Spring 2008 GEOG 5160/6160 Spatial Modeling with GIS
Department of Geography, University of Utah

Syllabus

Instructor: Ikuho Yamada, Ph.D.
Email: ikuho.yamada@geog.utah.edu
Phone: 585-3177
Office: OSH 270 J
Office hours: Mon. & Wed. 2:45 – 4:15 p.m.
Teaching assistant: Richard Medina
Email: richard.medina@geog.utah.edu
Office hours: TBA

Class # (section #): 8848/8923 (001/001)
Catalog number: GEOG 5160/6160
Time: Mon. & Wed. 8:05 – 9:25 a.m.
Location: OSH 273
Units: 3.0

Catalog 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.

- Prerequisites:
  - GEOG 5140/6140 Methods in GIS.
  - Students should also be comfortable completing tasks within the ArcGIS environment.

- Graduate students should enroll in GEOG 6160 and will be held to higher standards and/or more work.

Course objective:
This course is designed for intermediate and advanced GIS students. The objective of the course is to introduce advanced topics in modeling of spatial phenomena in GIS environments. In the course of the semester, you will

1. learn a variety of modeling frameworks as well as their advantages, disadvantages, and real-world applications,
2. review articles to critically analyze models discussed in them, and
3. build prototypical spatial models within a GIS environment.

You will use ArcGIS® as an example of GIS environments, so that you are expected to know basic operations in ArcGIS®, especially ArcMap™ and ArcCatalog™.
Course materials:

- Textbooks
  - There will be other reading assignments including book chapters and journal articles as listed in the tentative course schedule (page 5). Announcements will be made through the WebCT system (see below) when additional readings are required.

- Storage media
  - You will be assigned computer-based lab exercises during the course of the semester. You should have some form of media on which to back up your data and work.

- Online materials.
  - This course has an online component using the WebCT (web course tools) system ([https://webct.utah.edu/webct/logonDisplay.dowebct](https://webct.utah.edu/webct/logonDisplay.dowebct)), which provides access to course announcements, lecture note outlines, and other information related to the course. It is your own responsibility to check the site periodically to obtain necessary information in a timely manner.
  - See [http://webct.utah.edu/](http://webct.utah.edu/) for more information about the WebCT system. You must logon to WebCT using your university Network ID (uNID).

Evaluation:

Evaluation of this course will be based on the following components.

<table>
<thead>
<tr>
<th>Evaluation Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm exam</td>
<td>25%</td>
</tr>
<tr>
<td>Final exam</td>
<td>25%</td>
</tr>
<tr>
<td>Lab exercises</td>
<td>25%</td>
</tr>
<tr>
<td>Final project and presentation</td>
<td>25%</td>
</tr>
<tr>
<td>Class participation(extra credits)</td>
<td>Up to 5%</td>
</tr>
</tbody>
</table>

- Examinations (25% × 2)
  - There will be two examinations at the middle and the end of the semester; 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, and interpretation tasks. Exam contents will emphasize theories and applications covered in lectures, assigned readings, and concepts covered in lab exercises. 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. “Make-up” exams will not be given. Notify the instructor at least one week in advance of a scheduled exam date if an alternative date is necessary.

- Lab exercises (5% × 5)
  - There will be five assignments; each will be worth 5% of the total grade. The lab exercises are designed to reinforce students’ understanding of the theories and concepts covered in lectures as well as to give them hands-on experience with GIS modeling.
• Final project and presentation (25%)
  o As a final project, students will be required to build a prototypical spatial model using
    ArcGIS and present it in class. Detailed information about the final project is provided in
    pages 5-6.

• Grading scheme
  o Final letter grades will be assigned according to the scheme provided below. Grades on
    the upper edge of a grade interval will be rounded to the next letter grade using .5 as the
    break point (i.e., 89.5 → 90 → A-, 89.4 → 89 → B+). No additional rounding will be
    provided to students whose grade is “on the bubble.”

