YSS3273 Geospatial and Demographic Methods

Semester 2, 2022

Wednesday 9:00-12:00 | Computer Lab at Yale-NUS Library

Note: Classes end 10 minutes prior to the timetabled end time

Instructor: Chaewon Ahn (chaewon.ahn@yale-nus.edu.sg, she/her/hers)
Teaching support: Michelle Quak (michelle.quak@yale-nus.edu.sg)
Office Hours: Tuesday 10:00-11:00, Friday 13:00-14:00. Please make a reservation via https://calendly.com/chaewon-ahn. If none of these times work for you, please leave me a message.

COURSE DESCRIPTION

First developed in the 1960s, Geographic Information Systems (GIS) are tools that are widely used for the representation and analysis of geographic data. GIS provides the ability to organize, manipulate, analyze and communicate geographic data that contain the relative geographic information (coordinates) and the associated characteristics (attributes). Nowadays, GIS has become an important analytical tool in urban planning and is becoming more accessible with the rise of open-source software and open data.

The ***YSS3273 Geospatial and Demographic Methods*** course introduces students to the basics of GIS to equip them with the skills to answer spatial questions using QGIS. This course is renewed from the previous offerings to place an equal emphasis on skill-building and the development of a *reflexive* practice in using GIS. With the lectures, discussions, and hands-on exercises during lab sessions, students learn how to use GIS for spatial research, being cognizant of the histories and positions that the tools embody. The class covers data handling, projections, data joins, proximity analysis, network analysis, spatial analysis, and offers an introduction to advanced themes of web-based visualization and qualitative GIS. The class is organized into two parts. In the first part of the class, the focus is on skill-building, and in the second part, students develop their first spatial analysis project.

LEARNING OBJECTIVES

The objective of the course is to equip students with the following tools and way of thinking:

- Understand the epistemology of mapping, urban data and spatial analysis
- Critically employ GIS to gather, generate, manipulate, spatially analyze data, and communicate spatial analysis.
- Learn how to ask spatial questions.

- Tell convincing data stories using spatial data and analytical tools on socio-spatial urban problems.
- Acquire the skills to use GIS, R and web mapping (leaflet) tools jointly.

PRE-REQUISITES FOR THE COURSE

There are no pre-requisites for the course.

COURSE STRUCTURE

The class is organized into two parts. The first part focuses on skill-building and the second part helps students to develop their first spatial analysis project. The first part of the course continues until week 8 with a focus on building the essential skills through lectures, lab sessions, and exercises. The second part of the course which starts at week 9 places a focus on the development of an individual spatial analysis project using GIS.

Learning a new tool not only requires understanding of the concepts but also the hands-on experience to utilize them. The course meets every Friday between 9am to 12pm. The class time is divided into lectures & discussions, lab sessions, and group reviews. Each lecture is paired with a lab session where students gain hands-on experiences through a lab session that is designed to align with the lecture. The exercises reflect the lab session content, which will be reviewed with comments by the instructor and shared with peers during group reviews to facilitate peer-learning. The class covers data handling, projections, data joins, basic spatial analysis of performing overlays, creating buffers, calculate statistics and introduces more advanced proximity analysis, network analysis, and data collection methods. The classes are designed to be taught fully remotely this semester and will accommodate hybrid/remote learning scenarios.

- **Lectures & discussions:** The tools built in GIS embody particular positions associated with them. Each lecture introduces the tools, concepts and the critical reflections associated with the tools. During the lectures, students discuss the assigned readings that include theoretical foundations, critical reflections around GIS and exemplar research using GIS.
- **Group reviews:** The group review is a 15 min long breakout session for students to share how they approached their assignments from the previous week. The instructor provides feedback and clarifications on the common questions.
- **Lab sessions:** The lab sessions include the demonstration of the tool by the instructor, which is followed with a self-guided in-class exercise for the students to practice.

- **Exercises:** The exercises are meant to provide students with the opportunity to familiarize themselves with the new tools that were taught during lab.

