URBS 3300/5300: GIS Applications in Social Science

COURSE OVERVIEW

This course is a hands-on introduction to vector GIS using ESRI ArcGIS Pro software. Vector GIS is appropriate for modeling geographic objects such as bounded areas, specific locations, and networks. Students will develop the skills needed to perform basic GIS analysis, preparing them for future advanced GIS coursework.

This course focuses on ways in which GIS is and can be applied to urban history, public health, and equity analyses. Many of the readings use critical geography lenses (including anti-racist, queer and feminist geography lenses), raising issues of power and uncertainty that challenge conventional notions about science and data. The class also aims to help students develop an understanding of what is spatial, when GIS is appropriate for answering questions, and develop an awareness of the power dynamics and inequities inherently involved in map-making.

By the end of this course, students should be familiar enough with ArcGIS Pro to find, clean, map, and analyze data using basic GIS tools, and be able to teach themselves additional GIS skills using online materials and software manuals.

REQUIRED TEXTS

The following required textbook is available for purchase through the Penn bookstore:

Brewer, Cynthia A. *Designing Better Maps: A Guide for GIS Users*. ESRI Press, 2016.

ATTENDANCE & PARTICIPATION

Each student is required to lead class discussion on one week's course readings at least once during the semester. A sign-up sheet will be provided by the course instructor at the first meeting. This counts towards each student's participation grade. Students may sign up for one additional date, space permitting, for extra credit.

Pending updated guidance from Public Health Officials and the University's Administration, classes will be in-person for the Fall 2023 semester. Students should arrive on time and prepared. Students are expected to attend all class sessions unless they have spoken to the instructor beforehand regarding specific absences, and those who miss three (3) or more class sessions risk failing the course.

WEEKLY CLASS STRUCTURE

Students are required to attend both Monday and Wednesday class meetings in their entirety. The first 30 minutes of each Monday class will focus on the assigned reading/listening/viewing materials.

Assigned reading materials are essential to critically engage with the power (and the danger) of GIS and advancing mapping technologies. *Students are expected to come to class each Monday prepared to discuss the readings for that week.*

The remaining hour on Mondays and the full class on Wednesdays will cover hands-on work in ArcGIS Pro. Excused absences must be approved by the instructor in advance.

GROUP WORK & COLLABORATION

Working with your classmates and troubleshooting issues together is one of the best ways to learn GIS. **Collaboration is highly encouraged in this course.**

What matters is that everyone does their own work and submits their own unique assignments in accordance with the University's Code of Academic Integrity.

HOMEWORK ASSIGNMENTS

Students can complete their required coursework in one of two ways:

- **Option 1:** complete GIS Assignments 1 through 5, any *additional* three (3) GIS homework assignments, and the two required response papers.
- **Option 2:** complete GIS assignments 1 through 5, a final project *equivalent in scope to three GIS homework assignments*, and the two required response papers

Students must let the instructor know which option they choose by the end of class on Wednesday, 10/25/2023. Students interested in Option 2 (a final project) must meet with the instructor *prior to* 10/25/2023 to discuss their project idea and receive approval.

GRADING

Final grades will be based on a combination of homework (GIS assignments and required reflection papers), class engagement/participation, and attendance:

- **Homework** = 70% overall course grade
- **Engagement** = 20% overall course grade
- **Attendance** = 10% overall course grade

Each GIS homework assignment and reflection paper is worth 10 points. If a student receives a score of 7.5 or lower on a GIS assignment, they may resubmit it *within 3 days of the original due date.* The highest grade possible for a re-submission is a 9.

Most assignments include a detailed grading rubric. If an assignment submission meets the basic expectations and requirements outlined in the rubric, it is expected to receive a B (8 points/Good). Rubrics also typically provide additional ways through which students can earn extra points and receive a grade up to an A (10/Outstanding).

If a student completes more than the required number of GIS assignments during the semester, the highest 8 grades (or 5 if that student is doing a final project) will be counted and lower grades will be dropped.

Grades within the A range will be awarded only for work that exceeds the basic project/assignment expectations. An A+ grade cannot be earned on homework assignments but can be earned as a final course grade in instances of exceptional/outstanding work and effort over the course of the semester.

