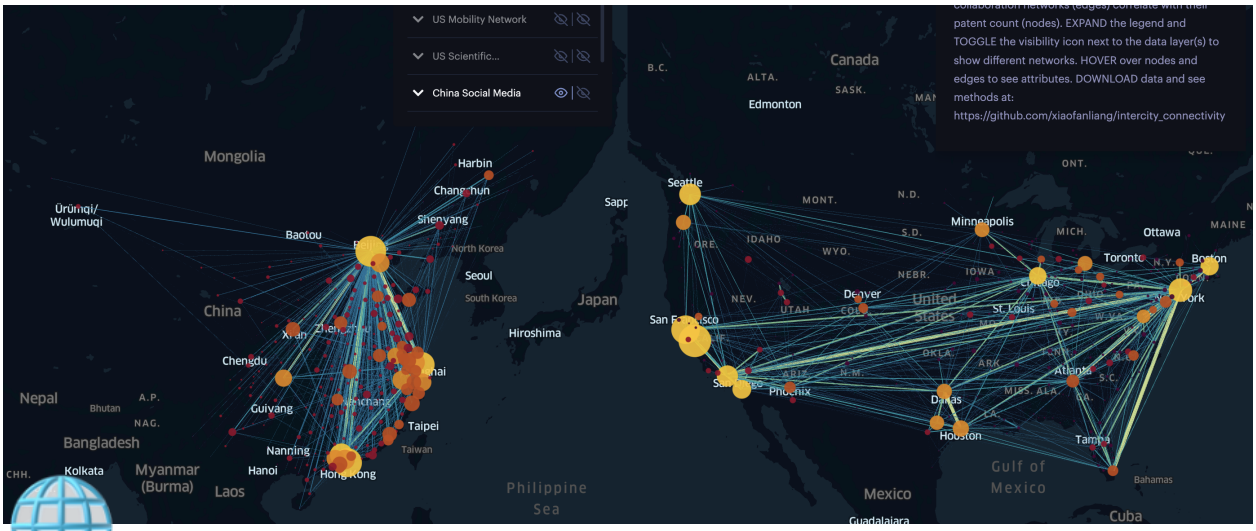

FALL 24: URP 610 / UT 402 Urban Networks

Course Staff and Schedule

Instructor: Prof. Xiaofan Liang

Email: xfliang@umich.edu (email handle includes: URP 610)

Slack: um-fa24-urp610.slack.com

Canvas: https://canvas.it.umich.edu/

Interactive Syllabus:

https://xiaofanliang.com/f24urp610

Lecture: T/Th 2:30pm-4:00pm, 2108 A&AB

Office: 2364 A&AB

Instructor Office Hours: T/Th 1:30-2:30pm or T/Th 4:00-5:00pm in person at office, or by request for virtual. T is open to drop-in. Th is reserved for 1-on-1 appointments (Th 1:30 book here. Th 4:00 book here).

📜 Course Description

Cities contain many interconnected networks for infrastructure, human mobility, and relationships. This elective introduces students to concepts and analytical methods for urban network analysis, including conceptualizing, analyzing, and visualizing cities as networks and fostering a critical perspective on how urban networks reflect and

reproduce urban inequality. Students will analyze both spatial and social networks and discuss their applications in urban transportation, social justice, and governance. The course will be taught with lectures and hands-on analytical labs. The labs will use Gephi, SNoMaN software, and the R programming language. Python submission is allowed. Prior programming and GIS experience is not required but recommended. Ability to adapt to new softwares is necessary.

Compared with other network courses, this course also has an emphasis on the integration of spatial contexts in network analysis. A mixture of GIS and statistics will be used with a focus on node properties, communities and network configurations, overlaid and fused with other spatial data. Final projects can involve a strong visualization or interactive design component.

🗝️ Learning Objectives

Knowledge: Understand how urban issues can be conceptualized and analyzed through network data.

Skills: Use R (or Python) and a variety of software to analyze and visualize spatial and social networks in cities, such as evaluating spatial network datasets, calculate properties of networks, embedding social network nodes and edges in geographic space and retrieve underlying spatial features and interacting features, and visualizing spatial networks with symbolized characteristics.

