GEOG 28602/38602
Geographic Information Science III

Spring 2019

Schedule and Location:
Tue Thurs, 11:00 am-12:20 pm
SS 122

Instructor:
Marynia Kolak, mkolak@uchicago.edu,
Office location: 232 Searle Chem Bldg
Office hours: Tu 1-3 pm & by appointment

OVERVIEW

This advanced course extends and connects both foundational and functional GIScience concepts. Students will be introduced to advanced programming and scripting languages necessary for spatial analysis and GIScience applications. Additional topics include customization, enterprise GIS, web GIS, and advanced visualization and analytic techniques.

This course maintains a no-paper policy (meaning no paper products), so all assignments etc. should be delivered in digital form (as a pdf – no Word documents!) to the Canvas site.

COURSE REQUIREMENTS

Each class session will have a combination of activities. Generally, classes will be include into lecture, labs, and group activities. The lecture will synthesize and review materials assigned for reading and practice. Labs will include a live demonstration related to coursework, group work, and individual practice opportunities. Because learning a programming language requires consistency, practice will be incorporated throughout. Guest speakers may also join class sessions for brief discussions and activities related to the course topic.

In addition to active participation in class sessions, students are expected to complete assignments, as assigned. Course participation via active in-class and online work is expected throughout the course (10%). Weekly discussion boards will be assigned to review course readings and lecture topics (3% each for a total of 30%). Lab assignments (5 labs at 3% each for a total of 15%) require an overview of data analysis completed, carefully labeled diagrams and figures, and thoughtful discussion on findings. The final project will involve a spatial analysis of the student's choosing that incorporates data management and spatial analysis techniques learned throughout the course. It involves a project proposal (5%), data report (10%), and final project (30%).

GRADING

Final grades are assigned by composition of work earned in participation, labs, weekly online discussions, and project work. Unless otherwise noted, each assigned work is graded on a 0-100 point scale (unless otherwise noted), and then weighted according to percentage worth for the final grade. Weighted grades as they are in current standing will be posted "live" on Canvas throughout the course for easy tracking.

Participation	10% Total	1% every week, 10 weeks
Discussions	30% Total	3% every week, 10 weeks
Labs	15% Total	3% each lab, 5 labs total
Class Project:		
Proposal	5% Total	5% for proposal
Data Report	10% Total	10% for report
Final Report	30% Total	30% for report

The Grading Schema is the following standard:
A = 90-100%, B = 80-89%, C = 70-79%, D = 60-69%.

SOFTWARE

The class uses only open source software (free and cross-platform). You are required to install it on your own machine. Everything can be readily downloaded from the web. Please contact the instructor if you cannot access your own machine (desktop or laptop) for this course.

· R (3.4.1. or later) and its associated spatial data analysis packages, especially foreign, spdep and gstat, and the tidyverse for data management, everything available from http://cran.r-project.org
· RStudio, a graphical user interface to R, available from https://www.rstudio.com/products/rstudio/download3/
· GeoDa, available from http://geodacenter.github.io/download.html. (Latest version)
See also the separate installation note handout (available on Canvas) for more details.

BOOKS

There are one required texts for this course (online version okay):

- Robin Lovelace, Jakub Nowosad, Jannes Muenchow. Geocomputation with R. 2019-03-23

A hardcopy text version may be available at the Seminary Co-Op Bookstore in April 2019. Additional readings may be assigned or recommended, and will be provided on the Canvas course page.

TENTATIVE COURSE OUTLINE

May be subject to change.

Section 1. Introduction to Course

Week 1. Introduction to Geographic Data in R

- Topics:
  i. R's Spatial Ecosystem
  ii. Vector and Raster Data
  iii. Coordinate Reference System Review
- Readings:
  i. Chapters 1 and 2 in text

Section 2. Geocomputation Foundations

Week 2. Attribute and Spatial Data Operations

- Topics:
  i. Vector and Raster Data Manipulations (e.g. Topological relations, Joins, Aggregations, Distance, Subsets, Map Algebra)
  ii. Spatial Operations in Vector and Raster Data
- Readings:
  i. Chapter 3 and 4 in text.

Week 3. Geometry Operations

- Topics:
  i. Geometric Operations in Vector and Raster Data (eg. Centroids, Transformations, Clip, Unions, Intersections)
  ii. Vector-Raster Data Interactions
  iii. Lab 1: Intro to Github and Jupyter Notebooks
- Readings:
  i. Chapter 5 in text.

Week 4. Geographic I/O

- Topics:
  i. Geographic data file formats
  ii. Geographic data packages and web services
  iii. Lab 2: Intro to Spatial Weights and Spatial Autocorrelation
- Readings:
  i. Chapter 7 in text.
  ii. Anselin, L. (1995). Local indicators of spatial association—LISA. Geographical analysis, 27(2), 93-115.
  iii. Getis, A. (2009). Spatial weights matrices. Geographical Analysis, 41(4), 404-410.

Project Proposal Due ~ end of Week 4

Section 3. Geocomputation Extensions

Week 5. Advanced Maps in R

- Topics:
  i. Static, Animated, and Interactive Maps
  ii. Mapping Applications
  iii. Lab 3: Intro to spatial data wrangling in python: pandas and geopandas
- Readings:
  i. Chapter 8 in text.

Week 6. Scripts, Algorithms, and Functions

- Topics:
  i. Scripts and Functions as the Glue and Building Blocks of Coding
  ii. Geometric Algorithms and Computational Geometry
  iii. Lab 4: Intro to the spatial data ecosystem in python: the pysal library
- Readings:
  i. Chapter 10 in text.

Week 7. Advanced Scripts, Algorithms, and Functions

- Topics:
  i. Basics of conventional statistical and spatial modeling in R
  ii. Group hack-a-thon; opensource collaboration in R and python
  iii. Lab 5: Intro to geovisualizations in python
- Readings:
  i. Chapter 11 in text.

Project Data Report Due ~ end of Week 7

Section 4. Geocomputation Applications

Week 8. Transportation and Applied Graph Theory

- Topics:
  i. Transport Zones
  ii. Nodes, Edges, Routes
  iii. Transit Infrastructures
- Readings:
  i. Chapter 13 in text.

Week 9. Geomarketing and Demographics

- Topics:

        i. Scenario Building
        ii. Census Data Wrangling
        iii. Location Suitability Analysis
    - Readings:
        i. Chapter 14 in text.

Week 10. Ecology and Advanced Raster Analysis

- Topics:
    i. Vector/Raster Data Integration
    ii. Dimension Reduction
    iii. Gradient Modeling
- Readings:
    i. Chapter 15 in text.

Final Project Due ~ Finals Week