GEOG 5160/6160
Spatial Modeling with GIS

Professor: Simon Brewer
Contact information: simon.brewer@geog.utah.edu, OSH 270H
Office Hours: Mon/Weds 9:00-10:30am

Teaching Assistant: Yangyi Wu
Contact information: yangyi.wu@geog.utah.edu
Office Hours: TBA

Class time and location: Mon-Wed 11:50am-1:10pm; Bldg 72 Room 115
Lab time and location: Mon 1:25pm-2:45pm; AEB 330

Course Description: The power to model complex environmental systems in a geo-spatial framework is one of the great assets of GIS. This course places the fundamental operations and software of spatial analysis and GIS in a modeling framework. The course addresses advanced concepts and techniques in map algebra, cartographic modeling, and descriptive and predictive spatial modeling. The course has both lecture and required lab components. Graduate students should enroll in GEOG 6160 and will be held to higher standards and/or more work.

Note: This course is designed for intermediate and advanced GIS students. GEOG 5140/6140 Methods in GIS as well as sufficient proficiency in ArcGIS® (especially ArcMapTM and ArcCatalogTM) is a prerequisite for this course.

Course Objectives: The objective of the course is to develop students’ fundamental knowledge and skills in spatial modeling in GIS environments. After successful completion of this course, students will be able to
- Describe important theories and concepts in spatial modeling
- Explain and compare various types of spatial models
- Discuss issues and considerations associated with spatial modeling
- Critically review real-world applications of GIS-based spatial modeling, and
- Design and develop prototypical spatial models in GIS environments.

This course primarily utilizes ArcGIS® as an example of GIS environments, but also includes exposure to other software for modeling spatial problems.

Teaching & Learning Methods: This course consists of lecture and lab components. The lecture component will primarily focus on theoretical aspects of spatial modeling and will include discussion of example applications. The lab component will give students hands-on experience in GIS-based spatial modeling. Reading assignments will also be given to further students’ understanding of materials presented in the lectures and labs. A final project will provide students with an
opportunity to apply theories and methods learned in the course to topics of their own interest.

Course materials:
- Textbooks
  - Other reading assignments are listed in the tentative course schedule.
- Online materials
  - This course will use the Canvas system to provide students with access to course announcements, lecture note outlines, and other course-related materials. It is your own responsibility to check the site periodically to obtain necessary information in a timely manner.

Grading:

- Exams (2) 2x20 = 40pts
- Lab assignments (10) 10x5 = 50pts
- Final project 35pts
- Total 125pts

- Examinations (20 pts. × 2)
  - There will be two examinations at the middle and the end of the semester (scheduled on February 28 and April 25); exam dates will be finalized at least two weeks in advance. The exams may include, but not limited to, multiple choice questions, short essay questions, interpretation tasks, calculation tasks, and problem solving questions.
  - Exam contents will emphasize theories, concepts, methods, and applications covered in lectures, labs, and assigned readings. The exams will not contain computer components, that is, there are no questions regarding “how to use ArcGIS.” The second exam might be cumulative depending on results of the first exam.
  - No “make-up” exams will be given; notify the instructor at least two weeks in advance of a scheduled exam date if an alternative date is necessary.
- Lab assignments (5 pts. × 10)
  - There will be ten lab assignments. The labs are designed to reinforce students’ understanding of materials covered in lectures and to give them hands-on experience in GIS modeling.
  - You will need some form of storage media on which to back up your data and work.
  - Lab assignments must be turned in through Canvas
- Final project (35 pts.)
  - Students will be required to build a prototypical spatial model as a final project.
Evaluation of the final project will be based on a two-page proposal (5 pts.; due on February 21), an in-class presentation (10 pts; scheduled on April 21 and 23), and a final report (20 pts.; due on April 30). More information is given below.

- Project work should be submitted using Canvas

- Letter grades will be assigned following the scheme provided below, using .5 as the break point:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Score Range</th>
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<tbody>
<tr>
<td>A</td>
<td>95+</td>
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<tr>
<td>A-</td>
<td>90~94</td>
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<tr>
<td>B+</td>
<td>85~89</td>
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<tr>
<td>B</td>
<td>80~84</td>
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<tr>
<td>B-</td>
<td>75~79</td>
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<tr>
<td>C+</td>
<td>70~74</td>
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<td>C</td>
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<td>C-</td>
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<td>D</td>
<td>50~59</td>
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<tr>
<td>E</td>
<td>~49</td>
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Class schedule:
The tentative schedule of the course and associated reading assignments are listed in the table below. Please note that this schedule is subject to change in the event of extenuating circumstances.

