GEOG 780: Seminar in Geospatial Computation
Fall 2024, Units: 3

Instructor
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Office: 311C Storm Hall
Office hours: Wed. 09:30-10:30 or by appointment

Course Schedule
Mon. 10:00-12:40 (SH325)

Instructional Mode
Face-to-face

Course Description
Geospatial computation is to enrich geography with a toolbox of computational methods to model and analyze a range of highly complex, often non-deterministic problems. During the seminar, we will discuss theories, concepts, methodologies, algorithms and applications of geospatial computational modeling by viewing phenomena such as cities, ecosystems, societies, and human dynamics as complex adaptive systems. Students will recognize complexity of geographic processes in the real-world, understand computational approaches to describe complexity, and learn computational techniques to analyze and model complex geographic phenomena.

Essential Student Information
For essential information about student academic success, please see the SDSU Student Academic Success Handbook.
- SDSU provides disability-related accommodations via Student Disability Services (sds@sdsu.edu |https://sds.sdsu.edu/). Please allow 10-14 business days for this process.
- Class rosters are provided to the instructor with the student's legal name. Please let me know if you would prefer an alternate name and/or gender pronoun.

Reading Materials
[1]   Flake, G.W. (1999) *The Computational Beauty of Nature*, MIT Press. https://mitpress.mit.edu/9780262561273/the-computational-beauty-of-nature/
[2]   Ehlen, J., Caldwell, D. R., & Harding, S. (2002). GeoComputation: What is it? *Computers, Environment and Urban Systems*, 26(4), 257–265. https://doi.org/10.1016/S0198-9715(01)00047-3
[3]   O'Sullivan, D. (2004). Complexity Science and Human Geography. *Transactions of the Institute of British Geographers*, 29(3), 282–295. https://www.jstor.org/stable/3804492
[4]   Batty, M. (1995). New ways of looking at cities. *Nature*, 377(6550), 574–574. https://doi.org/10.1038/377574a0
[5]   Goodchild, M. F. (2011). Scale in GIS: An overview. *Geomorphology*, 130(1), 5–9. https://doi.org/10.1016/j.geomorph.2010.10.004
[6]   Nara, A. (2021). Agent-Based Modeling. In B. Warf (Ed.), *Oxford Bibliographies in Geography*. Oxford University Press. https://doi.org/10.1093/obo/9780199874002-0236

[7]   Heppenstall, A. J., Crooks, A. T., See, L. M., & Batty, M. (Eds.). (2012). *Agent-Based Models of Geographical Systems*. Springer Netherlands. https://doi.org/10.1007/978-90-481-8927-4

[8]   Wang, S., Huang, X., Liu, P., Zhang, M., Biljecki, F., Hu, T., Fu, X., Liu, L., Liu, X., Wang, R., Huang, Y., Yan, J., Jiang, J., Chukwu, M., Reza Naghedi, S., Hemmati, M., Shao, Y., Jia, N., Xiao, Z., … Bao, S. (2024). Mapping the landscape and roadmap of geospatial artificial intelligence (GeoAI) in quantitative human geography: An extensive systematic review. *International Journal of Applied Earth Observation and Geoinformation*, 128, 103734. https://doi.org/10.1016/j.jag.2024.103734

[9]   Hu, Y., Goodchild, M., Zhu, A.-X., Yuan, M., Aydin, O., Bhaduri, B., Gao, S., Li, W., Lunga, D., & Newsam, S. (2024). A five-year milestone: Reflections on advances and limitations in GeoAI research. *Annals of GIS*, 30(1), 1–14. https://doi.org/10.1080/19475683.2024.2309866

[10]   Hsu, C.-Y., & Li, W. (2023). Explainable GeoAI: Can saliency maps help interpret artificial intelligence's learning process? An empirical study on natural feature detection. *International Journal of Geographical Information Science*, 37(5), 963–987. https://doi.org/10.1080/13658816.2023.2191256

Supplementary Reading Materials

[11]   Batty, M., & Longley, P. A. (1994). *Fractal Cities: A Geometry of Form and Function*. Academic Press. http://www.fractalcities.org/

[12]   Lam, N. S.-N., & Quattrochi, D. A. (1992). On the Issues of Scale, Resolution, and Fractal Analysis in the Mapping Sciences. *The Professional Geographer*, 44(1), 88–98. https://doi.org/10.1111/j.0033-0124.1992.00088.x

[13]   Goodchild, M. F., & Mark, D. M. (1987). The Fractal Nature of Geographic Phenomena. *Annals of the Association of American Geographers*, 77(2), 265–278. https://doi.org/10.1111/j.1467-8306.1987.tb00158.x

[14]   Brown, D.G., Riolo, R., Robinson, D. T., North, M. and Rand, W. (2005) Spatial process and data models: Toward integration of agent-based models and GIS, *Journal of Geographical Systems*, 2, 25-47. http://www-personal.umich.edu/~danbrown/papers/jgs_proof.pdf

[15]   Epstein, J. M. (2009). Modelling to contain pandemics. *Nature*, 460 (7256), 687–687. https://doi.org/10.1038/460687a