A+	A	A-	B+	B	B-	C+	C
Exceptional	*Outstanding*	*Excellent*	*Very Good*	*Good*	*Competent*	*Fair*	*Marginal*
10	*9.5*	*9.0*	*8.5*	*8.0*	*7.5*	*7.0*	*6.5*

FALL 2023 CLASS SCHEDULE

WEEK 1: MAPS AS PROPOSITIONS AND PROTEST
Required reading:
- Krygier, D. W., Wood, D. "CE N'EST PAS LE MONDE." *Rethinking Maps,* edited by Martin Dodge.
- Kurgan, Laura. *Close Up At A Distance: Mapping, Technology, and Politics.* Zone Books, 2013. pp. 19-36.
- Drozdz, M. (2020) Maps and Protest. *International Encyclopedia of Human Geography,* Elsevier, 367-378.
- Quiquivix, L. (2014). Art of War, Art of Resistance: Palestinian Counter-Cartography on Google Earth. *Annals of the Association of American Geographers*, 104(3), 444-459.
- Brewer, pages 1-16 (stop at "Map Projections in Design") and pages 32-37 (stop at "Mapping through Scale")

GIS Topics:
- Course Overview
- Introduction to ArcGIS Pro

WEEK 2: COMMUNICATING IDEAS THROUGH EFFECTIVE MAP DESIGN
Required reading:
- O'Beirne, J. (2016, April). *What Happened to Google Maps?.* justinobeirne.com. https://www.justinobeirne.com/what-happened-to-google-maps
- O'Beirne, J. (2016, April). *Cartography Comparison: Google & Apple Maps.* justinobeirne.com. https://www.justinobeirne.com/cartography-comparison (intro only!)
- Brewer, pages 47-66

GIS Topics:
- Panning & Zooming
- Layering Maps
- Identifying attributes

WEEK 3: SOCIAL SURVEY MOVEMENT & PUBLIC SOCIOLOGY
Required reading and viewing:
- Du Bois, W. E. B. (1899). The Philadelphia Negro: A Social Study. *Publications of the University of Pennsylvania series in Political Economy and Public Law*, 14.
- Video: Hillier, A. (2011) Legacy of Courage: W.E.B. Du Bois and The Philadelphia Negro. *(20 minutes)*
- Smith, H. (2020, March). *Coordinate systems: what's the difference?* ESRI ArcGIS Blog. https://www.esri.com/arcgis-blog/products/arcgis-pro/mapping/coordinate-systems-difference/
- Smith, H. (2020, February). *Geographic vs. Projected Coordinate Systems.* ESRI ArcGIS Blog. https://www.esri.com/arcgis-blog/products/arcgis-pro/mapping/gcs_vs_pcs/
- Brewer, pages 129-137 and pages 151-159

GIS Topics:
- Managing Projections
- Map symbology
- Thematic Maps

WEEK 4: PHILADELPHIA'S BLACK BOTTOM NEIGHBORHOOD

Required reading and viewing:

- Puckett, John L., and Mark Frazier Lloyd. *Becoming Penn: The Pragmatic American University, 1950-2000.* University of Pennsylvania Press, 2015. pp. 88-177.
- Orso, Anna. "How 'Penntrification' turned Black Bottom into University City and changed the neighborhood forever." *Billy Penn,* 5 August 2015. https://billypenn.com/2015/08/05/how-penntrification-turned-black-bottom-into-university-city-and-changed-the-neighborhood-forever/
- Video interview with Walter Palmer, former Black Bottom resident *(28 minutes)*
- Brewer, pages 103-128

GIS Topics:

- Georeferencing Historic Maps
- Labeling GIS Features
- Creating complete layouts

WEEK 5: CARCERAL GEOGRAPHIES PART 1

Required reading and viewing:

- Video: Laura Kurgan explains Million Dollar Blocks *(20 minutes)*
- Cadora, E., Kurgan, L., Reinfurt, D., Williams, S., Meisterlin, L. (2006). Architecture and Justice. *The Architectural League Spatial Information Design Lab,* Columbia University Graduate School of Architecture, Planning, and Preservation.
- Moran, Dominique. *Carceral Geography: Spaces and Practices of Incarceration.* Ashgate, 2014. pp. 60-70.
- Brewer, pages 194-200 (stop at "Visual Variable Pairs")

GIS Topics:

- Joining attribute tables to shapefiles
- Calculating attributes in tables

WEEK 6: CARCERAL GEOGRAPHIES PART 2

Required reading and viewing:

- Kirk, D. S. (2019). Where the Other 1 Percent Live: An Examination of Changes in the Spatial Concentration of the Formerly Incarcerated. *RSF: The Russell Sage Foundation Journal of the Social Sciences,* 5(1), 255-74.
- Annamma, S. (2018). Mapping Consequential Geographies in the Carceral State: Education Journey Mapping as a Qualitative Method With Girls of Color With Dis/abilities. *Qualitative Inquiry,* 24(1), 20-34.
- Ross, C. (2021). *Accessing US Census Data and Shapefiles* step-by-step guide.
- United States Census Bureau: Understanding and Using American Community Survey Data: What All Data Users Need to Know
- Berry, L., Lavery, D. (March 2021). *The Importance of Margins of Error and Mapping*. ESRI ArcGIS Blog. https://www.esri.com/arcgis-blog/products/arcgis-living-atlas/mapping/margins-of-error-and-mapping/

GIS Topics:

- Mapping Census Data (part 1)

WEEK 7: HIV/AIDS RISK, TREATMENT, AND ELIMINATION STRATEGIES

Required reading:

- Shabazz, Rashad. *Spatializing Blackness: Architectures of Confinement and Black Masculinity in Chicago.* University of Illinois Press, 2015. pp. 97-113
- Goldenberg, S.M., Deering, K., et. al. (2018). Community mapping of sex work criminalization and violence: Impacts on HIV treatment interruptions among marginalized women living with HIV in Vancouver, Canada. *International Journal of STD and AIDS,* 28(10), 1001-1009.
- Measuring Racial and Ethnic Diversity for the 2020 Census, Jensen et. al, United States Census Bureau, 2021.

GIS Topics

- Mapping Census Data (part 2)

WEEK 8: GEOGRAPHIES OF MIGRATION AND IMMIGRATION

Required reading:

- Ehrkamp, P. (2017). Geographies of migration I: Refugees. *Progress in Human Geography,* 41(6), 813-822.
- Ehrkamp, P. (2019). Geographies of Migration II: The racial-spatial politics of immigration. *Progress in Human Geography,* 43(2), 363-375.
- Conlon, D., Hiemstra, N., Mountz, A. (2017). Spatial Control: Geographic Approaches to the Study of Immigration. *Global Detention Project,* Working Paper 24.

GIS Topics:

- Geocoding addresses
- Spatial Joins (aggregation)

WEEK 9: QUALITATIVE MAPPING — FINDING INVISIBLE BARRIERS

Required Reading

- Boschmann, E. E., Cubbon, E., (2013). Sketch Maps and Qualitative GIS: Using Cartographies of Individual Spatial Narratives in Geographic Research. *The Professional Geographer,* 66(2), 263-248.
- Giordano, A., Cole, T., (2018). The limits of GIS: Towards a GIS of Place. *Transactions in GIS,* 22, 664-676.

GIS Topics:

- Euclidean Distances & Buffers
- Network Distances

WEEK 10: QUALITATIVE MAPPING FEMINIST PERSPECTIVES ON FEAR & SAFETY

Required reading:

- Kwan, M. (2007). Affecting Geospatial Technologies: Toward a Feminist Politics of Emotion. *The Professional Geographer,* 59(1), 21-34.
- Kwan, M. (2008). From oral histories to visual narratives: re-presenting the post-September 11 experiences of the Muslim women in the USA. *Social & Cultural Geography,* 9(6), 653-669.
- Bagheri, N., (2014). What qualitative GIS maps tell and don't tell: insights from mapping women in Tehran's public spaces. *Journal of Cultural Geography,* 31(2), 166-178.

GIS Topics:

- Attribute Queries
- Location Queries

WEEK 11: FOOD SHOPPING AND FOOD ACCESS

Required reading & viewing:
- Hillier, A., Chrisinger, B. "The Reality of Urban Food Deserts and What Low-Income Food Shoppers Need." *Social Policy and Social Justice,* edited by John L. Jackson, Jr, University of Pennsylvania Press, 2016, pp. 74-86.
- Cantor, C., Beckman, R., Collins, R.L., Dastidar, M. G., Richardson, A. S., Dubowitz, T. (2020). SNAP Participants Improved Food Security And Diet After A Full-Service Supermarket Opened In An Urban Food Desert. *Health Affairs,* 39(8), 1386-1394.
- Video: Access to Healthful Foods (15 mins)