Critical Thinking: Reflect on how infrastructure in cities that supports network flow may reinforce and reproduce urban inequality and describe challenges, considerations and possibilities of using spatial networks for urban and regional problems of input and output.

📖 Course Materials

Reading: There is no required textbooks for this course. Readings are in weekly folders and are appended as a list at the end of the syllabus. The instructor will provide a brief note for each reading on why it is included and how students should approach it (e.g., skim, technical resources, explore, etc.).

Computer: Bringing your own computer is recommended on Tuesday lectures and is required on Thursday labs.

Three-in-one: Students should have three links handy in the bookmarks: 1) the interactive Notion syllabus for course schedule, readings, and lab and assignment descriptions, 2) Canvas for work submission, reading PDFs, and lecture slides, 3) Slack for discussions and for technical help.

📆 Course Schedule

📌 Click `All` to see all entries. Click `Lessons` , `Labs` , and `Assignments` to switch to those entries separately. Click `Calendar` to see all due date in the calendar view. Hover over a weekly folder and click `⤢ OPEN` to see topics, readings, lecture slides, and to-do lists for the week. **This schedule is subject to change. Please check periodically.**

Schedule (1)

Aa Week	Dates	Type	Modules	Topic
Week 1	@08/27/2024	Lesson	Foundation	Cities as Networks
Lab 1	@08/29/2024	Lab	Foundation	Introduction to R/Python
Week 2	@09/03/2024	Lesson	Foundation	Network Properties
Lab 2	@09/05/2024	Lab	Foundation	Network Data Wrangling (R)
Week 3	@09/10/2024	Lesson	Non-planar Network	Network Structures
Lab 3	@09/12/2024	Lab	Non-planar Network	Network Metrics and Visualization (R)
Week 4	@09/17/2024	Lesson	Non-planar Network	Social Network Analysis in Planning Applications
Lab 4	@09/19/2024	Lab	Non-planar Network	Network Visualization (Gephi)
Week 5	@09/24/2024	Lesson	Spatial Social Network	Spatial Social Network in GIS
Lab 5	@09/26/2024	Lab	Spatial Social Network	Spatial Social Network in GIS (R)
Week 6	@10/01/2024	Lesson	Spatial Social Network	Advanced SSN Metrics and Visualization in GIS
Lab 6	@10/03/2024	Lab	Spatial Social Network	Advanced SSN Metrics and Visualization (SNoMaN)

Aa Week	Dates	Type	Modules	Topic
📒 Week 7	@10/08/2024	Lesson	Spatial Social Network	Mobility Flows #1
💻 Lab 7	@10/10/2024	Lab	Spatial Social Network	Linked Activity Spaces (R)
📒 Week 8 (NA)	@10/15/2024	No Class	Spatial Social Network	Fall Break (No Class)
💻 Lab 8	@10/17/2024	Lab	Spatial Social Network	(Optional) Assignment/Lab Help
📒 Week 9	@10/22/2024	Lesson	Spatial Social Network	Mobility Flows #2
💻 Lab 9	@10/24/2024	Lab	Spatial Social Network	Commute Flow Analysis and Visualization (R)
🗺️ SSN Analysis and Visualization	@10/27/2024	Assignment	Spatial Social Network	SSN Analysis and Visualization
📒 Week 10	@10/29/2024	Lesson	Planar Networks	Infrastructure Networks
💻 Lab 10	@10/31/2024	Lab	Planar Networks	Road Network Analysis (R)
📒 Week 11	@11/05/2024	Lesson	Planar Networks	Network Traversal and Routing
💻 Lab 11	@11/07/2024	No Lab	Planar Networks	(No Lab) Work on Project Proposals / ACSP Conference
📒 Week 12	@11/12/2024	Lesson	Network Infrastructure	Network Infrastructure Duality / Final Project Proposal Consultation
💻 Lab 12	@11/14/2024	Lab	Network Infrastructure	Routing on Road Network (R)
📒 Week 13	@11/19/2024	Lesson	Synthesis	Guest Lecture
✏️ Final Proposal	@11/21/2024	Assignment	Synthesis	Final Project Proposal Due
💻 Lab 13	@11/21/2024	Lab	Synthesis	Final Project Help / Final Project Proposal Feedback
📒 Week 14	@11/26/2024	Lesson	Synthesis	Final Project Help

