Autumn 2024

GEOG 6226: Spatial Simulation and Modeling in GIS

Course Information

- **Course times and location:**
  - Lecture or Lab: Weekly Asynchronous Online
- **Credit hours:** 3.0
- **Mode of delivery:** Online

This course is designed for graduate students only, where all the lecture and labs are integrated and will be delivered asynchronously online by weekly posts on Carmen. Those who need to have an in-person discussion will have an opportunity to meet the instructor during in-person office hours.

Instructor

- **Name:** Dr. Chayanika Singh
- **Email:** singh.1883@osu.edu
- **Office location:** 1123 Derby Hall

- **Office hours:**
  - Thursday 2:00 pm- 3:00 pm (in-person) or
  - Zoom by appointment (send me an email for setting zoom meeting)
- **Preferred means of communication:**
  - My preferred method of communication for questions is **email.** Please have the email subject as "**Geog 6226_.....",** to make sure it gets my attention.
  - My class-wide communications will be sent through the Announcements tool in Carmen Canvas. Please check your notification preferences (go.osu.edu/canvas-notifications) to be sure you receive these messages.

Course Prerequisites

There is no prerequisite for this course in terms of computer science, programming, or advance mathematical skills. However basic understanding of geography and geographic/spatial

processes will be helpful. Students are expected to have familiarity with spatial structures and concepts, and some basic understand/maturity with computing skills. In order to perform well in this course, student must be:

- Interested in some area of real-world geographical phenomena where spatial simulation approach can be applied (e.g. the environment, urban areas, public health, etc. etc..)
- Curious to know about scope and limitations of spatial simulation in various domains and challenges associated with its application.
- Motivated to learn from existing literature, models, research papers to gain insights on concepts that are related to course content but not extensively covered in lectures.
- Excited to create own model.

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 finer level of granularity, providing new insights that were unavailable through traditional modeling techniques.

We will explore four 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, iii) percolation and growth processes, and iv) Networks. We will also discuss issues such as the role of spatial simulation in geographic information science, representation of space and time, and how to build more complete models of human, physical and linked human-physical dynamic spatial processes.

Credit Hours and Work Expectations

This is a 3 credit-hour course. According to Ohio State bylaws on instruction (go.osu.edu/credithours), students should expect around 3 hours per week spent on direct instruction (instructor content and Carmen activities, for example) in addition to 6 hours of homework (reading and assignment preparation, for example) to receive a grade of C average.

Learning Outcomes

By the end of this course, students should successfully be able to:

- Think like a spatial scientist: The ability to conceptualize real-world phenomena as comprised of fundamental spatio-temporal processes occurring in specific geographic contexts

- 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.
- Understand common spatial simulation techniques: A basic understanding of techniques that are especially well-suited for simulating physical and human geographic processes.
- 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.
- Develop spatial simulation software skills: The ability to program and conduct experiments within the NetLogo software environment.

Course Materials and Technologies

Required Materials and/or Technologies

Textbook:

- [SS] O'Sullivan, D. and Perry, G. (2013) *Spatial Simulation: Exploring Pattern and Process,* Wiley. **Available in pdf format on Carmen website** or get the book from university bookstore.
- [ABM] Crooks et al. (2022) *Agent Based Modelling and Geographic Information Systems: A Practical Primer*, Sage publication. Chapters will be **available in pdf format on Carmen website** or get the book from this link**:** Agent-Based Modelling and Geographical Information Systems: A Practical Primer (Spatial Analytics and GIS): Crooks, Andrew, Malleson, Nick, Manley, Ed, Heppenstall, Alison: 9781473958654: Amazon.com: Books

Readings:
Additional topic 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) or access to cloud drive (Box, OneDrive, Dropbox etc.) is needed for data storage.

Required Equipment

Computer: current Mac (MacOS) or PC (Windows 10) with high-speed internet connection

Webcam: built-in or external webcam, fully installed and tested

Microphone: built-in laptop or tablet mic or external microphone

Other: a mobile device (smartphone or tablet) to use for BuckeyePass authentication

If you do not have access to the technology you need to succeed in this class, review options for technology and internet access at go.osu.edu/student-tech-access.

Required Software

Microsoft Office 365

- All Ohio State students are now eligible for free Microsoft Office 365 ProPlus through Microsoft's Student Advantage program. Each student can install Office on five PCs or Macs, five tablets (Windows, iPad®, and Android™), and five phones.
- Office 365 is installed within the student's BuckeyeMail account. Full instructions for downloading and installation can be found here.

NetLogo

- it is a free and open source software, you can download and install NetLogo on your personal machines: https://ccl.northwestern.edu/netlogo/
- 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.

