



ENVS 250: Geospatial Information Systems (GIS)

Term: Fall 2026

Credits: 3.0

Lecture Times & Location: Tuesday & Thursday 11:00 a.m.–12:15 p.m., Ashby Hall 230

Modality: In-Person

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Instructor Information

- **Instructor:** Dr. Keiko Tanaka (Assistant Teaching Professor of Environmental Science)
- **Email:** ktanaka@university.alkimi.ai
- **Office:** Meridian Science Center 416
- **Office Hours:**
 - Monday & Thursday: 9:00–10:30 a.m. (In person, Meridian Science Center 416)
 - Friday: 9:00–10:00 a.m. (Virtual via Zoom; link posted in Canvas)
 - Also available by appointment.

Course Description

Spatial data models, coordinate systems, map projections, remote sensing imagery, geoprocessing, and spatial analysis for environmental and infrastructure planning, using ArcGIS Pro and QGIS. ENVS 250 provides a practical, project-based introduction to geographic information systems, geospatial data science, and spatial cartography. Meeting in the Ashby Hall geospatial computing laboratory, students master vector and raster data architectures, georeferencing, coordinate systems, and map projections using industry-standard ArcGIS Pro and open-source QGIS software. We explore spatial analysis workflows, multi-criteria site suitability modeling, watershed delineation from digital elevation models (DEMs), remote sensing image classification, and professional cartographic design for environmental planning and policy.

Prerequisites

None.

Measurable Student Learning Outcomes

Upon successful completion of ENVS 250, students will be able to:

1. **Analyze Spatial Data Models and Coordinate Systems:** Distinguish between vector and raster data structures, evaluate topological relationships, and select appropriate geographic coordinate systems and map projections.
2. **Execute Advanced Geoprocessing Workflows:** Perform spatial queries, buffer analysis, map overlay operations, spatial joins, and raster algebra to solve complex environmental planning problems.
3. **Process and Classify Remote Sensing Imagery:** Interpret multispectral satellite imagery, compute normalized difference vegetation index (NDVI), and perform supervised and unsupervised land cover classifications.

4. **Conduct Terrain and Hydrological Analysis:** Delineate watersheds, calculate flow direction and accumulation, and model stream networks from digital elevation models (DEMs).
5. **Construct Multi-Criteria Suitability Models:** Design weighted multi-criteria overlay models to evaluate habitat conservation corridors and municipal infrastructure siting.
6. **Design Professional Cartographic Maps:** Apply principles of visual hierarchy, symbology, color theory, and typographic balance to produce publication-quality maps and interactive web maps.

Required Course Materials & Approximate Costs

1. **Bolstad, Paul. *GIS Fundamentals: A First Text on Geographic Information Systems*. 6th ed., XanEdu Publishing, 2019.** Approx. \$45 for digital access; approx. \$65 for print purchase.
2. **ArcGIS Pro student educational license and open-source QGIS desktop software suite.** Free (provided to all enrolled students).
3. **External USB 3.0 flash drive or portable solid-state drive (minimum 32 GB) for spatial project backups.** Approx. \$15 to \$25.
4. **Total estimated cost:** \$15 to \$90.

Generative AI Policy (AI Level 2: AI Permitted with Disclosure for Specified Tasks)

In accordance with Alkimi University Academic Policies (Student Handbook §5.8), ENVS 250 operates under **AI Level 2**.

- **What is permitted:** You may use AI tools to troubleshoot Python geospatial scripts (ArcPy and PyQGIS), generate ideas for map design layouts, and clarify the mathematical definitions of coordinate projections.
- **What is prohibited:** You may not submit AI-generated map layouts, use AI to automate geoprocessing assignments without personal execution in GIS software, or access AI during quizzes and the final exam.
- **Disclosure:** For every GIS laboratory assignment and the final spatial analysis project, include a brief disclosure statement detailing any AI tools consulted for scripting or workflow design, or state that no AI tools were used.

Grading Components and Weights

- **Midterm Exam:** 15% (In class, Thursday, October 15)
- **Weekly GIS Laboratory Projects:** 30% (Weekly lab portfolio assignments due Fridays at 11:59 p.m. in Canvas (weeks 2–13; lowest dropped))
- **Spatial Analysis Term Project:** 20% (Due Friday, November 20 at 11:59 p.m.)
- **In-Class Practical Quizzes:** 10% (Canvas and lab practical quizzes administered alternate Thursdays; lowest dropped)
- **Final Comprehensive Examination:** 25% (Wednesday, December 16, 2026, 1:30–3:30 p.m.)

Grading Scale (Alkimi University Standard)

- **A:** 93–100% | **A-:** 90–92%
- **B+:** 87–89% | **B:** 83–86% | **B-:** 80–82%
- **C+:** 77–79% | **C:** 73–76% | **C-:** 70–72%
- **D+:** 67–69% | **D:** 60–66% | **F:** Below 60%
- **Extra credit:** Students can earn up to 2% extra credit by participating in an approved campus OpenStreetMap mapathon or submitting an innovative cartographic entry to the annual GIS Day exhibition.

