GIS and Spatial Data Analysis
Fall 2025

Instructor

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Course Description

Outline/Purpose:

The course aims to equip students with fundamental skills and knowledge in Geographic Information Systems (GIS) and its application in spatial data analysis. Through this course, students will gain proficiency in using GIS software tools, understand key concepts such as vector data, symbology, georeferencing, data editing, and geoprocessing, and learn to apply these concepts to analyze and visualize spatial data. With a combination of theoretical and practical lessons, including hands-on lab sessions and weekly assignments, the course aims to enhance not just understanding but also the ability to apply learned concepts in real-world scenarios. The course will also contribute to students' preparation for advanced GIS courses and future roles in urban planning, policy, and other spatial data analysis fields.

Course Learning Outcomes:

Upon completion of the course, students will be able to understand and apply the core principles and techniques of Geographic Information Systems (GIS) in the context of spatial data analysis. They will gain proficiency in utilizing GIS software tools. Through a combination of lectures, hands-on labs, and assessments, students will learn to effectively use GIS technology for spatial data analysis

Class Delivery Method: PPT lecture slides + Lab practice documents

Time: Monday, Wednesday (12:00 – 13:30)

Classroom: Building 28, Room 406

Credit: 3 credits

Language: English

Grading:

- This class follows absolute evaluation.
- A+: 95 and above, A0: 90 – 94, B+: 85 – 89, B0: 80 – 84, C+: 75 – 79, C0: 70 – 74, D+: 65 – 69, D0: 60 – 64, F: Below 60

Percentage of grade evaluation	Exam	Attendance	Assignment	Participation
	40%	20%	30%	10%

- Exam (40%): Three or four students will be grouped to work on a term project. For the mid-term exam, students will present their project proposal. In the final exam, students will present final team projects that are going to be prepared throughout the semester. There is no written tests in this class. Please stay tuned, assignment guidelines will be uploaded to the LMS
- Attendance (20%): Out of a maximum of 20 points (학칙시행세칙 제 56 조 제 2 항) → For general subjects (3 credits), 1/3 point will be deducted for every 1 hour of absence → 1 point will be deducted for 3 hours of absence. Students who miss more than one-third of the actual class hours or engage in

academic dishonesty will not be granted course credits, regardless of their exam scores or other grades (학생시행세칙 제 56 조 제 3 항).

- Assignment (30%): Students will submit weekly lab assignments. Every assignment is due before every Thursday class (due date will be indicated in the LMS) and should be submitted on LMS under assignments. Labs are intended to provide you with hands-on experience in land use planning and practices. Lab documents will be provided at the start of each lab session and students will work on the exercises in-class with help of the instructor. Extra credits will be granted when submitting extra lab sessions
- Participation (10%): Participation score will be graded by peers in your group. This is to prevent free riders.

Course schedule:

Week 01: Introduction to GIS

- Definition of GIS
- Why is a GIS needed in urban planning and policy
- Required functions for GIS
- Computer systems for GIS, GIS as a multi-disciplinary science
- Lab #1: Getting started with QGIS Software
  - Installing QGIS
  - Getting used to QGIS GUI
  - Download sample data and open it on the QGIS
- References
  - Tomlinson, R.F. (1969). A Geographic Information System for Regional Planning. *Journal of Geography*, 78, 45-48.
  - Masser, I., Ottens, H. (1999). Urban Planning and Geographic Information Systems. In: Stillwell, J., Geertman, S., Openshaw, S. (eds) Geographical Information and Planning. Advances in Spatial Science. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-662-03954-0_2
  - QGIS Documentation

Week 02: GIS Data Types and Its Applications

- GIS data types: vector versus raster data
- Browsing GIS open data sources in Korea
- GIS applications in urban planning
- Benefits, challenges, limitations, and future of GIS
- Good project topics in urban analytics using GIS
- Lab #2: Loading GIS data
  - Getting shapefile data (vector data, raster data)
  - Importing spreadsheets or CSV files
  - Searching and downloading OpenStreetMap data
  - Quick OSM
- References
  - Xhafa, S., & Kosovrasti, A. (2015). Geographic Information Systems (GIS) in Urban Planning. (2015). *European Journal of Interdisciplinary Studies*, *1*(1), 74-81. https://doi.org/10.26417/ejis.v1i1.p85-92

- Harris, T. M., & Elmes, G. A. (1993). The application of GIS in urban and regional planning: a review of the North American experience. *Applied Geography*, 13(1), 9–27. https://doi.org/10.1016/0143-6228(93)90077-e
- QGIS Documentation

Week 03: Spatial data and coordinate system

- Spatial data
- Coordinate system and projections
- Transforming tabular data into spatial data
  - Lab #3: Coordinate systems, projections, reprojection CRS
- References
  - *What is map projection? by ESRI* (link)

Week 04: Geoprocessing tools

- Vector geometry: Buffer, Centroids, Dissolve
- Vector overlay: Clip, Difference, Extract/clip by extent, Intersection
- Vector selection: Vector selection tools
- Lab #4. Practicing geoprocessing tools in QGIS

Week 05: Network Analysis

- Network analysis
  - Basic Network Visualization and Routing
  - Locating the Nearest Facility with Origin-Destination Matrix
  - Service Area Analysis using Open route service
  - Travel Time Analysis with Uber Movement
- Layer tools: Export layer information, Export to the spreadsheet, Extract layer extent
- Lab #5. Network analysis
- References
  - 28.1.10. Network analysis — QGIS Documentation (n.d.). (link)

Week 06: No classes on this week (Chu-Seok)

Week 07: Map Elements

- Common elements of a map
- Map title, map body, legend, north arrow, scale bar, acknowledgment, and map border
- Lab #6: Symbolizing features based on attribute values
- References
  - Chang, Kang-Tsung (2006). Introduction to Geographic Information Systems. 3rd Edition. McGraw Hill. ISBN: 0070658986
  - DeMers, Michael N. (2005). Fundamentals of Geographic Information Systems. 3rd Edition. Wiley. ISBN: 9814126195

Week 08: Mid-term exam

- Presenting term project proposal
- Submit a project proposal as per the instructions in the file

- The proposal will be documented in one or two pages, including the title, background, literature gap, objective, data collection plan, methods, results, and what to expect from the results.

Week 09: Map Design I

- Map Layout and Charts
- Create your first GIS map
- Add basic map elements to a map layout (title, scale, north arrow, descriptive text)
- Add advanced map elements (map grid and overview map)
- Lab #7: Designing, Critiquing, and Revising a Map

Week 10: Map Design II

- Create charts from spatial data
- Format and analyze GIS charts
- Lab #8: Designing, Critiquing, and Revising a Map

Week 11: Spatial Data Processing I

- Table joins
- Spatial joins
- Lab #9. Spatial Data Processing I
  - https://kevelyn1.github.io/QGIS-Intro/qgis/vector-analysis/

Week 12: Spatial Data Processing II

- Spatial data aggregation
- Advanced spatial joins (e.g., distance-based joins)
- Lab #10. Spatial Data Processing II

Week 13: Spatial Analysis I

- K-means clustering
- Nearest neighbor analysis
- Proximate analysis
- Overlap analysis
- Interpolation
- Lab #11: Advanced Spatial Analysis in QGIS I

Week 14: Spatial Analysis II

- Spatial pattern analysis
- Spatial regression
- Hotspot analysis
- Spatial autocorrelation
- Lab #12: Advanced Spatial Analysis in QGIS II

Week 15: Group meeting for a term project

Week 16: Final Exam