Note that you are on your own with installations on personal machines; we cannot provide technical support, however installation guidance will be provided in first lab session.

NetLogo models

- Since it is open source, NetLogo comes with a wealth of freely available models (programs) across a wide range of applications.

  Model sources include:

- Model 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 text in both the textbooks refer and discusses a large number of NetLogo models. You should experiment with these models as part of your study prior to class. There will be additional assigned readings related to these models and their implementations.
- 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.)

Have Question regarding software installation?

- **Post your questions in the Software Installation Q&A discussion board BEFORE reaching out to the other technical support resources provided.**
- There are many installation-related questions that we can answer because they are common. We may have heard them in past semesters and already know how to respond. However, if we are unable to help, we'll let you know that, and we'll confirm which

technical support contact is most appropriate for your problem. Be sure to include us on your email communication with technical support so that we can better understand your problem and help others experiencing the same.

CarmenCanvas Access

You will need to use BuckeyePass (buckeyepass.osu.edu) multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you do each of the following:

Register multiple devices in case something happens to your primary device. Visit the BuckeyePass - Adding a Device (go.osu.edu/add-device) help article for step-by-step instructions.

Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes good for 365 days that can each be used once.

Install the Duo Mobile application (go.osu.edu/install-duo) on all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service.

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at 614-688-4357 (HELP) and IT support staff will work out a solution with you.

Technology Skills Needed for This Course

Basic computer and web-browsing skills

Navigating CarmenCanvas (go.osu.edu/canvasstudent)

CarmenZoom virtual meetings (go.osu.edu/zoom-meetings)

Recording a slide presentation with audio narration and recording, editing and uploading video (go.osu.edu/video-assignment-guide)

Technology Support

For help with your password, university email, CarmenCanvas, or any other technology issues, questions or requests, contact the IT Service Desk, which offers 24-hour support, seven days a week.

- **Self Service and Chat**: go.osu.edu/it
- **Phone:** 614-688-4357 (HELP)
- **Email:** servicedesk@osu.edu

Grading and Faculty Response

Your Grades will be calculated based on the following assignment weightage.

Assignment Category	Points
Syllabus quiz	1%
Labs (7)	42%
Reading Discussions (5)	10%
Quizzes (4)	12%
Final Exam	15%
Project	20%
Total	**100%**

See course schedule, on the last page, for due dates.

Descriptions of Major Course Assignments

Labs

Description: There will be multiple labs associated with lecture content (almost) each week. You will be provided with data and step-by-step instructions for each lab, but keep in mind that the process of completing any given lab may not go as smoothly as planned. Unexpected challenges may arise, so set a goal to submit each lab in advance of the deadline. You are given all the questions in advance, at the end of the lab instructions. When you are ready to submit your lab, you open the lab assignment, enter your answers, upload any required files if required, and click Submit.
Once grades are published, if you did not receive full credit, you should review the feedback so that you know how to improve. If you have any trouble finding the feedback, please let us know.
Lab questions: If you have any questions on lab contents and/or grades (can't finish specific steps, tools are not working, etc.), **please contact your instructor via email.**

Reading Discussions

Description: There will be a few assigned readings for different topics covered in the lecture content. For each Reading Discussion assignment, you will need to pick at least one of the readings and submit a short summary/reflection. More information will be provided later.

Final Project

Description: You will complete a final project (creating a model) that focuses on a particular question of YOUR interest, to showcase the skills learnt. The deliverables will include a proposal, project presentation and a report. More details will be provided later.

Quizzes

Description: There will be one syllabus quiz and 4 short, noncumulative quizzes based on different topics/ modules presented in the lecture. More details will be provided later.

Exams

Description: There will be ONE final cumulative exam covering all the topics from the lecture. Exams will be administered online using the course website.

Exams must be taken at the scheduled times and places 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. Make-up exams for excused absences will not be penalized. Make-up exams for unexcused absences will be penalized 15%.

Q: What happens if I lose internet connection while taking the Exam/ Quiz?

A: If you lose connection momentarily, you should be able to resume the exam. If you lose connection for longer than the exam is available, the exam will automatically submit with the time is up.

- *Tip 1:* If you have a smartphone with a web browser, you should be able to use your cellular network (even if the WiFi connection is unavailable) to log in to Carmen on your cell phone's web browser and resume the exam, as long as the time isn't up. It's not ideal since you probably won't be able to access any notes efficiently, but at least you can still access the exam and enter answers.
- *Tip 2:* To make your internet connection a little more stable, make sure nothing is streaming like video or online games. If you have roommates that are watching Netflix or gaming, you might want to ask them to take a break while you take your exam so that your WiFi access can be prioritized.

