mind-bending and counterintuitive nature of quantum entanglement. Lastly, we will conclude this presentation by illustrating the remarkable real-world applications of quantum entanglement. From secure quantum communication to the potential for quantum computing and quantum cryptography, we will emphasize how entanglement has transitioned from a theoretical concept to a powerful tool with far-reaching implications in science and technology.

Keywords: Quantum Entanglement, Historical Perspective, Key Properties, Types of Entanglement, Real World Applications

Mentor(s):

Andreas Jung (Science); Lingqiang He (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1613
Presentation Time: Session 4: 1:30pm-2:30pm

Novel pancreatic cancer mouse model: uncovering the mechanism for decreased mouse survival from PP2A-B56a activation

Life Sciences

Author(s):

Sydney J. Clifford† (Science, JMHC); Ella Rose D. Chianis‡ (Science)

Abstract:

Pancreatic Ductal Adenocarcinoma (PDAC) is the 4th leading cause of cancer deaths and has one of the lowest five-year survival rates at just 12%. Over 90% of PDAC patients have mutated KRAS yet targeted therapeutics against the most prevalent mutation, KRASG12D, have yet to be FDA approved. Therefore, alternative therapeutic strategies are needed, potentially including cellular pathway targets that regulate KRAS activity.

Protein phosphatase 2A (PP2A) is a tumor-suppressive serine/threonine phosphatase that negatively regulates many of the downstream effectors of KRAS, making the activation of PP2A a potential therapeutic strategy. PP2A is a heterotrimeric complex whose function is dictated by the specific subunits incorporated. However, most studies have focused on the PP2A unit rather than the specific complexes, demonstrating a critical need to study specific PP2A complexes.

The PP2A-B56□ subunit has been previously implicated as a tumor suppressor in other cancers, but its role remains unknown in PDAC. A PDAC mouse model with genetic knockout of CIP2A, an endogenous inhibitor of PP2A-B56, surprisingly reduced survival. Because we have identified a novel role for PP2A-B56□□in generating oncogenic phenotypes, we have acquired ex vivo cell lines from this mouse model and are testing for the same mechanism as found in human PDAC cell lines. These studies will increase our understanding of PP2A-B56□ function in PDAC and will lay the foundation for future studies in this area.

Keywords: Pancreatic Cancer, Phosphatases, Oncogenic Phenotypes

Mentor(s):

Brittany Allen-Petersen (Science); Claire Pfeffer (Science); Jennifer P. Morton (University of Glasgow); Jukka Westermarck (University of Turku, Turun yliopisto, Finland)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1614
Presentation Time: Session 4: 1:30pm-2:30pm

An Investigation of Exosomal miRNAs in Cerebrospinal Fluid/Serum of the Rotenone-Induced Rat Model of Parkinson's Disease

Life Sciences

Author(s):

Matthew Corson† (HHS, JMHC); Sofia Schumann‡ (HHS)

Abstract:

Parkinson's Disease (PD) is a chronic neurodegenerative disorder identified by the loss of dopamine-producing neurons. The propagation of pathology in PD lies in intercellular communication, which occurs via extracellular vesicles known as exosomes. Rotenone is a chemical that has been identified as a PD risk factor.

The purpose of this study was to investigate how exosomal miRNAs in the cerebrospinal fluid (CSF)/serum of rats were altered in response to acute rotenone treatment. Preliminary experiments were done in primary midbrain and cortical neurons treated with rotenone, subsequently analyzing the exosomal miRNAs using qRT-PCR. Concentration/size characterization was performed using Nanoparticle Tracking Analysis (NTA).

Based on preliminary data, male Sprague Dawley rats were randomly assigned to treatment groups and given acute rotenone treatment for 8h and 24h at 3 months of age. The animals were euthanized after which point CSF and serum (from blood) were extracted, and exosomal miRNAs were analyzed in the biofluids.

We concluded that rotenone-treated primary neurons had enhanced exosome release, and there was higher exosome concentration after rotenone treatment in the serum of the rats, but not in the CSF. qRT-PCR results indicated that a few miRNAs were altered in both primary midbrain and primary cortical neurons in the presence of rotenone, which were also altered in the CSF and serum in the rotenone induced rat models.

In the future, the varying expression of specific miRNAs within the serum/CSF may serve as early diagnostic markers for PD-relevant neurotoxicity, which may be used to evaluate treatment response and prognosis.

Keywords: Parkinson's Disease, Rotenone, Exosomal miRNAs, Dopamine-Producing Neurons, Induced Rat Model

Mentor(s):

Jason Cannon (HHS); Fatema Currim (HHS); Josephine Brown (HHS); Reeya Tanwar (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1615
Presentation Time: Session 4: 1:30pm-2:30pm

IIoT-based Real-Time Sound Monitoring Framework for Manufacturing Machines and Processes

Mathematical/Computation Sciences

Author(s):

Vamsi Deeduvanu† (Science); Joseph Carrig† (Engineering); Aryan Khanolkar† (Science, JMHC)

Abstract:

The advent of the fourth industrial revolution, characterized by intelligent digital technologies, has found many small and medium-sized enterprises (SMEs) unprepared for its transformative effects. Notably, the majority of manufacturing machines remain isolated, with a significant portion being outdated. Addressing this, our research presents an IIoT-based monitoring solution for computer numerical control (CNC) machines using the MTConnect framework. Through the installation of sound sensors, we capture real-time operational errors during machining, with data collected via an edge device and virtual network connection. We optimize amplification gain and sensor placement to ensure the capture of precise audio data from a CNC machine. This data is subsequently processed by extracting sensor data and labeling it with timestamps. Further analysis of the sound data employs signal-processing techniques such as the fast Fourier transform (FFT), wavelet transform (WT), and short-time Fourier transform (STFT) to extract meaningful features. Ultimately, a neural network, such as a convolutional neural network (CNN), is trained to monitor manufacturing processes by predicting process quality and counting process cycles. Leveraging Grafana, an open-source web interface, a real-time monitoring dashboard is developed to visualize the sound signal and machine learning-based predictions. This integrative approach not only bridges the technological gap in SMEs but also paves the way for a more widespread embrace of smart technologies, with potential benefits in efficiency and productivity.

Keywords: IIoT, Sound Monitoring, Machine Learning, MTConnect, Data Annotation

Mentor(s):

Ali Shakouri (Engineering); Martin Jun (Engineering); Jiho Lee (Engineering); Junyi Yuan (Engineering); Yuseop Sim (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1616
Presentation Time: Session 4: 1:30pm-2:30pm

Automatic workflow to align multi-source global bike-share system data

Mathematical/Computation Sciences

Author(s):

Quan Dinh† (Science); Pratheek Kotla* (Science, DSB, JMHC)

Abstract:

Bike-share systems (BSSs) have emerged as a prominent form of micro-mobility in cities worldwide. However, BSS programs in different cities exhibit varying degrees of success. While some cities are expanding their BSSs, others face challenges in sustaining existing programs, leading to eventual closures. The birth, growth, and death of BSSs provide abundant examples to analyze the dominant factors impacting the success and failure of BSSs on a global scale. However, the diversity of data sources and formats poses a significant hurdle. In this project, we design a Python-based automated workflow capable of efficiently updating and harmonizing data, which is a fundamental step toward conducting a comprehensive global analysis of BSSs. The workflow involves the collection of BBS's demographic data, including GDP and population figures, from publicly available sources. Through it, we automate the data harmonization for different cities and generate structured data frames for further analysis. Preliminary results for GDP data in cities like Madrid and Paris have been produced to demonstrate the effectiveness of our approach. In the future, this developed workflow can adapt to future data inputs to reduce the manual effort required for updates, ensuring that later BSS analyses remain current and relevant over time. This serves as a valuable tool in advancing the understanding and deployment of BSSs worldwide.

Keywords: Bike-Share Systems, Automated Workflow, Data Scraping

Mentor(s):

Hua Cai (Engineering); Zhuoli Yin (Engineering); Laura Almeida Tinjaca (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1617
Presentation Time: Session 4: 1:30pm-2:30pm

Determining the pathway of cell death utilized by the pharmacological activation of PP2A in Pancreatic cancer.

Life Sciences

Author(s):

Indiraa Doraivel† (Science)

Abstract:

Pancreatic cancer is the fourth leading cause of cancer-related death in the United States. KRAS is an oncogene mutated in 90% of pancreatic cancer patients. But KRAS is considered hard to target, highlighting the importance of identifying alternative strategies to target this pathway. Pancreatic tumour microenvironment evolves with cancer cell progression leading to blood vessel collapse. This makes the tumours nutrient deplete. To circumvent this, cells employ KRAS-dependent macropinocytosis- a nutrient scavenging pathway. Macropinocytosis is the process by which cells take up extracellular material by membrane ruffling to form vesicles which then fuse with lysosomes to release nutrients. Targeting KRAS-driven macropinocytosis can be crucial to limiting nutrients to the cell. PP2A is a tumour suppressor which is repressed by mutated KRAS. Our hypothesis is that the activation of PP2A with the small molecular activator, DT061, prevents Macropinosomes from fusing with the lysosomes leading to cell death. However, how DT061-driven PP2A activity affects the macropinocytosis pathway is still unknown. Rac is a GTPase involved in membrane ruffling which is critical for the initiation of macropinocytosis. To show that Rac is needed for DT061 mediated macropinocytosis, we used EHT1864, a Rac family inhibitor. When cells were pretreated with EHT1864 prior to DT061, we saw that there is a reduction in the cell death caused by DT061 showing us that Rac is crucial to DT061 mediated cell death. Understanding the pathway of DT061 mediated cell death can be vital to developing this concept as a therapeutic method of treatment for Pancreatic cancer patients.

Keywords: Pancreatic Cancer, PP2A, Macropinocytosis, DT061, Rac

Mentor(s):

Brittany Allen-Petersen (Science); Garima Baral (Science); Claire Pfeffer (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1618
Presentation Time: Session 4: 1:30pm-2:30pm

TimeScale Creator Online

Innovative Technology/Entrepreneurship/Design

Author(s):

Hanna Ertel† (Engineering); Jaehyuk Lee† (Science); Sejal Kumar† (Engineering); Paolo Gumasing† (Engineering)

Abstract:

The purpose of this project is to make the Timescale Creator software more accessible to the public and to researchers by bringing it online. This software allows geologists to plot data based on certain parameters such as time periods and to import each region's specific data package. The web version provides convenience as users do not need to update their software to use each new update. Currently, the web version is not functioning at the same caliber as the original software because it lacks many of the available settings that are used in the Java program. Our goal is to create a more user-friendly interface that includes all of the specifications needed for a user to create and modify a chart. To do so, TypeScript with React and Java are utilized to meet this goal. Ultimately, users will be able to use all of Timescale Creator's functionality on the web.

Keywords: Geology, Visualization, User Interface, Earth History

Mentor(s):

James Ogg (Science); Aaron Ault (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1620
Presentation Time: Session 4: 1:30pm-2:30pm

Detection of dark matter candidates in the form of Weakly-Interacting Massive Particles (WIMPs) using scintillation data obtained from decay chains in the XENONnT experiment

Physical Sciences

Author(s):

Roy Galazka† (Science); Logan Carleton‡ (Science); Aniruddh Srivastava‡ (Science); Dhiresh Himthani‡ (Engineering)

Abstract:

Redacted

Keywords: Dark Matter Candidates, Weakly-Interacting Massive Particles (WIMPs), Scintillation Data, Decay Chains, XENONnT Experiment

Mentor(s):

Sayan Ghosh (Science); Husheng Guan (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1621
Presentation Time: Session 4: 1:30pm-2:30pm

Effects of Heterosis on Maize

Life Sciences

Author(s):

Alyson Godwin† (Agriculture, JMHC); Lara Staton* (Agriculture)

Abstract:

The purpose of this study was to understand the effects of heterosis on crop yield indicators such as maize ear length, and crop development traits like internode length. Plots in this study consisted of either mutated hybrid maize, inbred controls, or wild-type hybrid controls. Hybrid maize plots were examined over the course of the summer to identify ones where the plants were not homogenous. These plots should have been expressing traits in similar ways, but in one way or another, some plants would resemble their inbred parents more than the wild-type control. These plots with unusual expressions were the ones measured, and the two types of expression, normal or inhibited, were compared against each other to explore how heterosis affected the expression. While there were no trends found regarding the lengths of internodes between normal and inhibited plants, on average normal plants had one more internode than their inhibited siblings. This would suggest that the height difference associated with heterosis is not necessarily caused by lengthening the internodes, but by adding more nodes. Inhibited plants were generally shorter, had shorter ears, and had ears that were lower on the plant.

Keywords: Maize, Heterosis

Mentor(s):

Guri Johal (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1622
Presentation Time: Session 4: 1:30pm-2:30pm

Designing Li-Ion Battery Management System for AMP

Innovative Technology/Entrepreneurship/Design

Author(s):

Brandon Goeppner† (Engineering)

Abstract:

Lithium-Ion (Li-Ion) batteries are a type of rechargeable battery that is becoming widely used in portable electronics and electric vehicles. Li-Ion batteries are more efficient than the commonly used lead acid battery. However, if abused, Li-Ion batteries will lose most of their life expectancy. These batteries tend to be much more unforgiving than other battery chemistries. To keep these batteries "healthy" is to introduce a battery management system that will; monitor, protect, estimate the health and performance of the batteries, as well as reporting this information to the user. Currently, the Autonomous Motorsports Team at Purdue is using lead acid batteries to power their kart. They are wanting to transition to a Li-Ion powered kart for the future as it will make it more efficient. My role in this project is to conduct research to understand how a BMS works, the safety for BMSs, consider features and circuit topology that will work best for our kart, and to start considering how to design/start the design process for a BMS.

Keywords: Research, Design

Mentor(s):

Shreya Ghosh (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1623
Presentation Time: Session 4: 1:30pm-2:30pm

Analysis of food processing crystal images

Mathematical/Computation Sciences

Author(s):

Xinyi Guan† (Science); Jon Kouki Saathoff† (Polytechnic)

Abstract:

This project is currently based around analyzing images of food crystals. These crystals go through many stages during the food manufacturing process. This project primarily focuses on the first stage, the seed count stage. During this stage, crystal seeds, or the crystals before undergoing processing, are analyzed under a microscope in terms of size, number, clusters, and distance between crystals. The crystal seeds themselves can often contain imperfections, meaning that analysis of the crystals needs to be done. Manual analysis of these crystals can be costly in both time and money, as well as inaccurate at times. This project aims to answer these qualms by providing a tool to manufacturers that can automatically process and analyze these images. The automatic image processing aims to remove air bubbles that are formed during the creation of the microscope slide, as well as remove noise such as dust, background lines, and other imperfections in the image through simplification of the image. The tool aims to perform an automatic analysis of the crystals by counting each of the crystals and reporting back on their size in histogram form. Both the bubble removal and crystal counting processes included in this tool plan to utilize deep learning models in order to achieve this goal. This tool will aim to help food manufacturers improve their processes by allowing them to analyze their starting batches in a cheaper, faster, and more accurate way than before.

Keywords: Crystal Segmentation, Deep Learning, Bubble Removal, Image Processing

Mentor(s):

Jan Allebach (Engineering); Xiaoyu Ji (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1624
Presentation Time: Session 4: 1:30pm-2:30pm

Lithium Battery System for Purdue Autonomous Motorsports

Innovative Technology/Entrepreneurship/Design

Author(s):

Alex Hartman† (Engineering); Jasper Hochbaum‡ (DSB); Drake Hagerman‡ (DSB); Mohammed Khan‡ (Engineering); Ella Goodrich‡ (Engineering); John Min‡ (Engineering); Grace Gellatly‡ (Engineering)

Abstract:

Autonomous Racing Purdue specializes in building autonomous go-karts to test the vehicles tomorrow. As part of Vertically Integrated Projects, our group was given the job of designing the battery. Our large group was split into three subteams. One subteam was responsible for developing a versatile and lightweight enclosure for an electric kart's battery pack, ensuring it integrates smoothly with the kart's release mechanism and complex wiring. Another subteam was responsible for designing and 3D printing cost-effective, durable cell holders for lithium batteries, using a combination of ABS and polymers to ensure strength, heat resistance, and customization. These cell holders will be designed to securely fit together to form the desired battery configuration, and they will undergo rigorous testing to ensure they can withstand thermal and stress conditions. Finally, one subteam was tasked with designing the battery release mechanism. This subteam is tasked with creating a release mechanism for attaching a battery to a vehicle without bolts, with a focus on user-friendliness, ease of maintenance, and robustness under stress. All teams used a multidisciplinary approach along with the engineering design process to create designs. Preliminary design studies as well as Computer Aided Design models were used to create prototypes that stayed within the bounds of the guidelines laid out by AMP and completed their intended goals.

Keywords: Battery, Motorsports, Autonomous, Vehicle

Mentor(s):

Shreya Ghosh (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1625
Presentation Time: Session 4: 1:30pm-2:30pm

The role of Nox2 in retinotectal connections

Physical Sciences

Author(s):

Katherine Hutzel† (HHS, Liberal Arts)

Abstract:

Reactive oxygen species (ROS) are not only damaging when being abundant but also regulate various cellular functions when being at physiological concentrations. NADPH oxidases (Nox) are an enzymatic family that produce ROS endogenously. Previous work from our lab has shown that knocking out Nox2 and Nox5 in zebrafish by Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)/Cas9 caused significant defects in nervous system development. Whereas Nox5 zebrafish mutants die prematurely, Nox2 mutants develop into adulthood despite altered retina formation, retinotectal innervation, and other nervous system defects. At the moment, it is unclear which cells express Nox2 mediating these functions. To address this question, we are conducting a tissue-specific knockout in retinal ganglion cells (RGCs). We expect a similar phenotype as in the whole-body knockout if Nox2 in RGCs but not in other cells are responsible for the formation of retinotectal connections.

Keywords: Zebrafish, Retinotectal Connections, Retinal Ganglion Cells, NOX 2

Mentor(s):

Daniel Suter (Science); Paola Rodriguez (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1626
Presentation Time: Session 4: 1:30pm-2:30pm

Life Cycle Assessment of Aluminum Production in the United States

Mathematical/Computation Sciences

Author(s):

Grace Kuntz† (Engineering, JMHC)

Abstract:

This research focuses on conducting a comprehensive Life Cycle Assessment (LCA) of aluminum production in the United States, using a cradle-to-grave analysis. The LCA approach assesses the environmental impacts associated with aluminum production, following the resource flow from raw material extraction (cradle) to its disposal at the end of life (grave), including recycling scrap metal processes. The production input and output data are derived from the databases. The analysis will utilize the Tool for Reduction and Assessment of Chemicals and Other Environmental Impacts (TRACI) method and the ReCiPe model for completing the Life Cycle Impact Assessment (LCIA). The assessment quantifies the resource use, carbon footprint, energy use, and eco-costs associated with primary aluminum production. Additionally, the study will identify the stages within the aluminum production process that significantly contribute to the aforementioned environmental impact measures. The outcomes of this research aim to provide insight into how to further improve the aluminum production process to mitigate negative environmental impacts and support eco-efficient aluminum production processes in the United States.

Keywords: Sustainable Manufacturing, Aluminum Production, Environmental Impacts, Sustainable Processes, Life Cycle Assessment

Mentor(s):

Sidi Deng (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1627
Presentation Time: Session 4: 1:30pm-2:30pm

A New Approach: Analytical Solutions for a Couette Flow Using the Lattice Boltzmann Method

Mathematical/Computation Sciences

Author(s):

Jordan Larson† (Science)

Abstract:

Although sparse, analytical solutions to the Lattice Boltzmann Equation (LBE) make it possible to study the method itself, explore the properties of its collision operator, and reverse-engineer the implementation for boundary conditions. The purpose of this study was to find analytical solutions for a two-dimensional, incompressible, steady-state Couette flow. A previous result by Zou et al. was found to be inaccurate. An infinite-series solution for the LBE was derived. The series is often used as an intermediate step in the derivation of the hydrodynamic limit but is truncated to the first order only. For the special case of a Couette flow, the derivation can be extended to more terms. The results are sensitive to the choice of the local equilibrium distribution used in the collision operator. In particular, the quadratic and entropic equilibrium distributions were examined. The analytical solution was compared to convergent stationary solutions using the D2Q9 Lattice Boltzmann Method implemented in C. In the program, the Couette flow was induced by using both Lees-Edwards boundary conditions and insertion boundary conditions. The solution for the polynomic equilibrium distribution terminated and agreed with simulations up to machine accuracy. In the case of the entropic equilibrium distribution, the convergence depended both on the shear rate and the relaxation constant. While agreement is excellent in most realistic situations, some extreme regions of parameter space lead to non-convergence of the series solution. It is reasonable to expect agreement using different flows, such as the Poiseuille flow and an angled Couette flow.

Keywords: Lattice Boltzmann Method, Couette Flow, Analytical Solution, Lees-Edwards Boundary Conditions, Channel Flow

Mentor(s):

Alexander Wagner (North Dakota State University)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1628
Presentation Time: Session 4: 1:30pm-2:30pm

Understanding DFT & VLSI Testing

Innovative Technology/Entrepreneurship/Design

Author(s):

Ann Zi Lau† (Engineering); Mohammed Rafi† (Engineering); Gokulkrishnan Harikrishnan† (Engineering); Varun Gannavarapu† (Engineering); Richard VonTersch† (Engineering); Michael Fuchs† (Engineering); Pranay Jaggi† (Engineering); Roan Numa† (Engineering); Praneel Bhandari† (Engineering)

Abstract:

The goal of the SoCET test engineering team is to apply Design for Test (DFT) into the design process for different logic circuits. VLSI has a very huge need for increased reliability and testability. This is especially important as the technology process has reduced very rapidly from 180nm to 3nm in a span of 21 years. Without performing scan insertion, there is a considerable difficulty in testability as the controllability and observability from the top level is very low. The first step of DFT is to insert scan inserted flip-flops, specifically, muxed-D flip-flops, replacing the original flip flops. The team implements scan insertion using the Genus tool from Cadence and the TestMax tool from Synopsys. After generating a scan inserted netlist, Automated Test Pattern Generation (ATPG) is performed on the netlist to generate reports that indicate the test quality and test application time. It is done using the Modus tool or the TestMax tool. Through our project, we demonstrate the application of DFT to digital logic circuits and how it can be used to improve reliability and testability of digital circuits. We also demonstrate the working of an automated tester which can find its use in digital logic circuits and can be used on a reconfigurable logic device like a FPGA(Field Configurable Gate Array). For our future work, we will be implementing DFT for the AFTx08(the next System-on-Chip tapeout by the SoCET team) and enhancing the overall efficiency, reliability and testability of the tapeout process.

Keywords: Design for Test (DFT), Scan Inserted Flip-Flops, Automated Test Pattern Generation (ATPG), Reliability and Testability, Controllability and Observability

Mentor(s):

Abinands Ramshanker (Engineering); Mark Johnson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1629
Presentation Time: Session 4: 1:30pm-2:30pm

Health Disparities among Sexuality Minority Adolescents in Rural Indiana

Life Sciences

Author(s):

Kenzie Lawhorn† (HHS); Samuel J Gray‡ (HHS, Liberal Arts, JMHC); Mila Opacich‡ (Science); Amos Buschkoetter‡ (Science)

Abstract:

Sexuality minority adolescent (SMA) males experience numerous health disparities, have increased risk, and are less likely to be engaged in care or prevention. HIV prevention, such as testing and pre-exposure prophylaxis (PrEP) uptake, remains suboptimal among SMA males and priority populations in rural communities. One-time in-depth interviews were completed with SMA males (15-21 years of age) residing in rural Indiana to determine what perceived unmet healthcare needs they have regarding appropriate prevention and care related to sexual activity, sexuality, dating, or sexual identity, determining how they find information about sexuality and sexual health, and PrEP awareness and barriers to accessing PrEP. We found that rural SMA males experience numerous barriers to engaging sexual health resources, including prevention services and care, such as navigating discussion of sexual health needs with their parents/caregivers and medical providers, perceived limited access to HIV and STI testing services as minors, and accessing reliable sexual health resources which are responsive to the rural context. Participants indicated limited knowledge or awareness of PrEP. Among those interested in PrEP, few viewed they had the self-efficacy to navigate accessing PrEP (e.g., discussion with medical provider, insurance). Our findings underscore the need for sexual health, inclusive of HIV prevention, paradigms that are responsive to the unique needs of adolescents residing in rural areas. Findings suggest that parents and medical providers are gatekeepers for rural SMA males to access sexual health services, particularly PrEP.

Keywords: Sexual Health, LGBT, Rural Health, HIV/AIDS, Qualitative Research

Mentor(s):

Randolph Hubach (HHS); Brendan Bowns (HHS); Stewart Chang Alexander (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1630
Presentation Time: Session 4: 1:30pm-2:30pm

Quest for Novel Antibiotic Products

Life Sciences

Author(s):

Aditi Lohar† (Science)

Abstract:

Redacted

Keywords: Antimicrobial Resistance, Novel Antibiotic, Gamma Butyrolactones, natural products, Pseudo Receptor

Mentor(s):

Betsy Parkinson (Science); Amir Alwali (Science); Carson Roberts (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1631
Presentation Time: Session 4: 1:30pm-2:30pm

A prediction model of antibiotic treatment success in calves with bovine respiratory disease

Life Sciences

Author(s):

Erica Long† (Agriculture)

Abstract:

Bovine respiratory disease (BRD) is a bacterial and viral disease which causes respiratory illness particularly common in beef and dairy calves in which microbes infect the lung cavity, leading to cattle morbidity and mortality. BRD has been identified as the leading cause of death in pre-weaned dairy calves, leading to significant economic impact in producers because of animal death, reduced feed efficiency, and treatment cost. BRD is typically diagnosed on-site based on visual signs including coughing, nasal discharge, fever, labored breathing, or decreased appetite or water intake. Due to the lack of specificity in diagnosing BRD and determining the microbe causing BRD, it can be difficult to determine which antibiotic would be most successful.

Many farms regularly collect animal data to document events such as weight, serum protein, movement, feed intake, weather, and pneumonia treatments. Treatment success is defined through these data points based on time/presence of retreatment. The goal of this experiment is to develop a machine-learning algorithm based on animal metadata which could predict antibiotic treatment success. A large five-year dataset from a local Indiana dairy is to be cleaned and translated into a format readable to a machine learning model. A random forest model will be employed to determine correlation between factors (such as weather, feed intake, or age) and treatment successes, which will then be applied to use in farm settings as a rapid antibiotic prediction. If the model is able to predict successful treatment, then the frequency of chronic illness, re-treatments, and death are decreased.

Keywords: Bovine Respiratory Disease, Antibiotic, Prediction, Treatment, Calves

Mentor(s):

Tim Johnson (Agriculture); Jacquelyn Boerman (Agriculture); Isabela Garcia Mendes de Araujo Santos (Agriculture); Madison Simonds (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1632
Presentation Time: Session 4: 1:30pm-2:30pm

Dog and Cat Breed Detection Android Application

Mathematical/Computation Sciences

Author(s):

Luke Luschwitz† (Science); Abhilash Saravana† (Engineering); Chaeeun Kim† (Engineering); Sam Desai† (DSB); Selina Li† (Engineering); Nikhita Madhavan‡ (Engineering)

Abstract:

The purpose of this project is to create two android applications that classify images of dogs and cats by their breed. The applications will take a user's captured image, pre-process the image, send the image to an external server, use a machine learning algorithm to distinguish what breed the dog/cat is in the image, and return the correct breed back to the mobile device. The android application that analyzes images of dogs will distinguish if the image is of either a husky, beagle, or neither breed. The android application that analyzes images of cats will distinguish if the image is of either a sphinx, bombay, ragdoll, or none of these breeds. In our research, we compare and contrast different image processing techniques including grayscale conversion, Gaussian blurring, mean filter, Sobel edge detection, and Otsu thresholding. We also compare and contrast several image classification techniques including support vector machines, convolutional neural networks, and deep neural networks. Currently a work in progress, this application could be used by families to know the exact breed of their dog/cat, as well as by veterinarians to confirm the breed of a dog/cat for special treatment. The work in this project can be used as a foundation for a system that identifies any object in any image.

Keywords: Machine Learning, Mobile Application, Image Classification, Android, Computer Vision

Mentor(s):

Edward Delp (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1633
Presentation Time: Session 4: 1:30pm-2:30pm

Brain Tumor Detection

Mathematical/Computation Sciences

Author(s):

Anika Mathur† (Science); Matthew Roxas† (Engineering); Chingwo Cheung† (Engineering); Arin Asawa† (Science); Lourdes Ignacio† (Science)

Abstract:

As the amount of medical imaging data has increased over the past few years, the search for better diagnostic tools has also grown. This study explores the capability of convolutional neural networks on the classification of brain scans obtained from MRI (Magnetic Resonance Imaging) images for the presence of tumors.

To achieve this objective, the study draws upon the "Brain Tumor Object Detection" dataset, available through Kaggle. This dataset provides ground truth data for each MRI brain scan, paired with its corresponding tumor location label. Additionally, the dataset offers MRI images from the Axial (horizontal, or xy-plane view), Coronal (view from yz-plane), and Sagittal (view from xz-plane) planes of the brain. Our training and testing dataset creates two sets from the overall dataset with an 80-20% split. We created a convolutional neural network, which will be used to identify the location where a brain tumor most likely exists in each MRI image.

By simplifying and automating the analysis of MRI images, this model aims to reduce the potential for human error and expedite the delivery of diagnostic results to patients. The ramifications of this advancement are substantial, promising improved patient care, enhanced medical efficiency, and greater diagnostic precision.

Keywords: Convolutional Neural Network, Healthcare, Brain Tumor, Object Detection, Machine Learning

Mentor(s):

Edward Delp (Engineering); Carla Zoltowski (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1634
Presentation Time: Session 4: 1:30pm-2:30pm

Optimized Synthesis of a Pumpkin Shaped Molecule: A Supramolecular Story

Physical Sciences

Author(s):

Mia May† (Science); Sho Amagai† (Science)

Abstract:

Redacted

Keywords: Cucurbituril, Guest Host Chemistry, Molecular Recognition, Supramolecular Chemistry, Synthesis

Mentor(s):

Severin Schneebeli (Science); Kyle Faivre (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1635
Presentation Time: Session 4: 1:30pm-2:30pm

Exploring Geometric and Coating Parameters for Photocatalyst Synthesis and Mimicking Real-World Particle Distribution via Acoustic Forces

Innovative Technology/Entrepreneurship/Design

Author(s):

Sahda Mohammadu Haroon† (Engineering)

Abstract:

The COVID-19 pandemic has underscored the pressing demand for advancements in air purification technologies, particularly in light of the limitations posed by the current filters' Minimum Efficiency Reporting Value (MERV) rating. Existing filtration systems often fall short in capturing particles at their Most Penetrating Particle Size (MPPS) range of 100-300 nanometers, posing significant risks. In response, this research project explores two innovative approaches: acoustic air cleaning, which utilizes sound waves to control aerosol movement, and photocatalysis, which uses light-activated catalysts to break down pollutants. The study specifically focuses on integrating photocatalysis into HVAC systems to enhance indoor air quality by neutralizing bioaerosols. It aims to determine optimal geometric parameters for applying photocatalyst coatings on thin-film aluminum plates and replicate real-world particle distribution scenarios using Matlab. The potential implications of this research are profound, as it could lead to the development of advanced air purification technologies that significantly improve indoor air quality and address the critical issues surrounding the capture of particles at the MPPS range, especially in enclosed spaces during ongoing health crises.

Keywords: Photocatalysis, Air Purification, Thin Film, Acoustic Filtering, HVAC

Mentor(s):

David Warsinger (Engineering); Sudharsh Anandan (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1636
Presentation Time: Session 4: 1:30pm-2:30pm

Intro to SoCET: An Introduction to Different Aspects of System-on-chip Development

Innovative Technology/Entrepreneurship/Design

Author(s):

Amir Mokhtarpour† (Engineering, JMHC); Yash Mishra† (Engineering); Yilin Xu† (Engineering); Sahil Mitra† (Engineering); Cade Edward Shock† (Engineering); Siddarth Calida† (Engineering); Matthew Robert Walter† (Engineering); Jerry Chen† (Engineering)

Abstract:

System-on-Chip Extension Technology (SoCET) is a project-based research team within the School of Electrical and Computer Engineering (ECE) offering students an experience in system-on-chip design, mirroring industry standards and practices. Intro to SoCET is a sub-team that introduces new members to an overview of the system-on-chip (SoC) design workflow so that members can explore their interests and decide which subteam to join in the future. Members meet weekly to learn about new concepts and then are given a two-week period to complete a lab, offering insights into the practical application of these ideas. Topics covered include digital design, physical design, analog design, and design flow. Members use software tools such as SystemVerilog, GTKWave, and Cadence Virtuoso. Digital design labs typically consist of a template setup upon which the student identifies errors and implements logic to fulfill the task. Examples of these tasks include modeling combinational logic, writing testbenches for SV modules, and implementing a finite state machine. Physical, analog, and design flow labs consist of guided tutorials to make small projects in Cadence Virtuoso, such as making the FEOL design of a transistor or integrating a full chip. After completing the program, students will have a better understanding of SoC design and be able to contribute effectively to their next subteam.

Keywords: System-on-Chip Design (SoC), SoCET (System-on-Chip Extension Technology), Digital, Physical, and Analog Design, Software Tools in SoC Design, Practical Applications

Mentor(s):

Mark Johnson (Engineering); Jude Pinto (Engineering); Cole Nelson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1637
Presentation Time: Session 4: 1:30pm-2:30pm

Establishing Conditions for Bioengineering Baker's Yeast for the Reduction of Fructans in Food to Alleviate Functional Bowel Disorders

Life Sciences

Author(s):

Rebecca Mold† (Engineering, JMHC)

Abstract:

Redacted

Keywords: Yeast, Bioengineering, Food Science, Adaptive Laboratory Evolution

Mentor(s):

Eun Joong Oh (Agriculture); Fransheska Semidey (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1638
Presentation Time: Session 4: 1:30pm-2:30pm

Chronic Exposure to Aqueous Film-Forming Foams Leads to Evolutionary Responses in Daphnia magna

Life Sciences

Author(s):

Jack Morehouse† (Science)

Abstract:

Per- and polyfluoroalkyl substances (PFAS) have historically been a key component in aqueous film-forming foams (AFFF) used in fire suppression. With the increasing emphasis on phasing out PFAS use due to health and environmental concerns, several new chemical technologies have been used to create PFAS-free AFFF. Recent research has demonstrated that these replacement formulations are more acutely toxic to aquatic species than the traditional PFAS-containing AFFF. Given their relatively high toxicity, frequent exposure to the formulations could lead to evolutionary responses (i.e., evolved tolerance) in exposed populations. In this study, we examined the effects of chronic exposure to seven AFFF formulations (6 PFAS-free and 1 PFAS-containing) on the evolution of tolerance in the water flea Daphnia magna. Following an 84-day exposure to different concentrations of each formulation, we used a series of laboratory lethal concentration (LC50) tests on a subset of populations to examine the potential change in tolerance. We found that chronic exposure to three AFFF formulations led to a change in tolerance in exposed populations as compared to those with no previous exposure; two populations displayed increased tolerance and one showed decreased tolerance. This work is the first to examine evolved responses to AFFF formulations. Our results highlight the frequently overlooked evolutionary effects of contaminant exposure, particularly on keystone species in aquatic ecosystems, as well as the need to understand the effects of PFAS-free AFFF alternatives on the environment.