GIS Topics:
- Editing Shapefiles

WEEK 12: ENVIRONMENTAL RACISM & ENVIRONMENTAL JUSTICE

Required reading:
- Banzhaf, S., Ma, L., Timmins, C. (2019). Environmental Justice: The Economics of Race, Place, and Pollution. *Journal of Economic Perspectives,* 33(1), 185-208.
- Villarosa, Linda. "Pollution Is Killing Black Americans. This Community Fought Back." *New York Times Magazine,* online, 28 July 2020.
- "Environmental Racism." Last Week Tonight with John Oliver, created by John Oliver, season 9, episode 9, HBO, 2022. *YouTube,* uploaded by Last Week Tonight, 2 May 2022. https://www.youtube.com/watch?v=-v0XiUQlRLw
- Blount, Levert. "Lake Charles Louisiana & Sacrifice Zones." *TikTok*, uploaded by Levert Blount, 3 May 2022, https://www.tiktok.com/@levertthebassman/video/7093508183884598574

GIS Topics:
- Point Density
- Kernel Density

WEEK 13: DISRUPTING HETERONORMATIVITY / QUEERING THE MAP

Required reading:
- Queering the Map website: https://www.queeringthemap.com
- Ferreira, E., Salvador, R. (2015). Lesbian collaborative web mapping: disrupting heteronormativity in Portugal. *Gender, Place, and Culture,* 22(7), 954-970.
- The Philadelphia LGBT Mapping Project: Website & Google map
- Density Tools Handout on Canvas

GIS Topics
- In-class work session

WEEK 14: General Review

Required reading and viewing:
- None

GIS Topics:
- Collecting GPS Data
- Mapping GPS Data

WEEK 15: How space impacts outcome – Moving to Opportunity

Required reading and viewing:
- Rothwell, Jonathan. (2015) <u>Sociology's revenge: Moving to Opportunity (MTO) revisited.</u> Brookings Center for Economic Security and Opportunity.
- Duffin, Karen. "<u>Moving to Opportunity?</u>" Planet Money Podcast. 2019. *(20-minute listen)*

GIS Topics:
- Open topic review & in-class work session

WEEK 16: COURSE WRAP-UP

ASSIGNMENTS AND DUE DATES

ASSIGNMENT	TOPIC / DESCRIPTION	REQUIRED?	DATE DUE	TIME DUE
Discussion Leader	*Sign up on Canvas*	Yes	September 5th	11:59 PM
Reflection Paper 1	*Class 1 Readings*	Yes	September 11th	8:00 PM
GIS Assignment 1	*Thematic Mapping*	Yes	September 22nd	8:00 PM
GIS Assignment 2	*Georeferencing & Layout*	Yes	September 29th	8:00 PM
GIS Assignment 3	*Joining Tables*	Yes	October 6th	8:00 PM
GIS Assignment 4	*Census Data (part 1)*	Yes	October 13th	8:00 PM
Final Project	*Proposal due on Canvas*	Optional[1]	October 15th	11:59 PM
GIS Assignment 5	*Census Data (part 2)*	Yes	October 27th	8:00 PM
GIS Assignment 6	*Geocoding*	Optional[2]	November 3rd	8:00 PM
GIS Assignment 7	*Buffers & Distances*	Optional[1]	November 10th	8:00 PM
GIS Assignment 8	*Queries*	Optional[1]	November 17th	8:00 PM
GIS Assignment 9	*Density*	Optional[1]	December 1st	8:00 PM
Reflection Paper 2	*Student's choice*	Yes	December 8th	8:00 PM
GIS Assignment 10	*GPS Mapping*	Optional[1]	December 15th	8:00 PM
GIS Assignment 11	*Animation*	Optional[1]	December 21st	8:00 PM
Final Project	*Full project submission*	Optional[1]	December 21st	11:59pm

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[1] All students <u>must</u> complete homework assignments 1 through 5 and two short reflection papers. After that, students can choose to complete their coursework in one of two ways. They may either complete any additional three GIS assignments, or they may submit a final project equivalent in scope to three normal GIS homework assignments.

[2] All students <u>must</u> complete homework assignments 1 through 5 and two short reflection papers. After that, students can choose to complete their coursework in one of two ways. They may either complete any additional three GIS assignments, or they may submit a final project equivalent in scope to three normal GIS homework assignments.

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Assignment Descriptions

Reflection Paper 1

Reflection papers must be submitted in Times New Roman size 12 font with 1.5 line spacing. Your document must have 1" margins on all sides. Reflection papers should be between 1,000 and 2,000 words in length.

