SYLLABUS

GEOG 6226: Spatial Simulation & Modeling in GIS

Fall 2025 – ONLINE

COURSE OVERVIEW

Instructor

- **Name:** Dr. Chayanika Singh, GISP
- **Credentials:** PhD, Geographic information Sciences, Texas State University 2022
- **Email:** singh.1883@osu.edu
- **Office location:** 1123 Derby Hall
- **Office hours:** Zoom by appointment

- **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 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 various 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 GIS and its representation of space and time, in network models and how to build more complete models of human, physical and linked human-physical dynamic spatial processes.

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.)
- 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 spatial simulation model.

Course 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.

HOW DOES THIS COURSE WORKS

Mode of delivery: This course is 100% online. There are no required sessions when you must be logged in to Carmen at a scheduled time.

Pace of online activities: This course is divided into **modules** that are released at the beginning of the week. Students are expected to keep pace with weekly deadlines but may schedule their efforts freely within that time frame.

Credit hours and work expectations: This is a **3-credit-hour course**. According to Ohio State policy, students should expect around 3 hours per week of time 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.

Attendance and participation requirements: Because this is an online course, your attendance is based on your online activity and participation. The following is a summary of everyone's expected participation:

- **Participating in online activities for attendance**: **AT LEAST TWICE PER WEEK**
  Be sure you are logging in to the course in Carmen each week, including weeks with holidays or weeks with minimal online course activity. (During most weeks you will probably log in many times.) If you have a situation that might cause you to miss an entire week of class, discuss it with me *as soon as possible.*
- **Office hours and live sessions**: **OPTIONAL**
  This course is asynchronous, no live sessions. If you are required to discuss an assignment with me, please contact me at the beginning of the week to schedule a meeting (virtual/ in-person).
- **Participating in discussion forums**:
  Each module you can expect to post on the Carmen Discussion Board as part of our substantive class discussion on the module's topics. There are multiple discussion topic some weekly or biweekly that requires you to participate.

Course Materials and Technologies

Textbooks:

Required

- [SS] O'Sullivan, D. and Perry, G. (2013) *Spatial Simulation: Exploring Pattern and Process*, Wiley.
- This will be the primary text referred in this course
- The Digital book should be available on CarmenBooks

Recommended/ Optional

- [ABM] Crooks et al. (2022) *Agent Based Modelling and Geographic Information Systems: A Practical Primer*, Sage publication.
- Relevant Chapters will be available in pdf format on Carmen website or you can get the book from this link

Assigned Readings:

Additional topic readings 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 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 look at this semester will use the gradient extension. Installing the gradient extension is easy: 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. 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.

General technology

For help with your password, university email, Carmen, or any other technology issues, questions, or requests, contact the Ohio State IT Service Desk. Standard support hours are available at ocio.osu.edu/help/hours, and support for urgent issues is available 24/7.

- **Self-Service and Chat support:** ocio.osu.edu/help
- **Phone:** 614-688-4357(HELP)
- **Email:** servicedesk@osu.edu
- **TDD:** 614-688-8743

Baseline technical skills for online courses

- Basic computer and web-browsing skills
- Navigating Carmen: for questions about specific functionality, see the Canvas Student Guide.

Required Technology skills specific to this course

CarmenZoom virtual meetings

- Recording a slide presentation with audio narration
- Recording, editing, and uploading video

Required equipment

Computer: current Mac (OS X) or PC (Windows 7+) 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) or landline to use for BuckeyePass authentication

Carmen access

You will need to use BuckeyePass 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 take the following steps:

Register multiple devices in case something happens to your primary device. Visit the BuckeyePass - Adding a Device help article for step-by-step instructions.

- Download the Duo Mobile application to 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.

Grading and Faculty Response

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

Assignment Category	Points
Syllabus quiz	1%
Labs (6)	42%
Reading Discussions (5)	15%
Exams (7)	21%
Project	21%
Total	**100%**
Extra credit bonus assignment	3%

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

Descriptions of Major Course Assignments

The course is divided into 8 Modules. Module 1 to 7 provide learning material, conduct hands on lab exercises, topic-based reading discussions and an Exam for each module. Module 8 is dedicated to work on your term Project. See class schedule on last page for details.