ABBREVIATED WEEKLY SCHEDULE

Dates			Course Topics	Exercise given	Exercise due
Jan	Week 1	12	**Power of Maps** About Making Maps and Spatial Analysis I Getting Started with QGIS	Exercise 0	-
	Week 2	19	**Representation in Maps: Projections, symbols** Map Projections I Map Design	Exercise 1	Exercise 0
	Week 3	26	**"What Gets Counted Counts"** Census and Open data I Finding and Joining Data	Exercise 2	Exercise 1
Feb	Week 4	2	**Making Data Spatial** Geocoding, georeferencing, digitizing	Exercise 3	Exercise 2
	Week 5	9	**Spatial Analysis 1** Union, Buffer, Clip, Dissolve, Grids	-	Exercise 3
	Week 6	16	**Spatial Analysis 2** Heat maps, Contours, R and/in GIS	Problem Set 1	-
		23	Recess Week	-	-
Mar	Week 7	2	**Raster Decision making models and suitability** Raster Decision Making, Suitability Analysis and GIS	* Final project grouping	
	Week 8	9	**Spatial Analysis 3** Network Analyst, Clusters	Project Paragraph	Problem Set
	Week 9	16	**Project Proposal Workshop**	Project Proposal	Project Paragraph
	Week 10	23	**Data Gathering** GPS data I Spatial Surveys	-	Project Proposal

	Week 11	30	**Web Maps** Leaflet, Mapbox	Exercise 4	-
Apr	Week 12	6	**Qualitative GIS** Critical GIS, Qualitative GIS	Final Slides	Exercise 4
	Week 13	13	**Final Presentation**	-	Final Slides
	Week 14	20	**Final Presentation**	-	-

COURSE MATERIALS

All course materials, including readings, tutorial material, and lecture recordings will be available through Canvas. Please contact me if you have any problem accessing canvas.

- **Readings:** There is no need to purchase a textbook. All course material will be made available via canvas on the e-reserves.
- **Lab tutorial material:** On the Page tab, each week's material list will be provided. Each week's material includes links to nbox folders for the data and models to be used, a PDF of the slides, and a Panopto recording list that entails all videos shown during the tutorials. The material is meant to help students to revisit the lecture content by themselves beyond the class.

COURSE ASSESSMENT BREAKDOWN

Assignment		**% of Total**	**DUE Date**
Skill building exercises	Exercise 0	0%	Jan 17 at 23:59PM
	Exercise 1	5% (5 points)	Jan 24 at 23:59PM
	Exercise 2	5% (5 points)	Jan 31 at 23:59PM
	Exercise 3	5% (5 points)	Feb 7 at 23:59PM
	Problem Set	20% (20 points)	Mar 7 at 23:59PM
	Exercise 4	10% (10 points)	Apr 4 at 23:59PM
Final Project	Project Paragraph	5% (5 points)	Mar 14 at 23:59PM
	Project Proposal	10% (10 points)	Mar 21 at 23:59PM
	Presentation	30% (30 points)	Apr 11 at 23:59PM
Attendance and Participation		10% (10 points)	

- **Skill building exercises (45%):** Trying the tools oneself is the best way to acquire a tool. The objective of the exercises is to help students practice the skills acquired during the lab sessions and learn how to apply them in a different context. Exercise 0 is ungraded, and the following four exercises reflect the in-class material that student go through with the instructor during the lab session.

Each exercise is submitted in the following week on Monday 11:59 PM. The group review during the lab session will discuss how students have resolved common issues performing the exercises. The problem set will serve as a holistic review of the content covered until the middle of the semester.

- **Final Project (45%):** The final project is a group project with 2-3 people working together on a spatial research project. The final project assessment is divided into three parts: the project paragraph, the project proposal, and the final presentation. Each of the assignments are meant to help students develop the final project. The project paragraph entails a 100-word long problem statement of the final project that introduces the research question. Through the project proposal workshop, teams develop a proposal that includes the research question, the data and methods. Between week 7 – 10, additional office hours will open to help teams to finalize the idea of the final project. Teams will share the project during the final presentation with peers and outside critiques.

- **Attendance and Participation (10%):** The course is designed to be interactive with discussions and exercises, therefore, showing up for class either in person or remotely is required for this course. The attendance will be taken by the instructor. The lecture and lab sessions will be recorded and made available for students if they encounter reasons to miss the class. In such circumstances, please inform the instructor as soon as possible.