Course Schedule (Fall 2026)

Week	Dates	Topics & Readings	Assignments & Deadlines
Week 1	Aug 27	Foundations of GIS and Spatial Data Architecture: Spatial thinking concepts, GIS hardware/software architectures, vector versus raster representations, attribute tables, and software interface setup. <i>Reading: Bolstad Ch. 1</i>	<i>First day of classes: Wed Aug 26.</i>
Week 2	Sep 1, 3	Vector Data Models and Attribute Databases: Points, lines, polygons, shapefiles, file geodatabases, topological rules, relational database management systems, and SQL attribute queries. <i>Reading: Bolstad Ch. 2</i>	<i>Wed Sep 2: Add/section change deadline.</i>
Week 3	Sep 8, 10	Geodesy, Datums, and Geographic Coordinates: The geoid, reference ellipsoids, spherical and spheroidal coordinates, horizontal datums (NAD27, NAD83, WGS84), and vertical datums. <i>Reading: Bolstad Ch. 3.1–3.3</i>	<i>Mon Sep 7: Labor Day (no classes). Wed Sep 9: Census date (last day to drop without a W).</i>
Week 4	Sep 15, 17	Map Projections and Georeferencing: Developable surfaces (cylindrical, conic, planar), projection distortion properties, UTM and State Plane coordinate systems, and ground control points. <i>Reading: Bolstad Ch. 3.4–3.7</i>	—
Week 5	Sep 22, 24	Cartographic Design and Thematic Mapping: Color theory, choropleth and proportional symbol maps, visual hierarchy, typography, data classification methods (natural breaks, quantiles, equal interval). <i>Reading: Bolstad Ch. 4</i>	—
Week 6	Sep 29, Oct 1	Spatial Queries and Relational Joins: Location-based selection methods, topological relationships (intersect, contain, touch, within), spatial joins, and table relationships. <i>Reading: Bolstad Ch. 9.1–9.3</i>	—
Week 7	Oct 6, 8	Vector Geoprocessing and Spatial Overlays: Buffering, clipping, dissolving, union, intersection, identity, and automating multi-step geoprocessing models with ModelBuilder. <i>Reading: Bolstad Ch. 9.4–9.7</i>	—
Week 8	Oct 15	Raster Data Architecture and Grid Analysis & Midterm Exam: Raster data models, cell resolution, bands, compression algorithms; Midterm Exam in class on Thursday. <i>Reading: Bolstad Ch. 10</i>	<i>Oct 12–Oct 13: Fall break (no classes). Fri Oct 16: Midterm grades due. Midterm Exam (in class).</i>
Week 9	Oct 20, 22	Map Algebra and Spatial Modeling: Local, focal, zonal, and global raster operations, conditional statements (Con), raster calculation, and environmental surface analysis. <i>Reading: Bolstad Ch. 11.1–11.3</i>	—
Week 10	Oct 27, 29	Terrain Modeling and Surface Interpolation: Digital elevation models (DEMs), TIN surfaces, slope, aspect, curvature, hillshading, and spatial interpolation (IDW, Kriging). <i>Reading: Bolstad Ch. 11.4–11.6</i>	—
Week 11	Nov 3, 5	Hydrological Analysis and Watershed Delineation: DEM sink filling, flow direction algorithms (D8), flow accumulation grids, stream network derivation, and pour point watershed delineation. <i>Reading: Bolstad Ch. 12</i>	<i>Fri Nov 6: Last day to withdraw (W) or elect Pass/No Pass.</i>
Week 12	Nov 10, 12	Multi-Criteria Evaluation and Site Suitability: Standardization of criteria, analytical hierarchy process (AHP), weighted linear combination, cost distance analysis, and corridor modeling. <i>Reading: Bolstad Ch. 13</i>	—
Week 13	Nov 17, 19	Remote Sensing Fundamentals and Sensors: Electromagnetic radiation interactions with atmosphere and surface, spatial, spectral, radiometric, and temporal resolution of satellite sensors. <i>Reading: Bolstad Ch. 6</i>	Spatial Analysis Term Project due Fri Nov 20 at 11:59 p.m.
Week 14	Nov 24	Multispectral Imagery and Vegetation Indices: False color composites, spectral reflectance signatures, band math,	<i>Nov 25–Nov 27: Thanksgiving break (no classes).</i>

