GEOG 28602/38602
Geographic Information Science III

Spring 2020

Schedule and Location:
Updated: Remote/Online
Weekly check-in (optional) on Thurs from 2:30-3:30p via Zoom

Instructor:
Marynia Kolak, mkolak@uchicago.edu,
Office hours: Online via Zoom, Mon-Wed 20-min slots available between 1-3 pm (4/13 + after)

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 is expected throughout the course. Weekly discussion boards will be assigned to review course readings and lecture topics (4% each week, with best of 8 graded discussion posts included for a total of 32%). Lab assignments (7 labs at 4% each for a total of 28%) 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 (25%).

REMOTE/ONLINE CLASS OVERVIEW

In the remote version of this class, we will use the following guidelines:

- **Class content with weekly "to do" list will be posted each Monday.**
    - Recorded mini-lectures, coding snippets, and related content to be posted for review.
    - Readings assigned should be started at the beginning of each week. The text we are using incorporates coding through practice, so anticipate a lot of coding as you read.
    - While we will not meet during our regularly planned time, I strongly recommend you use that time for working through course material.

- **Original discussion posts are due each Sunday**. For original discussion posts, respond with a reflection or answer to the questions provided.

- **Response discussion posts are due each Sunday**. For response discussion posts, respond to at least 2 of your classmates' posts and discuss.

- **Weekly labs are due each Sunday.** For weeks without labs, project assignments are due at the same time.

- **Use the Class Troubleshooting Forum for questions.** If you have challenges with installation, chapter exercises, or anything related please use the forum after troubleshooting on your own. If you resolved a tricky bug, also post your find here to help your classmates.

- **Office hour 20-minute time slots are available each Monday and Wednesday from 1-3p.** Please only sign up for 1 meeting at the most per week to be fair to your classmates. Office hours are reserved for questions that cannot be answered within class discussions or via class troubleshooting forums. We follow collaborative practices and learning accordingly. Office hours begin the week of 4/13.

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.

Discussions	32% Total	4% every week, best of 8 posts
Labs	28% Total	4% each lab, 7 labs
Class Project:		
Proposal	5% Total	5% for proposal
Data Report	10% Total	10% for report
Final Report	25% Total	25% 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 and will be given instructions in the course material for each software required. 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.

BOOKS

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

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

Additional readings may be assigned or recommended, and will be provided on the Canvas 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
- Assignments:
  i. Discussion 1: Class Map, Troubleshooting Forum
  ii. Lab 1: Installation, Intro to RMarkdown & Github

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.
- Assignments:
  i. Discussion 2: Chapter Exercises
  ii. Lab 2: Descriptive Statistics & Basic Mapping in R (Urban Analytics 2020)

Week 3. Geometry Operations

- Topics:
  i. Geometric Operations in Vector and Raster Data (eg. Centroids, Transformations, Clip, Unions, Intersections)
  ii. Vector-Raster Data Interactions
- Readings:
  i. Chapter 5 in text.
- Assignments:
  i. Discussion 3: Chapter Exercises
  ii. Lab 3: Linking R to the Web (Urban Analytics 2020)

Week 4. Geographic I/O & Web Services

- Topics:
  i. Geographic data file formats
  ii. Geographic data packages and web services
- Readings:
  i. Chapter 7 in text.
- Assignments:
  i. Discussion 4: Chapter exercises
  ii. Project Proposal

Section 3. Geocomputation Extensions

Week 5. Scripts, Algorithms, and Functions

- Topics:
  i. Scripts and Functions as the Glue and Building Blocks of Coding
  ii. Geometric Algorithms and Computational Geometry
- Readings:
  i. Chapter 10 in text.
- Assignments:
  i. Discussion 5: Chapter exercises
  ii. Lab 4: Geographic Data Science with PySAL and the pydata stack, Part I

Week 6. 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
- Readings:
  i. Chapter 11 in text.
- Assignments:
  i. Discussion 6: Chapter exercises
  ii. Lab 5: Geographic Data Science with PySAL and the pydata stack, Part II (*or* Alternative Lab 5: Advanced Mapping in R with ggplot)

Week 7. Advanced Maps and Data VIsualizations

- Topics:
  i. Static, Animated, and Interactive Maps
  ii. Mapping Applications
- Readings:
  i. Chapter 8 in text.
- Assignments:
  i. Discussion 7
  ii. Project Data Report

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.
- Assignments:
  i. Discussion 8
  ii. Lab 6: Data Visualization: Mapping Flows in R (Urban Analytics 2020)

Week 9. Geomarketing and Demographics

- Topics:
  i. Scenario Building
  ii. Census Data Wrangling
  iii. Location Suitability Analysis
- Readings:
  i. Chapter 14 in text.
- Assignments:
  i. Discussion 9
  ii. Lab 7: Data Reduction - Geodemographics (Urban Analytics 2020)

Final Project Due ~ Finals Week