Aa Week	Dates	Type	Modules	Topic
💻 Lab 14 (NA)	@11/28/2024	No Lab	Synthesis	Thanksgiving Break
📒 Week 15	@12/03/2024	Lesson	Synthesis	Final Project Help
💻 Lab 15	@12/05/2024	Lab	Synthesis	Final Project Help
📋 Final Project	@12/10/2024	Assignment	Synthesis	Final Project Report Due
📣 Final Presentation	@12/10/2024	Presentation	Synthesis	Final Project Presentation and Reflection

💯 Grading

Breakdown

Participation: **10 pt**
Labs:
30 pt
Assignment:
20 pt
Final Proposal:
10 pt
Final Project:
30 pt

Scale / Minimum %

A+	100	A	95
A-	90	B+	87
B	83	B-	80
C+	77	C	73

Participation

Attendance at lectures and labs is required. Students who wish to receive credits for missed classes or labs should follow the following procedures:

1. Notify the instructor at least a week ahead, or as early as possible, to request access to a Zoom-based lecture or lab on a case-by-case basis.
2. If joining a lecture through Zoom is not possible, prepare a 300-word write-up summarizing your understanding of the missed lecture / readings. Email the write-up to the instructor before the next lecture. If joining a lab through Zoom is not possible, go through the lab materials at your own time.
3. Additionally, students are responsible for reviewing lecture slides afterward, submit lab quiz questions on time, and catch up with classmates on notes and

announcements.

Beyond attendance, students are encouraged to **post in the #general channels in Slack**. These posts can be any materials that are conducive for understanding the weekly topics, such as interpretations and thoughts around the readings, useful resources for labs, and news related to the weekly topics, and so on.

Peer Help

This class highly encourages peer help and collaborative learning. You are encouraged to help your peers to debug code, explain concepts, and work together on **lab practice questions and assignments**. You are also encouraged to post questions and solicit helps from your peers on Slack. **Up to two bonus participation points** will be given to students who actively participate in lectures, labs, and Slack, such as posting questions and sharing resources, interacting with the instructor (or guest lecturers), and helping your peers. If the help happened offline, you can email a paragraph of endorsement to the instructor to describe how your peer(s) have helped you in this class. The only portions that need to be completed independently are **lab quizzes**.

Labs

The instructor refers to the Thursday time slot as the "lab" time. **Only 10 labs in this course are graded (Lab 1 to 7, Lab 9, 10, 12).** Each lab worths 3 points (30 points in total). For each of the technical labs (coding with R), you will receive a lab folder that contains the lab lecture slides, any necessary data, and a R html file with examples and starter code. Lab materials will be posted on Canvas before the lab time. Note that the lab numbers correspond to the week numbers and may not be continuous integers.

During each technical lab session, the first 20 minutes will be dedicated to a brief lecture that explains the code and provides technical examples. The remaining time will be allocated for self-guided work on the lab examples and practice questions. Teaching assistant will be present in the room to offer assistance. If you require assistance with the practice questions, do not hesitate to seek help from the instructor. Labs are designed to provide practice opportunities for learning.

Each technical lab will have **three practice questions** and **three lab quiz questions**. The lab practice questions are designed to practice what you have learned and get help if needed; they resemble the lab quiz questions which must be **completed independently by the next lab (a week from the current lab)**. To submit your lab quiz questions and your R (or ipynb) file, please go to the Canvas course page ➡️ Assignments ➡️ Labs.

The labs are designed to be completed, or at least mostly completed, within the allocated lab time. If you consistently find it difficult to finish the labs, please don't

hesitate to ask for help during the lab time, either from me or from your peers.

If you finish a lab and lab quiz early, you are welcome to leave early or stay to help your peers.

SSN Analysis and Visualization Assignment

Students will complete an 🗺️ SSN Analysis and Visualization assignment. You will be asked to pick a spatial network dataset (e.g., geolocated social network, origin-destination flow, trajectories, mobile phone check-in data, etc.) and conduct analyses and visualization. You are allowed to solicit help from your peers or the instructor when you encountered challenges but you should complete the majority of work yourself. More details on instructions and grading metrics will be updated later.

