GEOL 5324
Geocomputation Syllabus
Fall 2016
CRN 18139

Lecture: M 9:00-10:50 GEO 320
Lab: W 9:00-10:50 GEO 409

Instructor

Deana Pennington
Department of Geological Sciences
GEO 305C
ddpennington@utep.edu
Office Hours: TBD, during lab, or by appointment

General Information

This course focuses on spatial simulation through time, computation and analytics using GIS in conjunction with other analysis and modeling software packages. Students will be introduced to fundamentals of scientific modeling and programming using Blockley, NetLogo, ArcGIS, and Python. In the last few weeks of the class students will be introduced to emerging topics in "big data" relevant to geospatial analysis and modeling.

Prerequisite: An introductory GIS course or equivalent experience.

Course Objectives

- Expand breadth and depth of GIS analysis and modeling concepts and skills
- Develop knowledge of tools, techniques, and methods used in spatial simulation
- Develop knowledge of principles of programming and practical programming skills
- Introduce newly emerging "big data" analysis and modeling approaches
- Foster ability to efficiently solve complex geospatial problems
- Develop experience completing a GIS project

Academic dishonesty

A student's submission of work for academic credit indicates that the work is the student's own. Any outside assistance should be acknowledged. While cooperation during class and in lab is encouraged, all assignments must be constructed and written by each individual student.

Makeup policy

Due dates are firm. 10% will be deducted for each day an assignment is late. Assignments will not be accepted more than one week late. Reading assignments must be complete prior to class. Summaries of assigned journal articles are due at the beginning of class. No late summaries of the reading will be accepted since the purpose is for you to be prepared for class.

Labs are due at the beginning of the next lab.

Students with Disabilities

Students with disabilities are referred to the Center for Accommodations and Support Services (CASS; http://sa.utep.edu/cass/) who will work with the instructor to identify appropriate adaptations to better foster a positive teaching and learning experience.

Drop Deadline
The deadline to drop this class is October 28th. No requests for a withdrawal will be approved by the College of Science after that date.

Course Textbooks
Reading will primarily be journal articles made available to you in one of the following ways (depending on logistics and copyright issues):

- on the Internet (e.g., certain open-access journal articles and websites);
- from a UTEP library database (go to the UTEP library home page, and type the exact name of the journal's title into the search window on the left side under E-Journals. This usually results in your being able to access the journal from one or more sources. Be aware that sometimes the listing suggests that fewer years are available than actually are, so always click as far as you can); or
- uploaded to Blackboard.

In addition, some of the labs and homeworks will include readings from Geospatial Analysis (http://www.spatialanalysisonline.com/HTML/index.html), a free, online textbook.

Grading

Class participation	25%
Homework	25%
Labs	25%
Final project presentation	10%
Final project write up	15%

Class participation
Class will be participatory rather than lecture based, and depends on your attendance and prior preparation. Your participation grade will be based half on attendance and half on a summary of assigned reading due at the beginning of each class. The summary should be ½ page single spaced, and should demonstrate that you completed the entire reading assignment. A sign in sheet will be available; you must sign in and turn in your summary by 9:00 to receive full credit. Late sign-ins will receive half credit for attendance for the day. Late summaries will not be accepted since the purpose is to ensure you are prepared for class.

Homeworks
Homeworks will be assigned to ensure that you understand the methods discussed in class and employed in lab. These will be throughout the course and will be given in lieu of a midterm exam.

Lab
Lab will be comprised of a set of exercises and accompanying questions to be answered, along with supporting maps and/or other visualizations. Please ensure that ALL visual products conform to the following quidelines:

A good map/visual should be technically correct, aesthetically pleasing, communicative, and thought provoking. Every map that you turn in will be reviewed using the following six guidelines:

1. Is the purpose clear? Is there a succinct and descriptive title?
2. Are all of the data selected relevant to the purpose? Are there one or more reference layers to provide context?
3. Is the selected level of detail appropriate for the purpose?
4. Are symbols distinctive, intuitive, and easy to interpret?

5. Are the categories appropriate for the purpose, and are there few enough to be cognitively manageable (seven or less)? Are the boundaries of the categories logical?
6. Are explanatory aids present? This includes title, date, author, legend, north arrow, scale bar, and data sources.