Do your best to ensure that you have a reliable internet connection and a reliable device (desktop, laptop, tablet, or phone) for accessing the exam *before* you get started. If you do completely lose access, cannot resume, and the exam submits before you can reestablish connection and submit answers, be sure to let me know. There may not be much that I can do, in the interest of fairness to all students, but I certainly want to hear about the situation to look into it, etc.

Late Assignments

Please refer to Carmen course website for due dates of assignments. Assignments will be penalized 10% for each day late. Thus, **assignments submitted 10 days after the deadline will be graded 0**. Extensions will not be granted due to lost work; be sure you back up and keep all your work. In case of unavoidable emergencies (for ex: health concerns or conference attendance) you must notify your instructor and request for permission to submit a late assignment.

Instructor Feedback and Response Time

Preferred contact method: If you have a question, please contact me first through my Ohio State email address. I usually reply to emails within **24 to 48 hours on school days**. If you do not get a response within 2 days, you should send a follow up email. To make sure your email does not go in my junk folder, **start the subject line as "GEOG_6226 …..".**

Class announcements: I will send all important class-wide messages through the Announcements tool in Carmen Canvas. Please check your notification preferences (go.osu.edu/canvas-notifications) to ensure you receive these messages.

Discussion board: I will check and reply to messages in the discussion boards at least once a week. You may get a quicker response from fellow classmates on discussion boards.

Grading and feedback: For assignments submitted before the due date, I will try to provide feedback and grades within **7 days after the due date**. Assignments submitted after the due date may have reduced feedback, and grades may take longer to be posted.

Grading Scale

93–100: A
90–92.9: A-
87–89.9: B+
83–86.9: B
80–82.9: B-
77–79.9: C+
73–76.9: C
70–72.9: C-
67–69.9: D+
60–66.9: D
Below 60: E

Other Course Policies

Discussion and Communication Guidelines

The following are my expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

Writing style: While there is no need to participate in class discussions as if you were writing a research paper, you should remember to write using good grammar, spelling, and punctuation. A more conversational tone is fine for non-academic topics.

Tone and civility: Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably. Remember that sarcasm doesn't always come across online. I will provide specific guidance for discussions on controversial or personal topics.

Citing your sources: When we have academic discussions, please cite your sources to back up what you say. For the textbook or other course materials, list at least the title and page numbers. For online sources, include a link.

Backing up your work: Consider composing your academic posts in a word processor, where you can save your work, and then copying into the Carmen discussion.

Synchronous sessions: During our Zoom sessions (if any) I ask you to use your real name and a clear photo of your face in your Carmen profile. During our full-group lecture time, you may turn your camera off if you choose. When in breakout rooms or other small-group discussions, having cameras and mics on as often as possible will help you get the most out of activities. You are always welcome to use the free, Ohio State-themed virtual backgrounds (go.osu.edu/zoom-backgrounds). Remember that Zoom and the Zoom chat are our classroom space where respectful interactions are expected.]

Academic integrity and collaboration: Your written assignments, including discussion posts, should be your own original work. In formal assignments, you should follow APA style to cite the ideas and words of your research sources. You are encouraged to ask a trusted person to proofread your assignments before you turn them in but no one else should revise or rewrite your work.

Academic Integrity Policy

See Descriptions of Major Course Assignments for specific guidelines about collaboration and academic integrity in the context of this class.

Ohio State's Academic Integrity Policy

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand

the university's Code of Student Conduct (studentconduct.osu.edu), and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the university's *Code of Student Conduct* and this syllabus may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the university or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the university's *Code of Student Conduct* is never considered an excuse for academic misconduct, so I recommend that you review the *Code of Student Conduct* and, specifically, the sections dealing with academic misconduct.

If I suspect that a student has committed academic misconduct in this course, I am obligated by university rules to report my suspicions to the Committee on Academic Misconduct. If COAM determines that you have violated the university's Code of Student Conduct (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the university.
If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.

Other sources of information on academic misconduct (integrity) to which you can refer include:

Committee on Academic Misconduct (go.osu.edu/coam)

Ten Suggestions for Preserving Academic Integrity (go.osu.edu/ten-suggestions)

Eight Cardinal Rules of Academic Integrity (go.osu.edu/cardinal-rules)

Copyright for Instructional Materials

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

Creating an Environment Free from Harassment, Discrimination, and Sexual Misconduct

The Ohio State University is committed to building and maintaining a community to reflect diversity and to improve opportunities for all. All Buckeyes have the right to be free from harassment, discrimination, and sexual misconduct. Ohio State does not discriminate on the basis of age, ancestry, color, disability, ethnicity, gender, gender identity or expression, genetic information, HIV/AIDS status, military status, national origin, pregnancy (childbirth, false

pregnancy, termination of pregnancy, or recovery therefrom), race, religion, sex, sexual orientation, or protected veteran status, or any other bases under the law, in its activities, academic programs, admission, and employment. Members of the university community also have the right to be free from all forms of sexual misconduct: sexual harassment, sexual assault, relationship violence, stalking, and sexual exploitation.