Week	Dates	Topics & Readings	Assignments & Deadlines
		Normalized Difference Vegetation Index (NDVI), and water indices. <i>Reading: Bolstad Ch. 7</i>	
Week 15	Dec 1, 3	Image Classification and Land Cover Mapping: Unsupervised k-means clustering, supervised maximum likelihood classification, training site selection, error matrices, and Kappa statistics. <i>Reading: Bolstad Ch. 8</i>	—
Week 16	Dec 8	Web GIS, Open Geospatial Standards, and Project Showcase: Web mapping services (WMS/WFS), cloud geospatial platforms, story maps, and final term project cartographic gallery showcase. <i>Reading: Bolstad Ch. 14 & Review</i>	<i>Wed Dec 9: Last day of classes. Thu Dec 10: Reading Day.</i>
Finals	Dec 16	Final Comprehensive Examination: Wednesday, December 16, 2026, 1:30–3:30 p.m., Ashby Hall 230.	Comprehensive examination covering spatial data models, coordinate geometry, geoprocessing algorithms, and remote sensing.

Course Policies

Attendance Policy

Because ENVS 250 meets in the computer laboratory and builds cumulative software proficiencies in ArcGIS Pro and QGIS, regular attendance is vital. If an illness or emergency requires an absence, notify Dr. Tanaka via email. You are responsible for catching up on software tutorials before the subsequent class session. Students who miss the first two class meetings without notifying the instructor may be dropped. Students may miss class for religious observance without penalty if they notify the instructor in writing within the first two weeks of the semester (by Wednesday, September 9, 2026). Absences for university-sponsored activities (athletics, performances, conferences) are excused with a letter from the sponsoring office at least one week in advance.

Late Work Policy

Weekly GIS laboratory projects submitted after the Friday deadline lose 10% per day and are not accepted beyond four days late. To accommodate software export issues or illness, the single lowest weekly GIS project score will be dropped at the end of the term.

Final Exam Policy

The final examination (Wednesday, December 16, 2026, 1:30–3:30 p.m.) is scheduled by the University Registrar and can't be moved without the Dean's written approval (Faculty Handbook §5.5). A student with three or more final exams on the same calendar day may reschedule one of them. Requests go to the instructor of the middle exam by the last day of classes. For this term, send the request by Wednesday, December 9, 2026 (Student Handbook §6.4).

Academic Integrity

Alkimi University is an academic community devoted to rigorous scholarship, open intellectual inquiry, and uncompromising ethical conduct. All students are subject to the regulations of the Alkimi University Academic Integrity Policy. Academic dishonesty—including plagiarism, cheating on examinations, unauthorized collaboration, fabrication of empirical data, and unauthorized submission of academic work generated by artificial intelligence—undermines the integrity of the university and carries severe disciplinary sanctions. Sanctions range from a failing grade on an assignment or exam to an administrative course failure recorded as an 'XF' on the official transcript, academic suspension, or expulsion. Suspected violations are formally investigated and resolved through the Office of Academic Integrity in accordance with Faculty Handbook §6. For detailed information, consult the Office of Academic Integrity, Lovell Hall 315, (555) 555-0163, integrity@university.alkimi.ai.

Accessibility Services

Alkimi University is committed to providing equitable educational access and reasonable accommodations for all students with documented disabilities, including physical, sensory, psychological, learning, and chronic health conditions. Students requesting academic accommodations must formally register with the Office of Accessibility Services, Harlan Hall 204, (555) 555-0155, access@university.alkimi.ai. Once approved, students will receive an official Faculty Accommodation Letter detailing approved accommodations. Students should present this letter to the instructor as early in the semester as possible, and at least one week prior to any exam or assignment requiring accommodation. Accommodations cannot be applied retroactively.

Student Wellness and Mental Health

Your physical health, psychological well-being, and mental health are essential to your academic success. If you experience heightened stress, anxiety, depressive symptoms, personal trauma, or academic burnout, free, confidential counseling and medical care are available through the Hollis Health & Counseling Center, located in the Hollis Center. Routine appointments are available Monday–Friday 8:00 a.m.–6:00 p.m. and Saturday 10:00 a.m.–2:00 p.m. during the semester by calling (555) 555-0190 or emailing health@university.alkimi.ai. Urgent, 24/7 crisis psychological counseling is accessible immediately at (555) 555-0199.

Campus Student Support Services

- **Academic Advising Center:** Lovell Hall 101 | (555) 555-0158 | advising@university.alkimi.ai
- **Writing Center:** Whitcombe Library 3rd Floor | Free consultations on papers, reports, and research projects at any stage.
- **Whitcombe Library:** Whitcombe Library, Main Floor | (555) 555-0170 | askalibrarian@university.alkimi.ai
- **Hollis Health & Counseling Center:** Hollis Center | (555) 555-0190 | 24/7 Counseling Line: (555) 555-0199 | health@university.alkimi.ai
- **GIS and Data Science Lab Support:** Student lab consultants are on duty in Ashby Hall 230 Monday through Thursday 5:00–8:00 p.m. for software troubleshooting.