<u>Preliminary project proposal</u>
The project will be developed around any topic of interest to the student. The project must include some form of simulation that represents entities in space through time, and some outcome of interest that can be measured from simulation results.

The purpose of the project proposal is to verify that the work is appropriate in scope, that the methods proposed are appropriate, that any new data required in fact exist, and that it is possible to complete the project in the time allocated. This description should be 1-2 pages in length. It should be professionally written with paragraphs, complete sentences, and no grammatical errors. Figures should be numbered, labeled, and referenced in the text. Make sure to include the following:

- Goal: What problem will be addressed and why it is of interest to you. Please provide a concept map.
- Entities: What entities will be modeled? What are their properties and relationships of interest? Please provide a representation of these (from mental modeler or any other tool).
- What data are required and if new data are needed, where do you intend to obtain these data?
- What methods do you intend to use? Please provide a logic model.
- What concerns do you have or what problems do you anticipate encountering?

<u>Final Project</u>
The project must involve spatial simulation through time. It can be conducted from within any of the environments introduced in this class, but if outside of GIS, it must utilize GIS plugins and extensions in significant ways. Results will be presented during a presentation November 28, and in a project report due Wednesday December 7 at 1:00 pm.

Final Project Report Guidelines - Report sections must include:
Introduction
Goals and objectives
Methods
    Input data types
    Data abstraction table or diagram: Entities, properties, relationships
    Logic model
    Algorithmic flowchart of part of the code, that demonstrates looping and conditionals
    Pseudocode for that same part of the code
Results
    At least one map
    At least one graph showing analytical results through time
Issues
    Whatever issues you encountered that you were unable to resolve in the allotted time.
Conclusions
    A few sentences that relate how the results informed your original goals.

SCHEDULE (SUBJECT TO CHANGE)

DATE	LECTURE	ADVANCE READING	HOMEWORK	LAB (WED)
22-Aug	Introduction; Modeling and simulation, representation		HW 1: Essay	Lab 1: Blockley
29-Aug	Programming fundamentals	Hulse et al. 2016	HW 2: Programming	Lab 2: NetLogo 1
5-Sep	Labor Day - no class			Lab 3: NetLogo 2
12-Sep	Modeling goals	Choose 2 of 6 articles from Ecosphere Special Issue	HW 3: Concept map	Lab 4: NetLogo 3
19-Sep	Problem conceptualization	Argent et al. 2016	HW 4: Entities	Lab 5: NetLogo 4
26-Sep	Qualitative modeling	Herr et al. 2016	HW 5: MentalModeler	Lab 6: Python 1
3-Oct	Logic models	Pianosi et al 2016	HW 6: Logic models	Lab 7: Python 2
10-Oct	Calibration; Verification, & validation	Bennett et al. 2013	HW 7: 2 articles	Lab 8: Python 3
17-Oct	Modeling complex problems	Kelly et al. 2013	HW 8: Project entities	Lab 9: ArcPy 1
24-Oct	Modeling examples 1	TBD Student selections	HW 9: Project logic model	Lab 10: ArcPy 2
31-Oct	Modeling examples 2	TBD Student selections	HW 10: Project proposal	Lab 11: Geosimulation 1
7-Nov	Modeling examples 3	TBD Student selections		Lab 12: Geosimulation 2
14-Nov	Share your project design			Work on project
21-Nov	Computing with complex datasets (guest speaker)			Work on project
28-Nov	Presentations			Work on project
7-Dec	Final project write up due Wednesday 1:00 pm			

Assigned Journal Articles

Argent, R. M., Sojda, R. S., Guipponi, C., McIntosh, B., Voinov, A. A., & Maier, H. R. (2016). Best practices for conceptual modelling in environmental planning and management. *Environmental Modelling & Software*, *80*, 113–121.