  Participation in this class means to be engaged and curious in the process to acquire a new way of thinking and working that GIS enables. I acknowledge that everyone learns differently. Therefore, participation can mean many things including, but not limited to, being expressive in the discussions, in the zoom chat, in the discussion forum on Canvas, sharing with classmates how they have resolved a problem or seeking help from the instructor when they struggle.

Your semester final letter grade will be based on the following grade scale:

Letter Grade	A+	A	A-	B+	B	B-	C+	C	D+	D	F
Points (%)	97 - 100	93 - 97	90 - 93	87 - 90	83 - 87	80 - 83	77 - 80	70 - 77	60 - 70	50 - 60	< 50

ABSENCE POLICY

Students are expected to attend all classes, and to notify the professor in advance if you will be absent. If you have required fieldwork/ class trips for another course, you should discuss this potential absence with me in advance. One absence over the course of the semester will be permissible, for academic or other reasons. But for additional absences, I will apply a 0.5 point/percentage grade penalty OR you will need to submit a reading summary to avoid such a penalty. It is your responsibility to get class notes from your peers and be prepared to rejoin the class after your absence. You will not be penalized for absences if you receive a Medical Certificate or AD Note.

LATE SUBMISSION POLICY

Students are expected to plan and manage their workloads, and to ensure they do not lose work through IT malfunction or poor planning. Your assignment will be considered late if it misses the deadline without you having secured advance permission. A late submission within 12 hours will be subject to a penalty of a -0.2 point deduction, and within 24 hours a -0.4 point deduction. (So please turn in the assignment even if you are late!) Beyond this point, a late assignment will be accepted up until one week after the original due date for a loss of one point (1%). After that point, late assignments will receive no credit and will not be accepted. You will not be penalized for late submission of work if you receive a Medical Certificate or AD Note.

EXPECTATIONS REGARDING STUDENT-FACULTY COMMUNICATION

I will not always be able to respond to email right away. If I have not answered an email by the next time I see you in class please be sure to remind me in class. It is likely that I did not see your email yet. I will do my best to respond to your emails in 24 hours during the week. **There are a lot of ways to find help for this class:** Canvas discussions, in-class group reviews, and instructor office hours are other good strategies to use. Please don't let an unanswered email hold you back.

INTELLECTUAL PROPERTY AND PRIVACY

Our academic model encourages open and penetrating discussion of what can sometimes be challenging materials. Additionally, we seek to cultivate an intellectual space in which, as stated in the Faculty Statement on the Freedom of Expression, "there are no questions that cannot be asked, no answers that cannot be discussed and debated." This kind of intellectual exploration requires trust and privacy. Therefore, students may not record and/or distribute course discussions, lectures, lecture slides or handouts, readings, videos, or any course related materials without prior permission of the instructor. This includes audio recording, video, transcription, and photography. Lectures and seminars that are delivered in-person, online, or as a pre-recorded videos should never be recorded or distributed beyond the course for which it was intended.

Any notes which a student takes for their own learning and retention should not be shared beyond the Yale-NUS community. Students are encouraged to reflect upon and share their own learning experiences and ideas in whatever forum they wish. However, they should not share course content produced by their professors or their peers (e.g. a peer's essay, comments made in class, posts to a Canvas discussion thread) without prior permission through any channels including social media.

Important Notes: Violation of this policy is addressed in the student Code of Conduct and could result in disciplinary and/or legal consequences. As per Clause F2(a) of Policies Relating To Yale-NUS College Intellectual Property, copyright to an Authored Work shall be owned by the University Member who authored it. Authored Work could include syllabi, tests, examination scripts, study guides, lecture notes and teaching materials, including lectures recorded on audio and/or visual recordings.

ACADEMIC INTEGRITY POLICY

Yale-NUS College expects its students to abide by the highest standards of academic integrity as a matter of personal honesty and communal responsibility. Acting with academic integrity requires that (a) students do their own work, (b) students not interfere with the work of others, (c) students accurately and honestly represent the content of their work, and (d) students properly attribute others' work. Violations of the College's academic integrity standards undermine both the community and the individual growth of students. Accordingly, they will be addressed with the utmost seriousness and sanctions ranging from grade penalties to expulsion. Examples of violations of academic integrity include plagiarism, copying or sharing homework answers, submitting work completed for one course as 'new' work for another course, or fabricating or falsifying research data. For more information please visit the Student Services website, Policies and Procedures section: https://studentlife.yale-nus.edu.sg/policies/academic-integrity/

The Yale-NUS Library provides resources on citations and plagiarism here: http://library.yale-nus.edu.sg/avoiding-plagiarism/

CLASS CLIMATE

- **Inclusive and Non-Discriminatory Language:** Faculty and students will endeavour to learn and respect each other's names and preferred pronouns. While we aim to harness and learn from the diverse experiences and identities in our classroom, we will avoid expecting individual students to represent their entire country, culture, gender identity, etc.

