San José State University

School of Environment, Planning, and Policy
GEOG 171, Advanced Geographic Information Systems
Spring 2025

Instructor:	Pietro Calogero
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Office Hours:	Wednesdays, 3-4pm in WSQ 208, or by appointment.
Class Time:	Wednesdays, 12:00-2:45pm, Washington Square 208
Lab:	Mondays 1-3pm on Zoom; link in Canvas

Course Catalog Description

Maps as tools of geographic expression and research. Introduction to spatial analysis through geographic information systems. Data collection and description; measuring absolute and relative location, patterns, interaction and association.

Prerequisites: GEOG 70 or instructor consent.

Course Description

This course covers more advanced techniques in geospatial research, analysis, and visual presentation. Students are expected to already understand attribute tables, basic data cleaning, table joins, basic projections, choropleths, buffers, and boolean operations. Here, students are expected to engage in more independent identification and evaluation of data sources and independent problem-solving in designing geospatial analysis. The primary objective of this course is to equip you with the skills to become a proficient and independent GIS analyst. In this course we will introduce the use of QGIS and R statistical language for GIS. Students must then choose which software to use to complete assignments for the course, most of which could be completed with ArcGIS, QGIS, or possibly R.

Course Format and Software

This course meets in-person for lectures on Wednesdays, 12-2:25pm. Lecture attendance is mandatory. The Lab is held on Zoom, on Mondays from 1-3pm. The course is technology-intensive. Students are expected to either own or check out a laptop that can run QGIS and R software. That means the laptop must be able to run Windows, or Mac OS, or Linux. QGIS does not run on Chrome OS, so a Chromebook is not sufficient.

To **install QGIS software**, go to: https://qgis.org/download/ In this course we will use the current Long Term version 3.34 (LTR), because it has the highest probability of stable, updated plugins.

To install R Studio: **first install R itself** from: https://cran.rstudio.com/ In this course we are using generation 4; currently this is version 4.4.2. You need to download the "binary," which is programmer-speak for the compiled software (what most of us now call a "program" or "app"). This is in contrast to downloading the source code, which will not run as software until it is compiled into a binary (machine-language) program.

Then install R Studio Desktop for your OS from: https://posit.co/download/rstudio-desktop/ For this semester, we will use version 2024.12.0 or later. R Studio is an "integrated development environment" or IDE; this means it is a "graphic front end" for the R statistical language.

Plain Text Editor: install Notepad ++ for Windows: https://notepad-plus-plus.org/downloads/ . The default TextEdit on Mac OS may suffice. On Linux I recommend Kate, but there are many options.

Course Learning Objectives (CLOs):

This course advances Geographic Information Systems knowledge through analysis of geographic relationships. Spatial distributions and phenomena will be examined through spatial anlaytics, and maps will be network and field representations of actual physical and environmental processes. While most techniques have a geographic origin, we will address all geospatially relevant methods, including geophysical, landscape ecological, econometric, epidemiological, and regional science approaches. On the practical side, you will be introduced to five different software and coding packages. Geoprocessing workflows are equally important at this level and is independent information system development.

- CLO 1. Critically interpret maps and GIS displays.
- CLO 2. Measure, model and analyze spatial data.
- CLO3. Apply locational insights to solve simulated real-world analytical problems and make choices among alternatives.
- CLO4. Integrate theory/science with technology to design, implement and present a GIS project.

Textbooks and Learning Sources

QGIS. 2018. *A Gentle Introduction to GIS:* https://docs.qgis.org/testing/en/docs/gentle_gis_introduction/index.html

Selected videos from Andrew Gard's YouTube channel: Equitable Equations.
Selected videos from Nick Bearman's YouTube channel

Optional: *Spatial Statistics for Data Science: Theory and Practice with R.* Paula Moraga. Chapman & Hall/CRC Data Science Series, 2023. https://www.paulamoraga.com/book-spatial/index.html

Optional: *Analyzing US Census Data: Methods, Maps, and Models in R.* Kyle Walker. CRC Press, 2023. https://walker-data.com/census-r/index.html

Optional: *Geocomputation with R*. This online book is freely available at: https://geocompr.robinlovelace.net/

Supplemental readings and tutorial videos will be posted to Canvas modules.

NOTE: in this course we will focus on data analysis in central and southern California. Therefore we will only be using the California State Plane projection, Zones III (Bay Area) through VII (Los Angeles specific). More explanation can be found at: https://www.conservation.ca.gov/cgs/rgm/state-plane-coordinate-system. This projection is in Imperial units (feet), whereas GIS for the rest of the world is done in SI (meters), typically using the Universal Transverse Mercator projections.