<p>| Date   | Topic                          | Reading     | Lab              |
|--------|                               |-------------|------------------|
| 01/08  | Course introduction           | Syllabus    | No lab           |
| 01/10  | Introduction to spatial modeling | SS Chapters 1-2 |                |
| 01/15  |                                |             | MLK Day          |
| 01/17  | Geosimulation                 |             |                  |
| 01/22  | Cellular automata I           | SS Chap. 3  | Cellular automata 1 |
| 01/24  | Cellular automata II          |             |                  |
| 01/29  | Agent-based models I          | SS Chap. 4-5 | Cellular automata 2 |
| 01/31  | Agent-based models II         |             |                  |
| 02/05  | Agent-based models III        | SS Chap. 6  | Agent-based models 1 |
| 02/07  |                                |             | Project discussion|
| 02/12  | Map algebra review I          | GMR Chap. 3-5 | Agent-based models 2 |
| 02/14  | Map algebra review II         |             |                  |
| 02/19  |                                |             | Presidents’ Day  |
| 02/21  | Dynamic raster modeling I     | GSAM Chap. 16 |                |
| 02/26  | Dynamic raster modeling II    |             | Dynamic raster models 1 |
| 02/28  |                                |             | Exam 1           |
| 03/05  | Uncertainty in GIS modeling I | GSAM Chap. 2 | Dynamic raster models 1 |
| 03/07  | Uncertainty in GIS modeling II| SS Chapter 7 |                  |
| 03/12  | Uncertainty in GIS modeling III|            | Uncertainty 1   |</p>
<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
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<tbody>
<tr>
<td>03/14</td>
<td>Group project work</td>
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<tr>
<td>03/19</td>
<td>Spring break</td>
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<tr>
<td>03/21</td>
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<tr>
<td>03/26</td>
<td>Spatial interaction modeling I</td>
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<tr>
<td></td>
<td>SI Chapters 1-2; GSAM Chap. 11</td>
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<tr>
<td>03/28</td>
<td>Spatial interaction modeling II</td>
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<tr>
<td>04/02</td>
<td>Spatial interaction modeling III</td>
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<td></td>
<td>GSAM Chap. 13</td>
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<td>04/04</td>
<td>Group project work</td>
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<tr>
<td>04/09</td>
<td>Transportation models I</td>
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<td></td>
<td>GT Chap. 8</td>
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<tr>
<td>04/11</td>
<td>Transportation models II</td>
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<td>04/16</td>
<td>Group project work</td>
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<td>04/18</td>
<td>Final project presentations</td>
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<td>04/23</td>
<td>Final project presentations</td>
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<td>04/25</td>
<td>Exam 2</td>
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**Textbook title abbreviations:**

**Guidelines for the final project:** Students will be required to conduct a group final project and build a prototypical spatial model. The objective of the final project is to provide students with an opportunity to solidify conceptual and technical topics learned in class by actually developing their own models within a GIS environment. Ideally, this experience will help them enhance their professional portfolio as they apply for jobs or graduate schools.

Students will be asked to form groups of three or four, based on their application/research interests (e.g., transportation, urban development, earthquakes, environmental conservation, and wildfire). Each group will choose a topic, determine a spatial problem to solve, collect data, and develop a spatial model. The final project is primarily a self-directed exercise that will require you to synthesize your GIS knowledge and creativity. Be sure to choose a topic/spatial problem that you are really interested in and start early.
• Students may use the same data and/or references that they have used/will use in their other projects. However, the final products to be presented or submitted for this course should be independent of any other projects.

• Examples of potential topics:
  o A gravity model that predicts migration flows from/to Utah
  o A spatial interaction model to evaluate accessibility to hospitals among county residents
  o An urban growth/land use change model for a town you live in
  o A transportation model to predict future congestion levels in the highway system in Utah
  o A model of West Nile virus risk potential
  o A watershed based hydrological model

Evaluation of the final project will be based on (1) a two-page proposal of the project, (2) an in-class presentation, and (3) a final report describing functions implemented in the model and background science. The proposal and presentation should be completed by the group. A final report should be completed and submitted by each student.

• Two-page proposal will include:
  o Description of a general topic that a group has chosen to work on
  o Description of a more specific spatial problem to solve via GIS-based spatial modeling
  o Work plan of the group (e.g., who will do what)
  o Tentative list of references for the topic and the spatial problem
  o Tentative list of data sets to be used in the project
  o **Note:** If you want to change topics or spatial problems, please contact the instructor. Substantial changes may require a new proposal to be submitted

• Final report (must be typed; 10-15 pages; double space, 10-12 fonts) will include:
  o Introduction to the general topic of the group project
  o Description of the specific spatial problem that your model attempts to solve and the objectives of the modeling exercise
  o Review of the literature on similar models previously developed
  o Conceptual framework upon which your model is built
  o Description of GIS data sets (real or synthetic) to be used to run your model
  o A description of the model, with sufficient detail to allow reproduction of your code. [If possible, submit actual data and the model in electronic format.]
  o Sample results from model runs
  o Discussion relating your results to the problem under investigation
  o Conclusions
  o Bibliography that lists all the references “cited” in the report

• Do not include references that you read for the project but are not cited.
• Your in-class presentation will be a condensed version of the final report. Use of PowerPoint presentation or like is strongly recommended.