- **Language & Conduct:** This course encourages non-discriminatory language and conduct. Students should not use racist, sexist, ableist or other discriminatory language in class discussions or written work. Instead, students should be mindful and respectful of the diverse identities present in the class, including but not limited to gender, sex, sexuality, (dis)abilities, socioeconomic class, religion, race, nationalities, language. If you have suggestions to improve class climate and inclusivity, please come talk to me during office hours, send me an email, or submit anonymous feedback via Canvas. I understand it can be uncomfortable to talk to a professor about these issues, and I want to assure you that any concerns or constructive feedback you raise with me even if it is about my own speech or teaching style will not lead to negative consequences for your grade or our interactions in the course. If you feel uncomfortable speaking with me directly or want to consult with another faculty member about difficulties you are facing in the class, I encourage you to reach out to your Assistant Dean, who can advise you on the process for referring complaints relating to content or behaviour that causes offence to the College administration.
- **Access Needs:** If you have any physical, psychiatric or learning conditions that may impact your performance in this course, please reach out to your Assistant Dean for advice and referral to further resources.
- **Class Discussions:** Some students will be more comfortable or assertive speaking in class than others. Students who tend to speak more frequently, louder, and longer are encouraged to make room in the conversation for other voices and develop their listening skills. At the same time, students who are more reserved about speaking during class are encouraged to participate vocally or in other formats. Please come talk to me if participation or classroom discussion dynamics are challenging for you. We can work together to identify appropriate modes for participation.
- If you are having inter-personal conflicts with a classmate in ways that undermines your learning or engagement, please come talk to me so we can identify constructive ways forward.

HEALTH AND WELLNESS

College can be a mentally burdening place. If you are struggling in any way, please feel free to approach me. If you feel that you might benefit from private counselling, please contact your residential staff, Assistant Dean or the Yale-NUS Counselling Centre. For more information on the Counselling Centre, visit https://studentlife.yale-nus.edu.sg/counselling/

ACADEMIC RESOURCES

- **Canvas Page Usage Policy:** All class material will be shared through Canvas. Readings shall be found on the 'E-reserves', and the link to the lab material, including slides, data, models, and Panopto recordings will be consolidated by week and shared on the 'Pages' tab. The material will be shared one week in advance, so students are encouraged to check the Canvas page on a weekly basis to gain access to the material prior to the class. For questions and problems, I encourage students to post the question first on the 'Discussion' page on canvas before sending me an email. When you start a 'discussion' to post your question, ensure to allow 'threaded replies' so that everyone can respond. This will allow peers to see how problems they also might be encountering can be handled. When posting a question, it is always useful to include images of the problem. I will respond to the questions in the discussion forum within 24 hours. The recordings of the class will be also made available through the 'Panopto Recordings' tab.

- **Research Consultations:** Librarians at the Yale-NUS Library meet with students to assist them with their research and with developing information literacy skills and habits. Students should contact their Subject Librarian (http://library.yale-nus.edu.sg/about/subject-librarians/) or complete the Research Consultation form (http://library.yale-nus.edu.sg/research-consultation/) to set an appointment.