[16]   O'Sullivan, D., Gahegan, M., Exeter, D. J., & Adams, B. (2020). Spatially explicit models for exploring COVID-19 lockdown strategies. Transactions in GIS, 24(4), 967–1000. https://doi.org/10.1111/tgis.12660

[17]   Silva, P. C. L., Batista, P. V. C., Lima, H. S., Alves, M. A., Guimarães, F. G., & Silva, R. C. P. (2020). COVID-ABS: An agent-based model of COVID-19 epidemic to simulate health and economic effects of social distancing interventions. *Chaos, Solitons, and Fractals*, 139, 110088. https://doi.org/10.1016/j.chaos.2020.110088

[18]   Brunsdon, C., Fotheringham, A. S., & Charlton, M. E. (1996). Geographically Weighted Regression: A Method for Exploring Spatial Nonstationarity. *Geographical Analysis*, 28(4), 281–298. https://doi.org/10.1111/j.1538-4632.1996.tb00936.x

Weekly Topics

Week	Date	Seminar Topic	Reading
1	08/26	Introduction: Complexity Science	[1] Ch. 1, [2], [3], [4]
2	09/02	Labor Day – No Class	
3	09/09	Self-similarity and Fractal Geometry	[1] Ch. 5-8, [6], ([11, 12, 13])
4	09/16	Nonlinear Dynamics and Chaos	[1] Ch. 10-12
5	09/23	Cellular Automata	[1] Ch. 15, [7] Ch. 4
6	09/30	Agent Based Model I	[1] Ch. 16, [6], [7] Ch. 5
7	10/07	Agent Based Model II	TBD
8	10/14	Game Theory	[1] Ch. 17, TBD
9	10/21	Artificial Neural Networks	[1] Ch. 18, TBD
10	10/28	Genetic Algorithm	[1] Ch. 20, TBD
11	11/04	GeoAI	[8], [9], TBD
12	11/11	Veterans Day – No Class	
13	11/18	GeoAI – Explainability	[10], TBD
14	11/25	Final Project Prep. – Thanksgiving Week	
15	12/02	Final Project Presentation	
16	12/09	Final Project Presentation	

* Seminar topics are subject to change. Alternative topics include Bayesian Statistics, Modeling Human Mobility, Machine Learning/AI, Geographically Weighted Regression, Modeling Urban Dynamics, Graph & Network Analysis, Spatiotemporal Data Analysis, etc.

Grading

Seminar Participation	25%
Leading Discussion	10%
Final Project Proposal	5%
Final Project Presentation	10%
Final Project	50%

Percent	Letter		Percent	Letter
97 - 100	A		77 - 79.99	C+
93 - 96.99	A		73 - 76.99	C
90 - 92.99	A-		70 - 72.99	C-
87 - 89.99	B+		67 - 69.99	D+
83 - 86.99	B		63 - 66.99	D
80 - 82.99	B-		60 - 62.99	D-
			< 60	F

Seminar Participation: Students are expected to actively participate in the weekly discussions. Each student must **post at least two discussion questions** related to the target topic on Canvas by **midnight on Sunday**.

Leading Discussion: Three students will lead the day's discussion. Discussion leaders are responsible for selecting relevant reading and/or associated materials and posting them on Canvas **one week before their scheduled Monday session**.

Final Project:
The final project is centered on topics related to geocomputation and aligned with each student's research interests. Students may choose to complete either a research paper or develop a computer program of equivalent scope. Both options will be evaluated based on a one-page project proposal, a project presentation, and a final report. For the research paper, students may choose to conduct a literature review, draft a research proposal, or write a full research paper. The paper should be approximately 5-10 single-spaced pages in length, excluding diagrams and references. Students who opt to develop a computer program are required to create software that analyzes data and/or models geographic phenomena using geocomputational approaches. They must also submit a concise final report that outlines the problem statement, rationale for the chosen geocomputational approach, findings, and challenges encountered during the project.

Copyright Policy

SDSU respects the intellectual property of others and we ask our faculty and students to do the same. It is best to assume that any material (e.g., graphic, HTML coding, text, video, or sound) on the Web is copyrighted unless specific permission is given to copy it under a [Creative Commons License](#). More information about the use of copywritten material in education as part of the [TEACH Act](#) and [Copyright Fair Use Guidelines](#). Whenever possible, you should attribute the original author of any work used under these provisions.

Course Materials

Course materials created by the course instructor available via Canvas are copyrighted. *These course materials are for the student's academic use only and should not be distributed in any manner to any other individual (No Redistribution Policy)*.

Audio/Video Recordings

Students may not record (audio or video) in this class except in accordance with ADA accommodations. Any recordings made in connection with a disability accommodation are for the student's personal academic use only and may not be distributed in any manner to any other individual.