Final Proposal / Project

Students will complete the ✏️Final Proposal and 📄 Final Project individually or in groups of no more than two other peers (maximum three people per group). More details will be updated in these pages later.

R... or Python?

Both R and Python are commonly used in industry and academia for analytics. There is a slight preference for R in social science research, and a slight preference for Python in computer science, especially for simulations, machine learning, and large data processing.

Most tasks in this course can be completed using either R or Python. The instructor has a preference for R, but want to provide flexibility for students. Therefore, this course allows Python submissions in the Jupyter Notebook format (ipynb files).

There are advantages to using Python, such as leveraging existing skills and exploring libraries or analytics that are exclusively available in Python (which you can do in your final project). However, it is important to consider the potential drawbacks of using Python for this class. Here are some bullet points to help you think about them:

- **Do you have experience with Python?** You are responsible for learning all the R labs in Python, and your instructor and peers may not be able to assist you.
- **Are you willing to invest additional time in searching for materials and adapting the labs to Python?** The R labs come with starter code, but if you choose to use Python, you will need to write your own. Even for experienced Python users, you may be surprised by the amount of time required to find a suitable library or code to perform the same analyses.

- **Are you prepared for solo projects?** Since your peers are learning R, they may not be able to divide analytical tasks across two languages in order to collaborate with you.
- **Do you want to learn a second language?** Having knowledge of both R and Python on your resume can make you more attractive in the job market.

You can switch back to R at any time during the semester or use Python for any labs or assignments. If you complete a significant portion of labs and assignments in Python, you will receive **3 bonus points** added to your final grade to recognize your efforts.

🔎 Resources

Institutions

- **Spatial and Numeric Data Services (SAND) Lab:** The University Library's Spatial and Numeric Data Services (SAND) provides assistance with spatial data, numeric data, and statistics for the University of Michigan community. SAND also provides access to and assistance with data from the Inter-university Consortium for Political and Social Research (ICPSR), Roper Center for Public Opinion Research, Europa World Plus, Global Insight, Geolytics, the U.S. Census Bureau, the U.S. Geological Survey, and other sources.
- **UM Clark Library Digital Projects Studio:** A resource providing tutorials and support for visualization work on campus. Includes resources on data analysis and mapping using R and Python, web mapping with Leaflet, network analysis using Cytoscape, and more.
- **Michigan Institute for Data Science:** A university-wide institute which fosters work in data science and artificial intelligence, and hosts many events and other resources available to students.
- **Art, Architecture, & Engineering Library**: This library hosts many useful research guides for students who need to find reading or data resources. Some of the guides include *Urban and Regional Planning Research Guide*, *Detroit Research Guide, and GeoSpatial Data Research Guide*. The recommended point of contact is Rebecca Price <rpw@umich.edu>.
- UM Central Student Government offers free student subscription to New York Times and the Wall Street Journal. Others such as Financial Times, the Washington Post, and the Atlantic are also available through library database. Some instructions are given in the link above.

Technical Materials

- R for Data Science (2nd Edition)
- Geocomputation with R
- Geocomputation with Python
- Spatial Social Networks (SSN) Visualization and Metrics with R
- Wheelan, C. (2013). *Naked statistics: Stripping the dread from the data*. WW Norton & Company.
- Stack Overflow

Scholarship, Grants, and Opportunities

- Taubman College Scholarship / Fellowship Opportunities
- Arts Engine
- Taubman Career Network

📎 Course Policy

Late Submissions

One late submission within 24 hours of the due time will be automatically excused. After that, late work will be deducted **5%** per twenty-four hour period that passes after the due time. No late submissions are allowed for the final project submission. Late work may be excused due to unavoidable personal or family emergencies or religious observance. In these cases, students are expected to communicate with the instructor as soon as possible to arrange accommodations. **Do not email me the late submission. Proceed to submit on Canvas (even though it may show you grade deduction at first) and attach explanatory notes in the comment section of the submission.**

Plagiarism

The Rackham Graduate School policy states: “Integrity in research and scholarship is a fundamental value of the University of Michigan. It is the responsibility of all students to conduct research and scholarly activities in an ethical manner at all times.” This requires that you are honest in all your course work.