Reflect on the readings you completed for Class 1 and the discussion we had during our class meeting. Write a short reflection paper that answers the following questions:

- What did you think about the readings? Were they interesting? Why or why not?
- What new concepts did the readings and our class discussion introduce you to?
- What impact do the concepts presented in the readings and our class discussion have on the way you think about mapping?
- Did the readings and our class discussion change the way you plan to approach this class and GIS coursework?
- What do you hope to be able to do with GIS by the end of the semester?
- How do you imagine you might use GIS and mapping in your future studies and/or career?
- Anything else you want to reflect on about the readings and our class discussion.

Reflection Paper 2

Reflection papers must be submitted in Times New Roman size 12 font with 1.5 line spacing. Your document must have 1" margins on all sides. Reflection papers should be between 1,000 and 2,000 words in length.

Reflect on any readings and class discussions we've had since the beginning of the semester. Write a short reflection paper that answers the following questions:

- Why did you choose these readings/discussion topics for your reflection paper?
- How did the readings/class discussions influence you as a mapmaker? Did they influence you in any other ways?
- What impact do the concepts presented in the readings and our class discussion have on the way you think about mapping?
- Thinking back to your first reflection paper, do you feel you're able (or more able) to use GIS the way you hoped to in September? Why or why not? What could be different?
- Thinking back to your first reflection paper, have your thoughts or expectations changed regarding how you might use GIS and mapping in your future studies and/or career?
- Anything else you want to reflect on about the readings and our class discussion.

Assignment 1 – Thematic Mapping

Create a series of 4-5 thematic maps using the Assignment 01 data provided on Canvas. Include at least 3 different kinds of map symbology (i.e., graduated color, graduated symbol, dot density, chart, etc.) and 3 different kinds of classification systems (i.e., natural breaks, equal interval, standard deviations, etc.).

Spend time refining each map to make that combination of symbology and classification system work as well as possible. Use the print screen, screen capture, or screenshot tool depending on your OS to capture each map with the table of contents showing and paste it into a Microsoft Word document (or another formatting software of your choice).

Include a description of each map, the different symbology used, and the information shown. In a few sentences, explain which combination of options works best. Which tells the most compelling story? Why? Be sure to pay attention to whether you are mapping counts or rates.

Minimum assignment requirements (8 points):
- Create at least 4 maps.
- Include 3 or more types of classification systems.
- Include 3 or more types of symbology.
- Exclude non-residential areas or areas with missing data.
- Provide some short/limited write-up based on your visual analysis of the spatial patterns you see in the maps.
- Demonstrate awareness of the difference between counts and rates and choosing appropriate symbology.
- Make sure each map has a polished layout including a title, north arrow, scale bar, data source, and legends.

Additional credit (up to 2 points):
> Map two layers at a time together effectively
> Provide strong analysis/interpretation of the spatial patterns
> Demonstrate visual clarity/excellence, strong choices around symbology
> Create a map layout with a legend rather than just screen capture

Assignment 2 – Georeferencing Historic Maps

Choose from the following cities and download the corresponding data provided:

- Baltimore, MD
- Detroit, MI
- New Haven, CT
- New Orleans, LA
- Philadelphia, PA

Georeference the 2020 census tracts for your chosen city with the historic HOLC map for that city. Map 4 different variables for the same area. Make sure your final maps have complete layouts and show the historical map lined up with contemporary shapefiles. Include a write-up as described below.
Upload your submission as a PDF file.

Minimum assignment requirements (8 points):
- HOLC map properly georeferenced
- 3 or more maps showing different variables for the area.
- A writeup that discusses the following:
    - How do modern-day conditions vary by historic HOLC grades?
    - What patterns do you see?
    - What might explain them? (Refer to readings and/or outside sources)
- A polished layout including a title, north arrow, scale bar, data source, and legends.

Additional Credit (2 points):
- Effectively map more than one attribute together
- Strong analysis and compelling narrative
- Outside readings to support propositions
- Connection to other class discussions
- Visual clarity / design and layout excellence

ESRI Georeferencing step-by-step guide:
https://pro.arcgis.com/en/pro-app/latest/help/data/imagery/georeferencing-a-raster-to-a-referenced-layer.htm

Assignment 3: Joining Tables

Download the Assignment 3 data provided below. Join each table to its appropriate shapefile. Note that each table has at least one thing wrong with it that will prevent it from joining. It is your job to use the skills discussed in class to troubleshoot the issue and edit the table so you can join it to the correct shapefile.