- **Writing Consultations and Peer Tutoring:** The Yale-NUS Writers' Centre provides individual writing consultations for class assignments. For more information on making appointments, visit https://writerscentre.yale-nus.edu.sg/ Many disciplines also have peer tutors available. To learn more and book an appointment, visit https://teaching.yale-nus.edu.sg/peer-tutoring-programme/

WEEKLY SCHEDULE

Week 1 (Jan 12): Power of Maps

- What is GIS?
- What are the various definitions of GIS?
- What would a socially responsible practice of GIS entail?
- Getting started with QGIS

Readings

- Paul A. Longley, Michael F. Goodchild, David Maguire, David W. Rhind, "Chapter 1: Geographic Information: Science, Systems, and Society." in *Geographical Information Systems and Science*. Fifth Edition, **pp. 11-13 and 16-19 and 23-32 only**.
- Pickles, J. (Ed.). (1995). "Representations in an Electronic Age: Geography, GIS, and Democracy" in *Ground truth: The social implications of geographic information systems*. Guilford Press. **pp. 1-30**

Exercise Due*:* none
Exercise Assigned*:* Exercise 0, due Monday, Jan 17 by 11:59PM.

-

Week 2 (Jan 19): Representation in Maps: Projections, symbols

- What is the logic behind map projections?
- How can we use map projections that best represent areas?
- What are the cartographic symbols that are accepted as *natural* in modern maps?

Readings

- Crampton, Jeremy. "Cartography's Defining Moment: The Peters Projection Controversy, 1974-1990." *Cartographica* 31, no. 4 (1994): **16–32.**
- Wood, D., & Fels, J. (2011). Design on Signs/Myth and Meaning in Maps. *The map reader: theories of mapping practice and cartographic representation*, **48-55.** (Full article is optional and posted in additional readings)

Resources (optional readings and resources added for fun)

- Paul Bolstad, GIS Fundamentals, Chapter 3, "Geodesy, Datums, Projections, and Coordinate Systems." XanEdu, 6th Edition, 2020, **p. 87-136**

- Wood, D., & Fels, J. (1986). Designs on signs/myth and meaning in maps. Cartographica: The International Journal for Geographic Information and Geovisualization, 23(3), **54-103.**
- Kai's Block, Comparing map projections: http://bl.ocks.org/syntagmatic/ba569633d51ebec6ec6e
- Can This New Map Fix Our Distorted Views of the World? (2021) https://www.nytimes.com/2021/02/24/science/new-world-map.html

Exercise Due*:* Exercise 0
Exercise Assigned: Exercise 1, due Monday, Jan 24 by 11:59PM.

-

Week 3 (Jan 26): "What Gets Counted Counts"

- What can we know with census data? what information is "not counted"?
- What are the ways in which census works as a means of control?
- What is the history of the Singaporean Census and open data?
- How do we use census and open data?

Readings

- D'Ignazio, C., & Klein, L. (2018). Chapter Three: "What Gets Counted Counts." In *Data Feminism*. Retrieved from https://mitpressonpubpub.mitpress.mit.edu/pub/rykaknh1
- Kitchin, R. (2014). "Open and linked data" In *The data revolution: Big data, open data, data infrastructures & their consequences*. SAGE Publications Ltd, **pp. 48-66**

Resources

- Singapore Census, https://www.singstat.gov.sg
- Singapore open data, https://data.gov.sg
- Singapore onemap, https://www.onemap.gov.sg/home/
- Benedict Anderson, "Census, Map. Museum," from *Imagined Communities:* Reflections on the Origin und Spread of Nationalism, revised edition (London: Verso. 1991), **pp. 163-185**.
- Guide for open urban data in Singapore https://ual.sg/post/2020/06/24/guide-for-open-urban-data-in-singapore/

Exercise Due: Exercise 1
Exercise Assigned: Exercise 2, due Monday, Jan 31 by 11:59PM.

-

Week 4 (Feb 2): Making Data Spatial - Geocoding and Digitizing Maps

- How do we know the location of a place?

Readings

- Paul A. Longley, Michael F. Goodchild, David Maguire, David W. Rhind, Geographical *Information Systems and Science*. Fourth Edition, "Chapter 4: Georeferencing". **pp. 77 - 88 only**
- Diana Shkolnikov, Befriending a Geocoder, State of the Map Conference, 2016 http://stateofthemap.us/2016/befriending-a-geocoder/

Resources

- Yale-NUS College GIS Library, https://libguides.nus.edu.sg/yncgis
- NUS Historical Maps of Singapore, https://libmaps.nus.edu.sg
- Old Maps Online https://www.oldmapsonline.org
- David Rumsey Map Collection https://www.davidrumsey.com

Exercise Due: Exercise 2
Exercise Assigned: Exercise 3, due Monday, Feb 7 by 11:59PM.

