UWSP Department of Geography and Geology

Geography 481/681 GIS Database Design and Modeling
Syllabus - SEM I 2013-14

Instructor: Eugene Martin. gmartin@uwsp.edu. Science B343.
Office hours: Mo 12-1:50; Tu 2-2:50; Th 2-2:50

Course meeting times:

	Day	Hour	Location
Lecture	Tuesdays & Thursdays	12:00 - 12:50	Science D326
Lab Sec 1	Mondays	3:00 - 4:50	Science D326

Course description: Geog 481/681 is an exploration of the theory and practice of modeling with GIS. The purpose of the course is to prepare students with GIS experience to apply the steps involved in formulation of models that address the spatial relationships of social and environmental phenomenon. It matches the theory, tools, and techniques of GIS modeling with the opportunity to practice model design, construction, and application. Course themes feature topics that connect measurement, representation and database development with models that are descriptive, prescriptive, deductive and inductive. The course format consists of lectures, reading assignments, lab assignments, and a final project. Students will learn the methods to build models from the bottom-up as they employ the course concepts toward modeling a phenomenon in their area of interest.

Course learning outcomes:

- Define modeling and describe modeling concepts as they are applied to spatial data measurement, data structure, database design and analysis.
- Compare and contrast different modeling strategies: descriptive, prescriptive, stochastic, deterministic, holistic, atomistic, heuristic, algorithmic, static, dynamic, inductive, deductive.
- Compare and contrast the data formats used in spatial databases and their relative strengths and weaknesses for representation, computation and analysis.
- Explain the importance and relationships among the conceptual, logical and physical stages of database design and modeling.
- Use entity-relationship and data flow diagrams to represent modeling and analysis activity.
- Describe the importance and differences between relational database management system and object oriented approaches to support database design and modeling.
- Use query languages to establish and interrogate databases

- Apply ESRI's data model and geodatabase structures to design and implement a database.
- Apply ESRI's Model Builder to design and implement an elementary urban change cellular automata model
- Apply NetLogo to design and implemet a simple biologic agent based model
- Apply appropriate GIS modeling procedures for a class project in your area of interest

Prerequisites: Geography 476 and 479.

Instructor commitment: The instructor will a) present clear, engaging, challenging lecture/lab presentations; b) keep the course on schedule; c) challenge each student to question; d) conduct fair and equitable evaluation of student work; e) encourage student participation; f) be available and accessible by email and office hours or appointments; g) be responsive to student needs/requests.
The instructor will not a) provide *the correct* answer without students' critical engagement of the question; b) scale grades to an established curve; c) pretend to teach; d) let students pretend to learn.

Student commitment: Students are required to engage with the course through regular attendance, active participation, and successful completion of all assignments. Students are also expected to read all assigned materials and to ask informed questions regarding the subject matter. As per the Student Handbook, students should anticipate two hours of course work for each hour of lecture or lab. Geog476 consists of two lecture and two lab hours a week meaning students can expect an estimated eight hours of self study beyond scheduled lecture and lab times. Students having difficulty completing the course work should consult with the instructor before falling behind.

Student Rights and Responsibilities: Your rights and responsibilities within the UWSP campus community, including required behavior by students and faculty within the classroom environment are detailed in these documents:
http://www.uwsp.edu/admin/stuaffairs/rights/rightsCommBillRights.pdf
http://www.uwsp.edu/admin/stuaffairs/rights/rightsChap14.pdf.

Required texts and reading assignments:
Expected dates for completion of reading assignments are listed with the lecture/lab schedule and with the lecture and lab material to which they pertain. Knowledge and understanding of required readings is expected prior to scheduled lecture and lab instruction and demonstrations.

Required texts:

- Worboys, M. F. and M. Duckam (2004). GIS - a Computing Perspective. New York, CRC Press. Available for rent at the bookstore and selected pages may be viewed at google books.