<table>
<thead>
<tr>
<th>Grade</th>
<th>Lower Limit</th>
<th>Upper Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>95~</td>
<td>94~</td>
</tr>
<tr>
<td>A-</td>
<td>90~94</td>
<td>90~</td>
</tr>
<tr>
<td>B+</td>
<td>85~89</td>
<td>89~</td>
</tr>
<tr>
<td>B</td>
<td>80~84</td>
<td>80~</td>
</tr>
<tr>
<td>B-</td>
<td>75~79</td>
<td>75~</td>
</tr>
<tr>
<td>C+</td>
<td>70~</td>
<td>74~</td>
</tr>
<tr>
<td>C</td>
<td>65~</td>
<td>69~</td>
</tr>
<tr>
<td>B+</td>
<td>85~</td>
<td>89~</td>
</tr>
<tr>
<td>B</td>
<td>80~</td>
<td>84~</td>
</tr>
<tr>
<td>B-</td>
<td>75~</td>
<td>79~</td>
</tr>
<tr>
<td>C</td>
<td>60~</td>
<td>64~</td>
</tr>
<tr>
<td>C-</td>
<td>55~</td>
<td>59~</td>
</tr>
<tr>
<td>D</td>
<td>50~</td>
<td>54~</td>
</tr>
<tr>
<td>E</td>
<td>45~</td>
<td>49~</td>
</tr>
</tbody>
</table>

Class policies:
• Evaluation related policies
  o Individual extra credit will not be assigned.
  o There will be no “make-up” exams or assignments.
  o An “incomplete” will be given only in extreme cases when conditions beyond the
    student’s control require an extended period of absence.
  o Any assignment presented 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. No hand-written
    assignments are accepted.

• Attendance
  o Perfect attendance is strongly recommended. The amount of material covered in a class
    meeting 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. If students miss two consecutive classes, they should notify the instructor and
    provide an explanation. Otherwise, students may be contacted by the University and be
    required to document that they have not unofficially withdrawn from the class.

• Student Responsibilities
  o Each student in this course is expected to act and behave according to the rules and
    regulations identified in the Student Handbook of the University of Utah
    (http://www.acs.utah.edu/sched/handbook/toc.htm). All students are expected to: (1)
    attend every class, (2) take lecture notes, (3) review the assigned readings before every
    class, (4) complete assignments and examinations on time, (5) participate in class
    discussions, and (6) conduct themselves as adults in the classroom.
  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.
• Academic Misconduct
  o 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.
  o 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.
  o 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.
  o 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.
• Liability Warning
  o Students are responsible for all activities on their computer accounts. Keep your user
    name and password confidential.
• 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 the class, reasonable prior notice
  needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020
  (V/TDD). CDS will work with you and the instructor 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.