Use your joined shapefiles and create at least three maps displaying two (or more) variables together. Create an appropriate layout for each map and export it. Include a write up that describes the story told by each map and answer the following questions:

1. What works well about the way you chose to display your variables?
2. What could work better or what would you like to know how to do to improve the symbology, if anything?
3. Is there additional data that would help dig into this story? What would that data help reveal?
4. Are there any limitations to the existing data in terms of the story your maps are trying to tell?
5. What are those limitations? How could they be addressed?

Upload your submission as a PDF file.

Minimum assignment requirements (8 points):
- Join each table to the appropriate shapefile.
- Create three maps using your joined data.
- Each map should show at least two variables.
- Exclude non-residential areas or areas with missing data.
- A polished layout including a title, north arrow, scale bar, data source, and legends.
- Short description for each map, discussing the following:
  - What data does your map show?
  - What story does your map tell?
  - What data or design elements would strengthen your map's story?
  - Properly projected shapefiles

Additional Credit (2 points):
- Strong analysis and compelling narrative for each map
- Appropriate use of outside readings / sources supporting your analysis and narrative
- Visual clarity / design and layout excellence
- Use of outside data / data not provided on Canvas

Assignment 4: Census Data Part 1

Download the Pennsylvania data provided. Use the skills we've covered so far to map two variables at the census block group, census tract, and county level. You can either create three maps showing two different variables together, or six maps where three compare one variable and three compare the other. You can decide which approach to take depending on the variables you choose and the most effective way to show them. Remember to pay attention to the formatting of your legends; the goal is to compare the same data across different geographic scales.

Create a layout for each map and export it. Include a write up comparing the maps to one another and answering each of the questions provided in the minimum assignment requirements, below.

Upload your submission as a PDF file.

Minimum assignment requirements (8 points):
- One map of your data at the Census block group level
- One map of your data at the Census tract level
- One map of your data at the Census County level
- A polished layout including a title, north arrow, scale bar, data source, and legends.
- A write up comparing your three maps and discussing the following:
    - What is the difference between Decennial Census data and American Community Survey data?
    - Why might you use one data source instead of another?
    - How do geographies of different scale impact the way you can tell a story with data?
    - Why might you use one geographic scale instead of another?

Additional Credit (2 points):
- Strong analysis and compelling narrative for each map
- Appropriate use of outside readings / sources supporting your analysis and narrative
- Visual clarity / design and layout excellence
- Label key features as necessary/appropriate

Assignment 5: Census Data Part 2

This assignment is the culmination of Assignments 1 through 4 and requires you to use the skills you've learned so far this semester. Your task is to create at least two maps that either:

A. show one or more variables at the census tract-level for the same county or counties over at least two periods of time (i.e., Philadelphia census tracts in 2010 and in 2020), or

B. show one or more variables at the county-level variables for the same state or country over at least two periods of time (i.e., Pennsylvania counties in 2000 and 2020)

You can choose what variables you want to compare over time and what geography you want to use. You must find, download, and clean your own data, then join it to your shapefiles. You will be required to upload your cleaned data tables as well as your maps.

Each of your maps should have polished layouts. Make sure your shapefiles are appropriately projected and your legends have the same values across time periods so they're directly comparable. This will likely involve manually adjusting the values to match.

Your write-up should be in the format of a short article (imagine this is being published in a newspaper or magazine) highlighting and explaining any changes or lack of changes shown by your maps. Make sure your write-up specifically describes the spatial patterns shown in your maps. Ideally, this will involve labels for key locations. Upload your submission as a PDF file.

Minimum assignment requirements (8 points):
- Two to three maps showing either:
- tract-level data for a single county over two or more time periods, or
- county-level data for an entire state or country over two or more time periods.
- Appropriately projected shapefiles
- A polished layout including a title, north arrow, scale bar, data source, and legends.
- A write-up in the format of a short article
- The data tables you joined to your shapefiles.

Additional credit (up to 2 points):
- Include more than one variable for comparison
- Label key features as appropriate
- Discuss your map propositions in the context of larger state/national/global issues
- Incorporate outside readings and sources to support your proposition
- Visual clarity / design and layout excellence

Assignment 6: Geocoding

Create a list of street addresses representing some specific data (i.e., real estate opportunities, restaurants, construction sites, etc.). You should choose data that are not publicly available as a shapefile on an existing GIS portal or website and create the data table with all fields yourself. Make sure you follow the guidelines below:

- Your data set should include at least 25 observations and at least one variable.
    - For example: if you choose restaurants, how many stars does each restaurant have? If you choose construction sites, what stage of construction are they in, or when was the construction permit issued?
- Symbolize the points using the variable(s) you included in your data and map them against census or other aggregate data to demonstrate a proposition.
    - For example, you might geocode check cashing locations along with median household income data by census tract.
- Describe the pattern you see and its implication in 500 words or less.
- Format your write-up as a brief report or memo for your boss.