- Zeiler, M. and Environmental Systems Research Institute (2010). Modeling our world : the ESRI guide to geodatabase concepts. Redlands, Calif., ESRI Press. Select readings will be provided through the course page on D2L. Some pages are viewable at google books.

These articles and selected book chapters are required and will be available through e-reserve and linked to related lecture and lab pages.

1. Abdul-Rahman, A. and M. Pilouk (2008). Spatial Concepts and Data Models. Spatial data modelling for 3D GIS. Berlin; New York, Springer: 22-51.
2. Agarwal, C., G. M. Green, et al. (2000). A review and assessment of land-use change models: Dynamics of space, time, and human choice. Indiana University, USDA and USFS.
3. Bï¿½dard, Y. and F. Paquette (1989). Extending entity/relationship formalisim for spatial information systems. AUTO-CARTO 9m 9th International Symposium on Automated Cartography, Baltimore MD, ASPRS-ACSM.
4. Bolstad, P. (2005). Chapter 12: Spatial models and modeling. GIS fundamentals : a first text on geographic information systems. White Bear Lake, Minn., Eider Press.
5. Booth, B. and I. Environmental Systems Research (2002). Building a geodatabase. Redlands, CA, ESRI.
6. Breman, J. (2005). Introduction to ArcGIS Data Models. Training seminar. Redlands, CA, Environmental Systems Research Institute.
7. Calkins, H. W. (2000). "Entity-Relationship Modeling Of Spatial Data For Geographic Information Systems." Center for Urban SImulation and Policy Analysis (2008). The Design and Implementation of an Operational Urban Simulation System. Documentation: Puget Sound UrbanSim Application. Seattle: 3-28.
8. Chrisman, N. R. (1997). Chapter 1: Reference systems for measurement. Exploring geographic information systems. New York, J. Wiley & Sons: 15-35.
9. Chrisman, N. R. (1997). Chapter 3: Representation. Exploring geographic information systems. New York, J. Wiley & Sons: 71-83.
10. Clarke, K. C. and S. Hoppen (1997). "A self-modifying cellular automaton model of historical urbanization in the San Francisco Bay area." Environment & Planning B: Planning & Design 24(2).
11. Clarke, K. C., B. O. Parks, et al. (2002). Geographic information systems and environmental modeling, Upper Saddle River, N.J., Prentice Hall.
12. Codd, E. F. (1982). "Relational database: A practical foundation for productivity." Communications of the ACM 25(2): 109-117.
13. Crooks, A., C. Castle, et al. (2008). "Key challenges in agent-based modelling for geo-spatial simulation." Computers, Environment & Urban Systems 32(6).
14. Crowther, P. and J. Harnett (2001). Handling Spatial Objects in a GIS Database - Relational v Object Oriented Approaches. GeoComputation 2001 : proceedings of 6th international conference on geocomputation, 24th-26th September 2001, The University of Queensland, Brisbane Australia. D. V. Pullar, GeoComputation CD-ROM.