Tentative course schedule:
The tentative schedule of the course and associated reading assignments are listed in the following table.
Please note that this schedule as well as the procedures explained above is subject to change in the event
of extenuating circumstances.
• Abbreviations used in the schedule table:
  o GSAM: Maguire, D.J., M. Batty, and M.F. Goodchild (2005). GIS, Spatial Analysis,
• Other reading materials:
  o Parker, D.C., S.M. Manson, M.A. Janssen, M.J. Hoffmann, P. Deadman (2003). “Multi-
    Agent Systems for the Simulation of Land-Use and Land-Cover Change: A Review.”
    Center for Advanced Spatial Analysis Working Paper Series 28. Available at:
<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topics</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/7</td>
<td>Course introduction</td>
<td>Syllabus</td>
</tr>
<tr>
<td></td>
<td>1/9</td>
<td>Introduction to spatial modeling</td>
<td>GSMA Chapters 1&amp;21</td>
</tr>
<tr>
<td></td>
<td>1/14</td>
<td>GIS modeling environment</td>
<td>GSMA Chapter 2</td>
</tr>
<tr>
<td></td>
<td>1/16</td>
<td><strong>Lab 1: Introduction to ModelBuilder</strong></td>
<td>---</td>
</tr>
<tr>
<td>2</td>
<td>1/21</td>
<td>Martin Luther King Jr. Day</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>1/23</td>
<td>Map algebra and cartographic modeling I</td>
<td>GMR Chapters 3-5</td>
</tr>
<tr>
<td></td>
<td>1/28</td>
<td>Map algebra and cartographic modeling II</td>
<td>The same as 1/23</td>
</tr>
<tr>
<td></td>
<td>1/30</td>
<td>Spatial interaction modeling I</td>
<td>SI Chapters 1-2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GSMA Chapter 11</td>
</tr>
<tr>
<td>3</td>
<td>2/4</td>
<td><strong>Lab 2: Map algebra</strong></td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>2/6</td>
<td>Spatial interaction modeling II</td>
<td>The same as 1/30</td>
</tr>
<tr>
<td>4</td>
<td>2/11</td>
<td>Spatial interaction modeling III (ArcGIS Spatial Analyst)</td>
<td>The same as 1/30</td>
</tr>
<tr>
<td></td>
<td>2/13</td>
<td>Transportation modeling I</td>
<td>GSMA Chapters 10&amp;13</td>
</tr>
<tr>
<td>5</td>
<td>3/3</td>
<td>Midterm exam</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>3/5</td>
<td>Uncertainty in GIS modeling</td>
<td>---</td>
</tr>
<tr>
<td>6</td>
<td>3/10</td>
<td>Geosimulation</td>
<td>GS Chapter 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GSMA Chapter 6</td>
</tr>
<tr>
<td></td>
<td>3/12</td>
<td><strong>Lab 4: Introduction to Python</strong></td>
<td>---</td>
</tr>
<tr>
<td>7</td>
<td>3/17, 19</td>
<td>Spring break</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>3/24</td>
<td>Cellular automata and multiagent systems I</td>
<td>GS Chapter 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GSMA Chapter 8</td>
</tr>
<tr>
<td>12</td>
<td>3/26</td>
<td>Cellular automata and multiagent systems II</td>
<td>GS Chapter 5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>GSMA Chapter 19</td>
</tr>
<tr>
<td>13</td>
<td>3/31</td>
<td>Land Use Land Cover (LULC) change models</td>
<td>GSMA Chapters 17&amp;19</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Parker et al. (2003)</td>
</tr>
<tr>
<td>14</td>
<td>4/2</td>
<td><strong>Lab 5: LULC modeling</strong></td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>4/7</td>
<td>TBA (or final project preparation)</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>4/9</td>
<td>Final project preparation</td>
<td>---</td>
</tr>
<tr>
<td>15</td>
<td>4/14, 16</td>
<td>AAG week (Instructor away)</td>
<td>---</td>
</tr>
<tr>
<td>16</td>
<td>4/21</td>
<td>Final project presentation</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>4/23</td>
<td>Final project presentation</td>
<td>---</td>
</tr>
<tr>
<td>17</td>
<td>4/28</td>
<td>Final Exam 8:00-10:00</td>
<td>---</td>
</tr>
</tbody>
</table>

**Guidelines for the final project:**

As a final project, students will be required to build a prototypical spatial model using ModelBuilder, which is a model building environment available in ArcGIS. 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.
The final project is primarily a self-directed exercise that will require you to use your creativity and synthesize your GIS knowledge. Be sure to start early and choose a topic that you are really interested in.

- Students may use the same data and/or articles that they have used/will use in their other projects. However, the final product to be submitted to the instructor should be independent of any other projects.
- Undergraduate students (GEOG 5160) may work in pairs. But if you choose to do so, be sure to choose a “right” partner! It is your own responsibility that you and your partner work “together.”
  - Also note that my expectation would be higher when students work in pair.
  - Graduate students (GEOG 6160) must work independently (i.e., no group work will be accepted).
- Evaluation of the final project will be based on (1) a one-page proposal of the project, (2) a paper describing functions implemented in the model and background science, and (3) an in-class presentation.
- One-page proposal:
  - You should describe general problems you are going to work on and objectives of your model/script to be developed.
  - It is also recommended that you include a list of potential references.
- Expected outputs of the final project:
  - A description of the problem your model attempts to solve as well as the objectives of the modeling exercise,
  - A review of the literature on similar models previously developed. A minimum of 5 references (journal articles, book chapters, etc.) is required,
  - A conceptual framework upon which your model is built,
  - A set of GIS datasets (real or synthetic) that can be used to run your model,
  - The ModelBuilder model,
  - Sample results from model runs, and
  - A report (must be typed; about 10 pages; double space, 10-12 fonts) and Power Point presentation (about 10-15 minutes) summarizing the elements listed above.
- Examples of potential topics:
  - A gravity model that predicts migration flows to Utah
  - A spatial interaction model that compares the accessibility of hospitals to the location of Salt Lake County residents
  - An urban growth/landuse change model for a town you live in
  - A network model to predict future congestion levels in the highway system in Utah
  - A model of West Nile virus risk potential
  - A model of earthquake damage potential
- Important dates
  - One-page project proposal due: **February 25th, 2008**
  - Final paper due: **April 23rd, 2008**
  - Final presentation days: **April 21st and 23rd, 2008**