Keywords: Contaminants of Concern, Forever Chemical, Genetic Accommodation, Sublethal Effects

Mentor(s):

Jason Hoverman (Agriculture); Devin Jones (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1639
Presentation Time: Session 4: 1:30pm-2:30pm

Microscopic Analysis of Silica Gels used in Thermal Ionization Mass Spectrometry

Physical Sciences

Author(s):

Tess Obuchowski† (Engineering, JMHC)

Abstract:

Thermal ionization mass spectrometry (TIMS) is used to date rock samples based on principles of radioactive decay. Uranium bearing minerals, like zircon, are ideal geochronometers. To date them, U and Pb are isolated from the mineral, combined with silica gel, and loaded onto rhenium filaments, where the temperature of the filament is raised to ionize the U and Pb. The silica gel acts as an ion emitter for the sample. One major challenge in TIMS analyses is low ion yields, with under 5% and 0.25% of total lead and uranium, respectively, reaching the detectors for measurement. This poor ionization efficiency limits analytical precision.

Previous research has found that the composition of the silica gel affects the ionization efficiency of U and Pb. This project is focused on observing chemical and structural differences in different silica gels to understand the variables that affect ionization efficiency. Two control silica gels of similar concentrations were made with silica colloids, manufactured by Merck and Sigma Aldrich, to establish differences associated with the composition of the starting colloid. The Sigma Aldrich gel was split into two additional aliquots and doped with rhenium or methanol, which are both suspected to affect ionization efficiency. Each of the four gels were loaded onto rhenium filaments and observed using an optical microscope and a tabletop scanning electron microscope (SEM) to document their structure and appearance, and how it relates to chemical composition.

Keywords: Silica Gel Composition, Thermal Ionization Mass Spectrometry, Scanning Electron Microscopy, Optical Microscopy

Mentor(s):

Mike Eddy (Science); Disha Okhai (Science); Ryan Ickert (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1640
Presentation Time: Session 4: 1:30pm-2:30pm

Assessing the Impact of Purdue University's Time Management Resources on Academic Performance and Procrastination Reduction Among Students

Social Sciences/Humanities/Education

Author(s):

Heemir Patel† (Engineering)

Abstract:

Time management poses a common challenge for university students. It has been directly linked to procrastination, which can negatively affect academic performance and increase stress levels. However, effective time management skills hold the potential to reduce procrastination and enhance students' academic performance. This paper aims to explore the time management resources offered at Purdue University and how they can impact students’ academic performance and their ability to reduce procrastination. Specifically, I intend to examine the workshops, online tools, counseling services, and academic advising offered at Purdue University and what these resources offer to affect students' academic performance and reduce their procrastination.

Keywords: Time Management, Academic Performance, Procrastination, Resource, Student

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1641
Presentation Time: Session 4: 1:30pm-2:30pm

Effects of a Ketogenic Diet on Meal-Related Hormones and Psychological Well-Being

Life Sciences

Author(s):

Victoria Patellos† (HHS)

Abstract:

Ketogenic diets (KD) are extremely high in fat with very limited carbohydrates. While decades of research demonstrate negative health consequences of consuming high fat diets, studies show increased weight loss with KD, as compared to weight-loss with low-fat or low-calorie diets, and improvements in cardiovascular parameters and cognitive function. Anecdotally, individuals report improved mood and increased energy while following a KD. Despite evidence suggesting positive metabolic and mental health outcomes from KD, mechanisms underlying its effects remain unclear. We recruited eight women, with BMI 25-35, to consume KD for 8 weeks. Meal-related hunger and satiety hormones were measured before, during, and after a test meal prior to KD, and after 2 and 8 weeks of diet. We hypothesized that consuming KD would decrease hunger signals before and enhance satiety signals during and after a meal. We also hypothesized that KD would decrease perceived food cravings and improve mood. Two and eight weeks of KD resulted in significantly lower body weight than at baseline, however there were no differences in meal-related hormones. Furthermore, no differences in mood or appetite, as assessed weekly by the Inventory of Depression and Anxiety Symptoms (IDAS-II), and the Three-Factor Eating Questionnaire (TFEQ), were detected. Our data demonstrate that while KD effectively induces weight loss, it does not affect meal-related hormones or mood.

Keywords: Ketogenic Diet, Hunger, Satiety, Mood

Mentor(s):

Kimberly Kinzig (HHS); Dan Foti (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1642
Presentation Time: Session 4: 1:30pm-2:30pm

Characteristics of metallic aerosols in solder fumes

Life Sciences

Author(s):

Nicholas Pecoraro† (HHS, JMHC); Shane Limas† (HHS, JMHC)

Abstract:

People can be exposed to metallic aerosols in recreational and occupational settings in the form of soldering fumes. If inhaled or ingested, metallic aerosols have been widely observed to have detrimental effects on people with enough exposure. Some of these effects include neurological damage and cancers. More specifically, chronic exposure to lead alloys in the solder fumes can cause lead poisoning which includes a variety of psychiatric, developmental, and motor disturbances. To protect people, understanding the source and path of lead in the soldering process is important. In this study, metal contents in the soldering iron and 2 different soldering wires (green and orange) used in soldering were analyzed using the field portable X-ray fluorescence (XRF). For the fume generation, a soldering station and sampling equipment were placed in the fume hood. A soldering wire was fed to the soldering tip manually and fumes were pulled through the sampling equipment. Metals in the solder fumes produced during soldering were captured in the sampling filter and then analyzed using XRF. The number size distribution was monitored using a scanning mobility particle sizer. A large amount of lead and other heavy metals were found in the soldering wires. The solder fumes contained nanoparticles (≤ 100 nm) and submicrometer particles. The total number concentrations of particles in the solder fumes ranged from 56,000 to 70,000 particles/cm3. In a further study, we will use a soldering chamber to minimize flow interference in the fume hood and the electric wire feeding system to produce more stable fumes. We also plan on analyzing the contents of metal in the soldering wires both before and after soldering to analyze the differences in metal content in the XRF. This will be used to compare the loss of metal in the soldering wires to the metal fumes collected in the soldering chamber.

Keywords: Soldering, Fumes, Metallic, Aerosols, XRF

Mentor(s):

Jae Hong Park (HHS); Chang G. Lee (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1643
Presentation Time: Session 4: 1:30pm-2:30pm

Testing Photonic circuits with Dual-comb spectroscopy

Physical Sciences

Author(s):

Stanislav Pelipad† (Engineering)

Abstract:

Photonic integrated circuits are a type of circuit on a semiconductor chip that uses photons, in contrast to electrical circuits which use electrons. In photonic circuits, information travels at the speed of light. Due to this and various other reasons, photonic integrated circuits have been an active area of research in the past couple of decades. Nearly all optical functionally – modulation, coupling, and filtering can be realized on a photonic chip using optical waveguides etched directly into the semiconductor. Testing such devices requires an input tunable laser and a power detector. However, such methods do not give any information about the phase response of such devices, which can be critical. The proposed method of this project presents the modeling and simulation setup for recording amplitude and phase characterizations of photonic components, through a method called dual-comb spectroscopy. We will use the commercial software, Ansys's Lumerical Interconnect, to get a realistic model of the dual-comb spectroscopy setup and apply it to measure the amplitude and phase response of an unknown component. A similar method can then be implemented in our lab to fully characterize integrated photonic circuits.

Keywords: Photonics, Frequency, Phase-Response, Test Bench, Simulations

Mentor(s):

Lucas Cohen (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1644
Presentation Time: Session 4: 1:30pm-2:30pm

Securing the Open-Source Software Ecosystem

Innovative Technology/Entrepreneurship/Design

Author(s):

Vinh Pham Ngoc Thanh† (Polytechnic); Eduard Tanase† (Engineering); Vignesh Charapalli† (Engineering); Connor Behrend† (Engineering, JMHC); Zeyad Aljaali* (Engineering); Vaibhav Turaga* (Engineering)

Abstract:

Our objective is to bolster the security of the open-source software ecosystem with cutting-edge tools and methodologies. Leveraging tools from the Open Source Software Foundation (OSSF), we pinpoint vulnerabilities in pivotal public repositories. Central to our work is the Omega-Analyzer, an OSSF-backed scanner, which produces in-depth security assessments for any open-source project. After refining the toolset for accuracy, we integrated a parser to classify the generated reports both qualitatively and quantitatively. This integration culminated in a GitHub workflow, allowing developers to autonomously assess their projects and obtain clear, digestible feedback. We have already applied Omega-Analyzer to over 5,000 open-source projects, sifting through the reports to discern genuine vulnerabilities from false alarms. Upon detection of authentic issues, we collaborate with developers via GitHub pull requests. Moreover, we're in the process of crafting infrastructure for streamlined security evaluations of GitHub repositories, aspiring to provide a comprehensive frontend and backend solution for automated checks using the OSSF Scorecard. While our project is still evolving, we are optimistic that our proactive stance will mitigate the frequency and impact of bugs in global deployments.

Keywords: Open-Source, Cybersecurity, GitHub, OSSF, Static Analyzers

Mentor(s):

Aravind Machiry (Engineering); Fabiha Hashmat (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1645
Presentation Time: Session 4: 1:30pm-2:30pm

Multisensing Self-powered Patch for Meltdown Prediction

Innovative Technology/Entrepreneurship/Design

Author(s):

Sarah Pushparaj† (Science); Paul Ulrich† (Engineering, JMHC); Sejal Rhodes† (Engineering, JMHC)

Abstract:

Redacted

Keywords: Autism Spectrum Disorder, Wearable Devices for Health Monitoring, Meltdown Prediction, Skin-Interfaced Triboelectric Sensor, Biomarker Detection

Mentor(s):

Wenzhuo Wu (Engineering); Pedro Henrique de Souza Barbosa (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1646
Presentation Time: Session 4: 1:30pm-2:30pm

Sometimes It's Okay To Resist Change

Innovative Technology/Entrepreneurship/Design

Author(s):

Misha Sachdeva† (Unknown)

Abstract:

Artificial Intelligence isn’t some unknown phrase floating around. It is the future of the world and is progressing rapidly right before our eyes. In this paper I will begin by introducing the concept of Ai and give examples that we see such as self-driving cars, chat gpt, duolingo, e.t.c. Looking at an article in respect to this, explains how using Ai causes students to, “lack the ability to adapt to individual learning styles, and may not provide critical thinking or problem-solving skills.” (Greene, Robin T. “The Pros and Cons of Using AI in Learning: Is CHATGPT Helping or Hindering Learning Outcomes?” eLearning Industry, 24 Apr. 2023). Using these platforms may help the students obtain a good grade, but does it help them learn or apply what they have learned in the real world? The paper will then move into how universities such as Purdue have begun to implement Artificial Intelligence into college education, and it must stop.

In a literature review I wrote in my English, I discussed if Artificial Intelligence was worth fighting for against Academic Integrity. In other words, which is more important: Ai or Ai? While researching the pros v.s cons, my mind hovered over the negatives, therefore choosing to be against the implementation of Ai at Purdue University. My paper will effectively provide explanations to support each example as well as provide a rebuttal. The future of my generation cannot be controlled by technology; Us free minded people have to think freely.

Keywords: Floating, Learn, Apply, Fight, Free-Minded

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1647
Presentation Time: Session 4: 1:30pm-2:30pm

Toward General-Purpose Computational Quantum Electromagnetics Modeling

Physical Sciences

Author(s):

Felipe Sandoval† (Engineering); Georgia Griffin† (Engineering); Ben Eng† (Science); Victoria Chen† (Science); Nicholas Helushka† (Engineering); Naren Rachapalli† (Science)

Abstract:

The rapid advancement of quantum computers presents exciting opportunities for scientific and technological innovation. However, the engineering design of these revolutionary systems is in its early stages. Versatile numerical modeling tools have been instrumental in successfully designing most modern technologies; however, for quantum computers, the computational limitations of numerical design methods have prevented them from analyzing systems of useful scale. To address this limitation, this project is developing more efficient numerical methods for modeling quantum electromagnetic technologies that can be used to build quantum computers. To analyze quantum electromagnetic effects, a robust finite element method (FEM) is being developed. Coreform Cubit is being used as a pre-processing tool to create and mesh geometries to prepare them for the FEM analysis. A custom FEM implementation is being created that is tailored to robustly solving electromagnetic eigenvalue problems, with adaptive mesh refinement techniques also being pursued to achieve efficient and accurate solutions. Analysis of simple waveguide structures is currently being used to build basic FEM functionality and to develop corresponding eigensolver methods. Once the electromagnetic eigenmodes have been found, the quantum dynamics of a system can be analyzed by solving the Schrödinger equation. Procedures are being developed to efficiently discretize the Schrödinger equation using the electromagnetic eigenmode information. Further, numerical ordinary differential equation (ODE) solvers are being implemented, analyzed, and compared for efficiency and accuracy in the context of this application. With additional development, the ODE solvers and electromagnetic simulator will be combined to form an efficient quantum electromagnetic modeling method.

Keywords: Quantum Computers, Finite Element Method (FEM), Electromagnetic Modeling, Numerical ODE Solvers, Schrödinger's Equation

Mentor(s):

Thomas Roth (Engineering); Samuel Elkin (Engineering); Soomin Moon (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1648
Presentation Time: Session 4: 1:30pm-2:30pm

Developing a Wildlife Corridor: How Vegetation influences Bobcat (Lynx rufus) Habitat Preference in Tippecanoe County, Indiana

Life Sciences

Author(s):

Abby Seybert† (Agriculture, JMHC); Luca Lacobucci* (Agriculture); Anthony Tan* (Science); Sierra Hunnicutt* (Science, JMHC); Hannah Reyes Charles* (Agriculture)

Abstract:

Forest vegetation can be a powerful indicator for ecosystem health in terms of plant species, plant coverage, and diversity. When considering new wildlife corridors, these vegetative factors are important in finding ideal pieces of land for certain wildlife to thrive. One such species, the bobcat (Lynx rufus), has a wide range across the United States. However, the bobcats' habitat in Indiana has been limited to the southern region due to urbanization and land development. This has led to significant habitat reduction and fragmentation, increasing the edge effects for the species. With a wildlife corridor, the bobcat could expand its range northward towards Tippecanoe County and improve its habitat connectivity. The purpose of this study is to find the vegetative landscape preference of bobcats and apply this information to future wildlife corridor development in Tippecanoe County. To investigate the bobcats' ideal plant habitat, vegetation quadrats were conducted in each cardinal direction at six different locations across the county. Each location was strategically placed to consider different land types, including agricultural - forest borders, dense forest, and river's edge locations. In each quadrat, the plant species' names and counts were collected in addition to the overall plant coverage of the square meter plot. The gathered data will recommend precise land acquisitions to landowners and land trust organizations for the creation of vital wildlife corridors along with their associated management considerations.

Keywords: Vegetation, Wildlife Corridors, Bobcat, Land Acquisition, Habitat Connectivity

Mentor(s):

Kristen Bellisario (JMHC)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1649
Presentation Time: Session 4: 1:30pm-2:30pm

Complete Analysis of 19F Energy Levels in 2021 Experiment for 15N(α, γ)19F Reaction

Physical Sciences

Author(s):

Melody Shimba† (Science)

Abstract:

Following on to a preliminary analysis of 15N(α, γ)19F performed in 2021, a more complete analysis was required. Studying 19F provides deeper understanding to its mirror nucleus, 19Ne, and gives understanding to novae nucleosynthesis as a result. The analysis of the experiment to confirm the initial conclusions made about 19F from 2021 was completed. This analysis looked at the previously completed experiment in detail to prove the accuracy in the 2021 early conclusions. We found positive correlations between the gamma rays in the experiment and where we expected to see them, thus confirming the work from O'Donnell. The further completeness of the energy levels in 19F will allow for future conclusions to be made about its mirror nucleus 19Ne which impact estimates of 18F synthesis in novae.

Keywords: Novae Nucleosynthesis, Nuclear Physics, Experimental Physics, Computation

Mentor(s):

Danny Milisavljevic (Science); Daniel Bardayan (University of Notre Dame)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1650
Presentation Time: Session 4: 1:30pm-2:30pm

Lake Michigan Shoreline Landowner Survey

Social Sciences/Humanities/Education

Author(s):

Colby Smock† (Agriculture)

Abstract:

My research explores the diversity of attitudes and perspectives of homeowners along the Indiana Lake Michigan Shoreline using survey methodology to understand the rapidly changing conditions they have observed in recent history. The shoreline of Lake Michigan in Indiana has undergone extreme stress due to water level fluctuations over the past ten years. From near-record lows in 2013 to record highs in 2020, the rapidly changing water levels have caused severe erosion of beaches and foredune areas. This has put the communities along this shoreline in a dire spot as they risk losing their beaches and homes along the lakeshore. Based on a comprehensive review of community plans and ordinances, many of these communities have little to no plan for how to move forward with addressing the management of their shoreline. This will significantly alter their ability to fund future management advancements. The data collected from the survey we developed and implemented will help these communities understand how to move forward with planning and provide a foundational understanding of landowner attitudes to support informed decision-making with their shoreline management. My research to this point has assessed the current conditions of the Indiana Shoreline, what plans are in place to deal with it, and data analysis on the survey entries we have gathered. Our survey is now closed, and we have a 55.6 percent response rate, representing 274 participants. With the data we now have, we are performing data analysis to better understand the dataset. Looking at questions like what influences shoreline management solution acceptability will allow us to conclude what these Indiana Lake Michigan shoreline communities want and need. This will create an opportunity for community-based informed decision-making.

Keywords: Lake Michigan, Shoreline Management, Community Survey, Shoreline Erosion

Mentor(s):

Aaron Thompson (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1651
Presentation Time: Session 4: 1:30pm-2:30pm

How does a detection algorithm perform when adapting current CNNs to monitor human influence on a remote acoustic sensing project?

Mathematical/Computation Sciences

Author(s):

Anthony Tan† (Science); Luca Lacobucci* (Agriculture, JMHC); Sierra Hunnicutt* (Science, JMHC); Hannah Reyes Charles* (Agriculture, JMHC); Abigail Seybert* (Agriculture, JMHC)

Abstract:

The conservation of biological diversity is an important goal of ecologists and conservationists today. With the advent of passive acoustic monitoring and camera traps, measuring the biodiversity of an area has never become easier. However, parsing through thousands of videos, photos, and sound files is a long and tedious task. Machine learning and its powerful capability to quickly provide accurate results has revolutionized environmental monitoring. However, many models have yet to be tested on accuracy and efficiency. Here, we aim to show that an object detection model (MegaDetector) and acoustic classifier (BirdNet) to camera trap and acoustic sensor data will detect humans, animals, and non-animal images and the acoustic classifier for bird richness, other animal sounds, and non-animal sounds. These detections will be utilized in the overall Niches Corridor Ecology project for a least cost path analyses to select habitats suitable for wildlife corridors. To do this, we will test an object detection model's performance in detecting humans, animals, and non-animal images and the acoustic classifier on animal sounds and non-animal sounds. We will compare results with a random selection of manual labeled data to verify accuracy and to compare the processing time of the model versus manually labeling data. We aim to calibrate the model to optimize accurate predictions comparable or quicker than other models currently being used.

Keywords: Artificial Intelligence, Computer Vision, Passive Acoustic Monitoring, Wildlife Corridors, Species Classification

Mentor(s):

Kristen Bellisario (JMHC)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1652
Presentation Time: Session 4: 1:30pm-2:30pm

Use of Behavior Trees in Decision-Making between Stimuli of Human Behavior Perception Simulation

Innovative Technology/Entrepreneurship/Design

Author(s):

Amy Tong† (Engineering); Tejasvi Nallagundla† (Science); Siddhant Tandon† (Engineering); Josh Chang† (Engineering)

Abstract:

This project explores artificial intelligence (AI) driven non-player character's (NPC’s) ability to display preferential behavior when faced with two distinct perception variables through the implementation of behavior trees. Behavior trees allow for structured definition of decision making given their hierarchical nature and are thus of value in exploring the prioritization in decision-making of AI driven NPCs which can allow for larger contributions towards several fields including game design, emergency access simulations, or architectural design processes. The team decided on Unreal Engine with its flexibility in customization of AI NPCs to respond to perception variables in simulated environments. Through the strategic implementation of a NPC’s perception system in conjunction with the decision-making nodes of behavior trees, we aim to have NPCs evaluate and prioritize traits based on unique and randomly generated personality preferences before initiating a movement response. Its integration into architecture and design can allow for intelligent decision making within automated systems to prioritize variables relevant to the context of the project and designer. With the use of real-life replication and simulation software in Unreal Engine, our team can develop and analyze the decision-making processes integrated with artificial intelligence driven characters. This allows us to discover scenarios and integrate algorithms into modern-day machine learning mechanisms that can be applied to real-world situations.

Keywords: Human AI Interaction, Human Behavior, Behavioral Simulation, Behavioral Tree

Mentor(s):

Dave Barbarash (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1653
Presentation Time: Session 4: 1:30pm-2:30pm

The Impact of Anorexia Nervosa on the Gut Microbiota

Life Sciences

Author(s):

Anjali Vanamala† (Engineering, JMHC)

Abstract:

Anorexia nervosa (AN) is an eating disorder with high prevalence of gastrointestinal dysfunction. The activity-based anorexia (ABA) is a well-established rodent model that resembles the psychological behavior of AN along with intestinal dysfunction. We hypothesize that gut microbiota changes will occur in adolescence and persist to adulthood in this ABA model. Adolescent female rats were assigned to one of the four treatment groups. The first group was allowed access to running wheels and ad libitum access to food (AL+). ABA group had access to wheels with restricted access to food (2h/day) for four days. Ad libitum access to food was returned at the end of the four-day ABA period, and wheels were locked. The third group did not have access to wheels and had ad libitum access to food (AL). The final group did not have access to wheels and had the same restriction on food as the ABA group (TR). Rats were euthanized after two bouts of ABA. We found that ABA and TR groups gained less weight than AL and AL+ groups. Shifts in the gut microbial community were observed. Interestingly, the gut microbiota of ABA and TR groups are similar to each other, and distinct from the AL and AL+ groups, suggesting that the gut microbiota is sensitive to the feeding paradigm. Our data suggests that the ABA paradigm impacts the gut microbiome in adolescent rats. Another cohort of rats will be euthanized in adulthood to assess the long-term impact of AN in the gut microbiome.

Keywords: Anorexia, Gut Microbiome, Data Analysis

Mentor(s):

Tzu-Wen L. Cross (HHS); Anna Clapp Organski (HHS); Abigayle M. R. Simpson (HHS); Kimberly Kinzig (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1654
Presentation Time: Session 4: 1:30pm-2:30pm

Heterogeneous integration of commercial dies into silicon substrates for low earth orbit applications

Innovative Technology/Entrepreneurship/Design

Author(s):

Mary Vaughan† (Engineering); Riley Arnholt† (Engineering); Sunehra Saleha† (Engineering); Chengyu Chiu† (Engineering); Feichi Huang‡ (Engineering)

Abstract:

With increased demands for size, weight and power of semiconductors for avionics, advanced packaging and heterogeneous integration are a rapidly growing solution space. These techniques allow manufacturers to optimize multi-functional avionics packages for specific applications. A common application is low-earth orbit satellites, where space and weight savings are particularly important because of launch costs, but several forms of space radiation can damage devices, which can increase size and weight. Silicon, a traditional substrate with well-known material properties and fabrication techniques, is ideal for low-power applications such as memory. This project focuses on developing methods for embedding commercial dies into silicon substrates along with materials and designs aimed at improving radiation-hardness. Deep reactive ion etching through 24 um of photoresist creates large vias (or holes) useful for incorporating commercial dies. Filler materials like Parylene-C, a conformal polymer, and several metals are compared as adhesives and radiation shields.

Keywords: Heterogenous Integration, Advanced Packaging, Low Earth Orbit Satellites, Silicon, Radiation Hardening

Mentor(s):

Peter Bermel (Engineering); Saeed Mohammadi (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1655
Presentation Time: Session 4: 1:30pm-2:30pm

Reaching Purdue Students Struggling with Mental Health: A Review of Current Methods and Recommendations for Improvement

Social Sciences/Humanities/Education

Author(s):

Sofia Vogt† (Agriculture)

Abstract:

Mental health is a hot topic, especially in today's society and especially concerning college students. Now more than ever, colleges are trying to get their struggling students the help they need. For example, Purdue University provides free counseling, hosts events that help raise mental health awareness, and has put effort into diversifying the methods of providing mental health help to reach as many students as possible. However, even after so much hard work to make mental health help accessible, some students still do not utilize the available resources. This study aimed to understand why students at Purdue University might avoid seeking help to aid in their mental health struggles and to look into what Purdue is doing or could be doing to help encourage their students to utilize their many valuable resources. This study analyzed data from studies that looked into why college students avoid seeking therapy, along with articles accessed through The Purdue Today Archive that discussed Purdue's efforts in promoting mental health awareness and the resources they currently have available both in-person and online to aid their students in bettering their mental health. The implications of this research would be beneficial for Purdue to consider, as knowing what drives a student away from seeking mental health help could drive them to adjust their promotion methods accordingly and thus expand their outreach.

Keywords: Mental Health, Resources, Students, Purdue, College

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1656
Presentation Time: Session 4: 1:30pm-2:30pm

Deep Learning Approaches for Chaotic Dynamics and High-Resolution Weather Simulations in the US Midwest

Mathematical/Computation Sciences

Author(s):

Vlada Volyanskaya† (Science); Kabir Batra† (Engineering); Shubham Shrivastava* (Science)

Abstract:

Weather prediction is indispensable across various sectors, from agriculture to disaster forecasting, deeply influencing daily life and work. Recent advancement of AI foundation models for weather and climate predictions makes it possible to perform a large number of predictions in reasonable time to support time-sensitive policy- and decision-making. However, the uncertainty quantification, validation, and attribution of these models have not been well explored, and the lack of knowledge can eventually hinder the improvement of their prediction accuracy and precision. Our project is embarking on a two-fold approach leveraging deep learning techniques (LSTM and Transformer) architectures.

Firstly, we model the Lorenz 63 and 96 systems, crucial for grasping chaotic dynamics. By harnessing these neural networks on local computers and the RCAC GPU cluster (Gilbreth), we aim for accurate multi-step forecasts, emphasizing hyperparameter influence on model performance. This research sets a foundation for advanced, transformer-based weather predictions.

Secondly, noting the dearth of high-resolution weather data in the US Midwest, including cities like Chicago, we're employing Nvidia's FourCastNet model. Integrated with vision transformers and Adaptive Fourier Neural Operators (AFNOs), it simulates severe Midwest weather events. Using the RCAC's Gilbreth cluster and tapping into the ECMWF Reanalysis (ERA5) dataset, FourCastNet forecasts up to a week ahead in under two seconds, outpacing existing systems. This efficient model promises enhanced weather predictions and extreme event risk assessments. Our goal: simulate the potent January 23, 2016, mid-Atlantic snowstorm and contrast results with traditional forecast models.

Keywords: Deep Learning, Weather Forecast, Chaotic Systems, High-Resolution Data, High-Performance Computing

Mentor(s):

Di Qi (Science); Wen-wen Tung (Science); Rishabh Gupta (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1657
Presentation Time: Session 4: 1:30pm-2:30pm

Impact of Structured Revision Intervention During the Peer Review Process on Scientific Writing Self-Efficacy in Undergraduate Biology Students

Social Sciences/Humanities/Education

Author(s):

Gwyneth Wong† (Science); Allison Peterson† (Science); Emelia Koester† (Liberal Arts, Pharmacy); Anna Leah* (Pharmacy)

Abstract:

Undergraduate students in biological sciences, from lab courses to research, are tasked with carrying out experiments and writing reports on their experimental design, findings, and interpretations. A quasi-experimental study was adopted to explore how structured revision intervention during the peer review process impacts science writing self-efficacy in undergraduate students enrolled in a first-year introductory biology laboratory course. Students were tasked with carrying out an experiment to identify different bacterial species based on their unique biochemical, metabolic, and physiological properties, writing a lab report, and providing feedback on their classmates' reports. One half of the class was given a structured revision process after receiving peer feedback and the other half a general revision process. In the structured revision intervention, students were asked to assess each piece of feedback received and separately determine if they would use it to revise their work. In the general revision process, students were asked to simply list any revisions they've made from their first to final draft. Minimal direct and specific support was given. Students were then surveyed on their confidence in their ability to be a peer reviewer and how useful they thought the peer review process was to their own writing. Students' responses were analyzed to develop a codebook which will be used to collect statistical data about students' scientific writing-self efficacy and perceived utility of the peer review process between these two revision procedures.

Keywords: Biology Education, Peer Review, Survey Study

Mentor(s):

Stephanie Gardner (Education); Jill Cornell (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1658
Presentation Time: Session 4: 1:30pm-2:30pm

Packaging with Kapton

Innovative Technology/Entrepreneurship/Design

Author(s):

Yu-Xuan Yang† (Engineering); Franco Harding† (Engineering); Siddhart Gaur† (Engineering)

Abstract:

The purpose of this research project is to experiment with novel methods of embedding chips into a Kapton film substrate. Kapton is a cheap polyimide film with high environmental resistance, predictable temperature related behavior, and relatively low tangent loss. The primary objective of this semester's project is to get wells created in the Kapton for chip embedding. There are three methods that are to be compared and contrasted for well creation; those being UV lasering, deep well creation, and through hole punching. UV lasering would be the most traditional approach but it is conjectured that its usage would result in distortions around the edge of the shape cut into the film. Deep well creation and through hole punching focus around a more mechanical approach to creating profiles in the Kapton through the usage of precision cut dies that contain the positive or negative of the desired profile in the Kapton. Deliverables would be holes or profiles created in the Kapton with minimal distortions around the edge definitions, ready for chip implantation. Additionally, silver ink printing will be experimented on in parallel as a stand-in for traditional metallization. In the future, silver ink will be applied to the fully integrated product. The direction of this research is to eventually created heterogeneously integrated packages on a flexible substrate creating a new dimension for electronics.

Keywords: Kapton, Heterogenous Integration, Deep Well Creation, Advanced Packaging, Screen Printing

Mentor(s):

Zhihong Chen (Discovery Park); Saeed Mohammadi (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Poster Presentation Abstract Number: 1659
Presentation Time: Session 4: 1:30pm-2:30pm

MOSFiT for Tidal Disruption Events

Physical Sciences

Author(s):

Phoebe Zhou† (Science); Mustafa Albahrani† (Science); Raymond Glowner† (Science, JMHC)

Abstract:

The upcoming LSST will give an order of magnitude more transits, including the TDES. Tidal Disruption Events (TDEs) are cosmic events where stars are tidally disrupted in a galaxy by the supermassive black hole in the center. The Zwicky Transient Facility (ZTF) gives us an opportunity to identify more transient events classified as TDEs. We pass bolometric luminosity curves of 100 spectroscopically confirmed TDEs from ZTF through the Modular Open Source Fitter for Transients (MOSFiT), which uses the Markov Chain Monte Carlo (MCMC) methods to generate the best assumptions for 11 parameters of the event. From these 11 parameters, we aim to identify patterns or relationships among all the different fitting outputs of these events. These patterns would give us a better understanding between the TDE and its host galaxy with its center supermassive black hole. This information will act as an important guide for future TDE observations. Most of the TDEs have a supermassive black hole mass around 100 solar masses.