15. Dale, M. R. T., P. Dixon, et al. (2002). "Conceptual and mathematical relationships among methods for spatial analysis." Ecography 25(5).
16. DeMers, M. N. (2002). Chapter 5: Modeling essentials. GIS modeling in raster. New York, J. Wiley: 94-120.
17. ESRI. (2009). "ArcGIS Desktop 9.3 Help An overview of Model Builder." from link
18. Gardner, M. (1970). "The fantastic combinations of John Conway's new solitaire game "life"." Scientific American 223: 120-123.
19. Getis, A. (1999). Spatial statistics. Geographical information systems : principles, techniques, applications, and management. P. Longley, M. Goodchild, D. Maguire and D. Rhind. New York; Chichester, John Wiley: 239-251.
20. Grimm, V., U. Berger, et al. (2006). "A standard protocol for describing individual-based and agent-based models." Ecological modelling. 198(1): 115.
21. Guisan, A. and N. E. Zimmermann (2000). "Predictive habitat distribution models in ecology." ECOLOGICAL MODELLING 135(2-3): 147-186.
22. Liu, Y. (2009). Modelling urban development with geographical information systems and cellular automata. Boca Raton, Fla., Taylor & Francis.
23. Macal, C. M. and M. J. North (2005). Tutorial on agent-based modeling and simulation. Winter Simulation Conference 2005.
24. Macal, C. M. and M. J. North (2006). Tutorial on agent-based modeling and simulation Part 2: How to model with agents. Winter Simulation Conference 2006.
25. Maguire, D. J., M. Batty, et al. (2005). Chapter 1: GIS, Spatial Analysis, and Modeling Overview. GIS, spatial analysis, and modeling. Redlands, Calif., ESRI Press: 1-17.
26. Maguire, D. J., M. Batty, et al. (2005). GIS, spatial analysis, and modeling. Redlands, Calif., ESRI Press.
27. Nyerges, T. L. (1991). "Geographic information abstractions: conceptual clarity for geographic modeling." Environment and Planning A 23: 1483-1499.
28. Nyerges, T. L. (1993). Understanding the scope of GIS: Its relationship to environmental modeling. Environmental modeling with GIS. M. F. Goodchild, B. O. Parks and L. T. Steyaert. New York, Oxford University Press: 75-93.
29. Peuquet, D. J. (1984a). "A conceptual framework and comparison of spatial data models." Cartographica 21: 66.
30. Shekhar, S. and S. Chawla (2003). Spatial databases : a tour. Upper Saddle River, N.J., Prentice Hall.
31. Skidmore, A. and H. Prins (2002). Environmental modelling with GIS and remote sensing. London; New York, Taylor & Francis. Wilensky, U. (1999). NetLogo. Evanston, IL, Center for Connected Learning and Computer-Based Modeling.
32. Worboys, M. F. and M. Duckam (2004). 1. Introduction. GIS - a Computing Perspective. New York, CRC Press: 1-34.
33. Worboys, M. F. and M. Duckam (2004). 2.3 Database development. GIS - a Computing Perspective. New York, CRC Press: 55-82.
34. Worboys, M. F. and M. Duckam (2004). 4. Models of geospatial information. GIS - a Computing Perspective. New York, CRC Press: 133-165.

35. Worboys, M. F. and M. Duckam (2004). 6. Structure and access methods. GIS - a Computing Perspective. New York, CRC Press: 221-258.
36. Worboys, M. F. and M. Duckam (2004). 7. Architectures. GIS - a Computing Perspective. New York, CRC Press: 259-278.
37. Worboys, M. F. and M. Duckam (2004). 8. Interfaces. GIS - a Computing Perspective. New York, CRC Press: 293-316.
38. Worboys, M. F. and M. Duckam (2004). 10. Time. GIS - a Computing Perspective. New York, CRC Press: 359-382.
39. Zeiler, M. and Environmental Systems Research Institute (1999). Modeling our world : the ESRI guide to geodatabase design. Redlands, CA, ESRI Press.

Desire2Learn (D2L): The course D2L page is a resource for lecture, lab and assignment management. Students are expected to be familiar and proficient with all of D2L features and functions. Lecture/lab outlines are linked to online content, required readings and related assignments. Note: D2L course resources are not a substitute for attending lecture or lab. The lecture/lab content on D2L are not self-explanatory and do not support stand-alone self study. Drop boxes are used for submission of all course deliverables. Discussion forums for lecture, lab assignments and exams are open dialogs for questions and answers and all students are encouraged to participate or observe the postings because these conversations contribute to better understanding of the course learning outcomes.

Software: ESRI's ArcGIS software with extensions is used to illustrate course concepts presented in lecture and use by students in the lab exercises. The portion of the course dedicated to agent based modeling will use NetLogo and server-side database design will use Microsoft Server Studio 2008r. Dia diagram creation software will support authoring of model schema and data flows. Lecture and lab presentations introduce software fundamentals leading up to each lab exercise. Students' software proficiency develops in the lab exercises through experiential learning and critical thinking. Work to accomplish the lab exercises and software self study will require additional time investment outside the hours of scheduled lecture and lab meetings.