Plagiarism is the use of someone else’s words, ideas, or work as one’s own in writing or presentations, and failing to give full and proper credit to the original source. It is failing to properly acknowledge and cite language from another source, including paraphrased

text. Plagiarism is a serious offense that will lead to grade penalties and a record filed with Taubman College. It may lead to failing a course or expulsion from the university.

These policies apply to all Taubman College students as well as non-Taubman College students who take courses within the college.

Since this course involves a significant amount of coding, it can be challenging to differentiate between peer support, online resources, and plagiarism. In general, you should provide proper credit to online posts or peers (e.g., Stack Overflow, blog posts, the names of your peers) that inform your code.

Generative AI tools

The use of generative AI tools (e.g., ChatGPT) is permitted with disclosure for the following activities in this course:

- Brainstorming and refining your ideas
- Fine tuning your research questions
- Finding information on your topic
- Checking grammar and style
- Explaining technical terms and concepts
- Consulting implementation pathways (e.g., how to implement X in Y?)
- Converting lab materials to Python

Overall, usage for conceptual understanding and learning is allowed. If you use generative AI tools for the above usages in assignments, an explanatory appendix is required for each and every unique usage to describe in clear steps how such a machine was used, including which machine, iteration of prompts, editing, etc. Violation of the explicit disclosure requirement may subject students to misconducts with penalties to grades.

The use of generative AI tools for the following activities are strictly prohibited in this course to ensure effective learning:

- Creating code and answers for lab quizzes, assignments, and the final projects
- Debugging code for lab quizzes, assignments, and the final projects
- Generating paragraphs for assignments and the final exam with prompts
- Summarizing readings
- Automating discussion posts

- Finding literature citations

Overall, the use of AI tools to actually "do" the work is prohibited. Your instructor and peers are the recommended sources for assistance. AI tools can be helpful for debugging and iterating on code for future work, but it is important to develop these skills independently first. In addition, AI tools are known for providing false references and incorrect information, so it is the responsibility of students to fact-check the AI responses. Similarly, penalties to grades will apply if unauthorized uses of AI tools are detected.

Writing Assistance

Students are encouraged to use the University's resources for writing instruction and assistance. For our multilingual students, the ELI faculty offer office hours in our building. Students can seek assistance through the student services team.

The resources of the Sweetland Center for Writing are available for both undergraduate and graduate students. They offer classes, one--on--one assistance in a variety of modalities, and resource guides.

Sweetland Writing Center: http://lsa.umich.edu/sweetland

Link to resource guides (designed for undergraduates, but even grad students might find them useful): http://www.lsa.umich.edu/sweetland/undergraduate/writingguides

[NEW] Individual English Language Support is available this semester for any student in Taubman College for whom English is not their first language. To sign up for an individual appointment, email kbecky@umich.edu. Please note that this is not a paper-editing service - you will work with an ELI faculty member on writing assignments, presentation skills, or language skills needed for academic or professional purposes.

Statement on Diversity, Equity, and Inclusion

Taubman College affirms the principles of diversity, equity, and inclusion as we organize resources and priorities that align with our values. We seek to have a diverse group of persons at all levels of the college - students, faculty, staff and administrators - including persons of different race and ethnicity, national origin, gender and gender expression, socioeconomic status, sexual orientation, religious commitment, age, and disability status. We strive to create a community of mutual respect and trust, a community in which all members and their respective backgrounds, identities, and views are represented without any threat of bias, harassment, intimidation, or discrimination. The College Compact is a description of the environment we wish to create and the behaviors we hope our community members will exhibit.

Mental Health

Taubman College is committed to advancing the mental health and wellbeing of its students. Studies and surveys indicate clearly that a variety of issues, such as strained relationships, increased anxiety, alcohol/drug problems, and depression, directly impact student academic performance. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, please reach out to any of the following for assistance:

