Geospatial Data Analytics

22541 - CE 50701; 24367 - EAPS 50701

Fall 2023, 3 credits

HAMP 2113; 8:30-9:20am, MWF

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A. Scope and objectives

The course will introduce fundamental theories, analytical methods and programming skills that are needed to work with geospatial data. Students will learn the theories, methods, and techniques to visualize, analyze and model various geospatial data through hands-on computer programming practice based on various opensource geospatial libraries. To be specific, the course will use R and its related packages as the basic tool for implementation. The goal is to enable the learners to develop their own geospatial analytical applications.

1) correctly interpret and evaluate the theories and methods of geospatial data analytics.
2) skillfully design and implement typical geospatial methods through programming
3) effectively visualize and interpret the outcome of geospatial data analytics
4) use R to make basic and advanced geospatial development

B. Prerequisites

1) Graduate standing; prior GIS course; programming experience; college statistics and linear algebra;
2) or under consent of the instructor

C. Contents

1) Introduction
   - Geospatial data
   - R basics
2) Data visualization and mapping with R
   - Reading and writing of geospatial data
   - Mapping geospatial data
   - Create descriptive statistics
   - Access to open source geospatial data
3) Geospatial analysis (GIS) with R
   - Geometric calculation
   - Topologic analysis
   - Object and layer operations
   - Raster/image analysis
4) Geospatial regression
   - Autocorrelation
   - Geographically weighted regression
5) Point pattern analysis with R
   - Basic statistics and metrics
   - Kernel density methods
   - Hot and cold spots
6) Surface modeling
   - De-noising and filtering
   - Triangulation and mesh
   - Spatial interpolation

D. Data to be handled

1) Conventional geographic data (e.g., census, roads, images, point clouds, etc.)
2) GPS trajectory and social media data
3) Domain specific data

E. Tools to learn and use:

- all developments will be based on R;
- limited assigned practice in using existing GIS packages (such as ArcGIS Pro or QGIS; we expect students know that already or be able to learn by themselves).

F. Examples of projects

1) Temporal exploration of geo-social media data
2) Spatial exploration of geo-social media data
3) Data classification and thematic mapping
4) Spatial pattern analysis for urban setups
5) Spatial clustering analysis
6) Spatial query
7) Spatial autocorrelation
8) Spatial interpolation and surface modeling
9) Geographic weighted regression