

## GEOG 5226 Spatial Simulation and Modeling in GIS AU 2021 (In-Person)

### **Class Meetings:**

- Monday & Wednesday 2:20 pm – 3:40 pm
- Derby 0135

### **Instructor Information:**

- Instructor: Dr. Sohyun Park, [park.2627@osu.edu](mailto:park.2627@osu.edu)
- Office Hours: Thursday 11:30-3:00pm in Derby 1120, or by appointment (Zoom meeting is also available).

### **TA Information:**

- Instructor: Xiaoyu Liang, [liang.918@osu.edu](mailto:liang.918@osu.edu)
- Office Hours: Tuesday 12:00-2:00pm in Derby 1086, or by appointment (Zoom meeting is also available).

### **Prerequisite:**

- N/A

### **Course Description:**

This course is about the use of computational techniques to simulate the evolution of complex spatial systems such as ecosystems, transportation, weather/climate, cities, economies, societies and landscapes. These and other complex systems have a multitude of relatively simple parts interacting over space and time to create surprising, emergent behaviors. Powerful computational techniques, often linked with GIS software, allow the simulation of realistically large systems at a fine-level of granularity, providing new insights that were unavailable through traditional modeling techniques.

We will explore three major types of “building-blocks” at the core of many dynamic spatial models: i) spatial aggregation and segregation processes; ii) random walks and mobile entities, and; iii) percolation and growth processes. We will also discuss issues such as the role of spatial simulation in geographic information science, representation of space and time, how to build more complete models of human, physical and linked human-physical dynamic spatial processes, and how to evaluate model performance and uncertainty.

The course is divided into weekly modules which are released weekly. Students are expected to keep up with weekly deadlines. This is a 3-credit hour class. For each week, students should expect approximately 3 hours spent on in-person lectures and labs, and 6 hours of independent study such as textbook reading, online quizzes, lab assignments and preparation for the exam to earn a C grade.

## Learning Objectives:

1. Think like a spatial scientist: The ability to conceptualize real-world phenomena as comprised of fundamental spatio-temporal processes occurring in specific geographic contexts
2. Understand spatial simulation as a tool for scientific investigation: The ability to translate theory into simulation models and design experiments for investigating theory; an understanding of the strengths and weaknesses of this approach to scientific investigation.
3. Understand common spatial simulation techniques: A basic understanding of techniques that are especially well-suited for simulating physical and human geographic processes.
4. Design and use of spatial simulation techniques: The ability to design a spatial simulation based on a real-world process and experiment with the model to understand that process.
5. Develop spatial simulation software skills: The ability to program and conduct experiments within the NetLogo software environment.

## Materials:

- Textbook (required):
  - O'Sullivan, D. and Perry, G. (2013) *Spatial Simulation: Exploring Pattern and Process*, Wiley. Available at university bookstore; also available in e-book format from Carmen website.
- Readings:
  - Additional readings and webpages will be posted at the Canvas course website. These resources will provide additional background material as well as deeper dives into the science behind the models discussed in class.
- Data storage:
  - A portable memory device (with 16GB or larger storage) or a cloud drive (Box, Dropbox etc.) is needed for data storage.

## Evaluation:

- Lab Assignments – 50%
  - There will be a total of seven NetLogo-based lab assignments throughout the semester. All lab assignments will be submitted via the course website and count toward your final grade of the course.
- Exams – 50%
  - There will be 4 short open-book examinations (<30 questions) during the semester. Exam questions will be drawn from the lectures, textbooks and labs. Exams will be online using Carmen during normal class times using the computers in our classroom. Exams must be taken at the place and time designated unless you have made prior, approved arrangements.
- Attendance – Extra credit up to 5%

- Considering previous (and on-going) situation, attendance will not be counted to the normal evaluation. Instead, you will get extra credit for attendance (0.2% per class, you get 5% if you attend more than 25 classes, including lectures, labs, and exams). An attendance sheet will be passed around the classroom.
- Grading Scale (OSU standard scale):
 

A	93-100%	B-	80-82%	D+	67-69%
A-	90-92%	C+	77-79%	D	60-66%
B+	97-89%	C	73-76%	E	0-59%
B	83-86%	C-	70-72%		
- Your final grade as seen on the course website will be rounded to the nearest whole number (e.g. an 89.49 is a B+ while an 89.50 is an A) before being submitted to the University Registrar at the end of the semester.