Keywords: MOSFiT, TDE, Supermassive Black Hole, Light Curves, MCMC

Mentor(s):

Danny Milisavljevic (Science); Ziwei Ding (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

RESEARCH TALKS

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

RESEARCH TALK SESSION 1 | 9:00AM-10:00AM

ROOM: STEW 214A

9:00 Odometry for Autonomous Motorsports
7000 *Rishi Mantri†*
Mentor(s): Shreya Ghosh

9:20 Characterizing Intervertebral Disc Strain under Dynamic Loading Conditions Using Ultrasound Texture Analysis
7001 *Radhika Kulkarni†*
Mentor(s): Craig Goergen; Elnaz Ghajar-Rahimi; Grace O'Connell; Shiyin Lim; Reece Huff

9:40 Cooperative learning strategies and their effect on the social-emotional development of students with Autism Spectrum Disorder
7002 *Anshi Shastry†; Marley Houin†*
Mentor(s): Youli Mantzicopoulos-James

ROOM: STEW 214B

9:00 Low-Power Computer Vision Challenge
7003 *Shubham Saluja Kumar Agarwal†; Vidisha Singhal†; Dennis Dai†; Leo Chen‡*
Mentor(s): Yung-Hsiang Lu

9:20 RISC-V Vector Processing for Embedded Microcontroller
7004 *Maxwell Michalec†; Om Gupta†; Fahad Aloufi†*
Mentor(s): Mark Johnson; Cole Nelson

9:40 Understanding Social Acceptance and Safety Aspects of Sidewalk Delivery Robots
7005 *Areli Viveros†; Hoang Hua†*
Mentor(s): Tho Le

RESEARCH TALK SESSION 2 | 10:00AM-11:00AM

ROOM: STEW 214A

10:00 RETHi: Fire Resilience in Space Habitats
7006 *Krish Thakkar†; Ben Krugman†; Audrey DeKoninck†; Ella Richardson†; Meredith Clark†; Kathleen Martinus†*
Mentor(s): Xiaoyu Liu

10:20 Research and Development in IoT and Edge Processing
7007 *Maximillian Farrell†; Jack Scarfo†; Arjun Gupte†; Anish Asthi†; Akshath Raghav†; Sergio Montalvo**
Mentor(s): Matthew Swabey; Jaeeun Kim

10:40 Pulse Flow Reverse Osmosis System for Applications in Vertical Farming
7008 *Emerson Zubb†*
Mentor(s): José Garcia

ROOM: STEW 214B

10:00 Effect of Marburg virus VP40 matrix protein mutations on virion assembly and budding
7009 *Mahesh Gupta†*
Mentor(s): Rob Stahelin; Balindile Motsa; Roopashi Saxena

10:20 Quantum Metrology for New-Era Electronics
7010 *Joseph Lopez†*
Mentor(s): Pramey Upadhyaya; Abhishek Solanki

10:40 Assessing How Parasite Exposure Frequency and Dosage Influences Infection Risk in PFAS-exposed Grey Tree Frogs
7011 *Alyssa Johnson†*
Mentor(s): Jason Hoverman

ROOM: STEW 214C

10:00 AI-Based Learning and Stressors: Stumbling up the Learning Curve
7012 *Leland Huey†*
Mentor(s): Jerod White; Tara Behrend

10:20 A Psychological Investigation of Crisis Center Volunteer Well-being
7013 *Sierra Allen†*
Mentor(s): Sang Woo

10:40 The effects of chronic PFOS exposure on motor behavior
7014 *Hurshal Pol†*
Mentor(s): Jason Cannon; Josephine Brown; Fatema Currim; Tauqueerunnisa Syeda

ROOM: STEW 214D

10:00 The Effect of Weaning and Transportation Stress on Subsequent Performance of Average Piglets
7015 *Isabel Turner†*
Mentor(s): Alex Pasternak

10:20 African American Studies and Research Center Undergraduate Summer Research Internship Program
7016 *Nah'Shon Williams†*
Mentor(s): Cornelius Bynum; Amy Childress

10:40 Purdue's AI Usage
7017 *Anjana Kidambi†*
Mentor(s): Michael Johnson

RESEARCH TALK SESSION 3 | 11:00AM-12:00PM

ROOM: STEW 214A

11:40 Examination of Racial Tensions at Midwest Waffle Houses
7018 *Mia Rodriguez†*
Mentor(s): Youli Mantzicopoulos-James; Spencer Headworth; Brenda Shein; Phoebe Pham; Xiang Zhou

ROOM: STEW 214B

11:00 Revolutionizing Autonomous Driving: Enhancing YOLOv4 with Vision Transformers for Robust Computer Vision
7019 *William Stevens†; Mykhailo Tsysin†; Vishal Urs†; Karthik Selvaraj†; Gabriel Torres†*
Mentor(s): Edward Delp; Carla Zoltowski

11:20 Investigation of Tactile and Strain Sensing Utilizing Carbon-Fiber Network in Silicone Elastomer Matrix
7020 *Harry Lee†*
Mentor(s): Garam Kim; Eduardo Barocio

11:40 3D Printed Porous Structure For Mircrobump Bonding
7021 *Cole Stephens†*
Mentor(s): Tiwei Wei

ROOM: STEW 214C

11:00 Effect of Social Demands on Occurrence of Repetitive Behaviors in Children with Autism
7022 *Riley Rozniarek†; Anna Hodge‡; Mallory Schrof‡*
Mentor(s): Brandon Keehn

11:20 Which Attitudinal Risk Factors for Sexual Violence Predict Sexual Objectification Perpetration
7023 Among College Men?
Marie Blankenberger†
Mentor(s): Chris Eckhardt; Daniel Oesterle; Niamh Christie

11:40 Nutritional Nudges in US-based East Asian Restaurants
7024 *Clay Watkins†; Ansley Smith*; Shuhan Sun**
Mentor(s): Karen Byrd

ROOM: STEW 214D

11:00 Russian Media Language and Techniques in Turbulent Times
7025 *Evan Landau†*
Mentor(s): Olga Lyanda-Geller

11:20 Analyzing the Dynamics of Online Political Discourse through Temporal Community Detection
7026 *Juniper Rodriguez†*
Mentor(s): Jeremy Foote; Mirta Galesic

11:40 Linguistic Changes in the Economic and Business Domains of the Russian and Ukrainian
7027 Languages
Davyd Revenko†
Mentor(s): Olga Lyanda-Geller

RESEARCH TALK SESSION 4 | 12:00PM-1:00PM

ROOM: STEW 214A

12:00 Modeling and Simulating Initial Task Allocation in Multi-Human Multi-Robot Teams
7028 *Arjun Gupte†*
Mentor(s): Byung-Cheol Min; Ruiqi Wang

12:20 Additively Manufactured Dissolvable Packaging for Recycle and Reuse of Chips for Sustainable
7029 Reduction of E-Waste
Sunehra Saleha†; Hannah Houston‡; Carl Hahn‡
Mentor(s): Muhammad Hussain; Dhiya Belkadi; Min Sung Kim

12:40 Quantification of intervertebral disc strain from high-resolution ultrasound imaging during dynamic
7030 loading
Diya Sakhrani†; Radhika Kulkarni; Grace Rennekamp**
Mentor(s): Craig Goergen; Elnaz Ghajar-Rahimi

ROOM: STEW 214B

12:00 Structural and Functional Characterization of Phospholipase C β3
7031 *Kennedy Outlaw†*
Mentor(s): Angeline Lyon; Isaac Fisher

12:20 Heterogenous Multicore for Embedded Applications
7032 *Malcolm McClymont†; Burkay Sahin†; Devin Singh†*
Mentor(s): Mark Johnson; Cole Nelson

12:40 PEAVS: Parallel Encrypted Arithmetic Vector Scheduling
7033 *Dulani Wijayarathne†; Sreevickrant Sreekanth†*
Mentor(s): Milind Kulkarni; Raghav Malik

ROOM: STEW 214C

12:00 Racial and Ethnic Disparities in Service Referral and Use Among High-Risk Children Diagnosed
7034 with Autism Spectrum Disorder
Aaliyah Saunders†; Victoria Bozinovski‡; Sarah Langdon‡
Mentor(s): Brandon Keehn

12:20 Analysis of heavy metals in wine using portable X-ray fluorescence (XRF)
7035 *Anthony Bovenschen†*
Mentor(s): Jae Hong Park; Subin Han; Johnathan Klicker-Wiechmann

12:40 You have the right to remain pregnant: Exploring patient experiences pre- and post- Dobbs in
7036 Indiana
*Alexandra Finlayson†; Gracia Bujambi**
Mentor(s): Kathryn LaRoche; Scotty Secrist

ROOM: STEW 214D

12:00 How Has Purdue Supported Students' Physical Health on Campus?
7037 *Andrew Nilsson†*
Mentor(s): Michael Johnson

12:20 Nurturing Students' Opportunities to Learn Elementary Mathematics in a Crowded Curricular
7038 Landscape
Bronwyn Rigsby†
Mentor(s): Jill Newton; Doris Fulwider; Bima Sapkota

12:40 Exploring the Integration of Generative AI, ChatGPT, in Higher Education: A Case Study of Purdue
7039 University.
Muhammad Hamza†
Mentor(s): Michael Johnson

RESEARCH TALK SESSION 5 | 1:00PM-2:00PM

ROOM: STEW 214A

1:20 A Feynman-Kac Type Theorem for ODEs: Solutions Of Second Order ODEs as Modes of Diffusions
7040 *Hudson Hochstedler†*
Mentor(s): Harsha Honnappa; Zachary Selk

1:40 Efficient simulation of degenerate optical parametric oscillator networks for combinatorial
7041 optimization
Spencer Bowles†; Michael Foster‡
Mentor(s): Peter Bermel; Jie Zhu

ROOM: STEW 214B

1:00 Hardware Multithreading on RISC-V Microcontroller
7042 *Rohan Gangaraju†; Pranav Srisankar†; Sean Greenley†*
Mentor(s): Mark Johnson; Cole Nelson

1:20 Forecasting EV Demand for Demand Response Applications
7043 *Byung Wook Kim†; Hyunjun Park†; Spencer Gries†; Kisal Wijesooriya†*
Mentor(s): Sivaranjani Seetharaman

1:40 Integrating Young Mothers into an Engineering School
7044 *Abigail Frank†*
Mentor(s): Kirsten Davis; Jennifer DeBoer; Stephanie Claussen; Lucy Nyambura

ROOM: STEW 214C

1:00 Revealing the lipid landscape: Microglial lipid droplets in Alzheimer's disease.
7045 *Shailee Patel†*
Mentor(s): Gaurav Chopra

1:20 Organophosphate (OP) exposure, particularly to chlorpyrifos, causes dopaminergic neurotoxicity
7046 and is associated with Parkinson's Disease (PD).
Sofia Schumann†; Matthew Corson‡
Mentor(s): Jason Cannon; Reeya Tanwar; Fatema Currim; Josephine Brown

1:40 Being Asian American in the Midwest: Reflections as a Student Researcher
7047 *James Zhou†*
Mentor(s): Stewart Chang Alexander

ROOM: STEW 214D

1:00 Role of KMT5C in EGFRi Resistance in Non-Small Cell Lung Cancer
7048 *Maximillian Hellrung†*
Mentor(s): Andrea Kasinski; Jihye Son

1:20 How can acoustic monitoring and AI-CNN technology predict the influence that other
7049 mesocarnivores have on bobcat (Lynx rufus) habitat selection in a midwestern river valley?
Luca Iacobucci†; Abby Seybert; Anthony Tan*; Hannah Reyes Charles*; Sierra Hunnicutt**
Mentor(s): Kristen Bellisario

1:40 Poetry in the Classroom
7050 *Adeline Waltz†*
Mentor(s): Mary Ellen Lennon

RESEARCH TALK SESSION 6 | 2:00PM-3:00PM

ROOM: STEW 214A

2:00 Material Stiffness Sensing using DEAs
7051 *Pranav Parigi†*
Mentor(s): Alex Chortos; Jue Wang

2:20 Centrality and Adversarial Attacks in Decentralized Federated Learning Networks
7052 *Adam Piaseczny†*
Mentor(s): Chris Brinton; Eric Ruzomberka; Rohit Parasnis

2:40 The Impact of Directionality and Infill on Detonations of High Explosives
7053 *Jack Martin†*
Mentor(s): Diane Collard; Steven Son

ROOM: STEW 214B

2:00 Generation and Detection of Synthetic Cartoon Faces Using Generative Adversarial Networks
7054 *Avigdor Roytman†; Ashwin Sreedhar†; Abhiram Nambiar†; Kris Gurung†*
Mentor(s): Edward Delp; Carla Zoltowski

2:20 Applying the Critical Incident Technique in Biomedical Engineering in Regards to Faculty
7055 Researchers
Tyler Ramsey†
Mentor(s): Justin Hess

2:40 Mining Pre-Trained Models in Open-Source Software
7056 *Dulani Wijayarathne†; Anika Bajpai‡*
Mentor(s): James Davis; Jason Jones

ROOM: STEW 214C

2:00 Miscarriage impacts on Women of Color
7057 *Gracia Bujambi†*
Mentor(s): Kathryn LaRoche

2:20 The Liking/Learning Gap for Immersive Versus Desktop Virtual Reality
7058 *Ben Blachly†*
Mentor(s): Tara Behrend; Jerod White; Brad Pitcher

2:40 PP2A-EGFR crosstalk in PDAC: a novel activating role
7059 *Ella Rose Chianis†; Sydney Clifford‡*
Mentor(s): Brittany Allen-Petersen; Claire Pfeffer; Garima Baral

ROOM: STEW 214D

2:00 Girls Excelling in Math and Science (GEMS) Clubs: Stories of the Original GEMS Girls
7060 *Meredith Chasse†*
Mentor(s): Jill Newton

2:20 Child Automated Speech-To-Text (CAST) Project - A Machine Learning Approach to Understanding
7061 Child Speech
Aakanksha Shripal†; Aadya Pawar†; Jonah Nichols†; Jasper Koliba‡; Aarohi Panzade‡; Aarini Panzade‡; Daniel Zheng‡; Anish Bhowmik‡; Reagan Becker‡; Son Ha‡
Mentor(s): David Purpura; Avery Closser

2:40 Social Emotional Learning for English Learning Students
7062 *Yilin Huang†*
Mentor(s): Youli Mantzicopoulos-James

RESEARCH TALK SESSION 7 | 3:00PM-4:00PM

ROOM: STEW 214A

3:00 Contribution of Home Demographics and Environmental Factors to Indoor Surface Dust
7063 Concentrations in Urban and Suburban Homes in the U.S.
Ishika Jindal†; Sienna Grey†
Mentor(s): Brandon Boor; Satya Patra; Nusrat Jung

3:20 Identifying Vaginal Microbes and Metabolites with Pro- and Anti-Histamine Potential
7064 *Reagan Bushok†*
Mentor(s): Leopold Green; Douglas Brubaker; Damilola Lawore; Smrutiti Jena

3:40 Terahertz time-domain spectroscopy and Raman spectroscopy for polymer identification
7065 *Marco Herbsommer†*
Mentor(s): Vikas Tomar; Sushrut Karmarkar; Mahavir Singh

ROOM: STEW 214B

3:00 Aluminum Nitride-based Heterogeneously Integrated Low-Earth-Orbit Sensors (HILEOS-AlN)
7066 *Ethan Kovalan†; Frank Huang†; Yiyun Wang†; Ching Chen†*
Mentor(s): Zhihong Chen; Peter Bermel; Saeed Mohammadi

3:20 Time interleaving switched capacitor array true time delay unit for baseband beamforming
7067 *Long Nguyen†*
Mentor(s): Sutton Hathorn

3:40 Extracting Heart Rate from Strain Gauge Respiratory Signals
7068 *Pei-Lun (Patricia) Chen†*
Mentor(s): Steve Steinhubl; Matthew Ward; Mohamed Elgendi; Carlo Menon

ROOM: STEW 214C

3:00 Developing Realistic Quantum Error Correction Models
7069 *Santiago Lopez†; Jonathan Andrade Plascencia**
Mentor(s): Alex Ruichao Ma; Gabriel Perdue; Botao Du

3:20 Investigation of Optimal Machining Parameters for Fiber Reinforced Thermoplastic Composite
7070 Materials
Min Yong Chun†; Harry Lee‡
Mentor(s): Garam Kim; Eduardo Barocio

3:40 CATT: Understanding the Online Behavior of Sex Offenders
7071 *Reeya Ramasamy†*
Mentor(s): Kathryn Seigfried-Spellar; Tatiana Ringenberg

ROOM: STEW 214D

3:00 Exploring Neurite Complexity in Cortical Neurons Carrying an Epilepsy-Linked SCN2A Mutation: A
7072 Human-Induced Pluripotent Stem Cell Study
*Hope Harlow†; Muhan Wang**
Mentor(s): Yang Yang; Maria Olivero-Acosta

3:20 Developing a Selective Irreversible Peptidic Inhibitor for CBX2
7073 *Sam King†; Gabby Conjelko‡*
Mentor(s): Emily Dykhuizen; Sijie Wang; Sandra Ordonez

3:40 Animacy Effects and the Production of Relative Clauses in Mandarin: differences between native
7074 speakers and heritage speakers
Yongjia Deng†
Mentor(s): Elaine Francis; Vanessa Sheu

RESEARCH TALK SESSION 8 | 4:00PM-5:00PM

ROOM: STEW 214A

4:00 Real-Time Volatile Chemical Screening of Environmental Media to Support Disaster Response
7075 *Grayson Wittbrod†*
Mentor(s): Brandon Boor; Nusrat Jung; Jinglin Jiang; Xiaosu Ding

4:20 Rheological Behavior of Cellulose Nanofibril Suspensions with Varied Levels of Fines and Solid
7076 Content
Ethan O'Banion†
Mentor(s): Dr. Siamak Shams Es-haghi

4:40 An Analytical and Statistical Analysis of Turbofan Engine Sensor Data
7077 *Stan Melkumian†*
Mentor(s): Haritima Chauhan

ROOM: STEW 214B

4:00 Analysis of Tight Integration Between Vector and Scalar Compute Units
7078 *Johnathan Hong†; Sooraj Chetput†; FangLing Zhang†; Zengxiang Han‡*
Mentor(s): Tim Rogers; Mark Johnson; Anusuya Nallathambi; Sharath Shivakumar

4:20 Dynamic Local Planner for High-Speed Autonomous Racecars
7079 *Alec Pannunzio†*
Mentor(s): Sam Labi

4:40 LLM-Assisted Software Energy Optimizations for Data Center
7080 *Fah Yen†; Max Chang‡; Samay Nandwana‡*
Mentor(s): James Davis

ROOM: STEW 214C

4:00 Sound Archive
7081 *Gavin Cloyd†; Jackson Stone†; Sahil Desai‡; Jue Fang‡*
Mentor(s): Jason Ware

4:20 Automated Crater Morphology Characterization on the Moon Using an Unsupervised Neural
7082 Network
Sara Cuevas-Quiñones†
Mentor(s): Ali Bramson; Lior Rubanenko

4:40 Why do we need to teach quantum to K-12 and early college students?
7083 *Priyam Gupta†; Eric Broyles‡*
Mentor(s): Bob Kenley; Dongyang Li; Mahdi Hosseini

ROOM: STEW 214D

4:00 Steven Spielberg's Bridge of Spies as a Russian Fairy Tale
7084 *Umbert Caseres†*
Mentor(s): Amina Gabrielov

4:20 Relocation Incentives in Alaska; Or, The Call of the Wild and Transfer Payments
7085 *Nathan Miller†*
Mentor(s): Jillian Carr

Research Talk Presentation Abstract Number: 7000
Presentation Time: 214A at 9:00am-9:20am

Odometry for Autonomous Motorsports

Innovative Technology/Entrepreneurship/Design

Author(s):

Rishi Mantri† (Engineering)

Abstract:

The purpose of this work was to implement odometry for an autonomous racekart. The aim was to make use of physical equipment on a kart to estimate its position at any given time (relative to its initial position) and map a race track it's currently on. The map, created in the kart's first pass through the track, would then allow it to autonomously navigate through the track in its second pass. To do so, various methods were considered, which included the use of cameras and image processing algorithms, IMUs, and sensor fusion techniques. Eventually, the decision was made to use a LIDAR sensor, along with SLAM algorithms to localize the kart and create a map of its surroundings. To implement these techniques in the kart, the tools available through ROS (Robot Operating System) were used. The process included several stages of trial and error, where we visualized ROS bag LIDAR datasets and ran ROS implementations of SLAM on local machines. Ultimately, the work can help further the implementation of 3D LIDAR and SLAM research through ROS packages and allow for it to be accessible for a broad range of autonomous navigation tasks.

Keywords: LIDAR, Odometry, ROS, SLAM, Racing

Mentor(s):

Shreya Ghosh (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7001
Presentation Time: 214A at 9:20am-9:40am

Characterizing Intervertebral Disc Strain under Dynamic Loading Conditions Using Ultrasound Texture Analysis

Life Sciences

Author(s):

Radhika Kulkarni† (Engineering)

Abstract:

Herniated discs in the spine are a significant patient burden, with potential links to lower back and leg discomfort and a considerable impact on daily life. These discs, located between spinal vertebrae, are comprised of the annulus fibrosus (AF) and the nucleus pulposus (NP). Herniations happen when the NP protrudes through a full-thickness annular tear, possibly compressing spinal nerves. The mechanical factors underlying herniated discs are poorly understood, necessitating research into these mechanisms and accessible diagnostic techniques. Our study employs high-resolution ultrasound and texture correlation to quantify strain patterns in intervertebral discs during dynamic loading.

A motion segment from the bovine caudal spine was prepared for investigating disc mechanics, secured in a mechanical tester, and subjected to axial compression. B-mode ultrasound images (40 MHz center frequency, Vevo3100) were acquired at two axial displacements: 0.5 mm and 1 mm. We used a direct deformation estimation (DDE) approach to analyze the image data and quantify strain within the disc, providing insights into its mechanics.

Our analysis revealed a heterogeneous strain pattern, with DDE highlighting interspersed areas of high tension and compression. Additionally, we observed that as displacement increases, first principal strain (E1) values rise, while second principal strain (E2) values decrease. Future work will encompass a broader sample size and a wider range of compression distances to further advance our understanding of NP and AF kinematics during loading. This research holds promise as ultrasound presents a novel, fast, and region-specific approach to quantify strain, offering exciting prospects for advancing our understanding of disc mechanics.

Keywords: Herniated Discs, Ultrasound, Texture Correlation, Kinematics, Vertebrae

Mentor(s):

Craig Goergen (Engineering); Elnaz Ghajar-Rahimi (Engineering); Grace O'Connell (University of California Berkeley); Shiyin Lim (University of California Berkeley); Reece Huff (University of California Berkeley)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7002
Presentation Time: 214A at 9:40am-10:00am

Cooperative learning strategies and their effect on the social-emotional development of students with Autism Spectrum Disorder

Social Sciences/Humanities/Education

Author(s):

Anshi Shastry† (Education); Marley Houin† (Education)

Abstract:

The importance of cooperative learning strategies has been highlighted in educational research since the 1990s. However, the field has not adequately addressed the potential social-emotional (SE) benefits of cooperative learning for elementary age students with autism. Although students with ASD (Autism Spectrum Disorder) progress at different rates, most IEP (individual education plan) goals, developed for these students, have similar themes. Our proposed research aims to address this shortcoming and includes two main goals: 1) identify which SE developmental goals are best supported by cooperative learning strategies and 2) what cooperative learning strategies are most effective for students with ASD. To address the first goal, we will conduct interviews with special education teachers and IEP teams. Data from these interviews will document what works for students in different classrooms and highlight specific legal and administrative limitations. To address the second goal, we will use observational progress-report checklists to record students' achievement before and after the cooperative learning strategy is introduced. These series of observations will happen three times a week over the course of a month. Our main data will come from a variety of students in a K-2 Autism classroom that focuses on functional life skills. We will evaluate our findings with reference to themes reported in previous literature, including accommodating behaviors, active listening skills, and the effects of different types of cooperative learning strategies. Our goal is to identify strategies that support students with ASD and their social-emotional development, particularly in ways that encourage independence and confidence-building.

Keywords: Cooperative Learning, Autism Spectrum Disorder, Social-Emotional Development

Mentor(s):

Youli Mantzicopoulos-James (Education)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7003
Presentation Time: 214B at 9:00am-9:20am

Low-Power Computer Vision Challenge

Mathematical/Computation Sciences

Author(s):

Shubham Saluja Kumar Agarwal† (Engineering); Vidisha Singhal† (Engineering); Dennis Dai† (Engineering); Leo Chen‡ (Engineering)

Abstract:

The Low Power Computer Vision Challenge is an international endeavor aimed at uniting computer vision enthusiasts from around the world, as well as obtaining better and more efficient methods of making computer vision models.

Our goal focuses on two key elements:

Base Model Development: We will provide an initial 3D reconstruction model as a baseline to surpass. Participants will use this as an example, and attempt to surpass this to qualify, fostering the evolution of 3D reconstruction technology.

Evaluation Method: To ensure fairness, an evaluation method will be established, allowing for standardized assessment of submitted 3D reconstructions. It will serve as a grading system for quality and accuracy of submissions.

Through this initiative, we hope to make an impact on spatial modeling and automotive vision.

In brief, our project aims to revolutionize spatial modeling by hosting an inclusive competition that drives progress and technological development in 3D reconstruction.

Keywords: Low Power, Computer Vision, Challenge, Evaluation, 3D Reconstruction

Mentor(s):

Yung-Hsiang Lu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7004
Presentation Time: 214B at 9:20am-9:40am

RISC-V Vector Processing for Embedded Microcontroller

Mathematical/Computation Sciences

Author(s):

Maxwell Michalec† (Engineering); Om Gupta† (Engineering); Fahad Aloufi† (Engineering)

Abstract:

RISC-V's vector extension, ratified in November 2021, adds vector instructions to the ISA that can exploit data-level parallelism in tasks like machine learning, graphics processing, and digital signal processing to improve a CPU's execution speed. This project aims to implement the Zve32x standard extension , which is an integer-only subset of the full "V" extension with a maximum element size of 32 bits. This extension will be added to the SoCET team's 32-bit RISC-V core to improve its performance on the aforementioned tasks in embedded applications. We will implement a 'scalar bypass' design that adds vector execution stages at the end of the scalar pipeline and will generate micro-ops to execute complex instructions. The hardware RTL design will be done in SystemVerilog, and the design will be simulated and verified using Verilator. The eventual goal is to fabricate the design using Skywater's 130nm process node. To demonstrate performance improvements on the target applications, we will use the Embench benchmark suite compiled with Clang , which supports auto-vectorization for the RISC-V ISA. Based on preliminary analysis and research, implementation of the vector extension will result in significant static and dynamic instruction count reductions in key benchmarks which should translate into performance gains by reducing program execution time.

Keywords: Computer Architecture, Vector Processing, Embedded Systems, RISC-V, CPU Performance

Mentor(s):

Mark Johnson (Engineering); Cole Nelson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7005
Presentation Time: 214B at 9:40am-10:00am

Understanding Social Acceptance and Safety Aspects of Sidewalk Delivery Robots

Innovative Technology/Entrepreneurship/Design

Author(s):

Areli Viveros† (Polytechnic); Hoang Hua† (Engineering)

Abstract:

As the deployment of sidewalk delivery robots becomes increasingly common, assessing the factors influencing their social acceptance and safety has become imperative. This research delves into the characteristics of these robots, categorizing them based on type (delivery, prototype, or others) and the environment of operation (indoor or outdoor). A comprehensive review of existing studies, utilizing Google Scholar, Scopus, and Web of Science databases, was conducted, scrutinizing the methodologies employed, such as surveys, videos, observations, and the types of questions posed (Likert, etc.). Evaluation criteria encompassed speed, distance, functionality, appearance, and the potential impact of social demographics.

Our research findings emphasize crucial aspects of interaction, perception, safety, and other. Our results highlight the significance of enhancing delivery robots' human-like qualities to build trust and acceptance. Pedestrians generally feel more at ease when they maintain a certain distance from these robots, and prefer those that exhibit amiable social behavior while moving at a slower pace. It is apparent that pedestrians prefer audio and visual feedback mechanisms. Safety, influenced by the robot's path and speed, is a significant concern. Furthermore, our investigation underscored the dearth of standardized knowledge regarding these robots, while revealing that bystanders often express empathy when these machines encounter obstacles. Job displacement emerged as a prominent concern, contrasting with the potential benefits for individuals with reduced mobility. Notably, visually impaired individuals articulated apprehensions due to the lack of accessible feedback and standardized knowledge, underpinning the crucial nexus between safety, acceptance, and public comfort in the presence of delivery robots.

Keywords: Sidewalk Delivery Robots, Social Acceptance, Safety Perception, Human-Robot Interaction, Autonomous Robotics

Mentor(s):

Tho Le (Polytechnic)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7006
Presentation Time: 214A at 10:00am-10:20am

RETHi: Fire Resilience in Space Habitats

Innovative Technology/Entrepreneurship/Design

Author(s):

Krish Thakkar† (Engineering); Ben Krugman† (Engineering); Audrey DeKoninck† (Engineering, JMHC); Ella Richardson† (Engineering, JMHC); Meredith Clark† (Engineering); Kathleen Martinus† (Engineering)

Abstract:

Permanent habitation on Moon or Mars is an essential step in our outer space exploration roadmap as humankind. To operate under disruptions requires the achievement of resilience of the habitat through safety controls. In this project, we focus on a preliminary study to demonstrate the influence of safety control strategies for a normal residential house on Earth. We consider the disruption as building fire. To capture the disruption and the response, we build and program four core components: fire model, prevention model (surge protectors, fire doors, and firewalls), detection model (fire detectors, smoke detectors), and mitigation model (extinguishers). Last three component functions as a passive or active safety control strategy which can be readily changed to varying effectiveness for comparison. To test effectiveness of different safety controls, we utilize Markov process modeling for performing hundreds of rapid simulations. Then, we are able to visualize trends with tabulated data and graphs. Along with resilience, all encompassing costs of layouts are also tracked over time, delivering comprehensive outcomes. Overall, this project can steer house configurations for optimal fire resilience, and serve as the basis for performing similar studies in the outer space environment.

Keywords: Resilience, Fire Safety, Simulations, Modeling, Habitats

Mentor(s):

Xiaoyu Liu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7007
Presentation Time: 214A at 10:20am-10:40am

Research and Development in IoT and Edge Processing

Innovative Technology/Entrepreneurship/Design

Author(s):

Maximillian Farrell† (DSB); Jack Scarfo† (Engineering); Arjun Gupte† (Engineering); Anish Asthi† (Engineering); Akshath Raghav† (Engineering); Sergio Montalvo* (Engineering)

Abstract:

The Bechtel Innovation and Design Center (BIDC) is Purdue's central makerspace and a creative hub for makers across campus. With facilities ranging from machine shops to electronics labs, 3D design studios, and more, the BIDC provides essential resources for all engineering projects. With numerous students utilizing this shared space simultaneously, ensuring safety is the highest priority. However, the BIDC lacks a robust and intelligent automated system that monitors the environment and alerts occupants before an incident occurs. We address this critical gap and ensure the safe operation of tools and machinery by monitoring signs of danger by building an array of sensors and working with our ML team. Previous teams have laid the initial groundwork for air quality sensing and data logging using Sensirion SEN55s linked to Orange Pis. Our team is creating new sensor nodes with a Wi-Fi enabled microcontroller that allows us to centralize ML classification to one Orange Pi. These ESP32 microcontrollers use an ad hoc network called ESP-NOW. An Orange Pi 5 stores and will eventually process the data. Our project includes a robust data pipeline to manage insights from our sensor network. It seamlessly integrates data into a local database for immediate storage and analysis. Real-time monitoring is ensured through automatic synchronization with an online NoSQL database. Weekly updates will include predicted labels generated by our prediction system. By combining sensor data with these labels, we will enhance the capabilities of our system, enabling continuous model improvement through re-training.

Keywords: IoT, Edge Processing, Safety, Monitor, Air Quality

Mentor(s):

Matthew Swabey (Engineering); Jaeeun Kim (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7008
Presentation Time: 214A at 10:40am-11:00am

Pulse Flow Reverse Osmosis System for Applications in Vertical Farming

Innovative Technology/Entrepreneurship/Design

Author(s):

Emerson Zubb† (Engineering)

Abstract:

Reverse osmosis is the most efficient method of purifying and recycling contaminated water. However, reverse osmosis is a process that requires high pressure systems, and somewhat involved flushing cycles of the membranes used to separate clean water from brackish water. There is a need for a streamlined process for the filtration of water, so the process is more continuous and efficient. Current trends in urban and vertical farming rely heavily on clean water for the production and sustainability of freshly produced foods grown indoors. An energy efficient and streamlined approach for recycling water in indoor farms will improve the sustainability of vertical farms by reducing water consumption and water contamination. This project is focused on the design, prototyping and testing of a Pulse Flow Reverse Osmosis test bench for the application of recirculating water in a vertical farming prototype. The system will be tested by examining a variety of properties such as water pressure, temperature, flow, and light intensity. The goals of this project are centered around studying the feasibility of implementation of a novel and efficient reverse osmosis system for water purification and recycling to be used in indoor hydroponic systems.

Keywords: Sustainable Cities, Urban Environments, Water Management, Reverse Osmosis

Mentor(s):

José Garcia (Polytechnic)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7009
Presentation Time: 214B at 10:00am-10:20am

Effect of Marburg virus VP40 matrix protein mutations on virion assembly and budding

Life Sciences

Author(s):

Mahesh Gupta† (Science, JMHC)

Abstract:

Marburg virus (MARV) is a lipid-enveloped negative-sense single stranded RNA virus. It can cause a deadly hemorrhagic fever and has had sporadic outbreaks in sub-Saharan Africa. There is no specific treatment for Marburg virus. MARV encodes seven proteins, including VP40 (mVP40), a matrix protein that dimerizes at the plasma membrane inner leaflet to facilitate the budding of viral particles from the host cell. A previous study deep-sequenced the MARV genome after passages of MARV, revealing VP40 mutations acquired when the virus enters a host. These mutations can be advantageous or harmful to the virus by affecting plasma membrane oligomerization of VP40. Studying these mutations could lead to the identification of regions of the viral genome that are specific for virulence.

A suite of mutants including mVP40-S34P, V57A, and T111A were made and fused with green fluorescent protein (GFP). A human cell line was transfected with VP40 mutations to produce virus-like particles (VLPs). Confocal imaging was used to determine if the wild-type phenotype, VP40 aggregation at the plasma membrane, occurred or if the mutation altered plasma membrane localization. Additionally, mutant protein production was quantified via western blot analysis. Imaging showed no altered phenotypes among the three mutant proteins. This study will identify if mVP40 mutations alter plasma membrane assembly and budding, and it could serve in identifying targets for the treatment of Marburg virus.

Keywords: Marburg Virus, Filovirus, Plasma Membrane, Viral Budding, Oligomerization

Mentor(s):

Rob Stahelin (Pharmacy); Balindile Motsa (Pharmacy); Roopashi Saxena (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7010
Presentation Time: 214B at 10:20am-10:40am

Quantum Metrology for New-Era Electronics

Innovative Technology/Entrepreneurship/Design

Author(s):

Joseph Lopez† (Engineering, JMHC)

Abstract:

Redacted

Keywords: Quantum Sensing, NV Center, Spintronics, Nanotechnology, Semiconductors

Mentor(s):

Pramey Upadhyaya (Engineering); Abhishek Solanki (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7011
Presentation Time: 214B at 10:40am-11:00am

Assessing How Parasite Exposure Frequency and Dosage Influences Infection Risk in PFAS-exposed Grey Tree Frogs

Life Sciences

Author(s):

Alyssa Johnson† (Agriculture, JMHC)

Abstract:

Per- and polyfluoroalkyl substances (PFAS) are persistent environmental contaminants known to bioaccumulate in the environment and adversely affect ecosystem health. PFAS exposure in wetland systems occurs alongside stressors, such as parasitism. While previous studies identified the effects of PFAS on host-parasite interactions, little information is available regarding how trematode exposure dosage and frequency impacts infection risk in PFAS-exposed tadpoles. We assessed this limitation using a two-stage experimental design with tadpoles and trematodes. Our first stage included a 10-day exposure to 10 ppb perfluorohexanesulfonic acid (PFHxS). During stage two, we exposed individual tadpoles to 50 or 100 echinostomes at three timing intervals: 0-day, 2-days, and 5-days post-PFAS exposure. Additionally, we exposed a treatment group to either 10 or 20 trematodes daily for 5 days to assess the effects of PFHxS on trematode loads with constant exposure. Results to date have found that tadpoles exposed to trematodes continually for 5 days yielded higher trematode loads than tadpoles in the 0-day group within both the control and PFAS treatments. Additionally, within the 0-day trematode exposure group, we observed higher trematode loads in PFAS-exposed tadpoles compared to the control group. Lastly, trematode loads did not differ between the control and PFAS exposure groups when tadpoles received trematodes continually for 5 days. These findings emphasize the importance of assessing the influence of contaminants on host-parasite dynamics at multiple timings and doses and suggest that trematodes may be able to infect tadpoles more effectively at lower concentrations, possibly due to decreased competition.