-

Week 5 (Feb 9): Spatial Analysis 1 - Union, Buffer, Clip, Dissolve, Grids

- What makes the operations for spatial analysis spatial?
- What are the underlying assumptions?
- What does each method fail to account for?

Readings

- Paul A. Longley, Michael F. Goodchild, David Maguire, David W. Rhind, Geographical *Information Systems and Science*. Fourth Edition, "Chapter 13: Spatial Data Analysis". **pp. 290 - 317**

Case Studies (optional readings – skim the case studies and understand how the methods are applied!)

- Foda, Mohamed A., and Ahmed O. Osman. "Using GIS for measuring transit stop accessibility considering actual pedestrian road network." Journal of Public Transportation 13, no. 4 (2010): 2.

- Browning, M., & Lee, K. (2017). Within What Distance Does "Greenness" Best Predict Physical Health? A Systematic Review of Articles with GIS Buffer Analyses across the Lifespan. *International journal of environmental research and public health*, *14*(7), 675. https://doi.org/10.3390/ijerph14070675
- Setiawan, I., Mahmud, A. R., Mansor, S., Mohamed Shariff, ,A.R., & Nuruddin, A. A. (2004). GIS-grid-based and multi-criteria analysis for identifying and mapping peat swamp forest fire hazard in pahang, malaysia. *Disaster Prevention and Management, 13*(5), 379-386.

Exercise Due: Exercise 3
Exercise Assigned: none

-

Week 6 (Feb 16): Spatial Analysis 2 - Heat maps, Contours, R and/in GIS

- What are the ways in which we can describe density?
- What are the underlying assumptions?
- In what ways can be these measures misleading?

Readings (Focus on how the methods were used to extract meaningful results!)

- Chen, Y., & Yang, J. (2020). Historic neighborhood design based on facility heatmap and pedestrian simulation: Case study in china. *Journal of Urban Planning and Development, 146*(2), 4020001. https://doi.org/10.1061/(ASCE)UP.1943-5444.0000554
- Nefros, K. C., Kitsara, G. S., & Photis, Y. N. (2018). Using geographic information systems (GIS) to develop prioritization maps in urban search and rescue operations, after a natural disaster. case study: The municipality of agia paraskevi, athens, greece.*Ifac Papersonline, 51*(30), 360-365. https://doi.org/10.1016/j.ifacol.2018.11.332
- Khan, N. U., Wan, W., & Yu, S. (2020). Location-based social Network's data analysis and spatio-temporal modeling for the mega city of shanghai, china. *ISPRS International Journal of Geo-Information, 9*(2), 76. doi:http://dx.doi.org.libproxy1.nus.edu.sg/10.3390/ijgi902007

Exercise Due: none
Exercise Assigned: Problem set 1, due Monday, March 7 by 11:59PM.
* Grouping in pairs for the final project

-

Feb 23: Recess Week

-

Week 7 (Mar 2): Raster Decision making models and suitability

- How are raster decision making models (a.k.a. map algebra) used?
- What limitations of existing methods do raster decision making models amend?
- What are the underlying assumptions?

Readings

- Tomlin, C. D. (2016). Cartographic modeling. *International Encyclopedia of Geography: People, the Earth, Environment and Technology: People, the Earth, Environment and Technology*, **1-6.**

Case Studies (optional readings – skim the case studies and understand how the methods are applied!)

- Kar, Bandana, and Michael E. Hodgson. "A GIS-based model to determine site suitability of emergency evacuation shelters." Transactions in GIS 12.2 (2008**): 227-248.**
- Delamater, P. L., Messina, J. P., Shortridge, A. M., & Grady, S. C. (2012). Measuring geographic access to health care: Raster and network-based methods. *International Journal of Health Geographics, 11*(1), 15-15. https://doi.org/10.1186/1476-072X-11-15

Exercise Due: None
Exercise Assigned: None

-

Week 8 (Mar 9): Spatial Analysis 3 - Clusters and Networks

Readings

- Getis, Arthur. "Spatial autocorrelation." In *Handbook of applied spatial analysis*, **pp. 255-278**. Springer, Berlin, Heidelberg, 2010.

Case Studies (optional readings – skim the case studies and understand how the methods are applied!)