Expected Workload

You are expected to spend three hours per unit per week in courses at SJSU. For this 4-unit course, this means 12 hours per week on this course. This includes class, reading, and writing time.

Grading of the course

Grading is based on a total of 100 possible points, so they are equivalent to percentage points. Letter grades will be according to the following distribution:

A+ = 100 to 96	B+ = 89 to 87	C+ = 80 to 78	D+ = 69 to 67	F = 59 points or lower
A = 95 to 93	B = 86 to 84	C = 77 to 73	D = 66 to 63	
A- = 92 to 90	B- = 83 to 81	C- = 72 to 70	D- = 62 to 60	

University Policies

Per University Policy S16-9 (http://www.sjsu.edu/senate/docs/S16-9.pdf), policies for all courses are listed on the Syllabus Information Page: https://www.sjsu.edu/curriculum/courses/syllabus-info.php

Here are direct links to the various policies listed on that page:
General Expectations, Rights and Responsibilities of the Student
Academic Integrity
Accommodation to Students' Religious Holidays
Adding and Dropping Classes
Attendance and Participation
Accommodations for Students with Disabilities
Accommodations for Students with Disabilities
Consent for Recording of Class and Public Sharing of Instructor Material
Timely Feedback on Class Assignments
Workload and Credit Hour Requirements

Furthermore, the page contains links to critical campus resources:
Counseling at the Wellness Center
Mentoring and tutoring through Peer Connections
Food, shelter and safety at SJSU Cares
Computers, printing, and more at Student Technology Resources
Writing assistance at the Writing Center

Course Schedule

In a table, list together the Week | Date | Topics, Readings, Assignments, Deadlines | CLO(s)

Week	Topic	Due Date	CLOs Covered
1	Introduction; installation of QGIS and R Studio		
2	First run of QGIS. Intro to data-sets Reading: Chapters 1 & 2 of *A Gentle Introduction*		2,3
3	How to output graphics in QGIS, and graphics principles Reading: Chapters 3 & 4 of *A Gentle Introduction* **Task 1: Visualization 1: choropleth map with all elements (10 points)**	Feb 14	1,4
4	Identification of dataset for final presentation **Task 2: Proposal Topic for final Presentation (10 points)**	Feb 21	1,4
5	QGIS: raster data (DEMs, landcover) **Task 3: Evaluation of Dataset for final Presentation (10 points)**	Feb 28	2,3,4
6	Spreadsheet work and introduction to R Studio: the panes, the idea of data-frames, idea of libraries, managing command-line syntax		
7	R Studio: viewing data, editing column names, merge operation, creating a map with a scrip using tmap library.		
8	R Studio: review and refinement of map-making **Task 4: Choropleth tract map output from R Studio (10 points)**	March 21	1,4
9	R Studio: comparison of map-creation libraries **Task 5: Use leaflet to create probability heatmap (10 points)**	March 28	1,2,3,4

	SJSU SPRING BREAK, March 29-April 6		
10	Drone imagery in GIS		
11	Integrating drone imagery into a map **Task 6: create map using drone imagery (10 points)**	April 18	1,4
12	Which approach to use? GIS research design		
13	**Task 7: In-Class Presentation of individual GIS Project (15 points)**	May 2	1,2,3,4
14	**Task 7, continued: In-Class Presentations**	May 7	1,2,3,4
15	**Task 8: Write-up of Presentation as Final Exam (25 points)**	May 20, 12:45pm	1,2,3,4

Task 1: Visualization

Make a basic choropleth map, including the following elements: scale, north arrow, title, and legend.

Task 2: Final Project Proposal

Based on what you have learned thus far, and in consultation with your classmates, describe a GIS project you would like to present at the end of the semester. It should be specific, such as: "Correlation of race with poverty in Santa Clara County using American Community Survey Data", or "Relationship of wildfire risk to terrain steepness and roughness in eastern Santa Clara County"
- Include identifying header
- Include a rich title, like the ones I just gave as examples above
- Identify the dataset you will use.
- Length: 250-280 words.

Task 3: Evaluate a Dataset

Review the data and metadata of a dataset you will use for your final presentation.
- Explain how you will use the information for your final presentation.
- Describe problems with the dataset: too much or too little data, missing information, inconsistencies, excessive coverage that needs to be trimmed.
- Comment on anything that seems unusual in the metadata or documentation. One subtle example of this: parcel data tends to be kept up-do-date because counties use this GIS information for property-tax collection. VTA spatial data is not cleaned reliable because there is no apparent incentive (or maybe just no funding) to maintain cleaned datasets for transportation planning.
- Include identifying header
- Include a rich title
- Include the URL of the dataset you are evaluating
- Length: 360-400 words.