To report harassment, discrimination, sexual misconduct, or retaliation and/or seek confidential and non-confidential resources and supportive measures, contact the Office of Institutional Equity:

Online reporting form at equity.osu.edu,

Call 614-247-5838 or TTY 614-688-8605,

Or email equity@osu.edu

The university is committed to stopping sexual misconduct, preventing its recurrence, eliminating any hostile environment, and remedying its discriminatory effects. All university employees have reporting responsibilities to the Office of Institutional Equity to ensure the university can take appropriate action:

All university employees, except those exempted by legal privilege of confidentiality or expressly identified as a confidential reporter, have an obligation to report incidents of sexual assault immediately.

The following employees have an obligation to report all other forms of sexual misconduct as soon as practicable but at most within five workdays of becoming aware of such information: 1. Any human resource professional (HRP); 2. Anyone who supervises faculty, staff, students, or volunteers; 3. Chair/director; and 4. Faculty member.

Your Mental Health

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. No matter where you are engaged in distance learning, The Ohio State University's Student Life Counseling and Consultation Service (CCS) is here to support you. If you find yourself feeling isolated, anxious or overwhelmed, on-demand mental health resources (go.osu.edu/ccsondemand) are available. You can reach an on-call counselor when CCS is closed at 614- 292-5766**. 24-hour emergency help** is available through the National Suicide Prevention Lifeline website (suicidepreventionlifeline.org) or by calling 1-800-273-8255(TALK). The Ohio State Wellness app (go.osu.edu/wellnessapp) is also a great resource.

Accessibility Accommodations for Students with Disabilities

Requesting Accommodations

The university strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability including mental health, chronic or temporary medical conditions, please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services (SLDS). After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. In light of the current pandemic, students seeking to request COVID-related accommodations may do so through the university's request process, managed by Student Life Disability Services.

Disability Services Contact Information

- Phone: 614-292-3307
- Website: slds.osu.edu
- Email: slds@osu.edu
- In person: Baker Hall 098, 113 W. 12th Avenue

Accessibility of Course Technology

This online course requires use of CarmenCanvas (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations as early as possible.

CarmenCanvas accessibility (go.osu.edu/canvas-accessibility)

Streaming audio and video

CarmenZoom accessibility (go.osu.edu/zoom-accessibility)

Course Weekly Schedule

This is a tentative guideline subjected to change as the course progress.
Refer to the Carmen Canvas course for up-to-date due dates.

		Spatial Simulation & Modeling in GIS	
Week		**Geog 6226**	*Assignments due*
1	**8/20/2024**	**Course Overview & Basics**	
		Lab 1: Netlogo basics	syllabus quiz
2	8/26/2024	**ABM Basics**	Lab 1
		Lab 2: World and Agents	Quiz 1
3	9/2/2024	**Patterns & Processes R1**	
		Lab 3: Programming	Lab 2
4	9/9/2024	**PP. Cont. & Project Overview**	RD1
		Lab 3: Programming	Lab 3
5	9/16/2024	**Aggregation & Seggregation R2**	RD 2
		Lab 4: variables & breeds	Quiz 2
6	9/23/2024	**Random Walk & Mobility R3**	RD 3
		Lab 4: variables & breeds	Lab 4
7	9/30/2024	**Percolation & Growth R4**	RD 4
		Lab 5: Using GIS data	
8	10/7/2024	Lab 5: Using GIS data	Lab 5
		Autumn Break	Quiz 3
9	10/14/2024	**Networks**	
		Lab 6: Building Graph networks	Project Proposal
10	10/21/2024	**Space & Time R5**	RD 5
		Lab 6: Building Graph networks	Lab 6
11	10/28/2024	**Human behaviour**	
		Lab 7: Modeling human behaviour	Quiz 4
12	11/4/2024	**Review and exam prep time**	
		Lab 7: Modeling human behaviour	Lab 7
13	11/11/2024	Project consultation/ prep time	**EXAM**
14	11/18/2024	project consultation/ prep time	
15	11/25/2024		Project presentations due by midnight 11/27
		Thanks Giving	
16	12/2/2024		Project report & peer reviews due by midnight 12/03