### Course Policies:

- Email correspondence policy
  - You are responsible for all course related emails, so be sure to check your inbox on a daily basis.
  - When emailing your instructor, please always begin the subject of the email with the course number (GEOG5226) and your name (first name followed by last name). This is important as your instructor and TA teach multiple classes and need to know to which class you are referring. A proper email subject should be like this:  
     GEOG5226\_Jesse Pinkman\_Schedule a make-up exam
- Course website policy
  - You are responsible for all announcements, additional readings, assignments and other material posted on the course website. Be sure to check it frequently.
- Lab questions policy
  - Please send your lab-related questions as least 24 hours before the day/time the lab is due to allow your TA time to respond.
- Late submission policy
  - Lab assignments will be penalized 10% for each day late. Thus, assignments submitted 10 days after the deadline will be graded 0.
  - For extensions, you should inform and get approved by the instructor or TA 3 days before the deadline.
  - Extensions will not be granted due to lost work. Be sure you back up and keep all your work.
- Exam policy
  - Exams must be taken at the scheduled time, unless you have informed your instructor before the exam with proper reasons and documents, and got approved by the instructor. Please contact your instructor in advance of the scheduled exam to schedule a make-up exam, except in the case of emergency.
  - You are expected to finish all exams on time.
- Disability services policy

- Students with disabilities that have been certified by the Office for Disability Services (SLDS) will be appropriately accommodated and should inform the instructor as soon as possible of their needs.
  - Address: 098 Baker Hall, 113 W. 12th Ave, Columbus, OH 43210
  - Telephone: 614-292-3307
  - Website: <http://slds.osu.edu/>
- Registration with SLDS does not grant accommodations automatically. You need to bring the accommodation form provided by SLDS to the instructor to work out a plan for accommodations. Please contact the instructor as soon as you are registered with SLDS for attendance, assignment and/or exam accommodations.
- Academic Misconduct policy
  - It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term “academic misconduct” includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct: [http://studentlife.osu.edu/pdfs/csc\\_12-31-07.pdf](http://studentlife.osu.edu/pdfs/csc_12-31-07.pdf).
  - Collaboration for the purposes of troubleshooting is highly encouraged in this course, but everyone is expected to submit their own unique work. For example, asking a classmate how to resolve an unexpected error message is OK, but using another classmate’s work (e.g. screen captures, etc.) as your own is NOT ok, regardless of whether or not they provide consent for the use of their materials. (Note: There are many other acceptable/unacceptable actions than those exemplified here.) If you have any questions or concerns about acceptable/unacceptable actions, ask your instructor for clarification/permission.
  - All open-ended responses to questions, prompts, etc. must be written entirely, nearly entirely, or at least in majority using your own words. Use credible sources, and cite all sources, including those only referenced, those indirectly paraphrased, and those directly quoted, being sure to use quotation marks to identify excerpts from these credible sources. This expectation to cite all of your sources also extends to the textbook, the lab instructions, lecture slides, other course materials, online resources, etc. Please contact Center for the Study and Teaching of Writing (CSTW, <https://cstw.osu.edu/writing-center>) or the instructor if you have difficulties organizing language for assignments.
- Other Course Policy
  - Please refer to Student Academic Services for more academic services provided by OSU.
  - Other student services can be accessed [here](#).

**Course Technology:**

Please contact OSU IT Service Desk for any help with password, university e-mail, Carmen, or any other technology issues, questions, or requests. Standard support hours are available at <https://ocio.osu.edu/help/hours>, and support for urgent issues is available 24x7.

- Phone: 614-688-HELP (4357)
- Email: [8help@osu.edu](mailto:8help@osu.edu)
- Self-Service and Chat support: <http://ocio.osu.edu/selfservice>

Basic technical skills necessary for this course

- Basic computer and web-browsing skills
- Navigating and utilizing Carmen

Equipment

- Computer: a Windows/Mac PC is needed.
- Webcam: built-in or external webcam, fully installed.
- Microphone: built-in laptop or tablet mic or external microphone.