- Karen Henry is a CAPS Embedded Psychologist who offers counseling here at Taubman College (karhenry@umich.edu). Note that appointments may take place via phone call or BlueJeans when COVID-19 precautions are in place.
- Counseling and Psychological Services (CAPS) can be reached at (734) 764-8312 and https://caps.umich.edu/ during and after hours, on weekends and holidays. When precautions for COVID-19 are in place, please contact CAPS at caps-uofm@umich.edu or schedule online here: https://caps.umich.edu/article/caps-initial-consultation-request
- For medications, contact University Health Services (UHS) at (734) 764-8320 and https://www.uhs.umich.edu/mentalhealthsvcs, or for alcohol or drug concerns, see www.uhs.umich.edu/aodresources.
- For an extensive listing of mental health resources available on and off campus, visit: http://umich.edu/~mhealth/.
- To get help right away, if you or someone you know is in a crisis situation, please do one of the following: Call 911 or Call (734) 996-4747 (U-M Hospital Psychiatric Emergency).
- If you are experiencing concerns, seeking help is a courageous thing to do for yourself and those who care about you. If the source of your stressors is academic, please contact me so that we can find solutions together. For personal concerns, U-M offers many resources, some of which are listed at Resources for Student Well-being.

Disability Support

In compliance with the University of Michigan Rackham Graduate School policy, I am available to discuss appropriate academic accommodations that may be required for students with disabilities. Requests for academic accommodations should be made during the first three weeks of the semester, except for unusual circumstances, so arrangements can be made. Some aspects of this course, the assignments, the in-class

activities, and the way the course is usually taught may be modified to facilitate your participation and progress. As soon as you make me aware of your needs, we can work with the Services for Students with Disabilities (SSD) office to help us determine appropriate academic accommodations. SSD (734-763-3000; http://ssd.umich.edu) typically recommends accommodations through a Verified Individualized Services and Accommodations (VISA) form. Any information you provide is private and confidential and will be treated as such.

Accommodations for Religious Holidays and Observances

The guidance on this issue issued by the Office of the Provost is as follows: “Although the University of Michigan, as an institution, does not observe religious holidays, it has long been the University's policy that every reasonable effort should be made to help students avoid negative academic consequences when their religious obligations conflict with academic requirements. Absence from classes or examinations for religious reasons does not relieve students from responsibility for any part of the course work required during the period of absence. Students who expect to miss classes, examinations, or other assignments as a consequence of their religious observance shall be provided with a reasonable alternative opportunity to complete such academic responsibilities. It is the obligation of students to provide faculty with reasonable notice of the dates of religious holidays on which they will be absent. Such notice must be given by the drop/add deadline of the given term. Students who are absent on days of examinations or class assignments shall be offered an opportunity to make up the work, without penalty, unless it can be demonstrated that a make-up opportunity would interfere unreasonably with the delivery of the course. Should disagreement arise over any aspect of this policy, the parties involved should contact the Department Chair, the Dean of the School, or the Ombudsperson. Final appeals will be resolved by the Provost.”

Audio and Video Recordings and Protecting Privacy

The pandemic crisis may require that synchronous class activities be recorded and posted for students who are unable to participate in-person. But recording lectures, discussions, and other similar course-related activities raises important privacy concerns. Instructors must balance the need to include all class members against the need to protect privacy concerns. Recording may stifle discussion and interfere with the free exchange of ideas, particularly when discussing sensitive subjects. Instructors may choose to have some sessions not recorded in order to encourage the free exchange of ideas, or they may choose to pause recording when discussion of sensitive subjects begins. Instructors will share recordings only with members of the class through a

platform that is only accessible by members, such as Canvas, to ensure that only members of the class in which the recording was made can access the recording. Faculty should take steps, such as preventing downloading capability, in order to protect the privacy of the members. Recordings and chat sessions are private and cannot be shared outside the classroom. Sharing recordings or chat sessions with anyone outside of the class will be considered academic misconduct. Course activities may be audio or video recorded and made available to other students in this course. As part of your participation in this course, you may be recorded. If you do not wish to be recorded, please contact the instructor the first week of class, or as soon as you enroll in the course, to discuss alternative arrangements. The university provides additional resources on recordings and privacy concerns.