Keywords: Ecotoxicology, Disease Ecology, PFAS, Amphibians, Echinostomes

Mentor(s):

Jason Hoverman (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7012
Presentation Time: 214C at 10:00am-10:20am

AI-Based Learning and Stressors: Stumbling up the Learning Curve

Innovative Technology/Entrepreneurship/Design

Author(s):

Leland Huey† (HHS, Science)

Abstract:

The purpose of this study is to understand how AI vs. human feedback influences learners’ skill acquisition over time. This study separated 530 participants into four different learning conditions. Participants in each condition used a virtual reality welding simulator to practice welding techniques across six attempts. After each trial, participants received feedback based on their experimental condition. These included 1) the AI software equipped on the simulator gave feedback on welding skills demonstrated, 2) an experimenter provided feedback, 3) both the experimenter and the AI software provided feedback, and 4) the participant received no feedback. Regardless of the learning condition, each weld made by a participant was graded by the AI learning software and given a score from zero to one hundred.

We expect that experiencing a decrease in performance after receiving the first round of feedback is a stressful event that lowers learners’ subsequent welding scores below what they have demonstrated they are capable of. Based on feedback intervention theory, these effects are likely stronger with human feedback. We will explore the effects of initial post-feedback performance (difference of performance in trials 1 and 2) and feedback source on subsequent performance and stress.

Learning involves making mistakes, and how learners react to these mistakes depends on their training environment. As artificial intelligence takes a larger role in organizations, individuals may find themselves getting training feedback from technology. This study explores the potential benefits of using AI to reduce learners’ stress and promote their skill acquisition.

Keywords: Interference Theory, IO Psychology, Learning, Stress, Artificial Intelligence

Mentor(s):

Jerod White (HHS); Tara Behrend (Michigan State University)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7013
Presentation Time: 214C at 10:20am-10:40am

A Psychological Investigation of Crisis Center Volunteer Well-being

Social Sciences/Humanities/Education

Author(s):

Sierra Allen† (Science, JMHC)

Abstract:

The goal of this research (which is currently in progress) is to examine (a) whether crisis center volunteers are experiencing burnout and compassion fatigue and (b) whether individual factors such as personality and empathy can influence the occurrence of burnout and compassion fatigue. Crisis centers serve their communities by offering confidential and non-judgemental support to individuals who are experiencing a crisis. Many of the people who keep the lines running are trained volunteers. These volunteers usually work remotely and help by taking shifts (usually around 4 hours each) to cover the line 24 hours a day, 7 days a week, every day of the year.

The data collection plan involves one survey that will be taken by volunteers at a local crisis center. The survey questions will help investigate the personality, emotions, and behaviors of volunteers overall, as well as their experiences as volunteers with the crisis center. Through this, the research aims to identify if burnout and compassion fatigue are prevalent in this population and how these are related to the personality of volunteers and the experiences they have when volunteering with the organization.

During the expo presentation, we will present our study design, goals, and review of existing research on this subject. This study seeks to contribute to an emerging body of research on crisis center volunteer experiences of burnout and compassion fatigue, as well as research showing correlations between personality traits and the experience of burnout and compassion fatigue.

Keywords: Crisis Center, Volunteer, Burnout, Compassion Fatigue, Personality

Mentor(s):

Sang Woo (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7014
Presentation Time: 214C at 10:40am-11:00am

The effects of chronic PFOS exposure on motor behavior

Life Sciences

Author(s):

Hurshal Pol† (HHS, JMHC)

Abstract:

Per and polyfluoroalkyl substances (PFAS) are a group of persistent organic pollutants that accumulate in the human brain. Perfluorooctanesulfonic acid (PFOS), the most prevalent PFAS pollutant, targets dopaminergic pathways which may lead to motor disorders, such as Parkinson's disease, and neuropsychiatric disorders, such as attention deficit/hyperactivity disorder (ADHD) and major depressive disorder (MDD). We hypothesized that chronic exposure to PFOS causes motor deficits using a mouse model. Mice were treated with drinking water containing 1.0 mg/kg/d PFOS or 0.5% tween-20 vehicle. After 16 months of dosing, neurobehavioral tests were conducted to assess cognitive and motor function. Locomotor activity measured exploratory activity levels in a box over an hour. Male PFOS-treated mice exhibited significantly elevated activity levels compared to controls and there was no effect on female mice. Challenging beam traversal assessed nigrostriatal motor function as mice traversed a wire-mesh-covered beam. Male PFOS-treated mice required significantly less time to traverse the beam, whereas female PFOS-treated mice required significantly more time to traverse the beam. Male mice had significantly increased errors/step and total errors compared to female mice, with no effects of PFOS treatment. This study demonstrates that chronic exposure to PFOS causes sex-specific hyperactivity in male mice and potential decreased motor function in PFOS-treated female mice. Given PFOS did not induce changes in errors/step, motor function alterations are likely independent of the nigrostriatal pathway affected in Parkinson's disease. Changes in activity level may suggest PFAS are affecting dopaminergic pathways (e.g. mesolimbic pathway) involved in neuropsychiatric disorders such as ADHD and MDD.

Keywords: Perfluorooctanesulfonic Acid (PFOS), Neurotoxicology, Neuropsychiatric Disorders, Chronic Exposure, Motor Behavior

Mentor(s):

Jason Cannon (HHS); Josephine Brown (HHS); Fatema Currim (HHS); Tauqueerunnisa Syeda (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7015
Presentation Time: 214D at 10:00am-10:20am

The Effect of Weaning and Transportation Stress on Subsequent Performance of Average Piglets

Life Sciences

Author(s):

Isabel Turner† (Agriculture, JMHC)

Abstract:

The modern American swine industry relies on a model where facilities for farrowing (birth) and lactation are geographically isolated from those used for later growth and finishing stages. This system necessitates multiple coincident stressors in the form of weaning, mixing, transportation and feed/water restriction. Previous studies indicate this combined stress reduces subsequent growth performance, however, the specific impact of each stressor on an average, objectively healthy piglet is not well understood. In this study, a total population of 588 piglets were weighed the day prior to weaning and N=230 piglets with the lowest Z-scores for body weight were selected. From this population N=70 were weaned directly into nursery pens and provided with feed and water, N=70 were transported for 10 hours with no access to feed/water and N=70 were grouped together into 2 large pens with no access to feed/water for an equivalent 10 hrs period. The remaining N=20 piglets were not weaned and served as an unstressed control group. N=10 pigs from each group were euthanized at 24 hours and 48 hours post weaning for tissue sampling. The remaining N=50 piglets from the three weaned groups were then weighed weekly throughout the nursery phase to determine the impact of each stressor on growth. There was no significant affect of treatment on long term growth performance of pigs, however, the acute response is still being evaluated.

Keywords: Swine, Growth Performance, Stress Response, Weaning, Transportation

Mentor(s):

Alex Pasternak (Agriculture)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7016
Presentation Time: 214D at 10:20am-10:40am

African American Studies and Research Center Undergraduate Summer Research Internship Program

Social Sciences/Humanities/Education

Author(s):

Nah'Shon Williams† (Liberal Arts)

Abstract:

This project will be a synopsis of my summer in the Office of Undergrad Research's African American History program. My time in the program was formative in my development as a historian and its my endeavor to promote it.

Keywords: Research, Formative, African American History, Immersive, Exposure

Mentor(s):

Cornelius Bynum (Liberal Arts); Amy Childress (Libraries)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7017
Presentation Time: 214D at 10:40am-11:00am

Purdue's AI Usage

Innovative Technology/Entrepreneurship/Design

Author(s):

Anjana Kidambi† (Liberal Arts)

Abstract:

AI within Purdue University's educational system is beginning to become a highly debated topic between staff members, students, and faculty. Purdue Global (online) is a leader in exploring AI opportunities in higher education, with an AI task force drawing on creativity and innovative thinking. A study has found that using AI generative bots, such as ChatGpt in Purdue Global shows promise of further-thinking and open-minded learning in higher education. Students find AI bots helpful and think that AI provides guidance rather than straight answers. Furthermore, Purdue University has published articles written by credible authors explaining the limits of AI within the university as well as what AI could provide the university. From this, it is found that research about AI in education is practical as well as has the ability to streamline processes and enhance efficiency so that individualized experiences at Purdue. Faculty of Purdue have begun to encourage AI use hoping that bots become a tool for guidance and not terribly wrong answers. AI is by no means unbiased or perfect as addressed by these studies, but with further technological improvements and research on AI's effect on students, it is hopeful that AI can be used for great improvements of the education system within Purdue University and higher education.

Keywords: AI, Higher Education, Research, Innovation, Bots

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7018
Presentation Time: 214A at 11:40am-12:00pm

Examination of Racial Tensions at Midwest Waffle Houses

Social Sciences/Humanities/Education

Author(s):

Mia Rodriguez† (HHS, Liberal Arts)

Abstract:

Current research regarding the American restaurant chain Waffle House, emphasizes racial tensions that transpire. In particular, many researchers discuss the role of Southern history and culture, and how this informs racially contentious interactions. However, research regarding racial tensions in Midwest establishments has yet to be investigated. Waffle House advertises an inclusive environment; its 24-hour service brings late-night partygoers, truck drivers, college students, families, and lone travelers. In this context, when examining interactions between diverse groups, Waffle House is a melting pot of individuals with different socioeconomic, racial, and class backgrounds. Many Waffle Houses are located in the bible belt region, but as the popularity of these establishments grew, Waffle Houses opened numerous locations in the Midwest. Research describing incidents at Waffle House establishments, primarily reports of lawsuits concerning racial discrimination in the Southeastern United States. My research seeks to identify racial tensions at Midwest Waffle Houses. Specifically, I will address how the history of racial discrimination in the Midwest informs racially contentious interactions, and compare racial tensions in the South and Midwest. In this research proposal, first I will conduct an extensive literature review of the history, lawsuits, and literature concerning racial discrimination at Southern and Midwest establishments. Second, I will utilize qualitative research methodologies to document racial tensions at Midwest locations. I intend to visit various Waffle House establishments and observe interactions between individuals. My research design is emergent and responsive to the discovery of new concepts and topics as my study unfolds.

Keywords: Racial Tensions, Racial Discrimination, Symbolic Interactionism, Midwest Values, The Southern Imaginary

Mentor(s):

Youli Mantzicopoulos-James (Education); Spencer Headworth (Liberal Arts); Brenda Shein (Education); Phoebe Pham (Education); Xiang Zhou (Education)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7019
Presentation Time: 214B at 11:00am-11:20am

Revolutionizing Autonomous Driving: Enhancing YOLOv4 with Vision Transformers for Robust Computer Vision

Mathematical/Computation Sciences

Author(s):

William Stevens† (Science); Mykhailo Tsysin† (Engineering); Vishal Urs† (Engineering); Karthik Selvaraj† (Engineering); Gabriel Torres† (Engineering)

Abstract:

With the prevalence of autonomous vehicles, the computer vision algorithms utilized for autonomous driving must be robust and accurate to assess road features through images captured in real time. In our previous work, we designed and implemented a multi-task neural network model according to the YOLOv4 architecture and trained on the BDD100k dataset, to give detections and classifications of objects, as well as segmentations and classifications of lane lines, in an image. While last semester's model was successful, there was room for improvement. This semester, we explored potential optimizations including the use of a vision transformer and other structural improvements to last semester's implementation. This process included the research, development, and testing of the transformer concept, which was revolutionized by its applications to natural language processing, specifically in chat bots such as ChatGPT. We focused on its applications to computer vision and object detection to benefit from its cutting-edge attention mechanism functionality, and implemented the concept into our model architecture as well as various other modifications to the model's control flow, allowing for increased performance and efficiency during training. These new developments will allow our multi-task model to perform the three vision tasks for autonomous driving at a lower computation cost while also achieving higher accuracy, thus creating an improved version of the model for future work to build upon.

Keywords: Computer Vision, Autonomous Driving, Vision Transformers, Object Detection, Lane Segmentation

Mentor(s):

Edward Delp (Engineering); Carla Zoltowski (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7020
Presentation Time: 214B at 11:20am-11:40am

Investigation of Tactile and Strain Sensing Utilizing Carbon-Fiber Network in Silicone Elastomer Matrix

Innovative Technology/Entrepreneurship/Design

Author(s):

Harry Lee† (Engineering, JMHC)

Abstract:

Wearable technologies seamlessly merge the digital and the physical world and have become widely used in industries such as entertainment, sports, military, healthcare, and security. With the growing popularity of wearable devices, flexible sensors play a crucial role in user interaction with technology. This study demonstrated multi-touch spatial mapping, normal force sensing, and strain sensing using carbon fiber as electrodes insides a silicone rubber matrix. The manufacturing method of the sensors adopted the wet layup and vacuum bagging process of thermoset composite manufacturing techniques, which resulted in a fast and cost-effective production method. The multi-touch spatial mapping capabilities were achieved through projected mutual capacitive touch sensing. Normal force sensing and strain sensing were achieved through resistive sensing, where physical deformation created changes in resistance of the carbon-fiber network within the silicone. The normal force sensor was characterized for its sensing range and sensitivity and the strain sensor was characterized for its range and sensitivity as well as its ultimate strength and stiffness. While each capability was demonstrated separately, the future aim is a multifunctional sensor using a carefully designed carbon fiber network within a silicone rubber. With the exceptional strength and fatigue resistance that carbon-fiber provides, these multifunctional sensors broaden the application of flexible sensors for harsher environments.

Keywords: Wearable, Carbon Fiber, Soft Robotics, Multifunctional Materials, Tactile Sensing

Mentor(s):

Garam Kim (Polytechnic); Eduardo Barocio (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7021
Presentation Time: 214B at 11:40am-12:00pm

3D Printed Porous Structure For Mircrobump Bonding

Innovative Technology/Entrepreneurship/Design

Author(s):

Cole Stephens† (Engineering)

Abstract:

As the physical limitation's of Moore's Law are beginning to be reached, the use of two-dimensional Integrated Circuits (IC's) are started to get phased out with Three-dimensional ICs. This advanced semiconductor device stacks multiple ICs on top of one another allowing for increased performance, reduced power consumption, and improved form factor. ICs are stacked using µbumps formed through Cu-Sn bonding of Cu Pillar and Sn alloy. The solder materials are heated to form high melting point intermetallics (IMC) to provide electrical connectivity and mechanical stability to stacked dies and allow for Heterogenous Integration. The diameter of Cu pillar micro-bumps in advanced package is usually below 40um. As the size of the µbump shrinks (with the miniaturization of electronic package size) to several microns, the volume of tin solder will need to decrease cubically. This current miniaturization causes issues with solder leakage as the high melting point creating the intermetallic (IMC) bonds of Cu_6Sn_5 can often move unpredictably, especially if Cu_3Sn is present due to corrosion of external oxygen and moisture. To solve this, microporous surface modification can be used to develop high density copper µbumps to prevent solder leakage. The focus of this project is a determination of the feasibility of the fabrication process of these porous structure solutions. Three main different types of porous models were explored and developed using SOLIDWORKS with µbump geometry in consideration. The specific process flow used for fabrication included two photon 3D microprinting our samples onto a copper surface using !P-Q resin. The model was then electroplated in a $CuSO_4$ and H_2SO_4 electrolyte solution. In the development stage, we treated the model with Acetone to revel the etched surface of the porous structure. In terms of Data Analysis, electroplating simulations were performed on the structure design to analyze effects of electroplating on our structure. Thermal cycle simulations were ran on our models to asses thermal properties and resistance. Scanning Electron Microscopy (SEM) was used to acquire real time visuals of the structure.

Keywords: Advanced Packaging, Semiconductors, Intermetallic Bonding, Integrated Circuit, Fabrication

Mentor(s):

Tiwei Wei (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7022
Presentation Time: 214C at 11:00am-11:20am

Effect of Social Demands on Occurrence of Repetitive Behaviors in Children with Autism

Social Sciences/Humanities/Education

Author(s):

Riley Rozniarek† (HHS); Anna Hodge‡ (HHS, JMHC); Mallory Schrof‡ (HHS)

Abstract:

Restricted interests and repetitive behaviors are a broad category of symptoms exhibited by individuals with autism, genetic disorders, and intellectual disabilities. However, research investigating these behaviors, and the contexts in which they occur is limited. The purpose of the present study is to examine the occurrence of three types of repetitive behavior (motor, object use, and speech) in low- and high-demand social contexts. To date, data from 29 participants (22 autism, 7 non-autism developmental delay) have been analyzed. Repetitive behavior type (motor, object use, or speech) and the level of social demand (high, low) have been coded using ELAN software. A total of 133 behaviors were recorded, 86 (65%) occurred in high-demand social contexts and 47 (35%) occurred in low-demand contexts. Motor and speech behaviors were more likely to occur in high-demand social situations, whereas object-use behaviors were present in equal distributions across low- and high-demand contexts. Preliminary findings highlight a link between high-demand social contexts and increased frequencies of repetitive behaviors. Our findings support the hypothesis that repetitive behaviors may be used as a coping mechanism and suggest object-use repetitive behaviors may have a different function than speech and motor repetitive behaviors. These findings can help caregivers and clinicians better understand the function of repetitive behaviors.

Keywords: Autism, Repetitive Behaviors, Developmental Delay, Social Demand

Mentor(s):

Brandon Keehn (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7023
Presentation Time: 214C at 11:20am-11:40am

Which Attitudinal Risk Factors for Sexual Violence Predict Sexual Objectification Perpetration Among College Men?

Social Sciences/Humanities/Education

Author(s):

Marie Blankenberger† (HHS, Liberal Arts)

Abstract:

Introduction: Sexual violence occurs along a continuum and includes behaviors ranging from unwanted sexual comments to rape. Despite the well-documented prevalence of sexual violence on college campuses, most research has focused on more severe manifestations, such as sexual assault and forced penetration. As a result, far less is known about less severe forms of sexual violence, such as women’s experiences of sexual objectification. The present study seeks to fill this gap in the literature by examining if attitudinal risk factors for sexual violence predict college men’s perpetration of sexual objectification towards women. Methods: Participants included 275 undergraduate heterosexual college men reporting past-year sexual activity with a female partner. As part of a larger study, men completed measures assessing 14 unique attitudinal risk factor constructs, as well as past-year perpetration of sexual objectification. Results: A total of 84.4% of participants (n = 232) reported past-year perpetration of sexual objectification. The overall model was significant (p < .001) and collectively predicted 22.4% of the variance in sexual objectification (R2 = .224). Attitudinal risk factors predictive of sexual objectification perpetration included: dominance (p = .001), masculine gender role stress (p = .024), and men’s rape attitudes and beliefs (p = .019). Discussion: These findings shed light on specific attitudinal risk factors that contribute to non-physical forms of sexual violence. Potential implications for interventions seeking to prevent sexual objectification will also be discussed.

Keywords: Sexual Violence, Attitudinal Risk Factors, Sexual Objectification, Gender Roles, Rape Myth Acceptance

Mentor(s):

Chris Eckhardt (HHS); Daniel Oesterle (HHS); Niamh Christie (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7024
Presentation Time: 214C at 11:40am-12:00pm

Nutritional Nudges in US-based East Asian Restaurants

Social Sciences/Humanities/Education

Author(s):

Clay Watkins† (HHS); Ansley Smith* (HHS); Shuhan Sun* (HHS)

Abstract:

With a high proportion of meals eaten away from home in the US combined with the demand for healthier options, restaurants can benefit from menu and restaurant design that nudge customers towards healthier decisions. This study aimed to understand whether US restaurants predominately serving East Asian cuisine use menu and restaurant design to nudge customers towards healthier options more than restaurants predominantly serving Western cuisine. Non-probability purposive sampling was used to select restaurants in the greater Lafayette, Indiana, area. Using the Nutritional Nudges Inventory at Restaurants survey tool, investigators scored 30 restaurants on the “nudges” available that may prompt customers to eat healthier, spanning categories such as lean foods, healthy preparation, menu and restaurant design, and offerings of fruits, vegetables, and whole grains. East Asian restaurants aggregately scored less than their Western counterparts by -2.15 points. The results of this study reveal an opportunity to increase nudges toward healthy eating in US restaurants serving East Asian cuisine. Further research is needed to determine which nudges are most effective for various restaurant types.

Keywords: Nutritional Nudges, Restaurant Design, Menu Design, East Asian Cuisine, Healthy Nudges

Mentor(s):

Karen Byrd (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7025
Presentation Time: 214D at 11:00am-11:20am

Russian Media Language and Techniques in Turbulent Times

Social Sciences/Humanities/Education

Author(s):

Evan Landau† (Engineering)

Abstract:

Since the intensification of the war between Russia and Ukraine, Russian popular media has focused on propagandizing and promoting the conflict. The research team focused on television media, to build on previous research studying Russian state-sponsored print media. The team investigated the methods used by Russian state-sponsored television programs to influence and manipulate the audience to better understand the political, cultural, and linguistic aspects of the conflict.

The team watched, analyzed, and partly translated episodes from two popular Russian political talk shows, and looked for commonalities in the techniques used and contrasts between the two programs. Both programs are state-sponsored and focus heavily on international issues, ensuring that information is relevant to the ongoing conflict. Overall, the team found that the techniques used were broadly similar, but that one show focused more on interpersonal arguments and the other focused more on satire. On the other hand, both programs had aggressive and assertive presentation styles, used clips from Western sources, and discussed unrelated topics to build credibility. Together, these techniques make these hosts persuasive and create effective propaganda.

Keywords: Russian, Language, Media, Propaganda

Mentor(s):

Olga Lyanda-Geller (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7026
Presentation Time: 214D at 11:20am-11:40am

Analyzing the Dynamics of Online Political Discourse through Temporal Community Detection

Social Sciences/Humanities/Education

Author(s):

Juniper Rodriguez† (Liberal Arts)

Abstract:

The digital sphere serves as fertile ground for political discourse to flourish. However, within online spaces, the political views expressed are often extreme and pose a potential threat to constructive and nonpartisan discourse. Often, the radical ideologies incubated within these spaces seem to be affected by current events as they adapt and evolve in response to the shifting political landscape. Emerging literature has found Natural Language Processing to be a promising class of methods for textual analysis, especially when interpreting political ideology and beliefs. For this project, we looked at the comment sections of five prominent U.S. news websites spanning the political spectrum: Mother Jones, The Atlantic, The Hill, Breitbart, and Gateway Pundit. Our dataset contains 401 million comments posted on these platforms by 643 thousand commenters from 2012-2019, which are then further sorted into 200-300 topics per platform. This research project utilized BERTopic modeling to create networks of topics, with the edges composed of C-TF-IDF (Class-Based Term Frequency-Inverse Document Frequency) vectors. We ran a temporal Louvain community detection algorithm on the networks, unveiling latent themes within each community of topics. From there, we will conduct analyses to examine the relationship between current events (e.g., wars, elections, protests, etc.) and network events (i.e., where does the community split/merge, grow/contract, appear/disappear). By utilizing tools such as topic modeling, community detection, and network analysis, we can examine how these political communities online adapt in response to real-world occurrences.

Keywords: Network Theory, Politics, Natural Language Processing, Digital Anthropology, Communication

Mentor(s):

Jeremy Foote (Liberal Arts); Mirta Galesic (Santa Fe Institute)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7027
Presentation Time: 214D at 11:40am-12:00pm

Linguistic Changes in the Economic and Business Domains of the Russian and Ukrainian Languages

Social Sciences/Humanities/Education

Author(s):

Davyd Revenko† (DSB, JMHC)

Abstract:

Language is a constantly evolving part of every culture that reflects shifts in society, technology, and the global landscape. The changes are especially rapid in areas that are developing and growing worldwide every day. My research focuses on the linguistic transformations within the Russian and Ukrainian languages, particularly in the context of business and economics. It examines the emergence of new vocabulary, the adaptation of foreign terms that have no synonyms, as well as those with existing equivalents, and the creation of innovative words by Russian and Ukrainian speakers. This research provides insights into how business language evolves to meet the demands of a changing economic and business environment, shedding light on the influence of globalization, technology, and cultural exchange on linguistic developments in this domain by categorizing words, and looking at trends in the modern Russian and Ukrainian languages.

Keywords: Business, Economics, Russian and Ukrainian Languages, New Words, Foreign Terms

Mentor(s):

Olga Lyanda-Geller (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7028
Presentation Time: 214A at 12:00pm-12:20pm

Modeling and Simulating Initial Task Allocation in Multi-Human Multi-Robot Teams

Mathematical/Computation Sciences

Author(s):

Arjun Gupte† (Engineering)

Abstract:

Multi-human multi-robot (MH-MR) teams hold significant potential for tackling complex and large-scale tasks by leveraging collaboration between humans and robots, each bringing unique capabilities and expertise. Effectively operating these heterogeneous teams and optimizing team performance necessitates advanced initial task allocation (ITA) strategies that account for the distinct characteristics of team members and tasks. However, current research lacks a robust simulation environment that adequately models the dynamics and heterogeneity inherent in MH-MR teams. Our research aims to bridge this gap by introducing a simulation environment built on the Webots platform and ROS2 to serve as the research basis of the ITA problem. Our simulation specifically focuses on a realistic large-scale environmental surveillance task, which requires collaboration between multiple human operators, Unmanned Aerial Vehicles (UAVs), and Unmanned Ground Vehicles (UGVs). We meticulously encode the heterogeneity of the MH-MR teams by considering various human factors, such as cognitive ability and operational skills, as well as robot characteristics like mobility and sensor capabilities. Moreover, we consider task attributes, such as physical location and inherent complexity. To facilitate seamless information flows in this multi-agent system, we leverage ROS2. To evaluate the effectiveness of our developed simulation, we conducted extensive experiments with different team configurations and state-of-the-art ITA strategies and compared the resulting team performances. Preliminary results indicate that our simulation environment provides a realistic and comprehensive framework for studying the ITA problem in MH-MR teams.

Keywords: Multi-Human Multi-Robot Collaboration, Heterogeneous Multi-Agent Teams, Initial Task Allocation, Physics-Based Robot Simulation, Robot Operating System (ROS2)

Mentor(s):

Byung-Cheol Min (Polytechnic); Ruiqi Wang (Polytechnic)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7029
Presentation Time: 214A at 12:20pm-12:40pm

Additively Manufactured Dissolvable Packaging for Recycle and Reuse of Chips for Sustainable Reduction of E-Waste

Innovative Technology/Entrepreneurship/Design

Author(s):

Sunehra Saleha† (Engineering); Hannah Houston‡ (Engineering); Carl Hahn‡ (Engineering)

Abstract:

Redacted

Keywords: Integrated Circuits, Additively Manufactured Dissolvable Packaging, Electronic Waste, Semiconductors, Recyclable Polymers

Mentor(s):

Muhammad Hussain (Engineering); Dhiya Belkadi (Engineering); Min Sung Kim (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7030
Presentation Time: 214A at 12:40pm-1:00pm

Quantification of intervertebral disc strain from high-resolution ultrasound imaging during dynamic loading

Mathematical/Computation Sciences

Author(s):

Diya Sakhrani† (Engineering); Radhika Kulkarni* (Engineering); Grace Rennekamp* (Engineering)

Abstract:

High-resolution ultrasound imaging employs high-frequency sound waves that can be used to noninvasively visualize the structures within the body, facilitating medical diagnosis without the need for open surgery. The widespread utilization of ultrasound is attributed to its affordability, non-invasive characteristics, and use of non-ionizing radiation. Nevertheless, ultrasound is prone to artifacts originating from the surrounding environment, gas-liquid interfaces, or dense tissue. These artifacts are common in ultrasound images and can cause dropout, noise, and degraded resolution. In this study we analyzed intervertebral disc (IVD) strain during two axial compression testing cycles of bovine intervertebral discs with a 2-dimensional direct deformation estimation (2D-DDE) strain mapping approach. Currently, signal dropout and noise can inhibit accurate strain analysis. With electrical noise present in the images collected, we focused on reduction of the artifact present after acquisition. Specifically, ultrasound images were averaged across compression cycles to increase the signal-to-noise ratio. This improved the quality of the image and reduced strain dropout when conducting 2D-DDE strain analysis. Image artifacts caused less dropout when averaging ultrasound images across each cycle. These results suggest that the quality of IVD strain analysis from high frequency ultrasound could be improved by image averaging. Future work with additional animal and human studies where disc strain is quantified could help improve our understanding of the relationship between IVD loading and herniation.

Keywords: Intervertebral Disc, High-Frequency Ultrasound, Strain, Direct Deformation Estimation

Mentor(s):

Craig Goergen (Engineering); Elnaz Ghajar-Rahimi (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7031
Presentation Time: 214B at 12:00pm-12:20pm

Structural and Functional Characterization of Phospholipase C β3

Life Sciences

Author(s):

Kennedy Outlaw† (Science)

Abstract:

Phospholipase C β (PLCβ) plays an important role in cardiovascular diseases and opioid analgesia. PLCβ catalyzes the hydrolysis of the inner membrane lipid into two crucial secondary messengers, phosphatidylinositol-4,5-bisphosphate (PIP2) to inositol-1,4,5-triphosphate (IP3) and diacylglycerol (DAG), which activate multiple signaling pathways to modulate cellular behavior. PLCβ is activated downstream of G-protein coupled receptors (GPCRs) by the heterotrimeric G protein subunits Gαq and Gβγ. In small-angle X-ray scattering (SAXS) experiments, the solution structure of PLCβ had additional density unaccounted for in crystal structures, suggesting that its structure was more dynamic than previously thought. To test this, we used cryo-electron microscopy (cryo-EM) single particle analysis to determine the solution structure of full-length PLCβ3 to 4.1 Å resolution. PLCβ3 adopted a compact, autoinhibited conformation under these conditions. This structure confirmed that the proximal C-terminal domain interacts with the core of PLCβ, but the autoinhibitory X–Y linker does not, suggesting more complex regulation of the lipase by the membrane. We are currently working to determine the structure of PLCβ3 on a model membrane to reveal the basally active state of the lipase.

Keywords: Structural Biology, Biochemistry, Cryo-Electron Microscopy

Mentor(s):

Angeline Lyon (Science); Isaac Fisher (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7032
Presentation Time: 214B at 12:20pm-12:40pm

Heterogenous Multicore for Embedded Applications

Mathematical/Computation Sciences

Author(s):

Malcolm McClymont† (Engineering); Burkay Sahin† (Engineering); Devin Singh† (Engineering)

Abstract:

Low power embedded systems often require short bursts of simple computation to interrupt long segments of complex computation. This heterogenous multicore design enables simple, low power applications and complex, high-speed computations to occur on separate cores simultaneously, preventing interruption between tasks. This project extends prior work towards a RISC-V heterogenous multicore processor for the AFTx series of microcontrollers from the System on a Chip Extension Technologies (SoCET) team. The design will feature one power efficient core and one high performance core to demonstrate decreased power consumption and increased computing speed. In a multicore system, memory atomicity and coherence become necessary due to multiple cores reading and writing to shared memory. To achieve coherence, this project will focus on integrating prior work towards MESI cache coherence to private CPU caches. To facilitate the atomicity of data stored in shared memory, the RISC-V Atomic extension will be implemented. This extension adds 9 new instructions that can be used to allow for synchronization between CPU cores. Of these instructions, load-reserved/store-conditional (LR/SC), will be implemented in hardware while the rest will be emulated in software. Individual components will be tested using functional testbenches. Integration of the complete design will be verified using Assembly self-tests and Universal Verification Methodology (UVM). The PAMPAR benchmark suite of parallel benchmarks will be used to evaluate the performance of the implementation.

Keywords: Computer Architecture, Digital Design, Multicore Processors

Mentor(s):

Mark Johnson (Engineering); Cole Nelson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7033
Presentation Time: 214B at 12:40pm-1:00pm

PEAVS: Parallel Encrypted Arithmetic Vector Scheduling

Mathematical/Computation Sciences

Author(s):

Dulani Wijayarathne† (Engineering); Sreevickrant Sreekanth† (Engineering)

Abstract:

Fully Homomorphic Encryption (FHE) empowers secure computations on encrypted data, ensuring privacy in various applications. However, FHE's practicality has been constrained by substantial computational overhead. Recent research has explored vectorization strategies to optimize FHE computations, yet it often overlooks the problem of excessive vector operand rotations in encrypted circuits. This paper leverages Coyote, an effective FHE compiler, capable of vectorizing computational kernels while minimizing rotations. However, it faces challenges with large circuits, leading to excessive rotations and lengthy compilation times.

To address this challenge, we introduce PEAVS, an approach that breaks down extensive arithmetic circuits into smaller replicated subcircuits, vectorizes these subcircuits, and then composes them back into a schedule for the larger circuit. We demonstrate that this strategy significantly improves compilation times, reduces excessive rotations, and minimizes vector instructions, resulting in more efficient and scalable compilation for large circuits.

Keywords: Fully Homomorphic Encryption, Vectorization, Encrypted Arithmetic, Optimization

Mentor(s):

Milind Kulkarni (Engineering); Raghav Malik (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7034
Presentation Time: 214C at 12:00pm-12:20pm

Racial and Ethnic Disparities in Service Referral and Use Among High-Risk Children Diagnosed with Autism Spectrum Disorder

Social Sciences/Humanities/Education

Author(s):

Aaliyah Saunders† (HHS, Liberal Arts); Victoria Bozinovski‡ (HHS); Sarah Langdon‡ (Indiana University)

Abstract:

Background: Early identification of autism spectrum disorder (ASD) and subsequent entry into early intervention is associated with more optimal outcomes. However, prior research has shown that racial/ethnic disparities exist for ASD service utilization and access.

Objectives: To measure racial/ethnic differences in early intensive behavioral intervention (EIBI) enrollment, wait times, dosage, and perceived progress for children diagnosed with ASD.

Methods: Participants included 47 young children with ASD (Non-Hispanic White [NHW]= 25, Any other race [OR] =22). Caregivers completed demographic and intervention surveys. The intervention survey focused on service recommendations and utilization, as well as barriers to service use. Families completed intervention survey within 8 weeks of diagnosis and 6 months later to measure changes in service utilization.

Results: Preliminary results show that at 6 months there were no differences in the proportion of NHW families (40.63%) compared to OR families (60%) receiving EIBI. Furthermore, for provider recommendations, the proportion of children recommended for Applied Behavior Analysis did not differ between NLW and OR families.

Additionally, wait times (NHW = 169.8 days; OR = 199.3days) and dosage (NHW = 28.19 hrs; OR = 31.88 hrs) did not differ between groups. However, perceived child progress was marginally lower in OR compared to NHW families.

Conclusions: Contrary to prior research that has shown disparities in service referral and use, which may negatively impact people of color, our findings show that these disparities may not exist within our current system of care. The current study is in progress; longitudinal data at 12- and 24-months will provide a further description of EIBI access and use in children with ASD.