Academic Honesty

The University adheres to a strict [policy prohibiting cheating and plagiarism](#). Examples of academic dishonesty include but are not limited to:
- Copying, in part or in whole, from another's test or other examination;
- Obtaining copies of a test, an examination, or other course material without the permission of the instructor;
- Collaborating with another or others in coursework without the permission of the instructor;
- Falsifying records, laboratory work, or other course data;
- Submitting work previously presented in another course, if contrary to the policies of the course;
- Altering or interfering with grading procedures;
- Assisting another student in any of the above;

- Using sources verbatim or paraphrasing without giving proper attribution (this can include phrases, sentences, paragraphs and/or pages of work);
- Copying and pasting work from an online or offline source directly and calling it one's own;
- Using information found from an online or offline source without giving the author credit;
- Replacing words or phrases from another source and inserting one's own words or phrases.

Unauthorized recording or dissemination of course instruction or materials by students, especially with the intent to disrupt normal university operations or facilitate academic dishonesty, is a violation of the Student Conduct Code. *This includes posting exam problems or questions to online platforms.* Violators may be subject to discipline.

The California State University system requires instructors to report all instances of academic misconduct to the Center for Student Rights and Responsibilities. Academic dishonesty will result in disciplinary review by the University and may lead to probation, suspension, or expulsion. Instructors may also, at their discretion, penalize student grades on any assignment or assessment discovered to have been produced in an academically dishonest manner.

Use of AI Generative Tools for "written" assignments
Any use of generative AI (like ChatGPT) for written assignments (i.e., Final Project Proposal & Final Report) may constitute academic dishonesty and be subject to discipline under the terms of the SDSU Student Code of Conduct.

Use of AI Generative Tools for "programming"
The use of AI-based assistance, such as ChatGPT and Github Copilot, is **allowed** and **encouraged** for "programming"; however, you should be aware of the concerns regarding *privacy* (e.g., link) and *veracity* (e.g., link). We treat AI-based assistance the same way we treat collaboration with other people: you are welcome to talk about your ideas and work with other people, both inside and outside the class, as well as with AI-based assistants. Nevertheless, ***all work you submit must be your own***.

You should never include in your assignment anything that was not written directly by you without proper citation (including quotation marks, in-line citation for direct quotes, and your prompt messages used in AI-based assistance tools). Including anything you did not write in your assignment without proper citation will be treated as an academic misconduct case.

Online resources and AI-based assistance tools citation examples:

    # Adapted codes from stackoverflow (2023)
    # stackoverflow (2023, Aug. 29). "Hello World in Python [duplicate]".
    # https://stackoverflow.com/questions/1077347/hello-world-in-python

    # Adapted codes generated by OpenAI (2023)
    # OpenAI. (2023, Aug. 29). "List 10 popular places in San Diego"
    # ChatGPT [GPT-3.5]. https://chat.openai.com

If you are unsure where the line is between collaborating with AI and copying from AI, we recommend the following heuristics:

- Never hit "Copy" within your conversation with an AI assistant. You can copy your own work into your conversation, but do not copy anything from the conversation back into your assignment. Instead, use your interaction with the AI assistant as a learning experience, then let your assignment reflect your improved understanding.
- Do not have your assignment and the AI agent itself open on your device at the same time. Similar to above, use your conversation with the AI as a learning experience, then close the interaction down, open your assignment, and let your assignment reflect your revised knowledge. This heuristic includes avoiding using AI assistants that are directly integrated into your composition environment: just as you should not let a classmate write content or code directly into your submission, so also you should avoid using tools that directly add content to your submission.

Deviating from these heuristics does not automatically qualify as academic misconduct; however, following these heuristics essentially guarantees your collaboration will not cross the line into misconduct.

In addition, *if a student's work is substantially identical to another student's work, that will be grounds for an investigation of plagiarism regardless of whether the prose was produced by an AI assistant or not*.

Turnitin
Students agree that by taking this course all required papers may be subject to submission for textual similarity review to Turnitin.com for the detection of plagiarism. All submitted papers will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. You may submit your papers in such a way that no identifying information about you is included. Another option is that you may request, in writing, that your papers not be submitted to Turnitin.com. However, if you choose this option you will be required to provide documentation to substantiate that the papers are your original work and do not include any plagiarized material.

Classroom Conduct Standards
SDSU students are expected to abide by the terms of the Student Code of Conduct in classrooms and other instructional settings. Violation of these standards will result in referral to appropriate campus authorities. Prohibited conduct includes:
- Willful, material, and substantial disruption or obstruction of a University-related activity, or any on-campus activity.
- Participating in an activity that substantially and materially disrupts the normal operations of the University or infringes on the rights of members of the University community.
- Unauthorized recording, dissemination, or publication (including on websites or social media) of lectures or other course materials.
- Conduct that threatens or endangers the health or safety of any person within or related to the University community, including:
  - Physical abuse, threats, intimidation, or harassment.
  - Sexual misconduct.

Land Acknowledgement

For millennia, the Kumeyaay people have been a part of this land. This land has nourished, healed, protected and embraced them for many generations in a relationship of balance and harmony. As members of the San Diego State University community, we acknowledge this legacy. We promote this balance and harmony. We find inspiration from this land, the land of the Kumeyaay.