📚 Appendix: Week by Week Reading

Week 1: Cities as Networks

- (SKIM) Castells, M. (2020). Space of flows, space of places: Materials for a theory of urbanism in the information age. In *The city reader* (pp. 240-251). Routledge. (PDF on Canvas)
- (OPTIONAL) Barabási, A. (2023). The hidden networks of everything. [Youtube] https://www.youtube.com/watch?v=RfgjHoVCZwU
- (TECHNICAL RESOURCE) Wickham, H., Çetinkaya-Rundel, M., & Grolemund, G. (2023). R for Data Science (Section Prerequisites). O'Reilly Media, Inc. https://r4ds.had.co.nz/introduction.html#prerequisites

Week 2: Network Properties

- (TECHNICAL RESOURCE) Network Analysis and Visualization with R and igraph. https://kateto.net/netscix2016.html
- (TECHNICAL RESOURCE) Networkx Tutorial. https://networkx.org/documentation/stable/tutorial.html
- (TECHNICAL RESOURCE) Wickham, H., Çetinkaya-Rundel, M., & Grolemund, G. (2023). R for Data Science (Section 3.1: Data Transformation; Section 5: Data tidying; Section 7: Data Import; Section 12-19: Transform). O'Reilly Media, Inc. https://r4ds.hadley.nz/data-transform

Week 3: Network Structure

- (SKIM) Derrible, S. (2012). Network centrality of metro systems. *PloS one*, *7*(7), e40575. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0040575 (Open-access
- (SKIM) Junker, N. (2020). Community Detection with Louvain and Infomap. https://www.r-bloggers.com/2020/03/community-detection-with-louvain-and-infomap/

Week 4: Application of SNA in Urban Planning

- (SKIM) Lienert, J., Schnetzer, F., & Ingold, K. (2013). Stakeholder analysis combined with social network analysis provides fine-grained insights into water infrastructure planning processes. *Journal of environmental management*, *125*, 134-148.
- (SKIM) Gerber, E. R., Henry, A. D., & Lubell, M. (2013). Political homophily and collaboration in regional planning networks. *American Journal of Political Science*, *57*(3), 598-610.
- (SKIM) Kim, H., Chung, J. K., & Lee, M. H. (2019). Social network analysis of the Jangwi urban regeneration community. *Sustainability*, *11*(15), 4185.
- (SKIM) Fang, L., Wen, Y., Zhang, J., Erlebacher, G., & Staley, S. (2024). Network Power or Power-Penetrated Network? An Analysis of the Communication Network in an Economic Development Project. *Journal of the American Planning Association*, *90*(3), 494-509.
- (DOWNLOAD) Gephi: The Open Graph Viz Platform. https://gephi.org/
- (WATCH) Gephi: Features. https://gephi.org/features/

Week 5: Spatial Social Network in GIS

- (SKIM) Andris, C., & Sarkar, D. (2022). Social networks in space. In *Handbook of Spatial Analysis in the Social Sciences* (pp. 400-415). Edward Elgar Publishing. https://www.dropbox.com/scl/fi/mmx4cvo47pdwbsgfobkis/Andris_Sarkar_SSNs.pdf?rlkey=p5y8wzr289btrmv30xktvqjco&e=1&dl=0A
- (SKIM) Bui & Miller (2015). The Typical American Lives Only 18 Miles From Mom. The New York Times. https://www.nytimes.com/interactive/2015/12/24/upshot/24up-family.html
- (SKIM) Andris, C., Liu, X., Mitchell, J., O'Dwyer, J., & Van Cleve, J. (2019). Threads across the urban fabric: Youth mentorship relationships as neighborhood bridges. *Journal of Urban Affairs*, *43*(1), 77-92.

- (SKIM) Kelly, J., Sarkar, D., & Andris, C. (2024). Locality, Personal Ties, and Efficiency in a Food Security Network. *Annals of the American Association of Geographers*, 1-12.

