GIS Applications in Civil & Environmental Engineering
CE3995 / CE5090-002 – Spring 2015

Meets Monday & Wednesday 3:35-4:25pm
room: Castleman 201
Lab Sessions: 001 Thursday 9-11am
002 Thursday 11am-1pm
room: Castleman 117

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Course Description

Civil and environmental engineers increasingly utilize spatially-referenced data and GIS software to solve problems related to water resources, transportation, urban planning, and environmental impact analysis. The successful application of GIS in civil and environmental engineering requires an appreciation of the importance of spatial relationships, an understanding of the technical capabilities of computer-based information systems, and the appropriate GIS software skills.

This course introduces students to the fundamental concepts and principles of geographic information systems (GIS) and demonstrates how GIS can be applied to solve CEE problems. The goal of this course is to provide students with a comprehensive understanding of geographic data management and analysis as it applies to CEE-related applications. This requires an understanding of basic concepts (i.e., lecture) and practice implementing them with GIS software (i.e., lab). The course emphasizes and explores CEE-related GIS data, analytical tools and applications. Among the topics covered in this course are: spatial data models and management, spatial coordinates systems, spatial analysis, terrain mapping, watershed and stream network delineation, spatial interpolation, pattern analysis, and network analysis.

Course Objectives

At the completion of this course, students will:

- appreciate the utility of spatial data in engineering problem solving
- understand the fundamental concepts and principles underlying the acquisition, organization and management of spatial data
- comprehend and apply basic spatial analyses to solve engineering problems
- become proficient users of GIS software
- practice professional communication through the preparation of laboratory assignments and learn to effectively communicate findings via visualization

Course Prerequisites

Recommended prerequisite: CE 2410
The course is designed so that students without a GIS background can succeed, but previous experience will no doubt be helpful. Although not required for this course, courses in the following areas can be helpful background work in GIS: remote sensing and image interpretation, statistics, cartography, geomatics, surveying, and computer programming.

Readings

The textbook required for this course is:

Bolstad, P. **2012**. *GIS Fundamentals: A First Text on Geographic Information Systems, Fourth Edition*. White Bear Lake, MN: Eider Press.

There are several good texts covering introductory GIS. Additional helpful texts include:

Clarke, K.C. **2011**. *Getting Started with Geographic Information Systems, Fifth Edition*. Pearson-Prentice Hall.

Law, M. and Collins, A. **2013**. *Getting to Know ArcGIS for Desktop, Third Edition*. Redlands, CA: Esri Press.

Price, M. **2011**. *Mastering ArcGIS, Fifth Edition*. New York, NY: McGraw-Hill.

Course Expectations & Evaluation

Students are expected to attend and participate in all class meetings, attend all laboratory sessions, and complete course readings. Attendance is essential to your understanding of and performance in both lecture and lab. From my experience, the single best predictor of performance in class is consistent attendance. Attendance will be recorded at each lab meeting. Planned absences should be brought to the instructor's attention prior to the missed class.

This course requires a substantial amount of work. Lab assignments will require work outside of class and lab times. Students can obtain a one-year, student copy of the GIS software (ArcGIS 10.2) for their personal use. Interested students should email Dr. Burnicki to receive download instructions and an authorization code.

<u>Undergraduate students</u>:
Your grade will be based on your performance on twelve laboratory assignments, two lecture exams, a lab exam, and a set of project assessments.

<u>Graduate students</u>:
Your grade will be based on your performance on twelve laboratory assignments, two lecture exams, a lab exam, and an end-of-term project.

There will be no extra credit.

Lab assignments:	Lab assignments will emphasize civil and environmental engineering-related GIS applications. All lab assignments are due prior the next lab session. I recommend you keep a lab notebook (digital or hardcopy), as later labs and the lab exam will require you to perform tasks that were described in detail in previous lab assignments.
Lab exam:	Students will complete a lab exam during the class week of the course. The exam will cover skills learned during the lab portion of the course. The lab exam is a take-home exam, but lab work is required. The final laboratory session of the semester has been designated for the lab exam (see course schedule).
Lecture exams:	There are two, non-comprehensive lecture exams. Lecture exams will focus on your understanding of the concepts presented in class. If you have a conflict (e.g., religious observation, scheduled conference, scheduled athletic team event) with the date/time of an exam, you need to notify Dr. Burnicki within the first three weeks of the term so a make-up exam can be scheduled. If you miss an exam without prior notification, you will need to provide proof (e.g., medical emergency).
Project:	Each graduate student is required to complete an end-of-term project that applies spatial analysis methods learned in class. The purposes of this project are to:

a. Explore in-depth a subject of personal interest to you and develop experience in the use of GIS to solve that problem
b. Provide experience in the formulation, execution, and presentation of original research

Your project grade will be based on: (1) project proposal, (2) project status report, (3) presentation (held during the last week of class; see course schedule), and (4) final report. More detailed information regarding the semester project will be distributed and discussed in class in the upcoming weeks.