Software

- NetLogo
  - It will be available on the computers in our lab. However, since it is free and open source, you can download and install NetLogo on your personal machines: <https://ccl.northwestern.edu/netlogo/> *Note that you are on your own with installations on personal machines; we cannot provide technical support.*
  - The basic NetLogo install is simple, but some of the programs we will look at this semester will use the *gradient* extension. Installing the gradient extension is easy: go to this [link](#), download and unzip the folder called *gradient* containing a single file called *gradient.jar*. Copy the entire folder to the same folder as your NetLogo models, or to the NetLogo *extensions* folder. (Some NetLogo models also require an R extension for data analysis and reporting, but we will not be using these models.) For more details on these extensions, see the textbook authors' website: <http://patternandprocess.org/>. You can also follow NetLogo on Twitter: <https://twitter.com/NetLogo>.
  - System requirements of Netlogo can be found [here](#). There are no official privacy policies from developers of QGIS.
- NetLogo models
  - Since it is open source, NetLogo comes with a wealth of freely available models (programs) across a wide range of applications. Models sources include:
    - Models Library - available in the NetLogo software itself; look under "Files" → "Models Library"
    - User community: <https://ccl.northwestern.edu/netlogo/models/community/>
- Models discussed in the textbook

- The O'Sullivan and Perry text references and discusses a large number of NetLogo models. You should experiment with these models as part of your study *prior to class*. We will also work with some of these models in class.
- Windows versions of the NetLogo models are available at the Canvas site: unzip the archive and copy the entire directory (including the gradient subdirectory) to your laptop or to a portable storage device for use during class.
- Other sources for the NetLogo models, including Mac versions, include:
  - The authors' website, **Pattern and Process**: <http://patternandprocess.org/>.
  - O'Sullivan also maintains the most up-to-date versions of these models at a github repository: <https://github.com/DOSull/model-zoo>. (Note that the github repository may be incomplete: some models from the textbook may be missing.)

## Course Content Schedule

Week	Date	Content	Reading	Note
1	W 08/25	Course overview; Lab 1 – Experimenting with NetLogo		
2	M 08/30	Chapter 1: Spatial Simulation Models - Part 1	Ch 1.1, 1.2	
	W 09/01	Chapter 1: Spatial Simulation Models – Part 2	Ch 1.3, 1.4	Lab 1 Due
3	M 09/06	Labor day – No class		
	W 09/08	Lab 2 – NetLogo world and agents		
4	M 09/13	Chapter 2: Pattern, Process and Scale – Part 1	Ch 2.1, 2.2	
	W 09/15	Chapter 2: Pattern, Process and Scale – Part 2	Ch 2.2	Lab 2 Due
5	M 09/20	<b>Exam 1 (2:20 pm – 3:40 pm)</b>		
	W 09/22	Lab 3 - Programming with NetLogo		
6	M 09/27	Chapter 3: Aggregation and Segregation – Part 1	Ch 3.1, 3.2	
	W 09/29	Chapter 3: Aggregation and Segregation – Part 2	Ch 3.3	Lab 3 Due
7	M 10/04	Chapter 3: Aggregation and Segregation – Part 3	Ch 3.4	
	W 10/06	Chapter 3: Aggregation and Segregation – Part 4	Ch 3.5~3.7	
8	M 10/11	<b>Exam 2 (2:20 pm – 3:40 pm)</b>		
	W 10/13	Lab 4 - Variables and Breeds		
9	M 10/18	Chapter 4: Random Walks and Mobile Entities – Part 1	Ch 4.1, 4.2	
	W 10/20	Chapter 4: Random Walks and Mobile Entities – Part 2	Ch 4.3	
10	M 10/25	Chapter 4: Random Walks and Mobile Entities – Part 3	Ch 4.4, 4.5	
	W 10/27	<b>Exam 3 (2:20 pm – 3:40 pm)</b>		
11	M 11/01	Lab 5 - NetLogo and GIS data		Lab 4 Due
	W 11/03	Chapter 5: Percolation and Growth – Part 1	Ch 5.1, 5.2	
12	M 11/08	Chapter 5: Percolation and Growth – Part 2	Ch 5.3	Lab 5 Due
	W 11/10	Chapter 5: Percolation and Growth – Part 3	Ch 5.3, 5.4	
13	M 11/15	Lab 6 - Agent-based modeling		
	W 11/17	Chapter 6: Representing Time and Space	Ch 6	
14	M 11/22	Lab 7 - Using BehaviorSpace to manage experiments		Lab 6 Due
	W 11/24	Thanksgiving – No class		
15	M 11/29	Chapter 7: Model Uncertainty and Evaluation – Part 1	Ch 7.1~7.3	
	W 12/01	Chapter 7: Model Uncertainty and Evaluation – Part 2	Ch 7.4~7.7	
16	M 12/06	Review session		Lab 7 Due
	W 12/08	<b>Exam 4 (2:20 pm – 3:40 pm)</b>		

\*Disclaimer: This course schedule provides a general plan for the course; deviations may be necessary. Any changes will be announced by the instructor with as much advance notice as possible.