Week 6: Advanced SSN Metrics and Visualization in GIS

- (EXPLORE) SNoMaN: https://sites.gatech.edu/snoman/software-and-analytical-tools/snoman-software/ (we will use in lab)
- (EXPLORE) Flowmapper: https://flowmapper.org/
- (EXPLORE) Kepler.gl: https://kepler.gl/ (the commercialized version: Foursquare Studio: https://studio.foursquare.com/)
- (EXPLORE) FlowmapBlue: https://www.flowmap.blue/ (the commercialized version: https://www.flowmap.city/)
- (SKIM) Andris, C., DellaPosta, D., Freelin, B. N., Zhu, X., Hinger, B., & Chen, H. (2021). To racketeer among neighbors: spatial features of criminal collaboration in the American Mafia. *International Journal of Geographical Information Science*, *35*(12), 2463-2488.
- (SKIM) Liang, X., Baker, J., DellaPosta, D., & Andris, C. (2023). Is your neighbor your friend? Scan methods for spatial social network hotspot detection. *Transactions in GIS*, *27*(3), 607-625.
- (SKIM) Sarkar, D., Andris, C., Chapman, C. A., & Sengupta, R. (2019). Metrics for characterizing network structure and node importance in Spatial Social Networks. *International Journal of Geographical Information Science*, *33*(5), 1017-1039.
- (SKIM) Jin, S., Endert, A., & Andris, C. (2024). SNoMaN: a visual analytic tool for spatial social network mapping and analysis. *Cartography and Geographic Information Science*, 1-19.
- (TECHNICAL RESOURCE) Liang, X., Andris, C., Dipto, S. Spatial Social Network Visualization and Metrics with R. https://friendlycities-gatech.github.io/SSN_tutorial/

Week 7: Mobility Flows #1

- (EXPLORE) Resilient Urban Networks Lab. Takahiro Yabe. New York University. https://www.takayabe.net/
- (EXPLORE) Social Urban Networks. Esteban Moro. Northeastern University. http://estebanmoro.org/

- (EXPLORE) GeoDS Lab. Research on Human Mobility and Urban Computing with Big Data. Song Gao. University of Wisconsin-Madison. https://geography.wisc.edu/geods/archives/582
- (EXPLORE) African Networks Lab. Oliver J. Walther. University of Florida. https://anl.geog.ufl.edu/
- (EXPLORE) Friendly Cities Lab. Clio Andris. Georgia Institute of Technology. https://friendlycities.gatech.edu/
- (SKIM) Wang, Y., Kang, C., Bettencourt, L. M., Liu, Y., & Andris, C. (2015). Linked activity spaces: Embedding social networks in urban space. *Computational approaches for urban environments*, 313-336. (PDF on Canvas)

Week 9: Mobility Flows #2

- (SKIM) Liang, X. (2024). Transforming Mobility Barriers to Connectivity: Examining the Impact of the AeroATL Greenway Plan in Reconnecting Aerotropolis Communities Around Atlanta Airport. https://github.com/xiaofanliang/AeroATLGreenway
- (SKIM) Xu, W., Wang, Z., Attia, N., Attia, Y., Zhang, Y., & Zong, H. (2024). An experienced racial-ethnic diversity dataset in the United States using human mobility data. *Scientific Data*, *11*(1), 638. https://www.nature.com/articles/s41597-024-03490-y (open-access)
- (SKIM) Yabe, T., Tsubouchi, K., Shimizu, T., Sekimoto, Y., Sezaki, K., Moro, E., & Pentland, A. (2024). YJMob100K: City-scale and longitudinal dataset of anonymized human mobility trajectories. *Scientific Data*, *11*(1), 397. https://www.nature.com/articles/s41597-024-03237-9 (open-access)

Week 10: Infrastructure Networks

- (SKIM) Graham, S., & Marvin, S. (2002). *Splintering urbanism: networked infrastructures, technological mobilities and the urban condition* (Chapter 1: Introduction, P.7-35). Routledge.
- (SKIM) Meko (2016). Six maps that show the anatomy of America's vast infrastructure. Washington Post. https://www.washingtonpost.com/graphics/national/maps-of-american-infrastrucure/ (also available as a PDF on Canvas)

Week 11: Network Traversal and Routing

- (SKIM) Liang & Yang (2024). Transforming Mobility Barriers to Connectivity: Examining the Impact of the AeroATL Greenway Plan in Reconnecting Aerotropolis Communities Around Atlanta Airport. https://github.com/xiaofanliang/AeroATLGreenway

Week 12: Network Infrastructure Duality

- (SKIM) Network Duality Case Studies (2024). https://drive.google.com/file/u/1/d/1Twbz-O3VVVJ_KN0xtzWbyZoPjZsB006R/view?usp=sharing
- (SKIM) Aiello, L., Vybornova, A., Juhász, S., Szell, M., Bokányi, E. (2024). Urban highways are barriers to social ties. *arxiv*. https://arxiv.org/abs/2404.11596