• Important dates:
  o Two-page project proposal due: March 02, 2018
  o Final report due: April 29, 2018
  o Final presentation days: April 18 and 23, 2018

Class policies:
• Evaluation-related policies
  o Individual extra credit will not be assigned.
  o There will be no “make-up” exams, quizzes, or assignments.
  o An “incomplete” grade will be given only in extreme cases when conditions beyond the student’s control require an extended period of absence.
  o Any assignments, including the final project report, submitted to the instructor after its due date will be worth only half of the earned points.
  o Materials to be turned into the instructor must be typed, and turned in using Canvas.
  o Students are encouraged to help each other in their work. However, final products turned into the instructor must display evidence of individual initiative and creativity. If not, no credits will be given to the particular work.

• Attendance
  o Full attendance is strongly recommended. The amount of material covered in class meetings is significant and the content of the course is progressive, meaning you must know the material from previous class meetings in order to understand subsequent material. When missing classes, students are responsible for seeking help to catch up with the class progress in a timely manner, if they need to.

• Email correspondence
  o Students must copy themselves on any email to the instructor to ensure documentation of submission date and time. Doing so will assist the student when system outrages occur.
  o Senders must also validate that all files are in readable format. Corrupted files are the responsibility of the sender and corrupted-file assignments will be marked as late.

• Cell phones
  o Please turn off your cell phones or use vibrate/silence mode during class meetings.

• Student responsibilities
  o All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook of the University of Utah (http://www.acs.utah.edu/sched/handbook/toc.htm). Students have
specific rights in the classroom as detailed in Article III of the Code. The Code also specifies proscribed conduct (Article XI) that involves cheating on tests, plagiarism, and/or collusion, as well as fraud, theft, etc. Students should read the Code carefully and know they are responsible for the content. According to Faculty Rules and Regulations, it is the faculty responsibility to enforce responsible classroom behaviors, beginning with verbal warnings and progressing to dismissal from class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee.

- Liability warning
  - Students are responsible for all activities on their computer accounts. Keep your user name and password confidential.

ACADEMIC MISCONDUCT SYLLABUS STATEMENT
- Academic misconduct will not be tolerated. Penalties may include failure of an assignment, the entire course, and/or the filing of formal charges with appropriate university authorities. Academic misconduct includes, but is not limited to, cheating, misrepresenting one’s work, and plagiarism:
- Cheating involves the unauthorized possession or use of information in an academic exercise, including unauthorized communication with another person during an exercise such as an examination.
- Misrepresenting one’s work includes, but is not limited to, representing material prepared by another as one’s own work or submitting the same work in more than one course without prior permission of all instructors.
- Plagiarism means the intentional unacknowledged use or incorporation of any other person’s work in one’s own work offered for academic consideration or public presentation.

As the only institution in the state classified in the highest research category (R1), at the University of Utah you will have access to state-of-the-art research facilities and be able to be part of the knowledge creation process. You will have the opportunity to do research of your own with faculty who are leading experts in their field, engaging in programs that match your research interests. Further, you will interact with and often take classes with graduate students that provide an advanced understanding of the knowledge in your field.

The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the instructor and to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD) to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability Services.
CSBS EMERGENCY ACTION PLAN

BUILDING EVACUATION
EAP (Emergency Assembly Point) – When you receive a notification to evacuate the building either by campus text alert system or by building fire alarm, please follow your instructor in an orderly fashion to the EAP marked on the map below. Once everyone is at the EAP, you will receive further instructions from Emergency Management personnel. You can also look up the EAP for any building you may be in on campus at http://emergencymanagement.utah.edu/eap.

CAMPUS RESOURCES
U Heads Up App: There's an app for that. Download the app on your smartphone at alert.utah.edu/headsup to access the following resources:
• Emergency Response Guide: Provides instructions on how to handle any type of emergency, such as earthquake, utility failure, fire, active shooter, etc. Flip charts with this information are also available around campus.
• See Something, Say Something: Report unsafe or hazardous conditions on campus. If you see a life threatening or emergency situation, please call 911!

Safety Escorts: For students who are on campus at night or past business hours and would like an escort to your car, please call 801-585-2677. You can call 24/7 and a security officer will be sent to walk with you or give you a ride to your desired on-campus location.
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