GEOG 460
GIS and Spatial Data Science
Syllabus

Description: GIS and Spatial Data Science. (4). Building upon the foundation of GEOG 360, this course cultivates the skills of spatial thinking and spatial data analysis through the use of Geographic Information Systems (GIS) and spatial data science. Focus will be placed on manipulating, analyzing, and visualizing spatial and temporal data to explore spatial patterns and relationships. Student designed projects will increase proficiency in the principles of spatial statistics and spatial data science.

Course Credits: 4 credits (approximately 120 hours of engagement)

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Office hours: **TBA** as well as Online via zoom or by appointment

Prerequisites: (GEOG 360, FE 257 or CE 202) and (MTH 112 or MTH 251) and (ST 314 or 351).

Course Objectives:
GEOG 460 is designed to provide students with practical applications of technologies and problem solving skills to spatial analysis within a geographic information system (GIS). This course focuses on developing a foundation in spatial thinking and guides students through the process of developing and carrying out spatial analyses using various spatial data, techniques and models. These techniques include spatial statistics and spatial data science. Students complete a spatial analysis project culminating in a written report and oral presentation to their peers.

Student Learning Outcomes:
In following this course, students will:

Learning Outcomes	Assessment Method
1. Understand the foundational nature and use of spatial information within the context of the science of Geographic Information Systems or GIScience and Spatial Data Science.	Assessments, Labs, Project
2. Synthesize and integrate concepts of GIS theory and methodology, including data models, data structures, topology, and spatial analysis.	Assessments, Labs, Project

3. Begin to articulate the role of space, as well as spatial and temporal scales, as sources for explanation and understanding of natural and human phenomenon.	Labs, Project
4. Demonstrate a conceptual and working knowledge of spatial analysis operations, including interpolation, transformation, spatial statistics, and estimation of error and uncertainty.	Assessments, Labs, Project
5. Demonstrate intermediate proficiency in map creation and design principles, including thematic map display, map projections and cartographic design.	Labs, Project
6. Develop and carry out a spatial analysis project	Project
7. Demonstrate intermediate GIS software skills, particularly in ArcGIS, as well as intermediate scientific computing and data science skills in completion of an analysis project.	Labs, Project
8. Create and disseminate professional GIS products.	Project Report and Oral Presentation
9. Employ verbal/written communication and computer technology skills by way of presentations.	Oral Presentation

Text:

Bolstad, Paul. GIS Fundamentals. 7th ed. Eider Press. 2023
ISBN: 9780971764750 (print via Baker & Taylor Publishing
OR for ebooks, ISBN 9780971764767 or ISBN
9780971764774

Access to the ArcGIS Pro software:

Access to the ArcGIS Pro software and other tools for the completion of the course exercises and your spatial analysis project will be via the Digital Earth lab computers and the CEOAS Virtual Desktop infrastructure (VDI). Instructions on accessing both will be provided in your first lab session.

Course format:

Lectures / Discussion board:

Lectures and the discussion board will be used to discuss and apply the concepts that are presented in the textbook and supplementary course material. In addition, students will be required to participate in the Muddiest Points Discussion board on a weekly basis to reinforce these concepts. The Muddiest Points discussion along with the I-GUIDE Hour of Cyberinfrastructure will form part of your participation grade for the course.

Labs / Project:

Weekly labs and other participatory activities will build upon GIS skills and techniques introduced in earlier courses and are intended to increase geospatial analytic and critical thinking skills. These weekly activities as well as the weekly project assignments will form the foundation of techniques for the completion of an individual spatial analysis project. This individual project will

culminate in a written paper as well as an oral presentation at the end of the term.

Assessments:
There will be one written exam in the course.

Grading system and policies:

Student progress toward learning outcomes will be evaluated through a series of exercises, along with a written exam and the weekly final project assignments.

The course point allocation is presented as percentages of the total course grade.

Grading System:

Assignment	Percent
Exercises	30
Participation	10
Exam	20
Final Project	40
Total	**100**

For a more detailed breakdown of individual assignments view the Grade Center on Canvas. This point allocation is subject to change. Canvas will be used to post results of all work as they are graded but letter grades are not assigned until the end of the term.

Grading Policy:
This class is graded on an absolute scale, determined by the number of points you earn. **NOTE to students electing S/U grade:** If you choose to S/U the class, you need to know that a D+ (less than 70%) is a U.

