COURSE SYLLABUS

Spatial Network Analysis
CP 8883 / CS 8803
SPRING 2020
Georgia Institute of Technology

Meeting times: Lecture & Labs: 1:30 pm - 2:45 pm, Tues and Thurs
Architecture (West) 359

Instructor: *Dr. Clio Andris* Please email me at clio@gatech.edu. My office is 204M – Architecture (East). T: 404-385-7215, C: 202-630-0085. Office hours are Tuesday and Thursday 2:45 – 4:30 or by appointment (e-mail me and we'll set it up).

Course Description: Spatial Network Analysis focuses on theories and implementation of spatial networks with an emphasis on non-planar networks that are becoming increasingly important in the 21st century, especially with the rise of social network data. We will be learning about spatial network types, data acquisition/ storage/ retrieval, network description & classification, treatment, techniques, methods, problem-solving, through instruction, reading, labs and a final project.

https://oscar.gatech.edu/pls/bprod/bwckctlg.p_disp_listcrse?term_in=202002&subj_in=CP&crse_in=8883&schd_in=%

Prerequisite: There are no prerequisites for this course. Ability to digest equations and adapt to new software is necessary.

Course Overview: This course extends this geographic information systems knowledge to modeling networks that involve connectivity from place to place. Spatial Network Analysis examines connectivity / origin-destination / flow / interaction / network / matrix data / graphs / node-edge-node configurations that have spatial references in the nodes and/or links. Properties of nodes (centrality, degree, utility, characteristics, position, clustering, etc.) and edges (directions, weights, magnitudes, cost) are paramount. Topical domains include flights, commuters, migrants, remittances, travel/transportation, social communities, telecommunications, social media, etc. A mixture of GIS and statistics will be used with a focus on node properties, diffusion, communities and network configurations, overlaid and fused with other spatial data.

This course also has an emphasis on flow visualization and uses principles of **cartography** and geovisualization. Final projects can involve a strong visualization or interactive design component.

Note: There are many classes on networks (ex. graph theory, complex networks, and transportation network analysis). This course is **not** a general networks course, but is specifically tailored to urban and regional problems and models, as well as visualization. Accordingly, students will not be expected to understand the physics of general networks without spatial context, but instead to understand their interconnection with planar geography.

Course Objectives: Upon completion, the student should be able to:

1. Find, use, store, retrieve and evaluate spatial network datasets as stored as edgelists, full matrices, etc.
2. Describe and calculate properties of networks such node features, degree distributions, distance distributions, triads, cliques, etc.
3. Effectively embed social network nodes and edges in geographic space and retrieve underlying spatial features and interacting features.
4. Describe challenges, considerations and possibilities of using spatial networks for urban and regional problems of input and output.
5. Implement capabilities, tools and packages in software environments.
6. Effectively visualize spatial networks with symbolized characteristics.
7. Use network statistics to describe connectivity between homogenous and heterogeneous locales.
8. Define functional regions and neighborhoods based on flow data.
9. Highlight spatial areas of high and low connectivity and low centrality.
10. Model network diffusion at different time steps.
11. Highlight network groups/modules within geographic space.

Course Structure: This course has laboratory and lecture components. The laboratory component will extend the concepts covered in lecture, and provide practical, hands-on experience. Regarding the lab portion, students will work individually, although helping each other on the *mechanics* of software commands is encouraged. The conceptual work and submitted lab reports are expected to be your own.

Grade components: Practical Labs (5 labs) (total of 50%)
Midterm (20%)
Final Project (25%)
Attendance, professionalism and participation (5%)

We follow the Georgia Tech grading scale.

Readings: There is no textbook for this class. Instead, this course uses a set of readings. Readings will be available on canvas and **will relate to the labs.**

GIS Lab: The Architecture building is locked on the weekends. Sometimes the lab is locked, sometimes it is open. If you need access on the weekends, please email helpdesk@design.gatech.edu to request access for your BuzzCard.

Course Materials and Software:

Please access all materials through our class's Canvas site. This includes readings, labs and lecture power points.