- **Labs:** There will be multiple labs associated with lecture content. 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.
  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 at least 24 hours before the due date.**
- **Reading Discussions**: There will be several 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 and must participate in the discussion. Detail guideline is available on Carmen.
- **Final Project**: Each student will work on a final project using the techniques learned in this class. The student is responsible for collecting data and implementing the project idea. Each project has a few deadlines for required deliverables, including a short proposal that describes the project idea, an early release of a working prototype, and the final product that include a final project report and a 10-minute video presentation of the project. Each project will also be peer reviewed by at least two students.Detail guideline is available on Carmen.

- **Exams:** There will be multiple (mini) Exams to cover different topics/modules from the lecture.
  Exams must be taken within the scheduled week 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 to re-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, and possibly consider alternatives.

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

I am providing the following list to give you an idea of my intended availability throughout the course. (Remember that you can call **614-688-HELP** at any time if you have a technical problem.)

- **Grading and feedback:** For large weekly assignments, you can generally expect feedback within **7 days after the assignment is closed.**
- **Email:** I will reply to emails within **48 hours** on days on school days. Feel free to send follow up email after 2 days of no response.
- **Discussion board:** I will check and reply to messages in the discussion boards Twice a week on school days.

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.
- **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.

Academic integrity policy

- **Quizzes and exams**: You must complete the quizzes yourself, without any external help or communication.
- **Written assignments**: Your written assignments, including discussion posts, should be your own original work. In formal assignments, you should follow Chicago 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.
- **Reusing past work**: In general, you are prohibited in university courses from turning in work from a past class to your current class, even if you modify it. If you want to build on past research or revisit a topic you've explored in previous courses, please discuss the situation with me.
- **Falsifying research or results**: All research you will conduct in this course is intended to be a learning experience; you should never feel tempted to make your results or your library research look more successful than it was.
- **Collaboration and informal peer-review**: The course includes many opportunities for formal collaboration with your classmates. While study groups and peer-review of major written projects is encouraged, remember that comparing answers on a quiz or assignment is not permitted. If you're unsure about a particular situation, please feel free just to ask ahead of time.

GENERATIVE ARTIFICIAL INTELLIGENCE TOOLS

Given that the learning goals of this class include getting yourself familiar with Web and tools available on web, in this course, students are **welcome to explore innovative tools and technologies including generative artificial intelligence (GenAI).** Students are permitted to use GenAI tools for most course assignments, except for **the final project assignments and reading reflections**. Your written assignments, including **discussion posts or essays**, should be your own original work.

If I suspect that you have used GenAI on an assignment for which it is prohibited, I will ask you to explain your process for completing the assignment in question. Submission of GenAI-generated content as your own original work is considered a violation of Ohio State's Academic Integrity policy and Code of Student Conduct because the work is not your own. The unauthorized use of GenAI tools will result in referral to the Committee on Academic Misconduct.

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*, 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:

- The Committee on Academic Misconduct web pages (COAM Home)
- *Ten Suggestions for Preserving Academic Integrity (Ten Suggestions)*
- *Eight Cardinal Rules of Academic Integrity* (www.northwestern.edu/uacc/8cards.htm)

Copyright disclaimer

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.

Statement on Title IX

All students and employees at Ohio State have the right to work and learn in an environment free from harassment and discrimination based on sex or gender, and the university can arrange interim measures, provide support resources, and explain investigation options, including referral to confidential resources.

If you or someone you know has been harassed or discriminated against based on your sex or gender, including sexual harassment, sexual assault, relationship violence, stalking, or sexual exploitation, you may find information about your rights and options at titleix.osu.edu or by contacting the Ohio State Title IX Coordinator at titleix@osu.edu. Title IX is part of the Office of Institutional Equity (OIE) at Ohio State, which responds to all bias-motivated incidents of harassment and discrimination, such as race, religion, national origin and disability. For more information on OIE, visit equity.osu.edu or email equity@osu.edu.

Intellectual Diversity

Ohio State is committed to fostering a culture of open inquiry and intellectual diversity within the classroom. This course will cover a range of information and may include discussions or debates about controversial issues, beliefs, or policies. Any such discussions and debates are intended to support understanding of the approved curriculum and relevant course objectives rather than promote any specific point of view. Students will be assessed on principles applicable to the field of study and the content covered in the course. Preparing students for citizenship includes helping them develop critical thinking skills that will allow them to reach their own conclusions regarding complex or controversial matters.

Grievances and Solving Problems

A student who encounters a problem related to his/her educational program has a variety of avenues available to seek resolution. (Note: the procedures for grade grievances are explicitly covered in the faculty rules) Typically, a student is advised to resolve any dispute, disagreement, or grievance as directly as possible, engaging with the person or persons most closely involved. The faculty and staff of the departments and colleges are available to work with students in this regard. If this step does not produce acceptable results, the student should follow a logical stepwise progression to address the academic concerns.

