CE 597: Geographic Information Systems

Spring 2022

In person mode: Geographic Information Systems - 21019 - CE 59700 - WNG
Asynchronous mode: Geographic Information Systems - 28265 - CE 59700 - EPE
(Course Syllabus subject to changes when deemed necessary)

Course Information

Course name: Geographic Information Systems
Credit: 3 credits
Offered: Every Spring semester
Mode: in person; and asynchronous online
Website: Brightspace (lecture videos, notes, assignments, submissions, etc.)
Classroom: WANG 2555
Time/day: 9:30am – 10:20 am, MWF (January 10 – April 30, 2022)

Instructor

- Jie Shan, *Professor of Civil Engineering, Purdue University*
  - Email: jshan@purdue.edu
  - Email window: 8:30 am – 8:30 pm ET (try to avoid urgent emails before a deadline)
  - Office hours: to be determined; WebEx link

Course Description

This course covers a range of fundamentals in geographic information science and technology. Students will learn the use of current popular geographic information system (GIS) tools to handle various geographic data. Through working on real world geospatial problems, students shall gain extensive and hands-on experience in geographic data manipulation, visualization, and analysis. Course assignments are focused on both GIS theoretical basics and practical skills for students to achieve expected proficiency.

The course will work with geospatial data in geography, topography, environmental science, hydrology, transportation, and geosocial science. It is targeted to students with interest in civil and environmental engineering, agriculture, geography, earth science, natural resources, smart cities or other related subjects.

Course Learning Outcomes

The overall objective of this course is to build and enhance students' capabilities in handling and analyzing geographic/geospatial data. In particular, the successful completion of this course will enable students to:

1. Demonstrate a comprehensive and in-depth understanding of GIS fundamentals
2. Effectively collect and handle various geographic data
3. Exhibit a proficient command of popular GIS software tools
4. Conduct GIS mapping, database design, analysis and visualization tasks independently

Prerequisites

- Junior status or above – with the discretion of the instructor
- Preferably had GIS knowledge or an introductory GIS course or training courses
- College math or equivalent

Course Materials

- **There is no required textbook for this course.** Lecture notes and reading materials will be provided by the instructor.

Reference Text (optional)

- Chang, Kang-tsung, 2019. *Introduction to Geographic Information Systems*, McGraw Hill Higher Education, 9th Edition, ISBN10: 1259929647, ISBN13: 9781259929649 or more recent edition.

Software

- The most recent version of ArcGIS Pro. **NOTE:** Detailed directions for how to access and install this software will be included in your first lab tutorial of this course.

Other References (GIS in general)

1. Lo, C.P. and Yeung, Albert K.W., 2002. *Concepts and Techniques of Geographic Information Systems*, Prentice Hall, New Jersey, ISBN 0-13-080427-4; **2nd Edition, 2007, ISBN 0-13-149502-X**
2. Tor Bernhardsen, 2002. *Geographic Information Systems - an Introduction*, **3rd Edition**, John Wiley & Sons, Inc. ISBN 0-471-41968-0
3. Christopher Jones, 1997. *Geographical Information Systems and Computer Cartography*, Longman, ISBN 0 582 04439 1
4. Peter A. Burrough, Rachael A. NcDonnell, 1998: *Principles of Geographical Information System*, Oxford University Press, ISBN 0-19-823366-3
5. Robert Laurini, Derek Thompson, 1992: *Fundamentals of Spatial Information Systems*, Academic Press, ISBN 0-12-438380-7
6. Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind, 2001. *Geographical Information Science*, John Wiley & Sons, Inc. ISBN 0-471-49521-2 (cloth); ISBN 0471-89275-0 (paper)
7. Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind (Eds), 1999. *Geographical Information Systems*, 2nd Edition, John Wiley & Sons, Inc., Vol. 1, Principles and Technical Issues, ISBN 0471-33132-5; **Vol. 2**, Management Issues and Applications, ISBN 0471-33133-3

Other References (algorithms oriented)

8. Michael F. Worboys, 1995. *GIS – A Computing Perspective*, Taylor & Francis, ISBN 0-7484-0064-8 (cased); ISBN 0-7484-0065-6 (paper). **2nd Edition, ISBN 0-415-28375-2, 2004**
9. Marc van Kreveld, Jürg Nievergelt, Thomas Roos, Peter Widmayer (Eds), 1997. *Algorithmic Foundations of Geographic Information Systems*, Springer, ISSN, 0302-9743; ISBN 3-540-638181-0
10. Shashi Shekhar, Sanjay Chawla, 2003. *Spatial Databases – A Tour*, Prentice-Hall, Inc., ISBN 0-13-017480-7
11. Mark de Berg, Marc van Kreveld, Mark Overmars, Otfried Schwarzkopf, 2000. *Computational Geometry, Algorithms and Applications*, 2nd Edition, Springer, ISBN 3-540-65620-0
12. Stephen Wise, 2013. *GIS Fundamentals*, 2nd Edition, CRC Press, ISBN 978-1-4398-8695-3
13. Ningchuan Xiao, 2016. *GIS Algorithms*, SAGE Publications Ltd.