Grade Option	S/U Option
A = 92.5 – 100 A- = 90.0 - < 92.5	S = 70 - 100

B+ = 87.5 - < 90.0 B = 82.5 - < 87.5 B- = 80.0 - < 82.5	
C+ = 77.5 - < 80.00 C = 72.5 - < 77.5 C- = 70.0 - < 72.5	
D+ = 67.5 – < 70.0 D = 62.5 – < 67.5 D- = 60.0 - < 62.5	U = 0 - 69.9
F = 0 - < 60.0	

Assignment Deadline Policies:

Due dates for all assignments will be posted on Canvas. Please make note of these due dates as late assignments, specifically exercises, will be penalized by 10% per day for each 24 hour period from the due date. If you have a legitimate excuse for not being able to complete the assignment on time, you must present this excuse (Dr.'s note, jury duty, etc) to the instructor before the due date of the assignment.

Exercises:

Lab exercises are due each week by the specified date via the Canvas Assignment tool. The exercise instructions and data will be available on Canvas. The exercises are to be completed as individual work although asking questions and helping each other in a community of learning and exchange is strongly encouraged.

Exam:

The exam date has been set and posted in Canvas. If for some legitimate reason, supported by official documentation, you are not able to take the exam within the specified period, it is your responsibility to notify the instructor and make other arrangements during the first 2 weeks of the course. Unless you have contacted the instructor within this time period, regarding a conflict with the exam periods, there will be NO rescheduling or make up exams.

Incompletes:
Incompletes ("I") are only given for circumstances that are beyond the student's control that prevent the completion of the course within the quarter. Official documentation may be required to support a student's request for an incomplete.

In addition, incompletes are only given when the student has successfully completed at least 50% of the course work before the incomplete is requested. In all cases, the remaining course work must be completed by the end of the next quarter. The instructor and student will decide on an appropriate timeline for the completion of the work within that deadline.

Please refer to the OSU Academic Regulations for specific grade regulations:
http://catalog.oregonstate.edu/ChapterDetail.aspx?key=75#Section2885

Academic Calendar:

All students are subject to the registration and refund deadlines as stated in the Academic Calendar: https://registrar.oregonstate.edu/osu-academic-calendar

Students with Disabilities:
Accommodations are collaborative efforts between students, faculty and Disability Access Services (DAS). Students with accommodations approved through DAS are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss

accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through DAS should contact DAS immediately at 541-737-4098 or at http://ds.oregonstate.edu.

Expectations for Student Conduct:
Student conduct is governed by the university's policies, as explained in the Student Conduct Code: https://beav.es/codeofconduct Students are expected to conduct themselves in the classroom and course in compliance with the university's regulations regarding civility.

Academic Integrity:
Students are expected to comply with all regulations pertaining to academic honesty, defined as: *An intentional act of deception in which a student seeks to claim credit for the work or effort of another person or uses unauthorized materials or fabricated information in any academic work.* For further information, visit Academic Integrity for Students provided by the OSU Libraries.

Use of Generative AI Is Prohibited in This Course
Use of generative AI tools such as ChatGPT is prohibited on all assignments in this course. This pertains especially to your individual spatial analysis projects and the referencing and writing of your final project report. Ask your Instructor if you have any questions about this policy.

Diversity Statement:
Oregon State University strives to create an affirming climate for all students including underrepresented and marginalized individuals and groups. Diversity encompasses differences in age, color, ethnicity, national origin, gender, physical or mental ability, religion, socioeconomic background, veteran status, sexual orientation, and marginalized groups. We believe diversity is the synergy, connection, acceptance, and mutual learning fostered by the interaction of different human characteristics.

Religious Accommodations:
Oregon State University strives to respect all religious practices. If you have religious holidays that are in conflict with any of the requirements of this class, please see me immediately so that we can make alternative arrangements. See the Religious Accommodation Process for Students.

Student Assistance:
Contacting the instructor:
Depending on your location, the Instructor may be contacted either via email or phone. Please use your ONID email address when sending emails and also state within the Subject line, which course you are taking. If your question is pertaining to the course material, please post this question to the General Discussion Board so that everyone can benefit from the exchange. If your communication is of a personal nature, please email, call or visit electronically via Zoom with the instructor.

Contacting you:
If we need to get in contact with you personally, we will use your OSU email account, and then use the information you have given to the university. Please make sure that you use your OSU email in communicating with us.

Accessibility of Course Materials:
All materials used in this course are accessible. If you require accommodations please contact Disability Access Services (DAS).

Additionally, Canvas, the learning management system through which this course is offered, provides a vendor statement certifying how the platform is accessible to students with disabilities.