Keywords: Autism, Disparities, Race, Ethnicity, Children

Mentor(s):

Brandon Keehn (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7035
Presentation Time: 214C at 12:20pm-12:40pm

Analysis of heavy metals in wine using portable X-ray fluorescence (XRF)

Life Sciences

Author(s):

Anthony Bovenschen† (HHS, JMHC)

Abstract:

The recent studies about the heavy metals in foods and drinks raise health concerns. Some heavy metals (i.g., manganese) are essential for everyday life in small doses, large amounts of these metals can be toxic. They have been found to alter the normal functions of vital organs, such as the lungs, brain, liver, kidneys, and more. Long-term exposure can lead to degenerative neurological disorders, and they have been linked to diseases such as Parkinson's and Alzheimer's. This research is motivated by the need to ensure food safety and assess potential health risks associated with wine consumption. Past studies have found trace amounts of mercury in samples of wine, which may pose a threat if consumed regularly and counter the potential health benefits of wine. Understanding the presence of heavy metals in wine and their potential health effects can inform both the wine industry and consumers about the quality and safety of wine products. In this continued study, other heavy metals in the wine were analyzed. Specifically, the concentrations of heavy metals in the wine, the bottle, and the cork or plug were measured using the portable X-ray fluorescence (XRF). A total of eight samples of wine, 4 red and 4 white wines were tested. In the results, heavy metals were found lower than detectable limits in the wine. However, the bottle contained 120.1 ± 6 ppm of lead and 61.9 ± 19 ppm of cadmium which could be a potential risk. In future research, the metals will be analyzed using a method having a lower detectable limit such as inductively coupled plasma (ICP) techniques. Our study will provide insights into heavy metal contamination in wine products and their potential health implications. The findings of this research are expected to contribute to the broader discussion on food and beverage safety.

Keywords: X-Ray Fluorescence (XRF), Heavy Metals, Food and Beverage Safety

Mentor(s):

Jae Hong Park (HHS); Subin Han (HHS); Johnathan Klicker-Wiechmann (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7036
Presentation Time: 214C at 12:40pm-1:00pm

You have the right to remain pregnant: Exploring patient experiences pre- and post- Dobbs in Indiana

Social Sciences/Humanities/Education

Author(s):

Alexandra Finlayson† (HHS); Gracia Bujambi* (HHS)

Abstract:

Abortion and miscarriage use the same medications and procedures as a part of routine care (ACOG et al.) Yet, due to the ways that these reproductive health experiences are differently politicized, access to, and standards of, care vary significantly between them. This study aims to document, explore, and compare the experiences of pregnant people in Indiana seeking abortion and miscarriage-related care. We conducted qualitative, in-depth interviews with 20 people who experienced a miscarriage in Indiana since 2018, and 20 people who had an abortion in Indiana between 2015 and 2018. We audio-recorded all interviews and transcribed them in their entirety. We carried out content and thematic analyses of the interviews using deductive and inductive techniques. Our preliminary analysis reveals that there are significant differences in people's ability to find and access quality miscarriage and abortion care. Abortion patients were able to access care at fewer health service delivery points but generally reflected positively on the care they received. Miscarriage patients were able to access care at a greater number of health service delivery points but had more negative interactions with health care providers. Participants from both groups wanted more information about pain management, products of conception, which are any tissues that developed from pregnancy (Czukas RN, MSN), and the physical process of pregnancy loss. Upon completion of this study, we will use our analysis and results to work with patients and healthcare providers to identify areas of improvement for both miscarriage and abortion care in Indiana.

Keywords: Abortion, Miscarriage, Mifepristone, Misoprostol, Dobbs Decision

Mentor(s):

Kathryn LaRoche (HHS); Scotty Secrist (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7037
Presentation Time: 214D at 12:00pm-12:20pm

How Has Purdue Supported Students' Physical Health on Campus?

Social Sciences/Humanities/Education

Author(s):

Andrew Nilsson† (Science)

Abstract:

As early as 1886, Purdue University has been aware that physical health is an important component of its students' well-being, and therefore their academic performance. Today, college students are not typically physically active, and show low interest in activities that promote an active, healthy lifestyle. This lack of engagement by college students is contradictory to most modern research that suggests that staying physically healthy, through sleep, nutrition, and fitness, can improve well-being and therefore academic achievement. Purdue has made many strides in an attempt to support the physical health and well–being of its students throughout its history through the construction of wellness centers, dining halls, and the creation of health programs. This paper aims to analyze how Purdue University facilitates its students' physical health, how it has changed over time, and how students have benefited, or been disadvantaged by the university's encouragement. An analysis of Purdue's attempts to facilitate physical health throughout history, its students' views on its programs, the number of students who take advantage of its services, and the cost of the programs has been performed. Purdue's Exponent newspaper archives will be utilized to determine how Purdue's facilitation of physical health has affected students. The results of this research could be used by Purdue University as insight into the performance of their promotions of physical health.

Keywords: Physical Health, Wellness, Purdue, Recwell, Student Life

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7038
Presentation Time: 214D at 12:20pm-12:40pm

Nurturing Students' Opportunities to Learn Elementary Mathematics in a Crowded Curricular Landscape

Social Sciences/Humanities/Education

Author(s):

Bronwyn Rigsby† (Education)

Abstract:

Following COVID-19, the curricular landscape was proliferated with online resources, challenging teachers to navigate a wide pool of mandated and supplemental materials to create mathematics learning opportunities for their students. Little is known about how teachers navigate this ever increasingly complex curricular landscape. The purpose of this study was to investigate how three components of teachers' curricular reasoning (i.e., curricular knowledge, curricular vision, and curricular trust) interact with each other when elementary teachers implement a range of these curricular resources. Using a collective case-study design, we identified themes related to the complex relationships among these components for two U.S. elementary teachers. These teachers were selected to provide representation of different grade levels (i.e., third and fourth) and teaching experiences (6 and 11 years). We explored these teachers' curricular decision-making through the lens of curricular reasoning. We used top-down and bottom-up interactive data analysis to draw meaning from a three-phase interview process— two individual interviews followed by a focus-group interview. Our preliminary findings align with Breyfogle et al. (2010), in that teachers' curricular knowledge is foundational to their curricular reasoning, which impacts their curricular vision and curricular trust. Understanding teachers' curricular reasoning in relation to knowledge, vision, and trust contributes to understandings needed to purposefully develop, adapt, and implement mathematics curricular materials in ways that are effective for creating equitable learning environments. Moreover, documenting and disseminating teachers' curricular reasoning is valuable to acknowledge the extensive time and intellectual effort that teachers devote to mathematics teaching.

Keywords: Curricular Decision Making, Curricular Reasoning, Curricular Knowledge, Elementary Mathematics, Mathematics Teaching

Mentor(s):

Jill Newton (Education); Doris Fulwider (Education); Bima Sapkota (University of Texas Rio Grande Valley)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7039
Presentation Time: 214D at 12:40pm-1:00pm

Exploring the Integration of Generative AI, ChatGPT, in Higher Education: A Case Study of Purdue University.

Social Sciences/Humanities/Education

Author(s):

Muhammad Hamza† (Engineering)

Abstract:

The integration of generative AI technology, including ChatGPT, in education has gained significant attention. This research explores the implications of integrating ChatGPT at Purdue University. It uses mixed methods, gathering data through surveys, interviews, and literature review. The study involves students, educators, administrators, and technical staff.

The investigation begins by examining the current educational landscape at the university, highlighting existing pedagogical practices and technological infrastructure. It then introduces ChatGPT as a transformative tool, elucidating its capabilities in natural language understanding, generation, and interaction. The study delves into three primary dimensions of ChatGPT's integration:

1) Enhancing Teaching and Learning: Investigating ChatGPT's role in instructional strategies, student engagement, personalized learning, and administrative task automation.

2) Ethical and Pedagogical Considerations: Analyzing ethical and privacy concerns, potential bias in AI-generated content, and educator responsibilities.

3) Technical Infrastructure and Integration: Assessing Purdue's readiness for AI integration, adaptability, scalability, and challenges in data security and maintenance.

The study also addresses overarching research questions pertaining to the university's preparedness for adopting generative AI technologies, the readiness of faculty and staff to embrace these innovations, and the concerns and expectations of students with respect to AI integration. The anticipated findings aim to provide invaluable insights for educational institutions contemplating or actively pursuing the integration of generative AI technologies. This research seeks to empower informed decision-making among educators and administrators, both at Purdue University and within the broader educational community. In conclusion, this research is a step towards promoting the responsible and effective utilization of AI at Purdue and beyond.

Keywords: Generative AI in Education, ChatGPT Integration, Educational Implications, Ethical Considerations, Technical Readiness

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7040
Presentation Time: 214A at 1:20pm-1:40pm

A Feynman-Kac Type Theorem for ODEs: Solutions Of Second Order ODEs as Modes of Diffusions

Mathematical/Computation Sciences

Author(s):

Hudson Hochstedler† (Engineering)

Abstract:

In this paper, we prove that the “most likely” path of a particular diffusion, as defined by the Onsager-Machlup function, solves a broad class of second order ordinary differential equations. Solving differential equations has long been a topic of interest in applied mathematics for its use in modeling a wide variety of physical phenomena, however, closed form solutions to these systems often do not exist and instead require numerical approximation. We take inspiration from the Feynman-Kac theorem which says the solution to a broad class of second order parabolic equations is the mean, rather than the mode, of a diffusion. Our result allows us to solve high-dimensional systems of ODEs more efficiently than conventional numerical integration techniques.

Keywords: Numerical Analysis, Probability, Optimization, Monte Carlo Simulation

Mentor(s):

Harsha Honnappa (Engineering); Zachary Selk (Queens University)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7041
Presentation Time: 214A at 1:40pm-2:00pm

Efficient simulation of degenerate optical parametric oscillator networks for combinatorial optimization

Mathematical/Computation Sciences

Author(s):

Spencer Bowles† (Engineering, JMHC); Michael Foster‡ (Engineering)

Abstract:

A wide range of combinatorial optimization problems, such as the traveling salesman problem, are time-consuming to solve using existing computers. Therefore, improved algorithms and hardware are needed to address these challenges. Fortunately, a growing interest into computational systems known as Ising machines have shown to be a promising tool for combinatorial optimization. The physical construction of these machines with networks of degenerate optical parametric oscillators (OPOs) allows for efficient solutions of the lowest energy states of these systems. However, there are numerous engineering challenges associated with the detailed simulation and fabrication of such machines. To investigate the simulated behavior of OPO networks, we utilize the Kraymer-Moyal representation of an OPO network and apply the Euler-Maruyama numerical stochastic integration algorithm to simulate the injection of noise into the network. This study investigates current implementations of stochastic solvers; however, they are programmed in high-level languages, introducing significant overhead. As such, we have utilized the C programming language as well as multiprocessing to achieve an approximate 500x speedup over our tests with high-level languages. Results for the modeling of a stochastic 100,000 node OPO network have been shown to agree with previous findings, taking a tenable two days to complete simulation. Efficient simulation of OPO networks would prove an effective method for determining the possible sizes and effectiveness of physical combinatorial optimizers.

Keywords: Physical Computing, Probabilistic Computing, Simulation, High Performance Computing, Quantum Adiabatic Optimization

Mentor(s):

Peter Bermel (Engineering); Jie Zhu (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7042
Presentation Time: 214B at 1:00pm-1:20pm

Hardware Multithreading on RISC-V Microcontroller

Mathematical/Computation Sciences

Author(s):

Rohan Gangaraju† (Engineering); Pranav Srisankar† (Engineering); Sean Greenley† (Engineering)

Abstract:

The AFT-series chips are RISC-V based microcontrollers developed by the System-on-Chip Extension Technologies (SoCET) team. This project focuses on the addition of hardware multithreading to the future AFT-series chips. Hardware multithreading is a technology that allows a single physical CPU core to execute multiple thread contexts simultaneously. This is often used in semiconductor companies such as Intel (Hyperthreading) and AMD to improve the overall performance and throughput of a processor. In the context of a microcontroller, it can enhance the responsiveness to the outside world by mapping sensor interrupts to threads such that data processing and real-time data acquisition can occur concurrently for multiple peripherals. This technology is achieved by replicating architectural state such as general purpose registers (GPRs) along with additional hardware to facilitate the switching of threads. Though multithreading adds more hardware for the state, it provides benefits such as increased processor resource utilization as threads stalling due to cache misses or long latency operations can be switched out for other threads to keep execution units busy and processor throughput high. This project group is committed to performing exhaustive benchmarking using custom micro-benchmarks that replicate real-world sensor data acquisition and processing via simulated interrupts. Through this testing, this group aims to validate that hardware multithreading will bolster real-time performance and enhance hardware efficiency for future AFT microcontroller generations.

Keywords: System on Chip Design, Computer Architecture, Multithreading, Microcontroller, RISCV

Mentor(s):

Mark Johnson (Engineering); Cole Nelson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7043
Presentation Time: 214B at 1:20pm-1:40pm

Forecasting EV Demand for Demand Response Applications

Innovative Technology/Entrepreneurship/Design

Author(s):

Byung Wook Kim† (Engineering); Hyunjun Park† (Engineering); Spencer Gries† (Engineering); Kisal Wijesooriya† (Science)

Abstract:

As the adoption of electric vehicles (EV) escalates, existing EV charging stations face the potential threat of congestion, leading to extended waiting times and suboptimal user experience. In addition, the surging demands for vehicular electrification undoubtedly intensifies the stress placed on electricity supply facilities near existing charging stations. While optimization models hold significant promise to address these constraints, prevailing approaches prioritize pinpointing ideal locations for new charging stations. Existing approaches often neglect the substantial time and resources required to build a single charging station. Therefore, we propose a comprehensive time-series forecasting and optimization framework. This framework not only forecasts the EV demand per targeted charging stations and the state-of-charge before and after of visiting EVs but also optimizes the efficiency of targeted charging stations, subject to specific constraints such as traffic volume, charging prices and EV counts. After collecting updated traffic data of five charging stations along the I-210 corridor, a prediction of EV charging needs at each station for different times of a day and seasons is returned. The forecasted values will then be incorporated into the optimization model where we furthermore aim to implement a dynamic pricing system based on real-time or forecasted demand. This additional aspect could incentivize off-peak charging, reducing user wait time as well as balancing the grid load. With continued research and development, this approach can be seamlessly scaled up, positioning it as a benchmark for EV charging station optimization that holistically addresses both user experience and grid stability.

Keywords: Time-Series Forecasting, Optimization, Electric Vehicle Charging Station, Business Analytics, Dynamic Pricing

Mentor(s):

Sivaranjani Seetharaman (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7044
Presentation Time: 214B at 1:40pm-2:00pm

Integrating Young Mothers into an Engineering School

Social Sciences/Humanities/Education

Author(s):

Abigail Frank† (Engineering, JMHC)

Abstract:

Investing in the education of young women, particularly young mothers, is one of the most cost-effective ways to encourage social, economic, political, medical, and technological development of a country. Yet, young mothers are consistently left out of education, particularly technical and engineering education in low-income contexts. This study explores the educational mechanisms and policies at one Kenyan technical school, the Tumaini Innovation Center, that enable their young mothers to be successful in completing their education and finding employment. The Tumaini Innovation Center provides engineering and vocational training to street-connected and vulnerable youth in Eldoret, Kenya. We used a qualitative case study approach to address the following research questions: what are the educational mechanisms and school policies that contribute to the well-being and success of young mothers? How does the Tumaini Innovation Center implement these methods? Our case study used interview transcripts and field notes collected from staff and students at the Innovation Center, which were analyzed using inductive coding and thematic analysis. The data revealed five main pillars necessary for success: an asset-based approach to curriculum development, on-site maternal and childcare, counseling and mentorship, positive relationship development with children and family, and financial support. The results indicate the critical importance of additional resources for this vulnerable student group. Overall, the study outlines the strengths of the program and makes recommendations based on community resources for future program development. Our findings suggest a framework for other engineering institutions serving similar communities to successfully educate more young mothers and boost community development.

Keywords: International Education Development, Engineering Education, Young Mothers, Qualitative Case Study, Education Policies

Mentor(s):

Kirsten Davis (Engineering); Jennifer DeBoer (Engineering); Stephanie Claussen (San Francisco State University); Lucy Nyambura (Tumaini Innovation Center)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7045
Presentation Time: 214C at 1:00pm-1:20pm

Revealing the lipid landscape: Microglial lipid droplets in Alzheimer's disease.

Life Sciences

Author(s):

Shailee Patel† (HHS)

Abstract:

Redacted

Keywords: Microglia Cell, Lipid Droplets, Immunohistochemistry, Alzheimer's Disease, Antibody

Mentor(s):

Gaurav Chopra (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7046
Presentation Time: 214C at 1:20pm-1:40pm

Organophosphate (OP) exposure, particularly to chlorpyrifos, causes dopaminergic neurotoxicity and is associated with Parkinson's Disease (PD).

Life Sciences

Author(s):

Sofia Schumann† (HHS); Matthew Corson‡ (HHS, JMHC)

Abstract:

Parkinson’s Disease (PD) is a chronic and progressive neurodegenerative disorder that is characterized by the death of the dopaminergic neurons in the substantia nigra in the midbrain region of the brain, resulting in motor symptoms like rigidity, bradykinesia, and resting tremor. The etiology of PD is said to be a complex combination of genetic and environmental factors, and familial PD accounts for 5-10% of the cases. Thus, there is a need for further research into environmental risk factors for PD. Chlorpyrifos belongs to a class of organophosphate (OP) compounds that is widely used as an insecticide and pesticide, which affects the neuron transmission making it highly neurotoxic. Polymorphisms in paraoxonase 1 (PON1), a key xenobiotic detoxification metabolism enzyme, further increases PD risk from chlorpyrifos exposure. Animal models enable us to explore the basic biology of gene-environment interactions that may potentiate or mitigate the severity and progression of PD-relevant neurotoxicity following chlorpyrifos exposure. Our interest is in determining the cellular targets of OPs in dopaminergic cells yielding neurotoxicity, and specifically, the production of toxic, reactive and dopamine-derived species. We will conduct a thorough assessment of the PON1-regulated chlorpyrifos neurotoxicity resulting in PD phenotype in rats, in terms of replicating key behaviors and pathology. By determining the mechanistic targets, we can identify interventions to mitigate cell injury as well as biomarkers to assess neurotoxicity.

Keywords: Parkinson's Disease, Environmental Neurotoxicity, Chlorpyrifos, Organophosphate (OP) Compounds, Animal Models

Mentor(s):

Jason Cannon (HHS); Reeya Tanwar (HHS); Fatema Currim (HHS); Josephine Brown (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7047
Presentation Time: 214C at 1:40pm-2:00pm

Being Asian American in the Midwest: Reflections as a Student Researcher

Social Sciences/Humanities/Education

Author(s):

James Zhou† (HHS)

Abstract:

Asian American adolescents in the Midwest represent an understudied demographic in the current literature. Despite preconceived notions about this group, experiences vary greatly depending on ethnicity, immigration status, rural/urban environment, discrimination, and other factors. As a student research assistant on a collaborative project between the Health Disparities Research Lab and the AAARCC Research Lab, we seek to analyze these themes to better understand the complexity of experience within this group, as well as interventions to address health needs.

In this presentation, I also discuss my engagement with the study as an Asian American who has spent most of his life in the Midwest. The process of conducting semi-structured interviews with high schoolers across Indiana and Illinois has given me insights on the diversity within this demographic and how geographic and temporal variation influence Asian American racialization and identity. Though adolescence is a key point of interest due to its formative nature, our identity is in constant flux, and this has prompted further introspection about my own. To better understand myself, it is imperative to understand my context and community.

Keywords: Asian American, Mental Health, Identity, Inclusion

Mentor(s):

Stewart Chang Alexander (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7048
Presentation Time: 214D at 1:00pm-1:20pm

Role of KMT5C in EGFRi Resistance in Non-Small Cell Lung Cancer

Life Sciences

Author(s):

Maximillian Hellrung† (Science, JMHC)

Abstract:

KMT5C is a known catalyst of histone H4 lysine 20 trimethylation (H4K20me3), which is canonically known to be a repressive modification. Loss of KMT5C in non-small cell lung cancer (NSCLC) cells results in increased resistance to epidermal growth factors receptor inhibitors (EGFRi). EGFRis are the primary treatment for cancers with EGFR mutations, and resistance to these inhibitors can lead to additional or recurring disease. The mechanism by how this resistance is conferred is not fully understood and further investigation into how, mechanistically, KMT5C loss drives resistance is needed. Patient data also indicates that KMT5C is downregulated in NSCLC patients, opposed to complete loss.

To evaluate KMT5C protein expression and understand its mechanism, a tool is needed to visualize KMT5C due to lack of available antibodies. Therefore, we developed HA-tagged KMT5C (HA-KMT5C) that can be detected following transfection into NSCLC cells using an anti-HA antibody. However, this tag could potentially interfere with KMT5C function, and if it does, a new system will need to be explored for future functional experiments. Our data demonstrates KMT5C's ability to catalyze H4K20me3 is unimpeded by the HA tag. Currently, we are using HA-KMT5C to validate HCC827 and PC9 cell lines that stably express a doxycycline-inducible shRNA targeting KMT5C. Validating these cells lines and HA-KMT5C in this study will be critical components for future assays to elucidate the role of KMT5C in EGFRi resistance and will advance the knowledge of the mechanisms behind EGFRi resistance.

Keywords: Epigenetics, Cancer, Drug Resistance, KMT5C

Mentor(s):

Andrea Kasinski (Science); Jihye Son (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7049
Presentation Time: 214D at 1:20pm-1:40pm

How can acoustic monitoring and AI-CNN technology predict the influence that other mesocarnivores have on bobcat (Lynx rufus) habitat selection in a midwestern river valley?

Life Sciences

Author(s):

Luca Iacobucci† (Agriculture); Abby Seybert* (Agriculture, JMHC); Anthony Tan* (Science, JMHC); Hannah Reyes Charles* (Agriculture, JMHC); Sierra Hunnicutt* (Science, JMHC)

Abstract:

Many species rely on forest interior habitat to thrive, reproduce, and disperse. Wildlife corridors are a way to encourage the dispersal of species into previously unavailable habitat. Corridors have become a necessity for certain species because of urbanization. The bobcat (Lynx rufus) is one of these species. With the historic overexploitation of bobcats by European settlers in the Midwest, the species has yet to return to areas like northern Indiana. There have been studies on the population dynamics of already established overlapping territories of mesocarnivores with bobcats; however, this study aims to elucidate the impacts of already established mesocarnivore territories such as eastern coyotes (Canis latrans) and raccoons (Procyon lotor) on new arrivals of bobcats from southern Indiana. By using remote acoustic monitors, AI-CNN technology, and camera traps, we aim to explain the relationship between wandering bobcats and other stationary mesocarnivores. We deployed camera traps as well as acoustic monitors (n = 6) in locations on the southern and northern sides of the Wabash River to track if bobcats were able to cross the river given the presence of other mesocarnivores. We will then use the photo, video, and audio recordings from our sensors to estimate population density of mesocarnivores in the immediate area and inform decisions on wildlife corridor creation to NICHES Land Trust.

Keywords: Bobcats, Ecological Corridor, AI-CNN, Acoustic Monitoring, Dispersal

Mentor(s):

Kristen Bellisario (JMHC)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7050
Presentation Time: 214D at 1:40pm-2:00pm

Poetry in the Classroom

Social Sciences/Humanities/Education

Author(s):

Adeline Waltz† (HHS, Liberal Arts)

Abstract:

Poetry is an expressive form of writing that has its own set of rules, expectations, and conventions separate from that of literature and fiction. Many teachers preach the importance of learning poetry, but teachers report feeling uncomfortable leading discussions centered on poetry. Some elements of poetry education that may be difficult is the broad nature of how varied a poem can mean for everyone. Selection of poems of interest to the class can be a barrier if specific curriculum is not developed. Additionally, a typical method of teaching poetry may also include teaching specific poems, and then having children replicate the forms in their own words. Oftentimes, teachers do not teach literature by making students write novels; why should this be the same in the poetry classroom? How is poetry meaningfully presented and practiced in high school curriculums? The purpose of this literature review is to determine how teachers lead units on poetry in their classrooms with the goal of improving teacher confidence in the subject field. My search criteria include articles from the United States from the 2000s to the present involving high school populations. A specific focus is given to Midwestern states due to the further research my team hopes to conduct being primarily in Indiana. The implications of this study will inform future research and allow for the development of a curriculum that could be implemented in Indiana middle and high schools.

Keywords: Poems in the Classroom, Teaching Poetry, Teacher Confidence, Curriculum Analysis, Poetry

Mentor(s):

Mary Ellen Lennon (Education)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7051
Presentation Time: 214A at 2:00pm-2:20pm

Material Stiffness Sensing using DEAs

Innovative Technology/Entrepreneurship/Design

Author(s):

Pranav Parigi† (Engineering)

Abstract:

Mechanical stiffness of soft materials is vital to the design and understanding of soft robotics. Development of a small-scale sensor capable of continuous monitoring will allow detailed measurements of materials while continuously in use. The goal of this project is to utilize Dielectric Elastomer Actuators (DEA) to design a cantilever-style bending actuator to stress a material and measure its deformation. DEAs can “self-sense” which means the deformation of the actuator can be measured through variation of capacitance across it. Thus, the sensor is capable of actuating the target site and measuring deformation simultaneously. The sensor was first modelled to understand the deformation and blocking forces with different materials and thicknesses. The results of the model were used to fabricate an initial sample DEA. The sample is tested on a soft hydrogel material with known properties to validate results. In addition to the mechanical design an HV switching circuit is designed to actuate the system and measure the capacitance across the actuator to understand the self-sensing characteristics. The development of such a sensor is novel both in its application in sensing and in the use of DEA’s self-sensing and actuation properties simultaneously. Such a sensor can easily be scaled for different applications and use cases providing a platform for future soft robotic sensor development.

Keywords: Soft Robotics, Dielectric Elastomer Actuator, Soft Actuators, Robotic Surgery, Artificial Muscles

Mentor(s):

Alex Chortos (Engineering); Jue Wang (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7052
Presentation Time: 214A at 2:20pm-2:40pm

Centrality and Adversarial Attacks in Decentralized Federated Learning Networks

Mathematical/Computation Sciences

Author(s):

Adam Piaseczny† (Engineering)

Abstract:

As Federated Learning (FL) grows in popularity, new decentralized frameworks are becoming widespread. These frameworks leverage the benefits of decentralized environments to enable fast and energy-efficient inter-client communication. However, this growing popularity also intensifies the need for robust security measures. While existing research has explored various aspects of FL security, the role of adversarial node placement in decentralized networks remains largely unexplored. This paper addresses this research gap by analyzing the behavior of decentralized FL systems across various well-known graph structures. We establish two baseline scenarios for selecting adversarial nodes: random selection and centrality-based selection. Building on this foundation, we introduce a novel attack algorithm specifically designed to enhance attack potency in independently and identically distributed (iid) scenarios. We demonstrate that the new attack algorithm significantly impacts key performance metrics such as testing accuracy, outperforming the baseline frameworks under specified conditions. Our findings provide valuable insights into the vulnerabilities of decentralized FL systems, setting the stage for future research aimed at developing more secure and robust FL frameworks.

Keywords: Federated Learning, Machine Learning, Networks, Adversarial Agents, Artificial Intelligence

Mentor(s):

Chris Brinton (Engineering); Eric Ruzomberka (Princeton University); Rohit Parasnis (Massachusetts Institute of Technology)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7053
Presentation Time: 214A at 2:40pm-3:00pm

The Impact of Directionality and Infill on Detonations of High Explosives

Physical Sciences

Author(s):

Jack Martin† (Engineering, JMHC)

Abstract:

With the use of Vibration Assisted Printing (VAP), manufacturing can be done at much higher speeds in more complex geometries that could enhance the range of tailorability. This project studied different inline and offset print geometries at two infill percentages to understand the impact on detonation shock front velocity using an RDX-based explosive. Four different print orientations—0° inline, 0° offset, 45° inline, and 45° crosshatch—were analyzed. Detonation testing was performed on all the samples and the tests were imaged with ultra highspeed imaging to determine the effects of printing on detonation propagation. The orientation (collinear or orthogonal) was observed to have a greater effect on detonation speed for low infill samples than high infill samples. For example, low infill inline stacked logs failed to detonate, while offset stacked logs of the same infill resulted in a detonation velocity similar to full infill counterparts. Jetting was observed along channels (inline) in between RDX explosive print beads which inhibited detonation propagation. This jetting was not readily observed in samples detonated orthogonally across the grain. This jetting weakened the incoming shock, and perhaps dead pressed the explosive inhibiting the detonation propagation. For full density samples, especially the 45° crosshatch prints resulted in similar detonation speed in both orientations.

Keywords: Additive Manufacturing, Detonation, Shock Physics, Jetting

Mentor(s):

Diane Collard (Engineering); Steven Son (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7054
Presentation Time: 214B at 2:00pm-2:20pm

Generation and Detection of Synthetic Cartoon Faces Using Generative Adversarial Networks

Innovative Technology/Entrepreneurship/Design

Author(s):

Avigdor Roytman† (Engineering); Ashwin Sreedhar† (Engineering); Abhiram Nambiar† (Engineering); Kris Gurung† (Engineering)

Abstract:

This project endeavors to harness the capabilities of Generative Adversarial Networks (GANs) to create lifelike facial images, followed by employing CycleGANs for the transformation of these realistic images into cartoon-style faces. Initially, the GAN model will be trained on a vast dataset of human faces, enabling it to generate new, unique, and realistic facial depictions. Once these faces are generated, a CycleGAN, proficient in style transfer techniques, will be utilized to metamorphose the realistic faces into their cartoon analogs. This dual-step approach not only ensures the creation of novel cartoon characters rooted in reality but also presents potential applications in animation, gaming, and digital media. The effectiveness of the proposed system will be gauged based on the quality, diversity, and perceptual appeal of the generated cartoon images. The project aims to bridge the gap between reality and art, offering a streamlined method for artists and designers to envision cartoon characters that resonate with human-like features while retaining the essence of animated aesthetics.

Keywords: GANs, CycleGANs, Machine Learning, Artificial Intelligence, Image Generation

Mentor(s):

Edward Delp (Engineering); Carla Zoltowski (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7055
Presentation Time: 214B at 2:20pm-2:40pm

Applying the Critical Incident Technique in Biomedical Engineering in Regards to Faculty Researchers

Social Sciences/Humanities/Education

Author(s):

Tyler Ramsey† (Engineering)

Abstract:

Within the field of Biomedical Engineering (BME), numerous concerns have risen over the last decade regarding the teaching of ethics. Many scholars feel that ethics are poorly considered within the field of BME. To better understand and gain perspective, our team interviewed 25 biomedical engineering researchers about their experiences with ethical engineering research. From the different backgrounds and experiences of the BME faculty, the research team is utilizing the Critical Incident Technique (CIT) to discover key incidents and experiences where ethical/unethical actions and choices were made by or experienced by BME faculty during their careers. From here, the research team will then place the extracted incidents into categories based on its type of incident. After extracting, analyzing, and categorizing the incidents, the research team plans to introduce educational methods for promoting cultures of of ethical engineering in BME. As of this writing, we have extracted 30 incidents from 4 interviews. We plan to extract incidents from all other interviews by the end of the semester.

Keywords: Biomedical Engineering, Research Ethics, Qualitative, CIT

Mentor(s):

Justin Hess (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7056
Presentation Time: 214B at 2:40pm-3:00pm

Mining Pre-Trained Models in Open-Source Software

Mathematical/Computation Sciences

Author(s):

Dulani Wijayarathne† (Engineering); Anika Bajpai‡ (Engineering)

Abstract:

In Open-Source Software (OSS), the adoption of pre-trained models (PTMs) is on the rise to enhance efficiency. However, there's limited research on their full integration and related challenges.

Our research project dives deep into the PeaTMOSS dataset, featuring 281,638 PTMs across 27,270 projects. We explore the motivation behind the introduction of PTMs by identifying methods they replace and new tasks they introduce. We discuss how PTM upkeep impacts projects, with an emphasis on measuring lag using a framework first utilized in the Node Package Manager (NPM) platform. The study also looks at reasons for replacing or removing PTMs, either due to the release of a better PTM or a return to traditional methods. Our work provides insight into the evolving use of PTMs in OSS.

Keywords: Open-Source Software (OSS), Pre-Trained Models (PTMs), Deep Neural Networks

Mentor(s):

James Davis (Engineering); Jason Jones (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7057
Presentation Time: 214C at 2:00pm-2:20pm

Miscarriage impacts on Women of Color

Social Sciences/Humanities/Education

Author(s):

Gracia Bujambi† (HHS)

Abstract:

The experiences of women of color (WOC) with miscarriage are often overlooked and misunderstood (Mukherjee, Sudeshna, 2013). WOC in the U.S. experience miscarriage at higher rates than white women (Mukherjee, Sudeshna, 2013). In addition, WOC are more likely to experience complications from miscarriage, such as heavy bleeding and infection. The experiences of WOC with miscarriage are shaped by a variety of factors, including race, resulting in discrimination and racism from healthcare providers. Differences in socioeconomic status affect access to culturally appropriate and affordable healthcare. In addition to the physical and emotional challenges of miscarriage, WOC may also experience social stigma and isolation. This study aims to explore the unique experiences of WOC in Indiana, Kentucky, and Missouri with miscarriage through qualitative interviews. The interviews will be transcribed and coded to identify emergent themes that shed light on the experiences of WOC with miscarriage. Our preliminary analysis predicts that WOC have a unique experience different from white Women who also participated in this study. This study will contribute to a better understanding of the unique experiences of WOC with miscarriage.

Keywords: Miscarriage, Women of Color, Experiences of Black Women, Qualitative Research, Affects of Miscarriage

Mentor(s):

Kathryn LaRoche (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7058
Presentation Time: 214C at 2:20pm-2:40pm

The Liking/Learning Gap for Immersive Versus Desktop Virtual Reality

Social Sciences/Humanities/Education

Author(s):

Ben Blachly† (HHS, JMHC)

Abstract:

Virtual reality is rapidly gaining popularity in educational and training contexts. We conducted a between-subjects experiment to explore how VR modality (immersive versus desktop) influences trainee reactions, performance, and learning. Results indicate that trainees performed better and learned somewhat more in the desktop VR condition. However, trainees in the immersive VR condition found the training to be less boring and reported higher levels of future interest in welding. There were no significant effects related to immersion, presence, task load, self-evaluation, or motivation.