Project Assessments: All undergraduate students must complete a set of project assessments during the last week of the course. The assessments will require you to (1) identify type of data and spatial analyses performed in each end-of-term project and (2) evaluate the strengths/weaknesses of GIS approaches in solving practical CEE problems.

Grade Calculation

	Undergrad	Grad
Lab Assignments	35%	30%
Exam 1	25%	20%
Lab Exam	10%	10%
Exam 2	25%	20%
Project Assessments	5%	---
End-of-Term Project	---	20%

Overall %	Grade
93 or above	A
90 – 92.9	A-
87 – 89.9	B+
83 – 86.9	B
80 – 82.9	B-
77 – 79.9	C+
73 – 76.9	C
70 – 72.9	C-
60 – 69.9	D
below 60	F

Additional Information

- Every effort will be made to accommodate the needs of students with hearing, visual, or other impairments and/or learning disabilities. Please notify your instructor and provide necessary documentation.
- A note on student work. Group discussion during lab sessions is expected and encouraged. However, lab assignments must be completed individually by each student. It is expected that work submitted by a student reflects his or her original ideas and responses. Submissions that reflect substantially similar work by more than one student will be dealt with as an act of scholarly dishonesty and a failing grade will be issued. Students are expected to be familiar with the university policies on academic misconduct as detailed in the UCONN student code: http://www.community.uconn.edu/student_code.html

Course Schedule

Changes to the schedule may be necessary based on class progress, but it is my intention to keep changes to a minimum. All changes will be announced in class and posted on the course website. It is your responsibility to stay apprised of changes to the course schedule.

Week	Day	Topic	Reading	Lab
1	Jan 21st	Introduction to GIS & Applications in Civil & Environmental Engineering	Ch1	
2	Jan 26th	Measuring Geospatial Data	Ch2: 25-34 & 58-61	Introduction to ArcGIS: Mapping land use and population centers
	Jan 28th	Maps as Models	Ch4: 131-40 & 164-71 and Ch9: 359-66	
3	Feb 2nd	Vector Data Models	Ch2: 34-43 & 55-56	Spatial Data Structures
	Feb 4th	Raster Data Models	Ch2: 44-54 & 61-63	
4	Feb 9th	Projections & Coordinate Systems	Ch3: 71-119	Projections & Coordinate Systems
	Feb 11th	Attribute Data Structures	Ch8: 307-20	
5	Feb 16th	CEE Data Sources	Ch7	Geodatabases: Census & Hydrology data
	Feb 18th	Data Querying & Description	Ch9: 347-58 & 368-9 and Ch10: 407-18	
6	Feb 23rd	Map Overlay	Ch9: 377-89 & Ch10: 418-23	Vector Analysis 1: Exploring land-use patterns
	Feb 25th	Distance & Buffer	Ch9: 370-6	
7	Mar 2nd	Review		Vector Analysis 2: Land-use change
	Mar 4th	**Exam 1**		
8	Mar 9th	Suitability Mapping	Ch13: 525-33 and Cargin & Dwyer 1995	Raster Analysis: Suitability mapping
	Mar 11th	Neighborhood Operations	Ch10: 424-33	
		Spring Recess		
9	Mar 23rd	Terrain Visualization	Ch2: 53 and Ch11: 443-5 & 458-64	Terrain Visualization
	Mar 25th	Terrain Analysis	Ch11: 445-58 Russell *et al*. 1997	
10	Mar 30th	Cost Surfaces	Ch10: 434-7	Terrain Analysis & Cost Distance
	Apr 1st	Spatial Interpolation	Ch12: 473-86	
11	Apr 6th	Spatial Prediction	Ch12: 491-8	Spatial Interpolation: Mapping ozone
	Apr 8th	Geocoding & Networks	Ch9: 395-6	
12	Apr 13th	Network Analysis	Ch9: 390-5	Network Analysis: Transportation routing
	Apr 15th	Pattern Analysis	Ch12: 487-91	
13	Apr 20th	Cartographic Modeling	Ch13: 521-4 & 533-44	Pattern Analysis: Exploring bike-route densities
	Apr 22nd	Review		
14	Apr 28th	Project Presentations		**Lab Final**
	Apr 30th	Project Presentations		
Exam Week		**Exam 2**		