Grading

This course will be graded based on the following criteria:

Assessment/ Learning Type	Description	% of Final Grade
Project Assignments	There will be a total of nine (9) project assignments. They are designed for students to use popular GIS tools to experience both basic theories and practical applications. These projects will cover the entire range of subjects discussed in the lectures and will be assigned in conjunction with the lecture materials being delivered. It is expected that three (3) projects will be assigned for each five-week module. One (1) of the three (3) projects in each module is comprehensive with the intention to review the materials covered in the module. Refer to the *Course Schedule* in Brightspace for project due dates.	85%
Lab tutorials	Lab tutorials are often assigned in conjunction with the projects. They are designed for students to self-practice functionalities of GIS tools to get the work done. Lab tutorials will not be graded.	0%
Activities	Activities are interactive materials that students can practice online. They are provided for students to further understand and explore the basic principles and methodologies. Activities will not be graded.	0%
Supplementary Materials	Supplementary materials can be in the form of videos or readings. They are provided for students to extend their knowledge beyond what is covered in the class.	0%
Final Exam	The final exam will be open book / open notes. Exams should be completed independently. The exam is comprehensive and will cover all materials discussed in class. It will focus on basic theories and methods. Refer to the *Course Schedule* in Brightspace for the exam due date.	15%

Grading Scale

Your course grade will be based on the following grading scale:

Letter Grade	Percentage
A+	[97-100%]
A	[93-97%)
A-	[90-93%)
B+	[87-90%)
B	[83-87%)
B-	[80-83%)
C+	[77-80%)
C	[73-77%)
C-	[70-73%)
D+	[67-70%)
D	[63-67%)
D-	[60-63%)
F	<60%

*Late submissions may cause an up-to 20% deduction (no late submissions will be accepted after 24 hours).

* The first instance of academic plagiarism will cause a reduced grade for the related assignment/project. The max grade you may receive is 50%, depending on the severity of the plagiarism. The second instance of academic plagiarism will cause failure of the course.

Course Content and Activities

Modules*	Topics	Assignments
1 – Geographic Data Fundamentals	1. GIS Concepts and Software	
	2. Thematic Mapping	• **Project 1**
	3. Georeference	• **Project 2**
	4. Topographic Data	• **Project 3 (Comprehensive)**
	5. Data Model and Structure	
2 – Geographic Data Operations	1. Geodatabase and Relational Database	• **Project 4**
	2. Data Quality and Topology	• **Project 5**
	3. Raster Data Analysis	
	4. Vector Data Analysis	• **Project 6 (Comprehensive)**
	5. Spatial Proximity	
3 – Geographic Data Analysis	1. Watershed Analysis	• **Project 7**
	2. Terrain Analysis	
	3. Network Analysis	• **Project 8**
	4. Spatial Interpolation	• **Project 9 (Comprehensive)**
	5. Geosocial Data Mining - Explore Patterns from Tweets	
Final Exam Week		• **Final Exam**

***Each module lasts five weeks.**

Estimated Effort

- 10 hours/week
- 16 weeks total

Course Help

To get help with the course content, students can approach the instructor through email and/or designated office hours. Students may ask questions of and interact with their peers through a course-wide discussion forum (NOTE: the instructor will not monitor this forum; it is for students to interact with their peers only). In-progress presentations and/or discussions will also be arranged for some of the projects so that students can share their experience with each other in a timely manner.

Discussion Guidelines

Please follow the Discussion Guidelines when contributing to discussions in this course. Here are a few of the key points you should remember:

- Do not use offensive language. Present ideas appropriately.
- Be cautious in using Internet language. For example, do not capitalize all letters since this suggests shouting.
- Avoid using vernacular or slang language. This could possibly lead to misinterpretation.
- Do not hesitate to ask for feedback.
- Be concise and to the point.
- Think and edit before you push the “Send” button.

University Policies

Please refer to the *University Policies* section in Brightspace.