Keywords: Industrial/Organizational Psychology, Training, Virtual Reality, Technology

Mentor(s):

Tara Behrend (Michigan State University); Jerod White (HHS); Brad Pitcher (HHS)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7059
Presentation Time: 214C at 2:40pm-3:00pm

PP2A-EGFR crosstalk in PDAC: a novel activating role

Life Sciences

Author(s):

Ella Rose Chianis† (Science); Sydney Clifford‡ (Science, JMHC)

Abstract:

Pancreatic ductal adenocarcinoma (PDAC) is the fourth leading cause of cancer-related deaths in the United States and has one of the lowest five-year survival rate at only 12%. In over 90% of PDAC cases, there is an activating mutation in the GTPase KRAS. Protein phosphatase 2A (PP2A), a major serine-threonine phosphatase, negatively regulates many of the downstream factors of KRAS, leading to its characterization as a tumor suppressor. However, preliminary data from our lab has shown that acute activation of PP2A through a small molecule activator leads to an upregulation of epidermal growth factor receptor (EGFR) activity through increased EGFR ligand expression. EGFR activity is required for the initiation of PDAC, and the crosstalk between PP2A and EGFR activity may implicate a new role of PP2A as an oncogene in PDAC. To further investigate this potential tumorgenicity, we have created cell lines that overexpress PP2A and characterized them based on phenotypic differences from control lines. We have also probed for a possible mechanism of action through evaluating differences in mRNA expression and ligand shedding with acute activation of PP2A. Our results support this novel role of PP2A as an EGFR activator, showing increased tumorigenic phenotypes with an overexpression of PP2A, and suggest that PP2A may upregulate the production of an EGFR ligand to mechanistically drive EGFR activation.

Keywords: Pancreatic Ductal Adenocarcinoma, PP2A, EGFR

Mentor(s):

Brittany Allen-Petersen (Science); Claire Pfeffer (Science); Garima Baral (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7060
Presentation Time: 214D at 2:00pm-2:20pm

Girls Excelling in Math and Science (GEMS) Clubs: Stories of the Original GEMS Girls

Social Sciences/Humanities/Education

Author(s):

Meredith Chasse† (Education)

Abstract:

Girls Excelling in Math and Science (GEMS) is an after-school club for girls to engage in informal STEM learning through problem-solving activities. Initially founded in 1994 by Purdue alumna, Laura Jones, it is now a network of clubs and a website with resources for those interested in starting a club. In 2017, it was bequeathed to Purdue University's College of Education to continue the legacy of fostering positive STEM learning experiences for girls through informal STEM activities. In this proposed Research Talk, we will present three Original GEMS Girls' (OGG - the first GEMS members in 1994) informal STEM learning experiences and how the OGGs reported that those experiences were enhanced in a girls-only space. We collected data (i.e., OGG's GEMS learning experiences, career choices, and gender, family, and math) through a series of individual and focused-group interviews. We used thematic analysis to construct narratives describing their experiences. Our preliminary findings suggest that these three OGGs experienced a positive and safe STEM learning environment in GEMS, in part because of the informal nature of activities. In addition, they highlighted that GEMS was a safe space for them to share their ideas in the absence of other concerns related to sharing academic spaces with boys. As an implication of our study, we will discuss how attention to gender and providing informal activities may contribute to enhancing motivation in STEM subjects, both in formal learning spaces and career choices.

Keywords: STEM Education, Girls Education, Informal Education

Mentor(s):

Jill Newton (Education)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7061
Presentation Time: 214D at 2:20pm-2:40pm

Child Automated Speech-To-Text (CAST) Project - A Machine Learning Approach to Understanding Child Speech

Innovative Technology/Entrepreneurship/Design

Author(s):

Aakanksha Shripal† (Engineering); Aadya Pawar† (Science); Jonah Nichols† (Engineering); Jasper Koliba‡ (Engineering); Aarohi Panzade‡ (Science, JMHC); Aarini Panzade‡ (Science, JMHC); Daniel Zheng‡ (Engineering); Anish Bhowmik‡ (Science); Reagan Becker‡ (Science); Son Ha‡ (Science)

Abstract:

Redacted

Keywords: Machine Learning, Artificial Intelligence, Speech Transcription, Child Speech Development

Mentor(s):

David Purpura (Education); Avery Closser (Education)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7062
Presentation Time: 214D at 2:40pm-3:00pm

Social Emotional Learning for English Learning Students

Social Sciences/Humanities/Education

Author(s):

Yilin Huang† (Liberal Arts)

Abstract:

The increasing cultural and linguistic diversity in educational settings has brought English Learning (EL) students to the forefront, necessitating a closer look at their unique needs. EL students often face challenges in adapting to new cultural and linguistic environments, impacting their social and emotional well-being.

There is a pressing need for tailored Social-Emotional Learning (SEL) programs for EL students. There is a major lack in SEL research with a fucus on EL students. SEL for EL students have its unique challenges. These programs must be culturally aware and sensitive to students' backgrounds. Instructors must be objective when evaluating cultural differences and refrain from being judgmental of students' home cultures.

To effectively assist EL students, we must first identify their unique struggles. Socio-emotional hurdles faced by EL students are unique. These factors include but are not limited to acculturation stress, communication apprehension, self-esteem issues, and difficulties in building intercultural relationships. EL students are going to be from different backgrounds. Therefore, there must be a way to measure cultural awareness among SEL curriculums. Research must be done in this area to ensure the success of English Learning students both academically and socially.

Keywords: Social Emotional Learning, English Learning Students, Cultural Awareness

Mentor(s):

Youli Mantzicopoulos-James (Education)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7063
Presentation Time: 214A at 3:00pm-3:20pm

Contribution of Home Demographics and Environmental Factors to Indoor Surface Dust Concentrations in Urban and Suburban Homes in the U.S.

Physical Sciences

Author(s):

Ishika Jindal† (Engineering); Sienna Grey† (Engineering, JMHC)

Abstract:

Infants ingest and inhale toxicants in indoor surface dust while crawling, which can affect their early development. The aim of this analysis is to examine how home demographics, ventilation conditions, and cleaning practices influence indoor surface dust concentration to predict early childhood exposure to dust-bound toxicants better. Home visits were conducted (n = 104) across urban (New York City, New York) and suburban/rural (Lafayette/West Lafayette, Indiana) regions to collect indoor surface dust samples, coupled with a questionnaire survey detailing home environment and cleaning practices. Urban homes exhibited a higher prevalence of window-mounted air conditioning systems (47%) in comparison to central air conditioning systems (23%), while in suburban/rural residences, the converse trend was observed, with central air conditioning being notably more common (72%). Across both locations, a greater proportion of homes featured wall-to-wall carpets in the child's sleeping area (67%) compared to their living rooms (22%). A substantial percentage of homes in both locations had at least one pet (44%). The questionnaire data also revealed 'no outdoor shoes' rules in 57% of urban homes and 38% in rural/suburban homes, with infants commonly playing on hard surfaces and grass outdoors. Comparatively, vacuuming sessions exceeding 5 minutes were observed more frequently in the living room, accounting for approximately 60% of instances, while in the child's sleeping area, such extended vacuuming sessions occurred in only 37% of cases. These survey statistics will be utilized to model indoor surface dust concentrations, highlighting the contribution of home demographics, ventilation conditions, and cleaning practices to these concentrations.

Keywords: Indoor Dust, Infant Dust Ingestion, Inhalation Exposure, Questionnaire Analysis

Mentor(s):

Brandon Boor (Engineering); Satya Patra (Engineering); Nusrat Jung (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7064
Presentation Time: 214A at 3:20pm-3:40pm

Identifying Vaginal Microbes and Metabolites with Pro- and Anti-Histamine Potential

Life Sciences

Author(s):

Reagan Bushok† (Engineering)

Abstract:

The vaginal microbiome is a critical player in women's health and disease. Histamine plays a key role in the allergic response, and histamine receptors H1 and H2 are dominant in the female reproductive tract. This indicates that histamine signaling may play a role in inflammatory conditions in women's health. However, the link between the vaginal microbiome and histamine signaling remains poorly understood. We aim to bridge this gap by identifying vaginal microbes and metabolites that mimic the function of histamine and antihistamines. Samples from the HIV pre-exposure prophylaxis (PrEP) study were used to determine relationships between vaginal microbiome factors and host proteomics or host transcriptomics using correlation analysis. Gene signatures of antihistamine drugs homochlorcyclizine, antazoline, and hydroxyzine were gathered from the Library of Integrated Network-Based Cellular Signatures (LINCS) database. Antihistamine gene signatures were compared to vaginal microbe and metabolite gene signatures to identify mimicry of drug activity by vaginal microbes or metabolites. Metabolites with potential mimicry of all antihistamine drugs included 13-hydroxyoctadecadienoic acid, imidazole propionic acid, methionine sulfoxide, N-acetyl putrescine, pyruvate precursor, and tyramine. Metabolites with anti-inflammatory effects, including xanthine, citrulline, hydroxyisocaproate, phenyllactate, and taurine, exhibited similar gene signatures to at least two antihistamines. Lactobacillus, Prevotella, and Gardnerella taxa had similar gene signatures to all antihistamine drugs. By exploring the identified microbes and metabolites, their impact on histamine signaling, and the relevance of these insights to inflammatory pathways in women's reproductive health, our goal is to highlight new paths for treatments and preventative approaches targeting vaginal microbiome-histamine interactions.

Keywords: Vaginal Microbiome, Women's Health, Histamine Signaling, Metabolite and Microbe Profiling, Bioinformatics

Mentor(s):

Leopold Green (Engineering); Douglas Brubaker (Case Western Reserve University); Damilola Lawore (Engineering); Smrutiti Jena (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7065
Presentation Time: 214A at 3:40pm-4:00pm

Terahertz time-domain spectroscopy and Raman spectroscopy for polymer identification

Physical Sciences

Author(s):

Marco Herbsommer† (Engineering)

Abstract:

Terahertz time-domain spectroscopy (THz-TDS) is used to measure the spectral signature of polymers in the terahertz range for common recyclable polymers. The interaction of materials with terahertz electromagnetic (EM) radiation for different polymers creates a unique spectral signature in the frequency domain which can be used to identify the polymer. A fast Fourier transform is used to convert the measured time domain response to frequency domain response. The spectral identification of each of the polymers is confirmed by a secondary Raman measurement for the polymer sample done concurrently with the THz-TDS measurement. We can identify specific absorption peaks and resonances as the spectrums reveal the material's unique response to the electromagnetic radiation. This study presents a framework for creating a database of material responses with terahertz and Raman spectroscopy using a 785 nm femtosecond laser and its applicability to recycling of plastics.

Keywords: Terahertz Time-Domain Spectroscopy, Polymer Identification, Raman Spectroscopy

Mentor(s):

Vikas Tomar (Engineering); Sushrut Karmarkar (Engineering); Mahavir Singh (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7066
Presentation Time: 214B at 3:00pm-3:20pm

Aluminum Nitride-based Heterogeneously Integrated Low-Earth-Orbit Sensors (HILEOS-AlN)

Innovative Technology/Entrepreneurship/Design

Author(s):

Ethan Kovalan† (Engineering); Frank Huang† (Engineering); Yiyun Wang† (Engineering); Ching Chen† (Engineering)

Abstract:

Advanced packaging and heterogenous integration are becoming increasingly prevalent in modern technology, particularly in aerospace applications where space and weight savings are essential. These techniques allow for existing dies to be integrated into a multi-level substrate with carrying material properties that are optimized for specific applications. The HILEOS (Heterogeneously Integrated Low-Earth-Orbit Sensors) project is specifically exploring the design and fabrication of a 2.5D HI light sensor with memory for recording and reporting orbital state for aerospace applications.

The aluminum nitride (AlN) sub-team is dedicated to exploring the unique capabilities of AlN as an interposer for this application. Aluminum nitride is a novel ceramic material that stands out due to its combination of being an electrical insulator and thermal conductor. This property enables the development of compact and lightweight packaging solutions, making it particularly advantageous for high-power applications such as Gallium Nitride (GaN) power amplifiers, which are increasingly prevalent in both aerospace applications and high-end consumer electronics.

Our team has carefully crafted a process flow starting with the use of a fiber laser for micromachining to create through-holes on the AlN substrate, followed by positioning the photodiode and D-latch into the holes with the interposer attached to a carrying substrate. After that, the metal binding agent will be deposited using PVD, before the interconnect is patterned through lithography and lift-off.

Keywords: Advanced Packaging, Heterogeneous Integration, Aluminum Nitride, Micromachining, Semiconductor Fabrication

Mentor(s):

Zhihong Chen (Discovery Park); Peter Bermel (Engineering); Saeed Mohammadi (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7067
Presentation Time: 214B at 3:20pm-3:40pm

Time interleaving switched capacitor array true time delay unit for baseband beamforming

Innovative Technology/Entrepreneurship/Design

Author(s):

Long Nguyen† (Engineering)

Abstract:

For baseband beamforming applications, the N-path filter stands out for its potentially good time delay and delay resolution with exceptionally high density per die area. However, the delay of the signal depends on how slow can we undersample the signal until the Nyquist frequency, which limits most N-path literature to sub 10 nanoseconds max delay. Time-interleaved switch capacitor sampling arrays (SCAs) are a promising new technology for baseband beamforming as they offer a number of advantages over traditional N-path filters, including high power efficiency, large delay range, and fine resolution. This paper explores the implementation of an SCA-based true time delay unit with an N-path filter oversampling the signal at low frequency to extend the possible delay and an outer layer N-path filter that samples the circuit at high frequency to maintain the signal waveform and possible aliasing issue from the inner layer N-path filter. By the time of writing this abstract, a preliminary 8x8 implementation already achieved an outstanding delay of 30nano seconds, further delay can be potentially realized with further optimization. Time-interleaved SCAs are a relatively new technology, but they have the potential to revolutionize baseband beamforming such as those used in 5G and future wireless communication systems.

Keywords: N-Path, Beamforming, Switched Capacitor, Sampling

Mentor(s):

Sutton Hathorn (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7068
Presentation Time: 214B at 3:40pm-4:00pm

Extracting Heart Rate from Strain Gauge Respiratory Signals

Innovative Technology/Entrepreneurship/Design

Author(s):

Pei-Lun (Patricia) Chen† (Engineering)

Abstract:

The electrocardiogram (ECG) and respiratory (RSP) signals can play a crucial role in clinical settings, providing insights into clinical diagnosis and response to therapy. The advancement of wearable technologies has allowed for the noninvasive collection of a range of biosignals, which can be used for real-time and real-world monitoring outside healthcare facilities. Therefore, there now exists a potential for the incorporation of wearable or portable biosensors in long-term patient monitoring, allowing for earlier detection of possible decompensation. In this study, we developed a model that performs signal-to-signal translation on RSP signals to pulse rate signals using a machine learning approach. Pulse rate is detected from RSP signals measured via strain gauge using preexisting, open-source algorithms. A U-NET model was created consisting of three convolution and three up-sampling layers. It was trained with an open-access dataset consisting of simultaneously recorded ECG and RSP signals with anxiety induction. The new model will open the possibility of obtaining information normally requiring two monitoring devices into needing just one, accelerating the incorporation of wearables in clinical management through improving patient usability and quality of life.

Keywords: Signal-to-Signal Translation, Machine Learning, Noninvasive Biosignal Collection, ECG and RSP signals, Heart Rate Detection

Mentor(s):

Steve Steinhubl (Engineering); Matthew Ward (Engineering); Mohamed Elgendi (ETH Zurich); Carlo Menon (ETH Zurich)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7069
Presentation Time: 214C at 3:00pm-3:20pm

Developing Realistic Quantum Error Correction Models

Mathematical/Computation Sciences

Author(s):

Santiago Lopez† (Science, JMHC); Jonathan Andrade Plascencia* (Cornell University)

Abstract:

Quantum computers are devices that experience increasing errors over time. It is crucial to correct these errors without gaining information about the quantum state, which would result in its destruction. This is where Quantum Error Correction (QEC) comes into play, as it provides information about the occurred error without compromising the quantum state of the system. However, the implementation of these algorithms has proven to be challenging due to the current performance levels of qubits. Specifically, superconducting qubits present certain issues that could hinder or complicate the use of these devices, even with the application of QEC. In this project, we have developed open-source Python models that simulate various QEC algorithms against realistic errors for superconducting qubits. This software enables research groups to test quantum circuits with up to 12 qubits, using specific qubit parameters that match their own devices. Our current focus revolves around optimizing parameters for single and multi-qubit operations using automated codes, as well as creating simple data models for single-qubit behaviors. The ultimate goal is to gain an understanding of single and multi-qubit behaviors to further optimize experiments.

Keywords: Quantum Error Correction, Superconducting Qubits, Qubit Modelling and Optimization, Automation

Mentor(s):

Alex Ruichao Ma (Science); Gabriel Perdue (Fermi National Accelerator Laboratory); Botao Du (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7070
Presentation Time: 214C at 3:20pm-3:40pm

Investigation of Optimal Machining Parameters for Fiber Reinforced Thermoplastic Composite Materials

Innovative Technology/Entrepreneurship/Design

Author(s):

Min Yong Chun† (Polytechnic); Harry Lee‡ (Engineering, JMHC)

Abstract:

Additive manufacturing technology for fiber-reinforced thermoplastic composites is widely used in tooling applications, where the quality of the tool surface finish holds utmost importance. Due to the heterogeneous nature of composites, improper machining parameters can lead to more pronounced surface defects, including fiber pull-out, fiber breakage, and melted polymer, in comparison to traditional metal tool machining processes. In this study, the relationship between machining parameters, specifically surface speed (SFM) and feed rate (IPT), and the surface finish quality of additively manufactured fiber-reinforced thermoplastic composites was investigated. This study aims to ascertain the optimal machining parameters for different composite materials. To assess the machining process under various parameters, temperature generated during machining, surface roughness and scanning electron microscopic (SEM) image of the machined surface were analyzed. Excessive heat generation on the tool or workpiece can result in the degradation of tool hardness and workpiece melting during machining. A thermal camera was installed to monitor the temperatures of the part, tool, and chip throughout the machining process. Surface roughness of the machined surfaces were measured using a stylus-type surface roughness tester. Lastly, SEM image of the machined surface was used to identify any defects that occurred during the machining process. For a more comprehensive understanding of the optimal machining parameters, two different composite materials, each has distinct mechanical and physical properties, were used in the study: carbon fiber reinforced Acrylonitrile Butadiene Styrene (ABS) composites and carbon fiber reinforced Polyethersulfone (PESU) composites.

Keywords: Additive Manufacturing, Tooling Manufacturing, Composite, Machining Parameter

Mentor(s):

Garam Kim (Polytechnic); Eduardo Barocio (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7071
Presentation Time: 214C at 3:40pm-4:00pm

CATT: Understanding the Online Behavior of Sex Offenders

Mathematical/Computation Sciences

Author(s):

Reeya Ramasamy† (Polytechnic)

Abstract:

The Chat Analysis Triage Tool (CATT) is a forensically sound investigative tool that analyzes chats between a minor or undercover law enforcement officer (UCLE) and offender. CATT assists law enforcement in prioritizing cases in which the offender is more likely to be contact-driven (high-priority) vs. fantasy-driven (solicitation only). These different online offenses all involve chats between minors/UCLE and offenders, in which the offenders engage in child sexual grooming. Child sexual grooming is the process by which an adult uses deceptive trust and friendship formation to lure a minor into engaging in sexual behaviors. The main research objective is to better understand chatting and the behavior behind offenders and minors through the various stages of this project. In Phase One of the project, the chats are being cleaned for grooming analysis (e.g., deidentifying and replacing names, location, email addresses). In Phase Two of the project, these chats are being coded to identify when risk assessment occurs by the offender. Risk assessment occurs when the offender becomes suspicious of whether the “minor” they are chatting with is a real minor or a law enforcement officer. It is expected to find that offenders engage in more risk assessment when chatting with a law enforcement officer compared to real minors. Overall, these findings will help inform algorithm development for CATT and law enforcement trainings on how to avoid risk assessment by the offender during sting operations.

Keywords: Sex Offender, Minor, Chats, Risk Assessment, Law Enforcement

Mentor(s):

Kathryn Seigfried-Spellar (Polytechnic); Tatiana Ringenberg (Polytechnic)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7072
Presentation Time: 214D at 3:00pm-3:20pm

Exploring Neurite Complexity in Cortical Neurons Carrying an Epilepsy-Linked SCN2A Mutation: A Human-Induced Pluripotent Stem Cell Study

Life Sciences

Author(s):

Hope Harlow† (Pharmacy); Muhan Wang* (Pharmacy)

Abstract:

Epilepsy is a neurological disorder that causes misfiring of neurons, leading to random, oftentimes unprovoked, episodes of seizures. The SCN2A gene, which encodes for Nav1.2, a sodium ion channel protein is implicated in severe seizures and epileptic episodes in infancy/younger adolescence1. A specific mutation that affects the SCN2A gene is L1342P2. There are only 6 known cases of epilepsy with the L1342P mutation in the world, so little information is known about how the mutation will affect neuronal development. Therefore, to study it, our lab uses hiPSCs-derived cortical neurons that have been CRISPR/Cas9 engineered to contain the Nav1.2-L1342P mutation. The objective of this project was to assess and quantify the changes in neuron morphology of hiPSC-derived cortical neurons carrying the Nav1.2-L1342P mutation. Our hypothesis was that this mutation would induce alterations in neurite complexity and shape. To evaluate our hypothesis, we employed the advanced software tool Neurolucida360 for comprehensive structural analysis of neurons, encompassing soma size, soma perimeter, number of neurites, as well as mean and total neurite length. By comparing the data collected from neurons containing the Nav1.2-L1342P mutation with that from neurons without the mutation, we aimed to discern significant differences. Our initial findings suggest that neurons carrying the Nav1.2-L1342P variant exhibit diminished neurite complexity in comparison to the control group. These results strongly indicate a potential role of the L1342P mutation in influencing neuronal development.

Keywords: Neuronal Morphology, Epilepsy, Control Vs Mutation

Mentor(s):

Yang Yang (Pharmacy); Maria Olivero-Acosta (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7073
Presentation Time: 214D at 3:20pm-3:40pm

Developing a Selective Irreversible Peptidic Inhibitor for CBX2

Life Sciences

Author(s):

Sam King† (Pharmacy, JMHC); Gabby Conjelko‡ (Science)

Abstract:

In the US, prostate cancer is a leading cause of cancer and the second leading cause of death in men. While prostate cancers respond well to anti-androgen therapies, they eventually develop various forms of resistance, which are believed to be driven heavily by epigenetic factors. The methyltransferase subunit of Polycomb repressive complex 2 (PRC2), EZH2, is upregulated during progression to therapy-induced neuroendocrine prostate cancer (NEPC). We found that the chromodomain-containing subunit of PRC1 that binds to histone methylation is CBX2, which is highly upregulated in NEPC compared to androgen-sensitive prostate cancer. We previously developed peptide-like inhibitors; however, high conservation within the CBX family makes selective inhibition a challenge. Here, we describe a modified version of a peptide inhibitor with an acrylamide to target CBX2's nonconserved cysteine residue using a structure-based design approach from a ligand-bound CBX2 crystal structure. To evaluate the inhibitor's efficacy, various techniques, including SDS-PAGE, proteomics, bioorthogonal biotin labeling, killing assays, and evaluation of CBX2's native targets via qPCR, have been utilized. Proteomics and labeling show on-target binding to CBX2 and limited off-target warhead activation. The results reveal the inhibitor's efficacy and allow comparison to its non-covalent counterpart. This inhibitor allows for more selective targeting of the CBX2 protein over other CBX paralogs and other benefits, such as increased potency. This inhibitor advances the selective targeting of CBX2 in prostate cancer and can be extended to various other cancers dependent on CBX2.

Keywords: Drug Discovery, Protein, Covalent Inhibitor, Prostate Cancer

Mentor(s):

Emily Dykhuizen (Pharmacy); Sijie Wang (Stanford University); Sandra Ordonez (Pharmacy)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7074
Presentation Time: 214D at 3:40pm-4:00pm

Animacy Effects and the Production of Relative Clauses in Mandarin: differences between native speakers and heritage speakers

Social Sciences/Humanities/Education

Author(s):

Yongjia Deng† (Liberal Arts)

Abstract:

Various linguistic pressures affect sentence production, including the semantic similarity of the entities. One example is animacy, or whether the entities are human or nonhuman: “the woman that kissed the girl” is more difficult to produce due to “woman” and “girl” both being animate; these are both potential agents and patients, causing interference. Individuals might use the passive relative clause to deemphasize the agent, such as “a girl that was kissed by a woman”, or even deletion in “a girl that was kissed”. Gennari (2012) found that speakers produced more passive relative clauses when both the agent and patient were animate. A study of Mandarin relative clauses showed similar results (Hsiao & MacDonald, 2016). Both studies suggest that using the passive form over the active allows speakers to differentiate between the patient and the agent. These two studies only include animate subjects with animate objects and inanimate objects. Our present study uses picture-based elicitation with native and heritage speakers and expands the condition to include inanimate subjects with animate and inanimate objects in Mandarin relative clauses. We hypothesize native speakers would produce passive relative clauses when describing entities with similar semantic features, e.g. when both agent and patient are inanimate. However, heritage speakers will use fewer passives due to unfamiliarity and produce more errors.

A second condition elicits the same relative clauses within a complex ba grammatical structure. We hypothesize that passives will be avoided by both groups when embedded inside a complex structure, as this requires more cognitive load.

Keywords: Sentence Production, Relative Clause, Heritage Speaker, Mandarin, Linguistics

Mentor(s):

Elaine Francis (Liberal Arts); Vanessa Sheu (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7075
Presentation Time: 214A at 4:00pm-4:20pm

Real-Time Volatile Chemical Screening of Environmental Media to Support Disaster Response

Physical Sciences

Author(s):

Grayson Wittbrod† (Engineering)

Abstract:

The growing complexity and economic relevance of commercial manufacturing necessitates increasingly precise, accurate analysis of contaminants to facilitate safe and controlled operations. Human and environmental health is jeopardized by insufficient management of such activity, particularly in the event of a chemical spill or release. A recent disaster in East Palestine, Ohio, underscores the importance of proper contamination assessment; on February 3rd, 2023, a Norfolk Southern train derailment led to the controlled burning of over 100,000 gallons of a known carcinogen, vinyl chloride, as well as leaking of various other hazardous compounds into creeks, soil, air, and homes. To gauge the extent of contamination and potential for health-related concerns, state-of-the-art proton transfer time-of-flight mass spectrometry (PTR-TOF-MS) has been utilized to analyze water samples in real time with a sensitivity to volatile organic compound (VOC) concentrations under 10 parts per trillion. Ionizing VOCs allowed for high resolution measurement of mass (over a thousandth of an AMU) and identification of compounds based on a mass to charge ratio spectrum. Quantifying the released compounds allows for better informed health advising, targeted cleanup methods, and a more steadfast metric to assess accountability from Norfolk Southern. Comparing these results with EPA response, a disparity is evaluated between disaster occurrence and effective risk communication revealing a dangerous gap in exposure and awareness. The results should serve to guide disaster relief efforts in East Palestine and beyond as well as improving standard practices pertaining to sustainable, safe practices in industrial manufacturing, human and environmental health monitoring, and remediation.

Keywords: PTR-TOF-MS, VOC, Chemical Disaster, Risk Measurement, EPA

Mentor(s):

Brandon Boor (Engineering); Nusrat Jung (Engineering); Jinglin Jiang (Engineering); Xiaosu Ding (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7076
Presentation Time: 214A at 4:20pm-4:40pm

Rheological Behavior of Cellulose Nanofibril Suspensions with Varied Levels of Fines and Solid Content

Physical Sciences

Author(s):

Ethan O'Banion† (Engineering)

Abstract:

The rheological behavior of mechanically disk refined cellulose nanofibrils (CNFs) aqueous suspensions with 50, 60, 70, 80, 90, 100 % fines contents at 1 and 3 wt.% solid concentrations was studied by conducting various dynamic and steady-state rheological experiments, including oscillatory shear, flow sweep, startup, flow loop, and three-step oscillation experiments. All the samples exhibited a gel-like behavior in oscillatory shear tests and samples, with 50 % fines showed the highest levels of dynamic moduli for both solid contents. Suspensions with higher concentrations of CNFs showed higher values for viscosity, complex viscosity, and dynamic moduli. A critical shear rate of 10 s-1 independent of the solid contents of the suspensions was found for varying fines levels, where viscosity measurements above this critical shear rate converged and viscosity measurements below it diverged. All samples exhibited yield in shear flow and yield stresses exhibited a decreasing trend followed by a plateau as fines levels increased. The level of yield stress for 3 wt.% suspensions was higher than that of 1 wt.% suspensions. The lowest structure recovery was observed for samples containing 50 % fines content. Moreover, a rheopectic-thixotropic transition was observed for samples with high fines content (90 and 100 %) at low solid content (1 wt.%).

Keywords: Rheology, CNF, Viscosity, Shear, Suspension

Mentor(s):

Dr. Siamak Shams Es-haghi (University of Maine)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7077
Presentation Time: 214A at 4:40pm-5:00pm

An Analytical and Statistical Analysis of Turbofan Engine Sensor Data

Innovative Technology/Entrepreneurship/Design

Author(s):

Stan Melkumian† (Polytechnic)

Abstract:

Predictive maintenance in aviation and aerospace applications is among the most explored problems in machine learning (ML) and artificial intelligence (AI), and datasets such as NASA's C-MAPPS turbofan engine degradation simulation data have helped researchers in exploring myriad questions on performance, maintenance, and failures of engines. The purpose of this study was to explore and extend the current research on predicting the remaining useful life (RUL) of the engines and risk classification. Starting with simple but under-investigated, non-linear survival and random forest models, the analysis used eXtreme Gradient Boosting (XGBoost) and long short-term memory (LSTM) from TensorFlow's Keras library. For both regression and classification, principal component analysis (PCA), lifelines survival analysis, k-nearest neighbors (KNN) algorithms, and random forests provided valuable insights. XGBoost and LSTM architectures yielded regression results comparable to those of related studies. XGBoost regressor yielded root mean squared error (RMSE) and R-squared scores as low as 21.29 and 0.74 respectively, outperforming LSTM by 25%. XGBoost classifier yielded accuracy scores as high as 90%, on par with LSTM and random forest classifiers.

Keywords: Machine Learning and Artificial Intelligence, Aerospace, Turbofan Engine, Predictive Maintenance, Remaining Useful Life and Risk Classification

Mentor(s):

Haritima Chauhan (Western Illinois University)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7078
Presentation Time: 214B at 4:00pm-4:20pm

Analysis of Tight Integration Between Vector and Scalar Compute Units

Innovative Technology/Entrepreneurship/Design

Author(s):

Johnathan Hong† (Engineering); Sooraj Chetput† (Engineering); FangLing Zhang† (Engineering); Zengxiang Han‡ (Engineering)

Abstract:

In contemporary server architectures, scalar cores traditionally process all incoming requests, treating each as an individual task. With the rise of microservices, the nature of these requests has evolved, becoming inherently parallelizable and offering an opportunity for optimization. To harness such parallelism, we propose a novel heterogenous architecture using existing open-source projects and inspiration from industry.

We propose a coupled vector and scalar core: the vector core introduces task level parallelism, whilst the scalar core introduces latency sensitivity into the system, which is crucial for microservices. The vector core introduces task level parallelism, whilst the scalar core introduces latency sensitivity into the system. The system is built on top of the Vortex Open-Source GPU.

We are exploring various degrees of integration between the scalar and vector cores: one approach involves them sharing an L2 cache but maintaining independent L1 instruction caches; another entails sharing a banked L1 instruction cache. The first design, which segregates high-priority and low-priority threads at the kernel level, promises ease of implementation. With such an approach, one downside is that the duplication of caches enlarges a system's memory footprint. In contrast, a design where the cache is shared would curtail the memory footprint. Additionally, we are contemplating an architectural design in which the scalar core operates at a higher clock rate than the vector core, thereby enhancing latency sensitivity.

Keywords: Computer Architecture, Microservices, Parallelism, Latency, Open Source

Mentor(s):

Tim Rogers (Engineering); Mark Johnson (Engineering); Anusuya Nallathambi (Engineering); Sharath Shivakumar (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7079
Presentation Time: 214B at 4:20pm-4:40pm

Dynamic Local Planner for High-Speed Autonomous Racecars

Mathematical/Computation Sciences

Author(s):

Alec Pannunzio† (Engineering, JMHC)

Abstract:

The Purdue AI Racing initiative, in conjunction with Black and Gold Autonomous Racing, is a team of individuals who engineer software for their Dallara AV-21 Racecar to compete in the Indy Autonomous Challenge. Within that software stack, there is a global planner, that takes the pre-computed optimal race-line trajectory and transforms it into the local frame of the car. The car then follows this trajectory with its controller.

To attack, defend, and overtake other vehicles, the stack must have a dynamic local planner that takes the static path served by the global planner, and performs adjustments to it for the current situation. For example, the global planner tells the car whether the track is turning to the right or the left, but it does not tell the car whether or how to adjust to pass another racecar. To solve this issue, I wrote a dynamic local planner that is built around a two-node system. Within the two-node system, one node controls strategy, while the other node controls how to adjust the path based on the served strategy, similar to a cascade controller. The strategy and path adjustments are computed by the planner based on the location, trajectory, and speed of the other vehicles.

Keywords: Autonomous Racing, Local Planning, Self-Driving Cars

Mentor(s):

Sam Labi (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7080
Presentation Time: 214B at 4:40pm-5:00pm

LLM-Assisted Software Energy Optimizations for Data Center

Mathematical/Computation Sciences

Author(s):

Fah Yen† (Engineering); Max Chang‡ (Science); Samay Nandwana‡ (Science)

Abstract:

We must discover more efficient ways of using energy, both to mitigate global climate change and to promote US national security through greater energy independence. One driver of energy use is increased reliance on computing in data centers, which use an estimated 2% of the energy in the USA. Researchers have improved traditional performance characteristics of data centers (lower latency, higher throughput, greater parallelism) but we know less about improving their energy efficiency. LLMs such as ChatGPT and GitHub Co-Pilot have shown impressive performance in assisting engineers to develop correct and secure software more quickly. They have not yet been applied to energy efficiency, but our preliminary data shows potential to do so. Our objective is to assess the risks and rewards of using an emerging technology called large language models (LLMs) to improve energy efficiency of the software used in data center. To achieve the objective, LLMs will require (a) careful prompting, and (b) access to feedback in the form of real-world energy data.