Task 4: Choropleth tract map output from R Studio

Use the Santa Clara 2020 census tract map.
Import an American Community Survey Data Profile table for all census tracts in the county.
Identify the variable you wish to incorporate and display on the map.
Merge() the attribute/column from the ACS_DP table into the map.
Use tmap to create a map
- File format: PDF

- Page format: ideally US Letter, either portrait or landscape orientation
- Include scale bar, north arrow, legend, title, and source attribution.

Task 5: Create an interactive Leaflet map from R Studio

Use the same spatial and table data as in Task 4 (optional: you can revise the data if you prefer)
Create an interactive map in Leaflet. Output format TBA.

Task 6: Create a map using drone imagery.

Use either QGIS, ArcGIS, or R Studio to create a map using drone imagery.
- File format: PDF
- Page format: ideally US Letter, either portrait or landscape orientation
- Include scale bar, north arrow, legend, title, and source attribution
- Include a very brief explanation of your choice of software.

Task 7: Presentation of your own GIS analysis

This should be a very brief presentation of a basic analysis.
Include a title slide, at least one map slide, and a Works Cited closing slide.
- Maximum 5 slides
- Time limit: 8 minutes for presentation

NOTE: you are encouraged to present this as a work-in-progress towards your final writeup. Ask questions of your classmates during your presentation, and be prepared for comments and questions after you present. LIKEWISE, be ready to ask questions and comment constructively on the presentations of your classmates.

Task 8: Final Write-Up

Write up your analysis, using the feedback you get during your presentation.
- File format: PDF
- Page layout: US Letter (8.5” x 11”) landscape orientation
- Include your presentation slides
- Include an explanation of your analysis. This can be an amended version of your presentation script. Limit: 1000 words.

NOTE: This counts as your final exam. We will NOT meet in person for the final exam. Your write-up is due on Canvas at the time that the exam ends: 12:45pm, May 20.

Muwekma Ohlone SJSU Area Land Acknowledgement

The San José State University community recognizes that the present-day Muwekma Ohlone Tribe, with an enrolled Bureau of Indian Affairs documented membership of over 550, is comprised of all of the known surviving American Indian lineages aboriginal to the San Francisco Bay region who trace their ancestry through the Missions Santa Clara, San José, and Dolores, during the advent of the Hispano-European empire into Alta California; and who are the successors and living members of the sovereign, historic, previously Federally Recognized Verona Band of Alameda County.

Furthermore, the San José State University community recognizes that the university is established within the Thámien Ohlone-speaking tribal ethnohistoric territory, which based upon the unratified federal treaties of 1851-1852, includes the unceded ancestral lands of the Muwekma Ohlone Tribe of the San Francisco Bay Area. Some of the enrolled Muwekma lineages are descended from direct ancestors from the Thámien Ohlone tribal territory whose ancestors had affiliation with Mission Santa Clara.

The San José State University community also recognizes the importance of this land to the indigenous Muwekma Ohlone people of this region, and consistent with our principles of community and diversity strives to be good stewards on behalf of the Muwekma Ohlone Tribe whose land we occupy.

This Land Acknowledgement was generously given to SJSU by the Muwekma Ohlone Tribe for SJSU use. Tribe Chairwoman Charlene Nijmeh gives a powerful detailed accounting of the specific steps and history of the disenfranchisement of the Muwekma Ohlone peoples, as well as the strength and presence of their community today. Tribe Vice Chairwoman Monica V. Arellano gives a detailed context to understand our presence on the ancestral lands of the Muwekma Ohlone, land on which our institution and the city of San Jose occupy. Their leadership reminds us of how much further we have to go, and that this Land Acknowledgement is a very small step towards further action.

We are grateful for Charlene Nijmeh and Monica V. Arellano of the Muwekma Ohlone Tribal Council for providing SJSU with a Land Acknowledgement and Greeting.

We encourage you to use the Land Acknowledgment in its entirety out of respect for the process and words given us by the Muwekma Ohlone.

Download a PDF version of this Land Acknowledgment

Link to shareable Google Slides document with this Land Acknowledgment specifically for SJSU events and meetings

Download a PDF of the Muwekma Ohlone greeting to Learn More about the Tribe and its History

Pronounciation Guide for this Land Acknowledgment