SIAL Lab policies: Lab policies are posted on bulletin boards in the SIAL. See Diane Stelzer in the department office to receive keys for the lab. Please pay attention to the rules for the keys on the signed form especially the ones that will result is revocation of key privileges.

Attendance: This course adheres to the UWSP attendance policy. Attendance is expected for all class meeting and absences will be noted. Regular attendance and participation in lecture and lab sessions are an integral and essential part of learning in this course. Attendence may be taken with a sign-in sheet at the beginning of each lecture/lab. After three absences a two point penalty will be applied to your final grade and again for each absence thereafter; see the grading scale below. Many themes presented in lecture and lab are not addressed in the required reading or on D2L content. University organization-sanctioned events, class field trips, death in the family, serious illness, accident, or similar are justifiable absences and will be considered for accommodation and a reasonable amount of additional help outside of normal lecture, lab and office hours. If you miss a class, even for a legitimate reason, you are still responsible for the material.

Lectures: Lectures introduce the theoretical background of database design and practical modeling with GIS and are further developed in the lab assignments. These build upon and extend material introduced in the required readings and concepts presented in prior lecture/lab meetings. They are the richest source of concise and accessible insight and knowledge needed to complete assignments and realize the course learning outcomes.

Labs: Course lecture material is linked with practical application in six lab exercises using the ArcGIS software suite. Exercises include software operation instructions and questions that address the operations and course concepts. Each exercise is worth eight or nine points; exercise questions are short answer worth 1-3 points each. In most cases the exercises will require more time than available in a lab period (110 min) to complete and students should anticipate some additional time commitment. Exercises are due generally 7-10 days after they are assigned and submitted through D2L drop boxes. Exercises not submitted by the due date will not be graded. Students are responsible for their own computer workspaces and maintaining current backups of all work; lab due dates are fixed regardless of lost or corrupt files. Exercises will be graded and reviewed in lecture the week after the due date. At least four lab assignments must be submitted before their scheduled due dates to receive a passing grade for the course.

Exercise	Assigned	Due
Ex. 1 Visualizing and representing reality: conceptual to logical		
Ex. 2 Cellular automata with Model Builder		
Ex. 3 Agent based modeling systems (ABMS) with NetLogo		
Ex. 4 RDMS and Structured Query Language (SQL)		
Ex. 5 Geodatabase design with domains, subtypes, and relationships		
Ex. 6 Data integration: Resolving incommensurability across spatial, temporal and semantic dimensions.		

Exams: The midterm and final exams are worth 15 and 10 points respectively. These are mostly short answer with some T/F and multi-choice. Students receive a list of learning outcomes covered on the exam a week before the exam date. Example question will be introduced in lecture/lab presentations and featured in the lecture quizzes. Time management during the exams is important; delay will make it difficult to answer all questions completely. Students who do not take the midterm and final exams are not eligible for a passing grade.

Evaluation: Final grades are based on points earned for successful completion of the lab exercises and exams weighted as follows:

60%	Laboratory exercises: 10 points ea.
20%	Midterm: 20 points.
20%	Final: 20 points

Grades will not be scaled except in extenuating circumstances. All students are eligible to earn an A; grades are not competitive.

Grading scale:

Points	Grade
93-100	A 4.0
90-93	A- 3.7
87-89	B+ 3.3
83-86	B 3.0
80-82	B- 2.7
77-79	C+ 2.3
73-76	C 2.0
70-72	C- 1.7
66-69	D+ 1.3
60-65	D 1.0
0 - 59	F

Final grade eligibility: To receive a passing grade you must meet these requirements:

- Submit at least four lab assignments on time.
- Take the midterm and final exams.