Keywords: Large Language Model, Code Efficiency, Energy Optimization, Data Center

Mentor(s):

James Davis (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7081
Presentation Time: 214C at 4:00pm-4:20pm

Sound Archive

Social Sciences/Humanities/Education

Author(s):

Gavin Cloyd† (Liberal Arts, JMHC); Jackson Stone† (Polytechnic, JMHC); Sahil Desai‡ (Engineering, JMHC); Jue Fang‡ (Polytechnic, JMHC)

Abstract:

Archives have existed for thousands of years, dating back to 3500 BCE. They serve more purposes than just to preserve the past, although that is the main purpose, they also serve to connect people, cultivate artistic inspiration, and influence public memory of the past. With the support of Purdue Libraries and Archives, our mission is to create a digital sound archive of Purdue with past and present sounds to capture and represent the complex and ever changing soundscapes of Purdue. We have begun creating a website to feature our sounds for the public. A digital archive comes with its own set of challenges in standardization, accessibility, organization, and data integrity which we discuss. The next challenge is defining and systematically recording a soundscape to get the best recording possible. Initially, we have focused on gathering keynotes and experiential sounds, but we plan to broaden our focus to soundscape ecology when we have enough data. Furthermore, we are also implementing a system for public sound submissions to be graded and contributed to the archive.

Keywords: Soundscape, Archive, Accessibility, Keynote, Recreating the Past

Mentor(s):

Jason Ware (JMHC)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7082
Presentation Time: 214C at 4:20pm-4:40pm

Automated Crater Morphology Characterization on the Moon Using an Unsupervised Neural Network

Physical Sciences

Author(s):

Sara Cuevas-Quiñones† (Science, JMHC)

Abstract:

Craters provide windows into a planet's geology, and their morphologies provide important information into the properties of the body that was impacted and the processes that have occurred since the crater formed. While previous lunar crater classification has been done by hand, it can be time consuming given the sheer number of craters that are on the Moon. We propose the use of unsupervised machine learning techniques for a systematic, time efficient approach to crater characterization. Unsupervised machine learning techniques deal with finding patterns in unlabeled data. One of their main purposes is to achieve a form of dimensionality reduction, i.e., condensing data into less features while still retaining the most important aspects. Using the python deep learning packages Keras and Tensorflow, we construct an autoencoder to categorize the morphology of simple craters and explore the natural clustering that results when crater images are put through the autoencoder.

We first create a trial data set of crater images obtained by the Lunar Reconnaissance Orbiter Camera Wide Angle Camera (LROC WAC). These are then put through an autoencoder neural network. We find our techniques can distinguish pristine craters from degraded craters and those with rims breached by the lunar mare basalts.

For our second trial, we compile remote sensing data (including LROC Narrow Angle Camera [NAC] mosaics, Mini-RF radar, and normalized nighttime temperatures) for 100 craters. 50 are cold spot craters, which are thermophysically distinct, and the other 50 are non-cold spot craters of similar size. Similarly, these were put through the autoencoder to evaluate the viability of using an autoencoder for automated detection of morphologies that distinguish cold spot craters.

Keywords: Moon, Craters, Machine Learning, Planets

Mentor(s):

Ali Bramson (Science); Lior Rubanenko (Technion Institute of Technology, Israel)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7083
Presentation Time: 214C at 4:40pm-5:00pm

Why do we need to teach quantum to K-12 and early college students?

Social Sciences/Humanities/Education

Author(s):

Priyam Gupta† (Engineering, JMHC); Eric Broyles‡ (Engineering, JMHC)

Abstract:

Our goal in teaching quantum to K-12 and undergraduate students isn't solely to create a quantum workforce but to ignite a profound passion for science. The field of quantum physics is a treasure trove of surprises, and sharing this with students isn't just about imparting fundamental knowledge; it's about fostering scientific literacy, critical thinking, innovation, and a broader perspective.

At the fundamental level, most processes are governed by quantum mechanical effects, and thus teaching these basic concepts is instrumental to our understanding of the world around us. There are many examples (MRI, lasers, etc), not counting emerging quantum computers, that justify investment in quantum education effort. To be able to justify research funding from taxpayers' money to the general public, we need to develop a common language to communicate the very essence of quantum research.

We found insights by reviewing relevant literature about successful K-12 and early college initiatives for quantum computing education. Gaps in the current state of quantum literacy and potential ways to fill these were also identified from the literature.

We undertook several initiatives exposing students to quantum physics and mechanics, with the help of NDEP funding. We received relevant feedback about these initiatives from students and teachers, from which we were able to gain insights about good practices. We also collected quantitative data showing the program success so far, and the positive impact of our quantum activities.

Keywords: Quantum Literacy, Quantum Education Initiatives, Science Education, Innovation in Teaching, Engineering Education

Mentor(s):

Bob Kenley (Engineering); Dongyang Li (Engineering); Mahdi Hosseini (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7084
Presentation Time: 214D at 4:00pm-4:20pm

Steven Spielberg's Bridge of Spies as a Russian Fairy Tale

Social Sciences/Humanities/Education

Author(s):

Umbert Caseres† (Liberal Arts)

Abstract:

Steven Spielberg's Film Bridge of Spies, a spy story based on real life events, and a thriller, addresses US-Russia relations. This paper examines the narrative structure of the story using Proppian functions, an analytical tool developed for the analysis of Russian fairy tales, which focuses on the plot and includes a set of character roles and narrative regularities typical for fairy tales. This paper uses microanalysis, or exploration of little details of the plot, and the timing of the film. The film has two parts, unified by the protagonist or "a hero", American attorney James Donovan. In the first part of the film, Donovan works on obtaining what will become "the magic help" of the story, Russian spy Rudolf Abel. In the second part, with the help of Abel, he is able to save the lives of two American hostages. My analysis of the film plot lines shows that Proppian functions, even though with certain exceptions, work well in explaining the narrative "scaffolding" of the story. My conclusion is that Proppian functions can be useful in the analysis of adventure films and stories.

Keywords: Spielberg, Spy Film, Russian Fairy Tales, Vladimir Propp, Narrative Structure

Mentor(s):

Amina Gabrielov (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Research Talk Presentation Abstract Number: 7085
Presentation Time: 214D at 4:20pm-4:40pm

Relocation Incentives in Alaska; Or, The Call of the Wild and Transfer Payments

Social Sciences/Humanities/Education

Author(s):

Nathan Miller† (Liberal Arts)

Abstract:

A paramount question for governments is how to best people a land. Especially when land is abundant and populations low, governments put many resources into incentivizing citizens to move to population-sparse tracts. In early America, such peopling cemented the new nation’s claim to territory and lowered per capita enforcement costs of property rights. More recently, sovereigns have invoked these schemes to invigorate local economies and attract human capital. It is thus valuable for political economists to understand how different programs incentivize migration. Alaska serves as an interesting case study for this purpose, having used homesteading in its early history and then the Alaska Permanent Fund Dividend in more recent history to issue transfer payments to those who move to the state.

I use a model developed by Southey (1978) to predict the rent captured by cultivating homesteaded parcels of Canadian prairie land into wheat farms to analyze homesteading in Alaska, and I develop my own model to predict utility gained from the Alaskan Permanent Fund Dividend. I conclude by comparing the models’ implications for migration against historic data.

Keywords: Homesteading, Alaska Permanent Fund, Transfer Payments, Rent Dissipation

Mentor(s):

Jillian Carr (DSB)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

VIRTUAL PRESENTATIONS

Presentations available on Fall Expo website November 14-21, 2023.
Presentations sorted by last name of first author.

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

9000 *Kyle Bautista†; Derek Chi†*
Mentor(s): Mark Johnson; Ryan Montsma

9001 *Jaehong Choi†; Rohan Joshi†; Wen-Bo Hung†; Yunlin Zhang†*
Mentor(s): Mark Johnson; Ryan Montsma; Cole Nelson; Maxwell Michalec; Jude Pinto

9002 *Ta-Kuan Chuang†*
Mentor(s): Brandon Boor; Nusrat Jung; Chunxu Huang

9003 *Lekha Durai†*
Mentor(s): Kirsten Davis; Jennifer DeBoer

9004 *Samuel Forfang†; Vincent Graciano‡; Pratheek Kotla‡*
Mentor(s): Mark Janis

9005 *Andrew Fulkerson†*
Mentor(s): Carlos Corvalan; Jiakai Lu

9006 *Emma Jeffries†; Future Jani‡*
Mentor(s): Gudrun Schmidt

9007 *Wesley Kestenbaum†*
Mentor(s): Michael Johnson

9008 *Rushil Khandelwal†; Prahlad Shelvapille‡; Jackson Thompson‡; Doren Cohen‡; Adrian Romo-Loomis‡; Alexander Collins‡*
Mentor(s): Shreya Ghosh

9009 *Kyung Min Ko†; Gunvanth Reddy Kandula†; Yash Rajendra Ashhtekar‡; Kanav Atre‡*
Mentor(s): Edward Delp

9010 *Pratheek Kotla†*
Mentor(s): Sergiy Chernenko

9011 *Garrett Lail†; Jonathan Huang†; Sudhanva Donakonda†*
Mentor(s): Cole Nelson

9012 *Yunhao Lan†; Ben Owen†*
Mentor(s): Mark Johnson; Ryan Montsma

9013 *Tam Le†; Tsai-Shuang Lan†; Andrew Schlabach†; Kerway Tsai†*
Mentor(s): Mark Johnson; Boyuan Chen

9014 *Michael Lee†; Rauf Emre Erkiletlioglu**
Mentor(s): Mark Johnson

9015 *Pu-Wei Lee†; Woosik Kim†*
Mentor(s): Ryan Montsma; Cole Nelson

9016 *Yuechan Li†*
Mentor(s): Abolfazl Hashemi; Shivam Bhat; Zijian He

9017 *Clark Liao†*
Mentor(s): Mark Johnson; Jude Pinto

9018 *Yung-Chieh Lin†; Qiuyang Huang†*
Mentor(s): Sam Labi; Shreya Ghosh

9019 *Ya-Han Lin†*
Mentor(s): Mark Johnson; Jude Pinto

9020 *Chia-Hua Lin†*
Mentor(s): Sudip Vhaduri; Jinjin Cai

9021 *Mateo Llerena†; Shalav Kakati*; Mridula Naikawadi*; Aditya Hebbani*; Luke DeLorenzo*; Dean Smith*; Devesh Mehra**
Mentor(s): Shreyas Sundaram; Charles D'Onofrio

9022 *Jeremy Lu†*
Mentor(s): Michael Johnson

9023 *Jingxi Ma†*
Mentor(s): Michael Johnson

9024 *John Mburu†; Joseph Lopez**
Mentor(s): Pramey Upadhyaya; Abhishek Solanki

9025 *Noah Merz†*
Mentor(s): Sidney Ducleroir

9026 *Asmi Mukherjee†*
Mentor(s): Douglas Brubaker

9027 *Saibya Padha†*
Mentor(s): Michael Johnson

9028 *Adrian Persaud†; Hana Wong†*
Mentor(s): Mark Johnson; Swapnil Bansal; Conor Green

9029 *Linh Pham†*
Mentor(s): Paul Parsons; Zixu Zhang

9030 *Annabelle Redman†*
Mentor(s): Kari Clase; Daphne Krutulis

9031 *Chelsea Reppert†*
Mentor(s): Inna Abramova; Lyubov Sylayeva

9032 *Patrick Robison†*
Mentor(s): Michael Johnson

9033 *Mark Rome†*
Mentor(s): Sidney Ducleroir

9034 *Ayush Singhal†*
Mentor(s): Michael Johnson

9035 *Aditya Sood†; Vishnu Lagudu‡*
Mentor(s): Mark Johnson; Jude Pinto

9036 *Sreevickrant Sreekanth†; Cy Logan‡; Vanamali Vemparala‡; Pratham Agrawal‡*
Mentor(s): James Davis

9037 *Harshith Suresh†*
Mentor(s): Charles D'Onofrio

9038 *Keerthana Thirumal†*
Mentor(s): Sidney Ducleroir

9039 *Tin Tran†; Duc Tri Than†; Duncan Nguyen†*
Mentor(s): Mark Johnson; Ryan Montsma; Cole Nelson

9040 *Boheng Zhao†*
Mentor(s): Conor Green; Mark Johnson

Virtual Presentation Abstract Number: 9000
Presentation Time: November 14-21 on Fall Expo Website

Serial Peripheral Interface (SPI) Implementation for the AFTx07

Innovative Technology/Entrepreneurship/Design

Author(s):

Kyle Bautista† (Engineering); Derek Chi† (Engineering)

Abstract:

The target of our research project aims to enhance the Serial Peripheral Interface (SPI) subsystem of the AFTx07 microprocessor under development by the SoCET team. The AFTx07 is an embedded processor that is capable of being used in various applications. This project in particular seeks to improve the existing SPI peripheral for better overall system performance and customized data transfers.

Our primary focus is to implement a synthesizable SPI interface, and possibly extending the work to implementing a Quad SPI interface. By aiming for faster clock speeds, clock configurations, and improved data transfer capabilities, this will significantly enhance the AFTx07's communication probabilities, making it suitable for demanding applications that require high-speed data exchange. Moreover, we aim to optimize the scalability of the design and to make it compliant to the APB bus standard to integrate it with the AFTx07's design.

Key objectives include designing a flexible and efficient SPI core, possibly integrating QSPI functionality into the AFTx07 microprocessor, providing seamless AFTx07 integration, and delivering a scalable SPI design. To achieve this, we will utilize hardware design techniques and implement the design with SystemVerilog, a hardware description language, to model a functional - and synthesizable - SPI peripheral.

Ultimately, the improved SPI interface will empower AFTx07 developers to create more efficient, high-performance applications while maintaining compatibility with existing SPI-based devices. This project represents significant advancement in the AFTx07 capabilities, expanding its usability and incorporating a modern standard in the digital electronics ecosystem.

Keywords: SoCET, Hardware, SPI, Digital Logic, AFTx07

Mentor(s):

Mark Johnson (Engineering); Ryan Montsma (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9001
Presentation Time: November 14-21 on Fall Expo Website

JTAG for AFTx08 Digital Design

Innovative Technology/Entrepreneurship/Design

Author(s):

Jaehong Choi† (Engineering); Rohan Joshi† (Engineering); Wen-Bo Hung† (Engineering); Yunlin Zhang† (Engineering)

Abstract:

As technology develops, the number of transistors on chips approximately doubles every two years based on Moore’s law, so IC complexity needs good ability for debugging. Additionally, advanced packaging techniques like ball grid arrays are more common which is difficult to fully test via physical wiring. These two factors increase the difficulty of testing the connection between each module on the board. Traditional in-circuit test methods like the bed of nails test, which involves connecting multiple pins onto physical contact points on the chip, are not able to test modern chips anymore because connecting wires to hundreds of physical test points are not feasible. JTAG was created to solve this testing problem. Joint Test Action Group (JTAG) is an IEEE standard (1149.1) that tests interconnects on printed circuit boards at the integrated circuit level without the need of physical access. Nowadays, its application has been expanded to in-system programming and software debugging.

We designed a JTAG module with additional support for programming and debugging the AFTx08 integrated circuit designed by the SoCET team. It supported all mandatory instructions defined in the standard, and added custom instructions for programming and debugging through the system AHB bus. Additionally, since the JTAG module and the system bus were in different clock domains, clock domain crossing was implemented to synchronize the signals/data. In addition, in order to send the signals from the host to our chip, we developed a software adapter that handled the encoding/decoding for sending/receiving JTAG signals.

Keywords: Digital Design, SoC, Design Verification, Boundary Scan, JTAG

Mentor(s):

Mark Johnson (Engineering); Ryan Montsma (Engineering); Cole Nelson (Engineering); Maxwell Michalec (Engineering); Jude Pinto (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9002
Presentation Time: November 14-21 on Fall Expo Website

The Development of a New Test Methodology for Rapid Ageing of HVAC Filters Abstract.

Innovative Technology/Entrepreneurship/Design

Author(s):

Ta-Kuan Chuang† (Engineering)

Abstract:

Indoor air quality has become increasingly important as more study has shown that poor indoor air quality is associated with respiration ailments and transmission, which is often directly related to the building's heating, ventilation, and air conditioning (HVAC) filter systems. Notably, the performance of the HVAC filters determines the effectiveness of preventing harmful outdoor aerosols from flowing into occupancy spaces. However, the traditional loading aerosols used to age HVAC filters are primarily composed of coarse mode particles distributed from 1 to 100µm, whereas the urban ambient aerosol often contains aerosol mass distribution between 0.1 and 1µm. Therefore, new standardized test methodologies are critical in evaluating the realistic performance and efficiency of the air-loading behavior of the HVAC filtration system. In this study, the long-term characteristics of MERV8, MERV13, and MERV14 HVAC filters are examined to provide more comprehensive testing protocols for the rapid aging of the filter. The filter is loaded with the sub-micron potassium chloride (KCl) aerosols generated by the thermal aerosol generator. The mass distribution of the potassium chloride is measured by the scanning mobility particle sizer (SMPS) and a high-resolution electrical low-pressure impactor (HR-ELPI+). The time variable determines the efficiency of the test filter for the pressure drop to reach 1.5-inch water column (inH2O). Based on the results, the new loading methodology successfully tested the long-term loading behavior of HVAC filters. The new methodology is a time- and- cost-effective technique to artificially age the HVAC filtration system, where the urban aerosols are realistically simulated.

Keywords: Indoor Air Quality, HVAC Filter, Aerosol Mass Distribution, Filter Efficiency, New Test Method

Mentor(s):

Brandon Boor (Engineering); Nusrat Jung (Engineering); Chunxu Huang (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9003
Presentation Time: November 14-21 on Fall Expo Website

Assessing the Mental Health of Students at a Technical School in Eldoret, Kenya

Life Sciences

Author(s):

Lekha Durai† (Engineering, JMHC)

Abstract:

Youth mental health problems are particularly under-researched in low- and middle-income countries. In Kenya, youth mental health is under supported and influences the development of poverty. Kenyan street children are a vulnerable population that disproportionately faces mental health inequities such as substance abuse and stress disorders. Alternative schools educating and supporting these youth provide them with mental health resources. However, there is little research studying the impact of these interventions on the mental health of street youth. We study the mental health of students at Tumaini Innovation Center (TIC), a technical school in Eldoret, Kenya, that was founded to support street children. TIC offers yearlong courses alongside multiple forms of mental health care. We used a mixed methods design to evaluate the changes in student mental health over time, the effectiveness of the mental health resources, and the validity of using the 21-item version of the Depression, Anxiety, and Stress Scale (DASS-21) with this population. We distributed questionnaires that asked about demographics, student backgrounds, and mental health, and that included the DASS-21. Additionally, we interviewed students, teachers, house parents, and counselors on their perceptions of student mental health. We analyzed the questionnaire data using descriptive statistics and performed a thematic analysis on the interview data. This work will provide clarity on the students' mental health and the impact of TIC's mental health resources. We will also confirm the validity of using DASS-21 in this street youth population so that future researchers can use this standardized questionnaire with this group.

Keywords: Youth Mental Health, Street Children, Mental Health Care, Mixed Methods Research Design, Questionnaire Validation

Mentor(s):

Kirsten Davis (Engineering); Jennifer DeBoer (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9004
Presentation Time: November 14-21 on Fall Expo Website

The Emerging Legal Framework for Resource Extraction on the Lunar South Pole

Social Sciences/Humanities/Education

Author(s):

Samuel Forfang† (Science, DSB); Vincent Graciano‡ (Engineering); Pratheek Kotla‡ (Science, DSB, JMHC)

Abstract:

In this project (SpaceLaw), we synthesize materials on the legal issues likely to arise in resource extraction activities on the lunar south pole. In Part I, we survey the technical literature on proposed lunar missions to the south pole, with a particular focus on understanding the scientific, engineering, and logistical aspects of proposed resource extraction operations. For example, we consider proposals from India's most recent space mission, Chandrayaan-3. Two more missions we will be exploring include the proposed Artemis III mission by the US and the Chang'e-7 mission conducted by China.

In Part II of our study, we analyze how existing space law rules are likely to be applied to lunar missions of the type currently being proposed. We explore the Outer Space Treaty (OST) and the Artemis Accords, examining their provisions related to lunar resource utilization and the establishment of "safety zones" on the moon. We evaluate the positions of the U.S. and other spacefaring nations on the OST's prohibition against claims of sovereignty on lunar territory, and address its significance for ownership in extracted lunar resources. Building upon these legal foundations, we consider the potential implications for resource extraction activities, space traffic management, and international cooperation on the lunar south pole. Our analysis will lead us to create recommendations and predictions on how these legal issues are likely to be resolved, offering insights into the evolving legal landscape of lunar resource extraction and the challenges that await stakeholders in this new frontier.

Keywords: Lunar South Pole, Lunar Resources, Legal Issues in Space, Artemis Accords

Mentor(s):

Mark Janis (Indiana University)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9005

Presentation Time: November 14-21 on Fall Expo Website

Machine learning reveals parsimonious differential model for myricetin degradation from scarce data

Mathematical/Computation Sciences

Author(s):

Andrew Fulkerson† (Engineering)

Abstract:

Accurately describing the degradation of food antioxidants in oil emulsions is essential to understanding and controlling factors that influence emulsion stability, such as the antioxidant concentration. Here, we present a machine learning approach that discovers an analytical equation to predict myricetin degradation in oil emulsions from a small experimental dataset. The approach discovers a parsimonious differential equation that describes the myricetin dynamics over a wide range of initial concentrations and extrapolates well beyond the learning data. This information could be used to develop food products with improved shelf life. The machine learning approach shows promise for discovering governing equations that describe the evolution of food systems where the underlying dynamics are difficult to capture from limited experimental data.

Keywords: Machine Learning, Differential Equations, Food Antioxidants, Oil Emulsions, Food System Dynamics

Mentor(s):

Carlos Corvalan (Agriculture); Jiakai Lu (University of Massachusetts, Amherst)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9006
Presentation Time: November 14-21 on Fall Expo Website

Wet Setting Adhesives Made From Plants for Dental and Oral Applications

Physical Sciences

Author(s):

Emma Jeffries† (Science); Future Jani‡ (Science)

Abstract:

Plant-based and nontoxic adhesives that work in wet environments could be advantageous for dental and oral applications. At this time, adhesives that stick in a wet oral environment, at body temperature and in the presence of saliva are rare or nonexistent. Removal on demand and degradability of these plant-based materials are further desirable properties. We have discovered that zein corn protein and tannic acid can be formulated with inorganic components such as calcium carbonate, to increase adhesion to surfaces covered in artificial saliva. Room temperature and body temperature were relevant to the use of dental and oral adhesives. Surfaces of interest to dental and oral applications development are hydroxyapatite to mimic tooth enamel, saliva covered collagen to mimic the oral mucous environment, and stainless steel to test efficacy on metals used in dental repair. Given the similarity in composition, limestone is a cost-effective alternative substrate to hydroxyapatite. Limestone tiles were used as substrates to screen hundreds of adhesive formulations. Optimal adhesion strength and the most promising adhesives for wet or mucous surfaces were examined. Adhesives were applied to the substrates in deionized water, saline solution and artificial saliva. Substrates were glued together and then cured in these “solutions”. After curing lap shear testing was used to determine adhesion strength. Data are presented as function of composition, substrate, solution type and temperature. Adhesive and cohesive failure modes are evaluated after lap shear testing. This undergraduate research study is part of a larger project in collaboration with the Wilker lab in Chemistry and the Liu lab in Chemical Engineering.

Keywords: Adhesives, Dental Applications, Plant-Based Protein, Lap Shear Testing, Inorganic Fillers

Mentor(s):

Gudrun Schmidt (Science)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9007
Presentation Time: November 14-21 on Fall Expo Website

Mental Health Evidence Based Argument

Social Sciences/Humanities/Education

Author(s):

Wesley Kestenbaum† (Engineering)

Abstract:

Mental health has been a serious problem on college campuses for a long time. However, the problem is only getting worse due to many different factors such as covid, pressure from high tuition, social media, drug use, and several other factors. Purdue University, like many other schools, has implemented a variety of programs in order to help reduce the presence of mental health illness on campus. My research aims to explore additional programs that Purdue can implement in order to further reduce the occurrence of mental health on campus. I intend to do this by conducting research on the programs that currently exist at Purdue and determining the effectiveness of them. I will then research programs other schools are providing to their students not offered by Purdue and contrast the effectiveness of these programs to ones that Purdue has to offer. Finally, I will then base my proposal on the results that work best either at Purdue or other universities.

Keywords:

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9008
Presentation Time: November 14-21 on Fall Expo Website

An inquiry into fiber-reinforced composites and their applications on the fabrication of objects within the field of autonomous motorsports

Innovative Technology/Entrepreneurship/Design

Author(s):

Rushil Khandelwal† (Engineering); Prahlad Shelvapille‡ (DSB); Jackson Thompson‡ (DSB); Doren Cohen‡ (Engineering); Adrian Romo-Loomis‡ (Engineering); Alexander Collins‡ (DSB)

Abstract:

The purpose of this investigation was to identify the best material matrix for future mechanical projects within Purdue's Autonomous Motorsports (AMP) club. This was done by looking into the materials carbon fiber, fiberglass, and kevlar, as these cover a wide range of fiber-reinforced composites available in the market. The chemical and physical characteristics were compared against one another, and it was identified that, while posing the highest strength-to-weight ratio, carbon fiber provided the most advantages in application to most projects within an autonomous racecar. It was also identified that, whilst expensive, carbon fiber posed the highest value out of the three investigated materials, and therefore was the best purchase prospect for Purdue's AMP on a macro level. It was, however, also identified that kevlar and fiberglass did pose benefits, especially with respect to gear shifters, for example, and this was also noted down.

The demonstration of the theoretical, chemical and physical characteristics of each material will now be explored with small samples. In addition, in application of this research, usage of carbon fiber will be leveraged within projects conducted within AMP. Any observations will be noted down, and instructions will be compiled in order to act as guidelines for any future projects within AMP.

Keywords: Materials, Composites, Motorsports, Fiber-Reinforced, Engineering

Mentor(s):

Shreya Ghosh (Engineering)

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Virtual Presentation Abstract Number: 9009
Presentation Time: November 14-21 on Fall Expo Website

Pedestrian Detection during COIVD-19

Mathematical/Computation Sciences

Author(s):

Kyung Min Ko† (Engineering); Gunvanth Reddy Kandula† (Science); Yash Rajendra Ashhtekar‡ (Engineering); Kanav Atre‡ (Engineering)

Abstract:

In this research, we are leveraging a real-world dataset that consists of images of walking pedestrians around the world before, during and post COVID-19. Our initial goal is to detect the number of pedestrians in the images to analyze pedestrian behavior related to social distancing affected by COVID-19. Therefore, we are building edge detectors such as Sobel and Canny edge detectors to better understand the concept of image segmentation and we are planning to develop machine learning algorithms to detect pedestrians more precisely. After we successfully detect pedestrians in the images, we are planning to find the distance between each pedestrian to measure the social distance between each pedestrian to solve social problems related to COVID-19.

Keywords: Machine Learning, Computer Vision, Image Processing, Edge Detection, COVID-19

Mentor(s):

Edward Delp (Engineering)

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Virtual Presentation Abstract Number: 9010
Presentation Time: November 14-21 on Fall Expo Website

Financial Investment Reports and the differences per county

Social Sciences/Humanities/Education

Author(s):

Pratheek Kotla† (Science, DSB, JMHC)

Abstract:

This study delves into municipal bond investment reports, initially focusing on Clark County, Nevada. Municipal bonds play a pivotal role in local government financing, making them an ideal subject for analysis and future investments. A significant challenge in this analysis is the fragmented nature of data in these investment reports, which come in various PDF formats. To tackle this, the study employs a Python-based workflow for automated data extraction and synthesis from these reports, ensuring data remains up-to-date and analyzable. The research method entails collecting essential demographic data, including GDP, population statistics, and government data, to comprehensively gauge Clark County's financial stability. This information feeds into a structured data frame, including key metrics like book value, par value, and market value. The results from this study offer valuable insights into municipal bond performance and the factors influencing it. These findings are crucial for financial decision-makers, policymakers, and investors alike. By gaining a deeper understanding of these bonds, this research provides guidance for more informed investment decisions, ultimately contributing to the financial well-being of Clark County and similar municipalities.

Keywords: Municipalities, Bonds, Counties, Analyzing, Statistics

Mentor(s):

Sergiy Chernenko (DSB)

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Virtual Presentation Abstract Number: 9011
Presentation Time: November 14-21 on Fall Expo Website

Modeling Performance of System on Chip using gem5

Mathematical/Computation Sciences

Author(s):

Garrett Lail† (Engineering); Jonathan Huang† (Engineering); Sudhanva Donakonda† (Engineering)

Abstract:

Implementing a system-on-chip is a time-consuming and highly specialized task. Alterations to an architecture are therefore costly, and can be performed only with extensive knowledge about the system. A simpler method to evaluate architectural options is a lower fidelity, but rapidly alterable software model. This model must closely approximate the performance of the real system while significantly lowering the complexity of modifying and analyzing it. The primary aim of the SoCET Performance Modeling project is to take the AFTx07 custom system-on-chip and provide the means to explore and guide future architectural enhancements through reliable software simulation. This project utilizes the gem5 simulator for the development of an AFTx07 system simulation. Evaluating the accuracy of the model involves correlating simulation results against real hardware results using established system benchmarks such as the Embench test suite. Additionally, another aim of the project is to characterize Embench using gem5, which will provide insights into the current AFTx07 performance. Future objectives include modifying the simulation to examine the system's performance under various microarchitectural modifications or the integration of new extensions. By simulating these modifications and collecting the necessary data, one could rapidly explore architecture choices without needing to implement them in hardware.

Keywords: SoC, Gem5, Microarchitecture

Mentor(s):

Cole Nelson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9012
Presentation Time: November 14-21 on Fall Expo Website

Design and implementation of half-precision floating-point unit for custom SoC

Innovative Technology/Entrepreneurship/Design

Author(s):

Yunhao Lan† (Engineering); Ben Owen† (Engineering, JMHC)

Abstract:

Our group focused on designing, testing, and implementing a half-precision floating-point unit (FPU) on AFTx07, the new RISC-V-based microcontroller currently developed by the System-On-Chip Extension Technologies team. An FPU is commonly used as a way to perform decimal number computations at a hardware level, resulting in much faster processing of these mathematical computations compared to software emulation. Although the most common implementation of an FPU is a single-precision (32-bit) unit, our team started with a more simple half?precision (16-bit) implementation.

Due to SoCET's requirements, we are beginning by only implementing floating-point addition, subtraction, and multiplication, saving both space on the microprocessor and development time. We used SystemVerilog to describe the hardware necessary for the protocol, utilizing the digital libraries in FuseSoC to implement simple lower-level modules and ensure smoother integration with the rest of the AFTx07 design. Our design implements the IEEE floating-point specification, ensuring predictable behavior compared to other microcontrollers. Verification of the hardware was performed using SystemVerilog test benches to ensure that the design worked in various real-world scenarios, such as overflow/underflow conditions, infinitesimal values, and other complex number representations.

Keywords: FPU, SoC, Digital Design, Design Testing, Integration

Mentor(s):

Mark Johnson (Engineering); Ryan Montsma (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9013
Presentation Time: November 14-21 on Fall Expo Website

Purdue SoCET, designing a Standard Cell Library Utilizing Open-Source Software

Innovative Technology/Entrepreneurship/Design

Author(s):

Tam Le† (Engineering); Tsai-Shuang Lan† (Engineering); Andrew Schlabach† (Engineering); Kerway Tsai† (Engineering)

Abstract:

The purpose of this study is to design a standard cell library for AS800 process utilizing only open-source software in collaboration with AcuSemi. AS800 is an AcuSemi's 800nm technology node developed for educational and demo purposes. The standard cell library will consist of a collection of low-level logic functions. The initial steps of this project, the development of schematics for basic CMOS logic gates (AND, OR, NOT, etc.) using XSCHEM, has already been completed. Further adjustments of PMOS and NMOS sizes and more simulations are needed to verify proper logic behavior. The simulation software used is Ngspice, which is built into XSCHEM. Next, layouts for each cell will be created in KLayout while performing DRC (design rule checking) and LVS (layout vs schematic) checks. DRC checks will involve ensuring that the width, spacing, extension, enclosure, etc of all design layers on each layout meet the specifications set by AcuSemi. LVS checks will confirm the layouts match the schematics by generating extracted layout netlists and then comparing them to the netlists taken from circuit schematics. The standard cell library will be built through an open-source standard cell characterizer such as vsdip to generate liberty format files for use with an OpenLane. OpenLane is, an automated RTL to GDSII flow, which includes asset of tools to perform synthesis, place & route, and verification. A RISC-V CPU core previously designed by SoCET will be recompiled using a newly developed standard-size library and manufactured by AcuSemi. Overall, the developed Open Source PDK and standard cell library will be formally documented and made publicly available via GitHub.

Keywords: Standard Cell Library, PDK, 800nm Process, Circuit Schematics, Layout

Mentor(s):

Mark Johnson (Engineering); Boyuan Chen (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9014
Presentation Time: November 14-21 on Fall Expo Website

Socet PCB Magnetometer Shield Design

Innovative Technology/Entrepreneurship/Design

Author(s):

Michael Lee† (Engineering, JMHC); Rauf Emre Erkiletlioglu* (Engineering)

Abstract:

The Purdue System on Chip team specializes in designing microcontroller chips with development towards machine learning optimizations. While software design is crucial, the hardware must extend beyond computing. Shields enable the chip to have more standard functionality and applications. Shields have previously been developed for various functionalities like ethernet, GPS, LCD, and WiFi. This project enhances the x06 microcontroller's functionality by enabling it to interface with and utilize a magnetometer via SPI communication. The shield's design consists of three primary components: voltage regulation, a test LED, and the magnetometer device (specifically, the LIS2MDL magnetic sensor). These components are interconnected and aligned with the x06's pin configuration, effectively transforming them into a functional shield. The design process was executed using KiCad 6.0 and used standard PCB design rules and layout.

Keywords: PCB, SoC, Electrical Design

Mentor(s):

Mark Johnson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9015

Presentation Time: November 14-21 on Fall Expo Website

Hardware Abstract Layer(HAL) for SoCET AFTx07 microcontroller

Innovative Technology/Entrepreneurship/Design

Author(s):

Pu-Wei Lee† (Engineering); Woosik Kim† (Engineering)

Abstract:

Hardware intricacies can be daunting for software developers unfamiliar with low-level hardware intricacies, potentially hindering development. Complex system construction necessitates effective abstraction, especially when dealing with intricate hardware. The Hardware Abstraction Layer (HAL) addresses this challenge by offering a comprehensible set of functions for hardware manipulation, facilitating software development for microcontroller devices.