Submit your map and write-up as a PDF file and include the table you created as a separate XLS file.

Minimum assignment requirements (8 points):
- One map including:
    - at least 25 geocoded locations with at least one variable, and
    - census or other aggregate data with at least one variable
    - Appropriately projected shapefiles
- A polished layout including a title, north arrow, scale bar, data source, and legends.
- A write-up in the format of a memo to your boss
- Your data table as an XLS or XLSX file

Additional credit (up to 2 points):
- Map additional data sets for comparison
- Map more than one variable in your geocoded data
- Discuss the pattern your map suggests in the context of larger state/national/global issues
- Discuss what next steps you would take to validate the pattern and/or investigate its causes
- Incorporate outside readings and sources to support your proposition(s)

Assignment 7: Buffers & Distances

In this assignment, you will use the Network Analyst extension to look at the differences between Euclidean Distance and Service Area in ArcGIS. The technical goals of this assignment are to practice performing both Euclidean and Network distance analyses and look at the routing tools available in ArcGIS Pro. The analytical goals are to understand the differences between different types of distance analysis and when to use them, and to understand the capabilities and shortcomings of the Network Analyst extension for routing in ArcGIS Pro.

Upload your submission as a PDF file.

Minimum assignment requirements (8 points):
- Two sets of point data to analyze. Choose your data knowing you will be calculating distances between one set and the other set.
- Create and compare Euclidean buffers and network service areas for one of your data sets:
    - Create Euclidean buffers of your choosing around one of your data sets. The distance you choose should make sense!
    - Create Network Service Areas of the same distance around the same data set. The goal is to compare, so make sure your distance and input data is the same!
    - Compare the results: Which approach makes more sense for your data? Why? Include this in a write-up comparing your results.
- Each of your maps should include the following:
    - Properly projected shape files
    - A full layout with a scale bar, north arrow, data source, title, etc.
    - A legend with human readable labels. Make sure you don't have weird layer names showing up!
- Ensure your maps are readable! If this requires putting each map on its own page, that's okay. If this requires changing your layout from Letter to another size, or switching from portrait layout to landscape layout, that's okay.

Additional credit (up to 2 points):
- Create a multi-stop route using Network Analyst
- Discuss the pros and cons of using ArcGIS Pro for network routing vs. open-source software such as Google Maps or Waze. When might one be better than the other?
- Include outside readings to contextualize the importance of network routing. What are some real-world examples of specific routing decisions and their impacts?
- Submit a final document with visual clarity and design/layout excellence.

Assignment 8: Queries

Describe a problem or question, then list the steps of a combination attribute and spatial query to address it. Be sure to include at least one attribute and one spatial query and a map showing the results of each step of the query (you can show the blue highlight for each step if you are using vector data/shapefiles). Your final map should not include any blue highlighting (use permanent symbology). Explain in 1-2 paragraphs the outcome of your query and its value.

Minimum assignment requirements (8 points):
- Clearly state and describe the problem or question you're looking at or trying to answer.
- One attribute query.
- One spatial query.
- One map for each stage of the query.
- One final map of your query results.
- One to two paragraphs explaining both the outcome of your query and its value (why it's important).
- Properly projected shapefiles.
- Each of your maps should include the following:
    - A full layout with a scale bar, north arrow, data source, title, etc.
    - A legend with human readable labels. Make sure you don't have weird layer names showing up!

Additional credit (up to 2 points):
- Perform more than one spatial query to address the problem or question you're looking at (0.5 points)
- Effectively map more than one attribute (0.25 points)
- Provide strong analysis and a compelling narrative in your narrative beyond the paragraph minimum (0.5 points)
- Include outside readings to contextualize and support your problem statement/question and your results (0.25 points)
- Submit a final document with visual clarity and design/layout excellence (0.5 points)

Assignment 9: Density

This assignment will look at different ways of calculating density using ArcMap, and different ways of symbolizing density using ArcGIS Pro. You will be asked to find a large point data set and map its density three different ways: using Kernel density, Point Density, and an aggregate count through a spatial join.

The intended outcome of this assignment is for you to demonstrate that you know how and when to use these different tools, what they do the same and what they do differently, and how they can be used to effectively analyze data and create compelling propositions.