- Tsai, Pui-Jen, Men-Lung Lin, Chien-Min Chu, and Cheng-Hwang Perng. "Spatial autocorrelation analysis of health care hotspots in Taiwan in 2006." *BMC Public Health* 9, no. 1 (2009): 1-13.
- Comber, Alexis, Chris Brunsdon, and Edmund Green. "Using a GIS-based network analysis to determine urban greenspace accessibility for different ethnic and religious groups." *Landscape and urban planning* 86, no. 1 (2008): 103-114.

Resource
- De Smith, Michael, Michael Goodchild, and Paul Longley, Geospatial Analysis, https://spatialanalysisonline.com/
- O'Sullivan, David and David J. Unwin. 2010. "Point Pattern Analysis." In *Geographic Information Analysis*, 2nd Ed, 121-154. Hoboken, NJ: Wiley. pp. 8-12
- Urban Network Analysis toolbox, City Form Lab, http://cityform.mit.edu/projects/urban-network-analysis

Exercise Due: Problem Set
Exercise Assigned: Project Paragraph, due Monday, March 14 by 11:59PM.

-

Week 9 (Mar 16): Project Proposal Workshop

Readings
- Gatrell, J. D., Bierly, G. D., Jensen, R. R., & Thakur, R. R. (2020*). Research design and proposal writing in spatial science (3rd 2020. ed.)*. Springer International Publishing. "Chapter 3. Research Questions". **pp.29-39**
- 5-Step GIS Analysis Process. Yale-NUS College GIS Library https://libguides.nus.edu.sg/c.php?g=566658&p=3976144

Exercise Due: Project Paragraph
Exercise Assigned: Project Proposal, due Monday, Mar 21 by 11:59PM.

-

Week 10 (Mar 23): Data Creation / QGIS app collection / GPS / Quantified self

Readings

- Williams, Sarah, Elizabeth Marcello, and Jacqueline M. Klopp. "Toward open-source Kenya: Creating and sharing a GIS database of Nairobi." Annals of the Association of American Geographers 104, no. 1 (2014): **114-130.**
- Elwood, Sarah. "Volunteered geographic information: key questions, concepts and methods to guide emerging research and practice." *GeoJournal* 72, no. 3 (2008): **133-135**.

Exercise Due: Project Proposal
Exercise Assigned: none

-

Week 11 (March 30): Web Maps

Readings
- Haklay, M., Singleton, A., & Parker, C. (2008). Web mapping 2.0: The neogeography of the GeoWeb. *Geography Compass*, *2*(6), **2011-2039.**
- Unwin, A. (2020). Why is Data Visualization Important? What is Important in Data Visualization? . Harvard Data Science Review, 2(1). https://doi.org/10.1162/99608f92.8ae4d525

Resources
- NYT 2020 Data stories https://www.nytimes.com/interactive/2020/12/30/us/2020-year-in-graphics.html?searchResultPosition=2
- Forensic Architecture, https://forensic-architecture.org
- Civic Data Design Lab, MIT. https://civicdatadesignlab.mit.edu
- Center for Spatial Research, https://c4sr.columbia.edu/projects
- Senseable City Lab, https://senseable.mit.edu
- Mapbox. https://docs.mapbox.com/mapbox-gl-js/example/
- Leaflet. https://leafletjs.com
- D3. https://observablehq.com/@d3/gallery

Exercise Due: none
Exercise Assigned: Exercise 4, due Monday, April 4 by 11:59PM.

-

Week 12 (April 6): Qualitative GIS

Readings

- Boschmann, E. Eric, and Emily Cubbon. "Sketch maps and qualitative GIS: Using cartographies of individual spatial narratives in geographic research." *The Professional Geographer* 66, no. 2 (2014): **236-248.**
- Kim, Annette M. "Critical cartography 2.0: From “participatory mapping” to authored visualizations of power and people." *Landscape and Urban Planning* 142 (2015): **215-225.**

Resources

- We Can. 2018. https://canners.nyc

Exercise Due: Exercise 4
Exercise Assigned: Final Presentation Slides, due Wednesday, April 9 by 11:59PM.
* Presentation schedule set up

-

Week 13 (April 13): Final Presentation Part 1

-

Week 14 (April 20): Final Presentation Part 2