The SoCET HAL project is dedicated to streamlining platform-specific functionalities for the AFTx07 microcontroller developed by the SoCET team. It achieves this by providing a layer of functions accessible to software developers. Custom HAL instructions drive each sub-system of the chip, simplifying hardware interaction. This project focuses on delivering a user-friendly programming interface, emphasizing intuitive configurations for communication protocols like GPIO and PWM. The project adopted an object-oriented approach in C++, and hardware simulation was conducted using the open-source Verilator software. Future endeavors entail expanding HAL's feature set and refining its syntax and accessibility to provide a more intuitive programming interface.

Keywords: ASIC, Hardware Abstract Layer, Simplified Programming, SoCET

Mentor(s):

Ryan Montsma (Engineering); Cole Nelson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9016
Presentation Time: November 14-21 on Fall Expo Website

Determining the Optimal Image Size for OpenCV Image Processing with GPU

Innovative Technology/Entrepreneurship/Design

Author(s):

Yuechan Li† (Polytechnic)

Abstract:

Fast image processing is a critical component of high quality computer vision. Although GPU (Graphical Processing Unit) has a significantly less amount of theoretical operation time compared to CPU (Central Processing Unit) in computer vision, some practical applications may yield an opposite result due to the time it takes to upload and download images to VRAM (Video Random Access Memory) when GPU is involved. Therefore, we propose a method using OpenCV (Open Source Computer Vision Library) to statistically determine the existence of a critical image size where CPU operation time is less than GPU operation time.

Keywords: OpenCV, CUDA, Computer Vision, GPU, Robomaster

Mentor(s):

Abolfazl Hashemi (Engineering); Shivam Bhat (Science); Zijian He (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9017
Presentation Time: November 14-21 on Fall Expo Website

SoCET SPI Verification

Innovative Technology/Entrepreneurship/Design

Author(s):

Clark Liao† (Education)

Abstract:

SPI (Serial Peripheral Interface) is a synchronous serial communication interface used for short-distance communication, primarily in embedded systems. There are few characteristics below:

1. Master-Slave Configuration: One device acts as master, initiating communication, while other devices act as slaves, responding to the master
2. MOSI (Master Out Slave In): Data from master to slave.

   MISO (Master In Slave Out): Data from slave to master.

   SCK (Serial Clock): Clock generated by the master to synchronize data transfer.

   SS (Slave Select): Select individual slaves.
3. Full Duplex Communication: Data can be sent and received simultaneously.
4. No Specified Maximum Speed: Data transfer rates depend on the specific application and device capabilities.

In this semester, I am going to apply UVM (Universal Verification Methodology) to verify the SPI module developed by digital design team. Here are some key characteristics of UVM:

1. Object-Oriented: UVM uses object-oriented features of SystemVerilog, allowing for inheritance and polymorphism.
2. Base Class Library: UVM provides a rich set of predefined classes that serve as building blocks for creating testbenches.
3. Stimulus Generation: UVM sequences allow for controlled and randomized stimulus generation, which can be directed or constrained-random to cover various scenarios and corner cases.
4. Reusable: Components created in UVM can be reused across different projects or stages of verification
5. End-to-End Checking: UVM employs scoreboards and checkers to observe and verify data flow throughout the design.
6. Coverage-Drive Verification: UVM emphasizes the collection of coverage data to ensure that all aspects of the design are verified. This helps in determining when the verification process is complete.

Keywords: SoC, SPI, Verification, UVM, SystemVerilog

Mentor(s):

Mark Johnson (Engineering); Jude Pinto (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9018
Presentation Time: November 14-21 on Fall Expo Website

Electrical Team Motor project

Innovative Technology/Entrepreneurship/Design

Author(s):

Yung-Chieh Lin† (Engineering); Qiuyang Huang† (Engineering)

Abstract:

This research project aims to enhance the performance of autonomous vehicles utilized by Purdue University's Autonomous Motorsports (AMP) club. Currently, the motors powering these vehicles operate at a 36-volt voltage level, which has proven inadequate in delivering the required torque for competitive races. To address this limitation, our project seeks to identify and implement high-voltage motors that can replace the existing 36-volt motors while seamlessly fitting within the previous motor cage.

Key aspects considered in this research include voltage compatibility, size and form factor, torque and power requirements, motor efficiency, control system integration, weight and balance considerations, heat dissipation, regulatory compliance, cost analysis, maintenance requirements, environmental impact, safety protocols, interfacing with existing components, integration with control software, longevity, material compatibility, and project timeline.

Through rigorous evaluation and testing, we aim to select motors operating within the 72-96 volt range that not only provide the required torque but also align with our project's goals and budget constraints. The project also emphasizes safety protocols and the seamless integration of these motors with other autonomous vehicle components.

The re-search aims to enhance the- competitiveness and performance of AMP's autonomous vehicles. Our-strategy is to replace low-voltage- motors with higher-voltage alternative-s, which is expected to ge-nerate a significant increase- in torque. This upgrade will ultimately contribute- to the club's success in autonomous racing competitions.

The re-search outcomes will play a crucial role in guiding the- selection and impleme-ntation of motors for AMP's autonomous projects. By embracing the powe-r of higher-voltage motors, their aim is to e-mpower the club and ensure- excellence- in their pursuits.

Keywords: Autonomous Motorsports Purdue, Go Kart, Electric Motor, High Voltage, Autonomous Robotic Improvement

Mentor(s):

Sam Labi (Engineering); Shreya Ghosh (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9019
Presentation Time: November 14-21 on Fall Expo Website

Verification of Half-precision FPU

Innovative Technology/Entrepreneurship/Design

Author(s):

Ya-Han Lin† (Engineering)

Abstract:

The purpose of this project is to verify a half-precision Floating Point Unit (FPU) that uses only 16 bits instead of the traditional 32-bit single precision or 64-bit double precision. This half-precision FPU aims to improve data processing speeds and minimize memory usage by reducing its size. Therefore, ensuring the reliability and accuracy of half-precision FPU is critical.

To ensure the system works correctly, a verification process using the Universal Verification Methodology (UVM) will be implemented. UVM is a standardized methodology for verifying digital designs that can improve verification efficiency and reduce development time. The verification process involved creating a detailed test plan, constructing a top-level testbench diagram, and establishing the verification testbench that stimulates the half-precision FPU with various inputs by coding on the verification components (drivers, monitor, sequencer, scoreboard…etc.), analyzing the result to see if it meets its intended requirements and functional coverage to check whether the design is thoroughly tested with 100% coverage.

This verification process will help ensure that the half-precision FPU is functional to achieve the goal of improving data processing speeds and minimizing memory usage.

Keywords: Half-Precision FPU, UVM, Verification

Mentor(s):

Mark Johnson (Engineering); Jude Pinto (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9020
Presentation Time: November 14-21 on Fall Expo Website

Toward Prediction of A User's Identity from Missing IoT Biometric Data

Mathematical/Computation Sciences

Author(s):

Chia-Hua Lin† (Polytechnic)

Abstract:

With the emergence of the Internet of Things (IoT), smart sensing devices such as smartwatches and smartphones are rich with various sensors, helping us with different services, including unlocking cars and validating financial transactions using various sensitive data, such as heart rate. Therefore, it is important to understand how missing biometric samples can be fatal in predicting a user’s identity and raise threats to the user’s IoT-connected cyber-physical space. On the other hand, while many advancements have been made in machine learning and neural networks at a steadily increasing pace, a major limitation of these works is the high costs of collecting required datasets. In this project, we demonstrate the usage of small multimodal corpora obtained from smartphones and smartwatches in an Internet of Things (IoT) setup with potential ways to improve data volume to better understand the power of missing data in the context of a user’s identity prediction and develop robust models in the future to safeguard the user’s identify.

Keywords: IoT, Smart Devices, Biometrics, Multimodal Data, Data Augmentation

Mentor(s):

Sudip Vhaduri (Polytechnic); Jinjin Cai (Polytechnic)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9021
Presentation Time: November 14-21 on Fall Expo Website

Purdue Aerial Robotics Team Competition Division

Innovative Technology/Entrepreneurship/Design

Author(s):

Mateo Llerena† (Engineering, JMHC); Shalav Kakati* (Engineering); Mridula Naikawadi* (Engineering); Aditya Hebbani* (Engineering); Luke DeLorenzo* (Engineering); Dean Smith* (Unknown); Devesh Mehra* (Engineering)

Abstract:

The Purdue Aerial Robotics Team Competition Division is developing an aircraft for the 2024 AVUSI SUAS competition. The team is composed of five subteams: Airframe, GNC, Mechanisms, Integration and testing, and Software.

The Airframe team aims to further develop the existing competition platform by shedding weight from the fuselage by removing core material from the composite layup, removing weight from the wings by using tapered wings and more efficient rib spacing, and by improving the interface between the rear landing gear and the fuselage.

The objectives of the Guidance, Navigation, and Control team include developing an efficient waypoint algorithm and a precise airdrop system to drop payloads on their respective targets accurately. The Airdrop Algorithm aims to ensure payload accuracy by employing differential equations and integration while accounting for uncertainty using Monte Carlo Simulations.

Dubins Path Planning is employed for 3D path optimization. GNC is also developing a streamlined UI for waypoint Entry.

The Mechanisms team's objectives are threefold. First, to improve the parachute deployment system by eliminating springs and harnessing the air to eject the parachute. Second is designing a simple,accurate, and consistent payload dropping mechanism. Third, Mechanisms is improving the aircraft's suspension and taxi steering capabilities.

The Integration and testing team works directly alongside other subteams to prepare flying test platforms like the “Anaconda” and the “Ranger” RC aircraft for testing different components.

The software is divided into core and external divisions. The external division is in charge of object detection, localization, and classification of targets and the core team is in charge of integrating systems.

Keywords: UAV, Software, Mechanisms

Mentor(s):

Shreyas Sundaram (Engineering); Charles D'Onofrio (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9022
Presentation Time: November 14-21 on Fall Expo Website

Investigating the Impact of Purdue University's Artificial Intelligence Innovations on its Students and Faculty.

Social Sciences/Humanities/Education

Author(s):

Jeremy Lu† (Science)

Abstract:

With the rise of recent artificial intelligence (AI) technology in modern society, universities have assumed the role of research bases to educate and develop AI literacy skills in campuses nationwide. As a research university known for STEM innovation, Purdue University is no different, and its research developments like the Institute for Physical AI are emerging with impactful AI applications. Despite the promising potential for AI integration in Purdue's education system, concerns towards AI bias, replacement of jobs in the workforce, and creativity, have risen from Purdue students and faculty members. Experimentation of AI practices by professors in classroom settings have been proposed and tested, yet there has not been thorough, public documentation on Purdue's implementation of this AI research through its labs or facilities. Through an informed analysis of gathered evidence, this paper aims to investigate the association between Purdue's relevant AI advances in fields—such as agriculture, security, automated manufacturing, and semiconductors—and opinions that students and faculty have using AI based on its level of sophistication at Purdue. Purdue's acceleration in AI academics and research will also be broadly compared with the landscape of AI at other universities. Relevant information from Purdue's official websites, documentation, and blog posts will be retrieved to support evidence about subjective opinions and numerical figures that will be illustrated in this work.

Keywords: Artificial Intelligence, Education, Research, Innovation, Generative AI

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9023
Presentation Time: November 14-21 on Fall Expo Website

Mastery in Virtual learning: Empowering Education in Mobile Age

Social Sciences/Humanities/Education

Author(s):

Jingxi Ma† (Science)

Abstract:

Mobile devices, including mobile phones, laptops, and tablets, are integral to college students' lives and significantly impact their learning. The impact of mobile devices varies depending on the users' purposes. Numerous studies show that extensive use of mobile devices for social and entertainment decreases college students' academic performance. In contrast, educational mobile applications improve students' grades. It is impossible to eliminate mobile devices from students' lives to maintain academic performance, and the pandemic reveals the benefits of mobile learning tools. The pandemic has catalyzed the impact of technological development on education, and now, online classes and mobile learning tools have become increasingly common. A growing number of recent research has found that the educational use of mobile devices can improve student achievement through enhancing class engagement, strengthening teacher-student connections, and improving time management skills. Overall, research in mobile education tools contributes to a more inclusive, flexible, and effective educational landscape that can better meet the diverse needs of learners. This article aims to study how the educational use of mobile devices helps Purdue students improve academic performance by investigating the most representative mobile applications used at Purdue and their impact. It employs information from Purdue websites, app developers, and existing academic research to determine the benefits of mobile devices for educational use. The personal experience and insight from professors and staff will also be considered. Reports from developers and researchers can provide statistical data and scientific justification, and responses from Purdue faculty and students can provide practical value.

Keywords: Mobile Device, Mobile App, Academic Performance, College Student, Education Tool

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9024
Presentation Time: November 14-21 on Fall Expo Website

Quantum Sensing using NV- centers in diamond

Mathematical/Computation Sciences

Author(s):

John Mburu† (Science); Joseph Lopez* (Engineering)

Abstract:

Redacted

Keywords: NV- Center, Raman Spectroscopy, Confocal Imaging Techniques, Quantum Sensor, Electron, Nuclear Spins

Mentor(s):

Pramey Upadhyaya (Engineering); Abhishek Solanki (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9025
Presentation Time: November 14-21 on Fall Expo Website

Characteristics of Green Spaces in Purdue University and the Effects on Student's Stress Recovery

Social Sciences/Humanities/Education

Author(s):

Noah Merz† (Science)

Abstract:

Stress levels and mental health of students are important issues on all college campuses. There are many factors and ways to address this issue. The factor that will be analyzed in this study is nature exposure, which has been found to be effective at reducing stress levels. More specifically, I will be analyzing the effectiveness of urban green spaces on stress recovery and how Purdue University's green spaces compare to other urban green spaces. There are many different styles and ways of designing urban green spaces with different effects on stress recovery. This study will cover what characteristics of urban green spaces have been found to have significant positive effects. Some of the important characteristics that will be discussed are the presence of water features such as fountains as well as the proximity of roadways to a green space. In this study I will be selecting several green spaces in Purdue and analyzing their important characteristics to demonstrate where improvements could be made. The effects of the urban green spaces and their characteristics will be analyzed through the lenses of Stress Reduction Theory and Attention Restoration Theory. These conceptual theories provide different reasons for why green spaces have this effect on stress recovery. Therefore, it can be discussed if these interpretations suggest different approaches to improving these spaces. Through the results of this analysis, I will demonstrate how Purdue may improve their green spaces as well as what practices should continue when designing new green spaces.

Keywords: Stress Reduction Theory, Attention Restoration Theory, Urban Green Space, Water Feature

Mentor(s):

Sidney Ducleroir (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9026
Presentation Time: November 14-21 on Fall Expo Website

Leveraging Cancer-Associated Mutations to Identify Synthetic Lethal Therapeutic Strategies in Endometriosis

Life Sciences

Author(s):

Asmi Mukherjee† (Science)

Abstract:

Endometriosis is a disease characterized by abnormal growth of the endometrium outside the uterus. Previous studies have revealed cancer-associated mutations in endometriosis (KRAS, ARID1A, PIK3CA, PPP2R1A). Of these, KRAS mutations (p.G12D, p.G12V) are of particular interest due to their strong influence on the pathogenesis of aggressive cancers. In cancer, genetic mutations can lead to a cell's increased reliance and activation of additional genes for its survival. Targeting these genes that become essential due to evolved dependencies is therapeutically known as Synthetic Lethality. Work by our group and others has shown that comparing the relative essentiality of genes in mutant cells compared to wildtype can uncover therapeutic strategies for targeting mutated cells. This approach has not been applied outside of cancer to situations where cancer-associated mutations occur in non-cancer cells, as in endometriosis. The relationship of KRAS mutations in endometrial lesions to other essential genes could reveal a new application for synthetic lethality as a strategy to pharmacologically regress endometriosis lesions. In this study, we combined transcriptomic data from endometriosis patients with genetic screening data from endometrial cancer cell lines to identify genes with dysregulated expression in endometriosis that exhibit increased essentiality in the presence of a KRAS mutation. We also applied this approach to other mutations in endometriosis, including ARID1A, PIK3CA, and PPP2R1A. Our results revealed a relationship between the KRAS mutants (especially p.G12V) observed in endometrial carcinoma and essential genes such as PSD3, IGFBP1, STAR, and RAB11FIP1 overexpressed in endometriosis, suggesting potential synthetic lethality in endometriosis.

Keywords: Endometriosis, Synthetic Lethality, Essential Genes, Mutation

Mentor(s):

Douglas Brubaker (Case Western Reserve University)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9027
Presentation Time: November 14-21 on Fall Expo Website

EMPOWERING THE FUTURE; BUILDING AI COMPETENCY AT PURDUE UNIVERSITY

Social Sciences/Humanities/Education

Author(s):

Saibya Padha† (Science)

Abstract:

Over the past few years, the rapid development of Artificial Intelligence technology has led to drastic transformations in various facets of our lives, including healthcare, marketing, finance, and education. This new era warrants a need for a new kind of digital competency in AI usage. Experts in the field agree that an AI literacy course must be mandatory or available as an elective for all students, not just computer science majors. However, Purdue University, like most other higher education institutions, does not currently offer such a course. This paper explores how an AI Literacy curriculum can be developed for undergraduate students at Purdue, based on pre-existing curricula and guidelines given by various experts. By synthesizing various sources and expert opinions, this paper provides an overview of the landscape of AI Literacy in higher education and the recommended elements of an AI Literacy curriculum. In the end, the paper aims to bridge the gap by presenting a hypothetical AI Literacy course syllabus which would be developed based on Purdue syllabus guidelines and would employ instructional technology tools supported by Purdue. Furthermore, this study sheds light on the potential impact of introducing an AI literacy course at Purdue. Instructors may find it helpful to draw upon the recommended curriculum, as it would be a step towards creating a generation better equipped to take on the future.

Keywords: Artificial Intelligence, AI Literacy, Curriculum, AI Literacy Course, Digital Competency

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9028
Presentation Time: November 14-21 on Fall Expo Website

Practical Implementation of OpenLane Design Flow

Innovative Technology/Entrepreneurship/Design

Author(s):

Adrian Persaud† (Engineering); Hana Wong† (Engineering)

Abstract:

The VLSI design flow is an incredibly complex web of software EDA Tools that work together in-order to produce a layout file that may be handed off to a foundry for fabrication. Additionally, educational licenses for this tooling can be hard to come by, leading to many academic settings often using older, unmaintained versions of the software which must then be carefully chained together using scripting. OpenLane, offers an "out of the box" solution that packages together a series of open-source EDA Tools with the necessary scripting to easily produce layout files from Verilog design files. This work aims to explore the OpenLane design flow in academic setting by running it on a fully verified design provided by SoCet to serve as an auxiliary design flow for the project and to explore OpenLane's capabilities and limitations.

Keywords: VLSI, OSS, Scripting

Mentor(s):

Mark Johnson (Engineering); Swapnil Bansal (Engineering); Conor Green (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9029
Presentation Time: November 14-21 on Fall Expo Website

The effectiveness of visual telemetry projections in maintaining situation awareness under communication delays

Innovative Technology/Entrepreneurship/Design

Author(s):

Linh Pham† (Polytechnic)

Abstract:

This study examines how might telemetry projection visualizations affect operators’ expectancy management and decision-making in anomaly response under prolonged communication latency. This study is conducted through an experiment where participants, with sufficient knowledge of engineering, will complete tasks using a visual interface in a simulated situation. One group of participants will be provided with visualizations of telemetry data infused with fast projections, and the other group will be provided with a default visualization. Both performance indicators (such as time or accuracy) and experience (such as cognitive load and usability feedback) will be taken into consideration during the data collection and analysis. Currently, we hypothesize that the visualization aid of telemetry projections will either improve or impede operators’ ability to manage expectations and decision-making or impair their mental workload compared with no projections. We expect that with the visualization aid of telemetry projections, operators might have higher performance in completing the given tasks under communication delay.

Keywords: Decision-Making, Telemetry Projection, Anomaly Response

Mentor(s):

Paul Parsons (Polytechnic); Zixu Zhang (Polytechnic)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9030
Presentation Time: November 14-21 on Fall Expo Website

Research in Biotechnology: Special Topics in Exploring Phage Biology and Function of Mr. Gordo

Life Sciences

Author(s):

Annabelle Redman† (HHS)

Abstract:

Bacteriophages are one of the most abundant forms of viruses in the environment. Fundamental knowledge about bacteriophage, viruses that infect bacteria, and their hosts has led to many applications in biotechnology. Phages are particularly interesting since they are a simple system where one can glimpse complex biological machinery in action. We have the ability to characterize these viruses at a more detailed molecular level with the recent decrease in the cost of genomics, lipidomics, and proteomics studies. I will use the existing Purdue phages library established from previous research efforts isolating, characterizing, and annotating novel bacteriophages. Predict the functional activity of putative genes using existing bioinformatics tools and databases. Conduct a thorough, iterative literature review focused on putative genes informed from the wet lab and annotation efforts of Mr. Gordo, and propose new models or refine existing models including a molecular mechanism that can guide future biochemical experimental analysis.

Keywords: Bacteriophage, Genes, Genomes, Mr. Gordo, Analysis

Mentor(s):

Kari Clase (Agriculture); Daphne Krutulis (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9031
Presentation Time: November 14-21 on Fall Expo Website

What It Means to Be an Anti-Racist

Social Sciences/Humanities/Education

Author(s):

Chelsea Reppert† (Education)

Abstract:

The purpose of this interdisciplinary mini-research project is to explore how people demonstrated civic virtue and civic engagement throughout history while fighting racism. The project integrates literacy with social studies and is focused on social studies concepts. Critical literacy is used as a theoretical framework for this research. Critical literacy views readers as active participants in the reading process and invites them examine or dispute the power relations that exist between readers and authors (Mclaughlin, 2004). Based on the readings and classroom activities, students identified the following research questions: How did this individual demonstrate civic virtue in the fight against racism? How was this individual civically engaged in the fight against racism? Will increase information about civic virtue and civic engagement improve students' understanding of the evil of racism? Data were collected by examining primary and secondary sources. Students also provide suggestions on how they can become civically engaged in their community.

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Keywords: Racism, Civic Virtue, Civic Engagement, Critical Literacy, Interdisciplinary

Mentor(s):

Inna Abramova (Education); Lyubov Sylayeva (Liberal Arts)

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Virtual Presentation Abstract Number: 9032
Presentation Time: November 14-21 on Fall Expo Website

Observing the Promotion of Campus Activities and How it Impacts the Involvement of Students

Social Sciences/Humanities/Education

Author(s):

Patrick Robison† (Agriculture)

Abstract:

Student involvement on campus is a major part of the college experience while being a student. Because of the importance of student involvement, it is indicative that a university offers clubs and activities that are accessible and promoted to the student body. The purpose of this research is to help recognize the ways that Purdue University promotes clubs and organizations on campus and how effective their approach is when trying to connect to the student body. The two objectives of this research project is to observe the current methods and their success rates and then to survey the student body on what changes should be made to the approach. By exploring these two areas there can become more detailed plans for future changes.The data gathered will be from student surveys and their own experiences. By making comparisons on how Purdue University promotes participation compared to other schools I can see what is already here and what may be missing. After collecting and making educated observations about the data, it is my hope for the findings to be presented to those who play a role in student involvement. School administrators, club organizers, and students should all be able to learn and help make changes to this situation.

Keywords: Campus, Involvement, Activities, Accessibility, Promotion

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9033
Presentation Time: November 14-21 on Fall Expo Website

Sleep Quantity vs Academic Performance

Social Sciences/Humanities/Education

Author(s):

Mark Rome† (Engineering)

Abstract:

Students across the world struggle with balancing time for study and time for rest. This article will begin with describing results of various research from different institutions and end with results of research done on Purdue students regarding the relationship between their sleep health and academic performance. The initial researchers conducted surveys where they analyzed participants' sleep habits by having them answer surveys in which they input various criteria regarding sleep statistics and academic statistics. These included students in high school and students of various majors such as finance, pharmacy, and even medical students. These efforts to have a variety of subjects allowed the researchers to get a diverse sample size and a well-rounded opinion. In addition, research was conducted on Purdue students which did not measure the effect sleep health had on academic performance but more so the effect it had on overall wellbeing. This research utilizes many questionnaires that ask many comparable questions to the research done by other institutions. Researchers concluded that having more sleep and better sleep reduced numerous negative health symptoms in students which allowed them to do better in school and in life. Implementation of an effective program for all students to improve their sleep schedules and time management skills would benefit students in their academic performance.

Keywords: Sleep Quantity, Sleep Quality, Academic Performance, GPA, Mental Health

Mentor(s):

Sidney Ducleroir (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9034
Presentation Time: November 14-21 on Fall Expo Website

Embracing AI in the Classroom: Where does Purdue stand?

Social Sciences/Humanities/Education

Author(s):

Ayush Singhal† (Science)

Abstract:

As artificial intelligence (AI) as a field continues to grow, Purdue University professors are increasingly facing the decision of implementing AI into their courses or not. AI presents innovative opportunities to transform traditional teaching methods, making education more interactive, efficient, and accessible. The purpose of this study is to gauge Purdue's current level of AI-based learning, with the aim of providing recommendations for the future integration and enhancement of AI in the educational environment. The research methodology used in this study includes the comparative analysis of papers that include quotes and anecdotal evidence from Purdue University faculty members and articles giving empirical evidence and explanations on how AI-based learning is enriching students' learning in the classroom. These articles are drawn from reputable sources and provide a diverse and comprehensive range of perspectives on integrating AI into education. The scope of this research offers valuable insights into the motivations and reservations in embracing AI-based educational technology, serving as a pivotal resource for educational institutions, especially Purdue, seeking to navigate the evolving landscape of digital learning methodologies. This comparative analysis ultimately shows the disparities between faculty views and those of AI-based learning advocates, shedding light on the nuances of AI-based learning's impact and the potential avenues for further encouragement at Purdue University. This information can inform institutional strategies aimed at supporting educators in implementing AI and improving the overall learning experience of students.

Keywords: Artificial Intelligence, Ai-Based Learning, Education

Mentor(s):

Michael Johnson (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9035
Presentation Time: November 14-21 on Fall Expo Website

SoCET Verification: Direct Memory Access (DMA) Module

Innovative Technology/Entrepreneurship/Design

Author(s):

Aditya Sood† (Engineering); Vishnu Lagudu‡ (Engineering)

Abstract:

The project delves into the intricacies of Universal Verification Methodology (UVM) applied to the verification of a Direct Memory Access (DMA) design, a crucial component within Purdue's System-on-Chip Extension Technologies (SoCET) team. The study addresses the challenges and solutions encountered in ensuring the robust functionality and reliability of the DMA design through systematic UVM verification.

The presentation highlights the unique features and complexities associated with DMA, emphasizing its role in efficient data transfers within the SoC architecture. It outlines the methodology to integrate UVM into the verification process, aiming to enhance design validation and identify potential issues early in the development cycle.

Key aspects covered include the creation of comprehensive testbenches, the utilization of UVM sequences for stimulus generation, coverage goals and the analysis of results to validate the DMA design's compliance with specifications. The findings contribute to the broader goal of making progress towards taping out AFTx07 - next generation of Purdue's in-house SoC IP.

Keywords: UVM, Design Verification, Processor Design, Memory System, Digital Design

Mentor(s):

Mark Johnson (Engineering); Jude Pinto (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9036
Presentation Time: November 14-21 on Fall Expo Website

Exploring Optimization Oppurtunities in the ONNX Ecosystem

Mathematical/Computation Sciences

Author(s):

Sreevickrant Sreekanth† (Engineering); Cy Logan‡ (Science); Vanamali Vemparala‡ (Science); Pratham Agrawal‡ (Science)

Abstract:

The Open Neural Network Exchange (ONNX) has emerged as a pivotal open-source framework for the representation and exchange of deep learning models, offering compatibility with various training frameworks and support for diverse algorithms and inference hardware acceleration. The study addresses the critical aspect of Operator Set Evolution within ONNX, acknowledging the challenge of aligning the operator set with the latest advancements in deep learning research. Additionally, the research investigates the interoperability of ONNX, assessing challenges encountered when migrating models across different deep learning frameworks or various ONNX versions. A key focus is placed on the complexities associated with deploying ONNX models on diverse hardware accelerators. The constant evolution of hardware platforms presents an ongoing challenge, demanding adaptability and optimization to ensure seamless execution. We present the outcomes of this study through benchmarks and analyses to explore optimization opportunities within ONNX.

Keywords: ONNX, Optimization, Benchmarks

Mentor(s):

James Davis (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9037
Presentation Time: November 14-21 on Fall Expo Website

Purdue Aerial Robotics - Software Core and External

Mathematical/Computation Sciences

Author(s):

Harshith Suresh† (Polytechnic)

Abstract:

The purpose of the Software Core and External Team was to develop new methods that are more efficient and accurate to meet our new goals for this year’s competition. There are 3 main requirements for our team this semester consist of object detection, a reliable flight system, and software integration working towards 6 main goals consisting of having a Remote ID (FAA compliance), improved transmission, telemetry, updated state machines, simple manual intervention, integrated AI into existing systems and Object Detection. The Drone will have a Dronetag attached to PixHawk and will be FAA-compliant and ready to fly. To improve our data flow, we are exploring options to reduce the image size while improving the transmission rate with a queuing system maintaining the telemetry data post-flight, and analyzing the data with Grafana for better results during subsequent flights while implementing Prometheus for state monitoring. Finally, in Object Detection and AI, we will be using Label Studio for data labeling, Neptune AI for model optimization, ONNX to support a universal runtime for production models, using the NVIDIA Jetson to improve training times, and retraining the model based on what we learn from the data analytics from test flights. We hope to be able to build a robust software architecture and machine-learning model that can be perfected to fit the competition's goals and ensure efficient and accurate flight performance.

Keywords: Model Optimization, Updated State Machines, Grafana, Software Integration, Data Flow

Mentor(s):

Charles D'Onofrio (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9038
Presentation Time: November 14-21 on Fall Expo Website

The Role of Social Media in College Activism

Social Sciences/Humanities/Education

Author(s):

Keerthana Thirumal† (HHS)

Abstract:

This paper explores the influence of social media on activism on college campuses as well as investigating how more students can be encouraged to meaningfully contribute to activism. Researchers have been looking into the effects of social media on college activism for years, trying to understand how colleges can facilitate an environment where their students can share and learn new perspectives. Through surveys and observations, researchers have found a relationship between the prevalence of social media on college campuses and student engagement in activism.

Students who are active on social media are more likely to engage in on-campus activism since they can express their opinions and gather support easily. By observing past on-campus activism movements, researchers have seen that activists and groups with a major social media presence have been more successful in bringing change to their campuses compared to before. Researchers have also been looking into identifying the difference between activism and slacktivism. Slacktivism occurs when people engage in activism online to boost their popularity and researchers are identifying ways to avoid this. From these results, I can conclude that in order to create a campus where the student body can prosper, colleges should work together with student activists instead of attempting to ignore them. The positive influence of social media on college campuses should be preserved and extended so that more students can express their voices and be heard in the future.

Keywords: Social Media, College, Activism

Mentor(s):

Sidney Ducleroir (Liberal Arts)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9039
Presentation Time: November 14-21 on Fall Expo Website

FreeRTOS on socet's AFTx07 microcontroller

Innovative Technology/Entrepreneurship/Design

Author(s):

Tin Tran† (Engineering); Duc Tri Than† (Engineering); Duncan Nguyen† (Engineering)

Abstract:

The goal of the SoCET RTOS (Real Time Operating System) project is to port a real-time operating system onto the custom AFTx07 microcontroller chip designed by SoCET. RTOSes are used primarily on small-memory, embedded systems, where there are severe memory and timing constraints. An RTOS is judged on its ability to respond to time-sensitive tasks, while a traditional desktop OS is judged on its task throughput. An RTOS provides adjustments like defined stack memory usage and task prioritization to accomplish its goal. An RTOS suits AFTx07 since it is a resource-limited embedded system intended for time-sensitive tasks.

FreeRTOS was chosen for the system because of its maturity and level of documentation. In addition, the FreeRTOS community already has a port to RISC-V architecture, which is what AFTx07 uses. From this base port, the RTOS must be further customized to the device resources available on AFTx07.

As AFTx07 has not yet been fabricated, testing of the FreeRTOS port was done on a simulated version of the chip using Verilator, an open-source RTL simulator. The goal for the team involves compiling FreeRTOS for a generic RISC-V target, running it in Verilator, manipulating/developing the kernel for more RAM optimization to emulate the AFTx07 chip more closely, and eventually running on AFTx07.

Keywords: RTOS, freeRTOS, Real-Time OS, Embedded OS, Embedded

Mentor(s):

Mark Johnson (Engineering); Ryan Montsma (Engineering); Cole Nelson (Engineering)

† Presenting Undergraduate Author; ‡ Contributing Undergraduate Author; * Undergraduate Acknowledgement

Virtual Presentation Abstract Number: 9040
Presentation Time: November 14-21 on Fall Expo Website

AFTx07 Digital Integration and Design Flow

Innovative Technology/Entrepreneurship/Design

Author(s):

Boheng Zhao† (Engineering, Science)

Abstract:

AFTx07 represents a cutting-edge RISC-V-based microcontroller project currently in development by the SoCET team, with plans to undergo the tape-out process at the SkyWater Foundry in the coming weeks. The core objective of the AFTx07 project is the integration and design of digital modules using hardware description languages and developing design flow scripts that aids the final tape-out process.

To ensure the robustness and correctness of AFTx07 before the tape-out phase, the team has been actively leveraging SystemVerilog to craft custom digital modules. These modules undergo rigorous simulation using tools like Verilator and Xcelium. Once they pass the simulation tests, further verification is conducted on an FPGA. During this stage, the design is mapped onto a Cyclone FPGA, and a battery of tests is executed to guarantee its flawless functionality.

Upon achieving RTL freeze, we proceed to synthesize the design into a gate-level netlist, employing electronic design automation (EDA) tools like Cadence Genus. The final step involves using Cadence Innovus to execute the RTL-to-GDSII flow, resulting in the transformation of our design into a GDSII file that will be transmitted to the foundry. This intricate design process incorporates vital checks throughout, including logic equivalence, design rule validations, and layout versus schematic assessments to maintain design integrity.

Ultimately, the AFTx07 microcontroller will provide the Purdue engineering community with an exclusive opportunity to test and employ a customized SoC. After the tape-out, we intend to make AFTx07 chips available for use by other Purdue organizations that rely on microcontrollers.

Keywords: Digital Design, Design Flow, Cadence Tool, Skywater Foundry, SoC

Mentor(s):

Conor Green (Engineering); Mark Johnson (Engineering)

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