Unlike typical assignments, fulfilling the minimum requirements below will result in a score of 9 out of 10. This assignment is due after the Thanksgiving Break to provide you with extra time to complete it. Unexcused late submissions will not be accepted.

Minimum assignment requirements (9 points):
- Large (500+) point data set
- Create at least four density maps:
    - Two Kernel Density maps with different cell sizes and search radii.
    - Two Point Density maps with different cell sizes and neighborhoods.
- Use a spatial join to aggregate your points to an appropriate polygon shape file (census tracts, counties, zip codes, etc.) and create at least two aggregate data maps:
    - One map symbolizing the raw count data.
    - One map symbolizing the normalized count data.
- Compare the results of the density maps and the aggregate spatial join maps:
    - What are the differences? What are the similarities?
    - Does your assessment of the spatial pattern differ by the type of map, parameters (cell size/radius) or normalization?
    - What is the most effective way to map this data and why?
- Each of your maps should include the following:
    - Properly projected shape files.
    - A full layout with a scale bar, north arrow, data source, title, etc.
    - A legend with human readable labels. Make sure you don't have weird layer names showing up!

Additional credit (up to 1 point):
- Accurately label your kernel density units in the legend
- Include additional 3D maps and compare them
- Submit a map (or maps) demonstrating visual clarity and design excellence

Assignment 10: GPS Mapping

For this assignment, you can choose between Option 1 and Option 2, below. Please review the requirements for each before submission – they are not the same!

Option 1: Collect and map GPS data marking a route to create your own drawing (see NYT article, "The Big Draw of a GPS Run). Download the data from your GPS app and map in ArcMap. In 500 words or less, describe the experience of collecting the data, especially as you passed through areas you don't usually see.

Minimum assignment requirements (8 points):
- Collect your own GPS data.
- Create a drawing with your route.
- Import your GPS data into ArcMap and create a static map of your route.
- Describe the following in at least 500 words:
- Your experience collecting the GPS data.
- Your experience of any new places you passed through.
- Full layout with appropriate elements
- Properly projected shape files

Additional credit (up to 2 points):
- Include an animation (separate file) of your GPS journey (0.75 points)
- Discuss what attributes you collected and what additional attributes would be useful to have (0.25 points)
- Discuss potential real-world applications and implications of collecting GIS data and using it in ArcGIS Pro (0.25 points)
- Submit a map (or maps) demonstrating visual clarity and design excellence.

Option 2: Use GPS to create a travel diary for a short or long journey. Download the data from your GPS app and map it in ArcMap. Your map must be accompanied by a description of the landmarks and destination(s) you visited, and a narrative of your experience visiting them. You might also enjoy "getting lost," using the Dérive app, which offers prompts for walking through the city without a destination in mind.

Minimum Requirements (8 points):
- Collect your own GPS data.
- Record a short or long journey.
- Import your GPS data into ArcMap and create a static map of your route.
- Label and describe any landmarks and locations you visited.
- In at least 500 words, provide a narrative of your journey and the experience of visiting the landmarks/locations.
- Full layout with appropriate elements
- Properly projected shape files

Additional credit (up to 2 points):
- Include an animation (separate file) of your GPS journey
- Discuss what attributes you collected and what additional attributes would be useful to have points
- Discuss potential real-world applications and implications of collecting GIS data and using it in ArcMap
- Submit a map (or maps) demonstrating visual clarity and design excellence

Assignment 11: Animation

Create two animations: a time series animation and a location over time animation.

You can use any data you want except the data used for the animation demo in class.

Final Project

The final project requires you to pose a question, find or collect your own data, create maps and conduct analyses in GIS to address your question. Your maps and analysis must be accompanied by a paper/report that:

- o Identifies the question or questions you set out to answer with your analysis.
- o Explains the spatial nature of your question and GIS is an appropriate tool for answering it.
- o Describes the data you used to answer your question, including where it came from and any required cleaning.
- o Explains your GIS methodology and the steps you took in your analysis.
- o Details the results of your analysis and whether you answered your question.
- o Reflects on things that worked well and things that didn't work well, and what you would do differently next time.
- o Suggests additional analysis you could undertake to continue this line of inquiry going forward.

Your submission can take the form of a traditional paper, a poster, a journal article, or another form that you find appropriate and compelling. It should include 4-6 maps and approximately 2,500 words of text (about 5 pages single-spaced). Your maps should be included in the body of your report, not at the end as appendices.

Cite all outside sources, including data sources, in the citation format appropriate for your field of study.