Graduate 681 requirements: Expectations and requirements for graduate students are different. The due dates, weights and grading scale for 681 are the same as 481 but the assignments and learning expectations are commensurate with graduate level studies. Lab assignments, midterm exam and final exam have additional or more challenging questions.

Printing costs: All student printers are now handed through UWSP-IT so you will be charged for 5 cents for each B&W page (single side) as well as 15 cents for each color copy (single side). You start out with $10 in a UWSP printing account for the semester (for all of your classes) and then are charged a fee at the end of the semester for any printing exceeding that initial balance. You can always check your student printing account on your myPoint portal page on the Finances tab. Most of your assignments that you hand-in will likely just be B&W copies and programming assignments will be graded through documentation (and final program) that you will deposit in your assigned class server directories.

Plagiarism: Plagiarism is defined in Chapter 14 of the UWSP Rights and Responsibilities section14.03. You plagiarize if you use someone else's ideas, even if you paraphrase them, and do not cite them. All assignments submitted to D2L drop boxes are evaluated with Turnitin.com for plagerism. Answers to exam questions that are too similar to be clearly original work will not receive a grade. See http://www.plagiarism.org for more explaination and steps you can take to avoid plagiarism.

Use of Cell Phones Use cell phones for voice or text messaging is not permitted during lecture. If you carry a cell phone please turn it off during lecture and leave the room if you must make/take a call during lab. Student who disregard this will be asked to leave the class for the remainder of that lecture or lab. Anyone expecting a phone call of an emergency nature may ask that their phone be on and are prepared to exit the class promptly if they receive a call.

Disabilities: Students with disabilities or requirements of any nature should meet with the instructor during the first week of classes to address satisfactory accommodation.

"Simply put, the greater the student's involvement or engagement in the academic experience of college, the greater his or her level of knowledge acquisition and general cognitive development" (*How College Affects Students*, Pascarella and Terenzini, 1991)

Getting help and how to succeed:

- *Attend lecture & lab meetings:* Regular lecture and lab section attendance is the single most effective investment toward success in Geog481. Lecture material builds upon and goes beyond the required readings as the foundation for the lab exercises. You should anticipate difficulty with timely completion of the lab exercises if you miss lecture/lab and do not recover.
- *Follow the learning outcomes:* The learning outcomes listed on the lecture and lab pages are the take home concepts of the course. They are what you need to know to succeed with GIS and are the basis for the lab exercises and exams.
- *Notetaking:* Taking notes during class meetings is a proven means of knowledge retention. Notes also help identify omissions and areas of difficulty during study and office hour consultations. Students are encouraged to share and compare notes with other students to improve understanding and learning.
- *Participate:* You are *always* encouraged to participate in class and on the D2L discussion forums by asking questions and contributing observations and comments. Active participation will improve your learning quality, quantity and proficiency.

- *Meet with the instructor:* The instructor is available to address your individual learning needs during office hours and by appointment. Scheduled office hours are open for drop-in consultation although prior scheduling is appreciated. Office hour topics include but are not limited to: a) further explaination of lecture material and lab exercises; b) software tech support; c) exam preparation; d) grading and evaluation discrepancies.
- *Submit assignments on time:* Prompt submission of required assignments by their due date is required to receive credit and insure you receive a passing grade. See the section on 'Final grade eligibility' for specific details.
- *Read the required readings:* Do this before the lecture/lab when they are discussed. Familiarity with the required reading is expected and serves as the foundation for lecture presentations. Required readings are part of the lecture quizzes.
- *Exam preparation:* Pay attention to the learning outcomes associated with the lectures and labs because these are basis for the quizzes, midterm and final. Make sure you know what is expected and practice answering the sample exam questions provided.
- *Do your own work:* Any lab exercise deliverable or exam question with answers that are too similar to others&' work to be unmistakably original will not receive a grade. Please take care to insure that your work is yours alone and not accessible to other students. All assignment deliverables are checked with Turnitin.com. See the section on plagiarism.