For the class, you will be using GIS software and Network Analysis software. You are also welcome to use R or Python for data calculations. We will be using ArcGIS for creating maps and for cartography skills. The final project can be done in any software.

Ethics and Conduct:

All homework assignments should be attempted individually. You are welcome to work together on conceptual issues and figuring out how to do things, but you must turn in individual work. Any code, models, texts, images, or deliverables that are not your original work should be clearly cited.

All class participants should exercise utmost care in their use of others' ideas and ensure such ideas are duly acknowledged. Plagiarism is a serious offense at this Institute and if I detect any instance of plagiarism the perpetrator will be reported and given failing grades in the class. Please make sure that you are familiar with the Honor Code.
https://osi.gatech.edu/content/honor-code.

Accommodations:

If you require course adaptations or accommodations due to a disability, if you have emergency medical information that I should be aware of, or, if you need special arrangements in the event the building must be evacuated, please make an appointment to discuss within the first week of classes, or, as soon as possible after a change in your circumstances occurs which requires an accommodation.

Those with bona fide illness or serious family problems should make themselves known and seek suitable arrangements at the earliest possible date. Such personal crises are the only acceptable justifications for the Incomplete grade.

Phones & Internet surfing:

This class has a very low tolerance policy for phones, Internet surfing, and checking email in class. Laptops can be used for note taking. Phones should be out of sight and silenced.

Additional notes on good practice:

1) The software can and will crash and stuff won't work like you want it to. Try not to wait until the last minute to do things and ask if you're having some trouble—also there are good online forums to help solve little problems. Quickly, ensure: (a) your filenames don't have special characters or spaces; (b) you can save where you're trying to save; (c) your table joins are text <–> text or number <–> number.

2) You can install software programs on your computer including ArcGIS, Gephi, R Studio and NetLogo. I sometimes can't help AS much on your own laptop but I will try my best. Macs don't run the ArcGIS software, but you can use it over a VM, or with bootcamp or parallels, etc.

3) Please get a USB thumb-drive or an external hard-drive to use. Due to performance and consistency issues, using the CoA network drive is NOT recommended during in-class lab exercise or homework activity. You will be asked to use a local hard drive (C:/) on local machine only for all lab exercises/homework. Students may copy all lab works to their personal network drive after class.

TENTATIVE CALENDAR: Subject to change

	Lesson	Lecture Topic	Lab Topic
1	Jan 7 & 9	Types of Spatial Networks, Spatial Networks as Data. Edges & Nodes	0: Skills Review
2	Jan 14 & 16	Degree & Degree Distributions, Network Structures	1: Social Network Mapping (American Mafia)
3	Jan 21 & 23	Node Roles Part 1	2: Node Centrality (Remittances)
4	Jan 28 & 30	Node Roles Part 2	2: Node Centrality (Remittances)
5	Feb 4 & 6	Edges: Weights and Distance Measurements	3: Heterogeneity & Friction: (Personal ties)
6	Feb 11 & 13	Non-Planar Networks and Geographic Information Systems	3: Heterogeneity & Friction (Personal ties)
7	Feb 18 & 20	Connecting Similar & Dissimilar Places. Segregation, Connecting across Boundaries.	4: Hubs & Traversal (Flights)
8	Feb 25 & 27	Internal vs. External Connectivity- Neighborhoods, Extensibility	4: Hubs & Traversal (Flights)
9	Mar 3 & 5	Spatial Modules and Administrative Boundaries	5: Spatial Modules and Regionalization (Migrants, Commuters)
10	Mar 10 & 12	Midterm I Review + Reading Discussion Midterm	
11	Mar 17 & 19	**No class, Spring Break**	
12	Mar 24 & 26	Spatial Modules and Regional Delineation	5: Spatial Modules and Regionalization (Migrants, Commuters)
13	Mar 31 & Apr 2	**Project Development**	Project check 1 in due
14	Apr 7 & 9	**Project (no class this week - AAG)**	Project check 2 in due
15	Apr 14 & 16	**Project (class time, peer evaluation, etc.)**	
16	Apr 21 & 23	**April 21 only: Project presentations.** **April 23: No class, no final exams.**	