Technical Assistance:
If you experience computer difficulties, need help downloading a program, browser or plug-in, or if you experience any errors or problems while in your online course, contact the OSU IT Service Desk for assistance. You can call (541) 737-8787, or visit the OSU IT Service Desk online.

Reach Out for Success:
University students encounter setbacks from time to time. If you encounter difficulties and need assistance, it's important to reach out. Please consider discussing your situation with me or academic advisor. Learn about resources that assist with wellness and academic success.

- **For Academic Success:**
  The Academic Success Center provides many resources to help you be successful as a student, including information on study skills as well as help in balancing your work/life demands. Please make use of these resources to help you be successful in your academic and personal endeavors.
  http://success.oregonstate.edu/
- **For mental health:**
  Learn about counseling and psychological resources for students. If you are in immediate crisis, please contact the Crisis Text Line by texting OREGON to 741-741 or call the National Suicide Prevention Lifeline at 1-800-273-TALK (8255).
- **For financial hardship:**
  Any student whose academic performance is impacted due to financial stress or the inability to afford groceries, housing, and other necessities for any reason is urged to explore these resources available for Basic Needs help.

There are many resources available to help you be successful as a student, including information on study skills as well as help in balancing your work/life demands. Please make use of these resources to help you be successful in your academic and personal endeavors.

Writing Assistance:

The OSU Writing Center has one-on-one appointments as well as an open Writing Studio. https://writingcenter.oregonstate.edu/. The Online Writing Suite is also available for students.

Class Schedule:
Please note that the topics will be lectures and/or discussions and are subject to change.

Week 1. Introduction and Review

- Topic: Core Concepts in GIS and Spatial Data Science
- Topic: Coordinate Systems and Projections
  - Review concepts from Intro GIS courses
  - Review Bolstad Chps 2 & 3
- Project: Developing a Spatial Analysis Question for Projects
- EX 1: Spatial Analysis using ArcGIS Pro

Week 2. Acquiring Data and Spatial Analysis

- Topic: Spatial Data and Scale
- Topic: Vector and Raster Analysis
- Topic: Sources of data on the Web
  - Read / Review Bolstad Chps 8, 9 & 10
- Project: Exploration of Spatial Analysis Question and Data Acquisition
  - Read Bolstad Chps 6 & 7
- EX 2: Vector & raster analysis

Week 3. Terrain Analysis

- Topic: Elevation Data & Terrain Analysis
- Topic: Spatial Databases and Database Management
  - Read Bolstad Ch 11
- Hour of CyberInfrastructure: Gateway lesson
- Project: Investigate Spatial Analysis Question and identify data sets
- EX 3: Terrain Analysis – Watershed Delineation

Week 4. Spatial Patterns

- Topic: Conceptualization of Spatial Relationships
- Topic: Spatial Autocorrelation
  - Read Bolstad Ch 12
- Hour of CyberInfrastructure: Computational Thinking
- Project: Refine Spatial Analysis Question and Data Sources
- EX 4: Multivariate Cluster Analysis

Week 5. Spatial Estimation

- Topic: Spatial Interpolation
  - Review Bolstad Ch 12

- Topic: Metadata and Data Quality
    - Review Bolstad Ch 4 pgs 165 - 167
    - Review Bolstad Ch 14
- Hour of CyberInfrastructure: CyberInfrastructure
- Project: Refine Methodology, Metadata and Data Quality issues
- EX 5: Surface Modeling (Interpolation)

Week 6. Spatial Models - Regression

- Topic: Regression Analysis
    - Review Chapters 9 & 12
- Hour of CyberInfrastructure: Big Data
- Project: Spatial Analysis project
- EX 6: Regression

Week 7. Spatial Models – Space & Time

- Topic: Spatial Models
- Topic: Spatial and Temporal Dimensions
    - Read Bolstad Ch 13
- Hour of CyberInfrastructure: Parallel Computation
- Project: Writing a Research Paper
- EX 7: Space – Time Analysis

Week 8. Analysis and Dissemination

- Topic: Spatial Data Science
- Topic: Future Developments
    - Read Bolstad Ch 15
- Lab: Spatial Analysis Project
- **Exam**

Week 9. GIS and Spatial Data Science

- Topic: Cyberliteracy for GIScience
- Hour of CyberInfrastructure: Interdisciplinary Communication
- Lab: Spatial Analysis Project

Week 10. Spatial Analysis Projects

- Lab: Spatial Analysis Project
- **Project: Oral Presentations during class**
- **Project: Final Project Report due by Friday via Canvas**

Week 11. Finals Week

- **Peer Critique of Oral Presentations due by Wednesday of Finals week**