According to University Policies, if you have a problem with this class, you should seek to resolve the grievance concerning a grade or academic practice by speaking first with the instructor or professor. Then, if necessary, take your case to the department chairperson, college dean or associate dean, and to the provost, in that order. Specific procedures are outlined in Faculty Rule 3335-8-23. Grievances against graduate, research, and teaching assistants should be submitted first to the supervising instructor, then to the chairperson of the assistant's department.

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. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you find yourself feeling isolated, anxious or overwhelmed, please know that there are resources to help: ccs.osu.edu. You can reach an on-call counselor when CCS is closed at (614) 292-5766 and 24 hour emergency help is also available through the 24/7 National Prevention Hotline at 1-(800)-273-TALK or at suicidepreventionlifeline.org. The Ohio State Wellness app is also a great resource available at go.osu.edu/wellnessapp.

Religious accommodations

Ohio State has had a longstanding practice of making reasonable academic accommodations for students' religious beliefs and practices in accordance with applicable law.

Students must be in early communication with their instructors regarding any known accommodation requests for religious beliefs and practices, providing notice of specific dates for which they request alternative accommodations within 14 days after the first instructional day of the course.

With sufficient notice, instructors will provide students with reasonable alternative accommodations with regard to examinations and other academic requirements with respect to

students' sincerely held religious beliefs and practices by allowing up to three absences each semester for the student to attend or participate in religious activities. Examples of religious accommodations can include, but are not limited to, rescheduling an exam, altering the time of a student's presentation, allowing make-up assignments to substitute for missed class work, or flexibility in due dates or research responsibilities.

If students have questions or disputes related to academic accommodations, they should contact their course instructor, and then their department or college office. For questions or to report discrimination or harassment based on religion, individuals should contact the Civil Rights Compliance Office. (see Policy: Religious Holidays, Holy Days and Observances)

Weather or other short-term closing

Following **Policy 6.15** (Weather or Other Short-Term Closing):

> *Should in-person classes be canceled, I will notify you as to which alternative methods of teaching will be offered to ensure continuity of instruction for this class. Communication will be via CarmenCanvas. Unless otherwise announced by the university, online or distance-learning classes will occur as scheduled.*

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. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. **SLDS contact information:** slds@osu.edu; 614-292-3307; 098 Baker Hall, 113 W. 12th Avenue.

Accessibility of course technology

This online course requires use of Carmen (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 with your instructor.

- CarmenCanvas accessibility
- Streaming audio and video
- CarmenZoom accessibility
- Collaborative course tools

Course 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.

AU25 Geog 6226: Spatial Simulation & Modelling in GIS					
Week	**Dates**	**Module**	**Content**	**Assignments**	**% weight**
w1	08/26 - 09/08	Module 1	**Course Overview**	syllabus quiz	1
			Lab 1: Netlogo basics		7
w2			**ABM Modeling Basics**	Exam 1	3
			Lab 2: World and Agents		7
w3	09/09 - 09/22	Module 2	**Pattern & Processes**	Exam 2	3
			Lab 3: Programming		7
w4				Readings 1	3
w5	09/23 - 10/06	Module 3	**Aggregation & Segregation**	Exam 3	3
			Lab 4: variables & breeds		7
w6				Readings 2	3
			Project overview		
w7	10/07 - 10/20	Module 4	**Random walk & Mobile Enti**	Exam 4	3
			Lab 5: Using GIS data		7
w8				Readings 3	3
Autumn break (10/16 - 10/17)					
w9	10/21 - 11/03	Module 5	**Percolation & Growth**	Exam 5	3
			Lab 5 cont.		
w10				Readings 4	3
				Proposal	1
w11	11/04 - 11/17	Module 6	**Human Behaviour**	Exam 6	3
			Lab 6: Modeling human behaviour		7
w12					
				project prototype	1
w13	11/18 - 12/01	Module 7	**Networks**	Exam 7	3
			Space & Time		
w14				Readings 5	3
Thanksgiving Break (11/26- 11/27), Columbus Day (11/28)					
w15	12/ 02 - 12/10	Module 8	prep time	Bonus*	
				Project presentations	9
w16				**Project report & peer reviews**	10
	* is an Extra credit assignment			**Total points**	**100**