Aronson, E. L., Bristol, S., Burgess, A. B., & et al. (2015). *Geoscience 2020: Cyberinfrastructure to reveal the past, comprehend the present, and envision the future* (No. ECWP-2015-1) (p. 19). EarthCube Working Paper, ECWP-2015-1, 19 p. http://dx. doi. org/10.7269/P3MG7MDZ. Retrieved from http://dx.doi.org/10.7269/P3MG7MDZ

Bennett, N. D., Croke, B. F. W., Guariso, G., Guillaume, J. H. A., Hamilton, S. H., Jakeman, A. J., … Andreassian, V. (2013). Characterising performance of environmental models. *Environmental Modelling & Software*, *40*, 1–20. http://doi.org/10.1016/j.envsoft.2012.09.011

Herr, A., Dambacher, J. M., Pinkard, E., Glen, M., Mohammed, C., & Wardlaw, T. (2016). The uncertain impact of climate change on forest ecosystems – How qualitative modelling can guide future research for quantitative model development. *Environmental Modelling & Software*, *76*, 95–107. http://doi.org/10.1016/j.envsoft.2015.10.023

Hulse, D., Branscomb, A., Enright, C., Johnson, B., Evers, C., Bolte, J., & Ager, A. (2016). Anticipating surprise: Using agent-based alternative futures simulation modeling to identify and map surprising fires in the Willamette Valley, Oregon USA. *Landscape and Urban Planning*. http://doi.org/10.1016/j.landurbplan.2016.05.012

Kelly (Letcher), R. A., Jakeman, A. J., Barreteau, O., Borsuk, M. E., ElSawah, S., Hamilton, S. H., … Voinov, A. A. (2013). Selecting among five common modelling approaches for integrated environmental assessment and management. *Environmental Modelling & Software*, *47*, 159–181. http://doi.org/10.1016/j.envsoft.2013.05.005

Nativi, S., Mazzetti, P., Santoro, M., Papeschi, F., Craglia, M., & Ochiai, O. (2015). Big Data challenges in building the Global Earth Observation System of Systems. *Environmental Modelling & Software*, *68*, 1–26. http://doi.org/10.1016/j.envsoft.2015.01.017

Pianosi, F., Beven, K., Freer, J., Hall, J. W., Rougier, J., Stephenson, D. B., & Wagener, T. (2016). Sensitivity analysis of environmental models: A systematic review with practical workflow. *Environmental Modelling & Software*, *79*, 214–232. http://doi.org/http://dx.doi.org/10.1016/j.envsoft.2016.02.008

Ecosphere Special Issue [Open Access] (choose 2):

Cortés Montaño, C., Fulé, P. Z., Falk, D. A., Villanueva-Díaz, J., & Yocom, L. L. (2012). Linking old-growth forest composition, structure, fire history, climate and land-use in the mountains of northern México. *Ecosphere*, *3*(11), art106. http://doi.org/10.1890/ES12-00161.1

Gutzler, D. S. (2013). Regional climatic considerations for borderlands sustainability. *Ecosphere*, *4*(1), art7. http://doi.org/10.1890/ES12-00283.1

Hogan, J. F. (2013). Water quantity and quality challenges from Elephant Butte to Amistad. *Ecosphere*, *4*(1), art9. http://doi.org/10.1890/ES12-00302.1

Johnston, B. R. (2013). Human needs and environmental rights to water: a biocultural systems approach to hydrodevelopment and management. *Ecosphere*, *4*(3), art39. http://doi.org/10.1890/ES12-00370.1

López-Hoffman, L., Breshears, D. D., Allen, C. D., & Miller, M. L. (2013). Key landscape ecology metrics for assessing climate change adaptation options: rate of change and patchiness of impacts. *Ecosphere*, *4*(8), art101. http://doi.org/10.1890/ES13-00118.1

Scott, C. A., & Buechler, S. J. (2013). Iterative driver-response dynamics of human-environment interactions in the Arizona-Sonora borderlands. *Ecosphere*, *4*(1), art2. http://doi.org/10.1890/ES12-00273.1

Sheng, Z. (2013). Impacts of groundwater pumping and climate variability on groundwater availability in the Rio Grande Basin. *Ecosphere*, *4*(1), art5. http://doi.org/10.1890/ES12-00270.1

Walsh, C. (2013). Water infrastructures in the U.S./Mexico borderlands. *Ecosphere*, *4*(1), 1–20. http://doi.org/10.1890/ES12-00268.1