GEOG 8350
Seminar in GeoAI and Machine Learning

Spring 2024

Lectures: 9:35 am – 12:05 pm, Tuesdays, **Room:** 321 GG Bldg

Instructors	**Dr. Gengchen Mai**	**Dr. Angela Yao**
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Office Hours	Thursdays 11:00 am -12:00pm	Thursdays 11:00 am -12:00pm

Course Content

This seminar explores selected topics in GeoAI and machine learning research to answer geospatial questions. Students will critically examine the current state of knowledge over a range of fundamental and frontier research issues in AI and particularly machine learning techniques to address geographical problems. The course aims to nurture independent learning and research ability and to motivate students' interests in geographically oriented machine learning research through readings, critiques, discussions, practices, and research writing.

Prerequisite

- GIS background: Geog4370/6370
- Basic programming background: CSCI 1301, CSCI 1360, Geog4590/6590, or equivalent
- (Optional) GeoAI: Geog4/6920

Texts

Articles from the literature (journals and books). The reading lists will be provided on a weekly basis.

Format and Activities

<u>**Class participation:**</u>
Most meetings of the seminar are in the format of round-table discussion on the assigned topic of that week.
- Before class
  - Read the provided materials for the week
  - Write a critique on the readings of the week *by 5pm on Monday*. **No need to do this if you are the discussion leader of that week.** Summarize and critique each

article separately, and if you can, provide some general comments, thoughts, or extra information, on the topic of the week.
  - o Submit your critique digitally on ELC discussion board to share with the class. For better viewing and organization experience, please submit by replying to the first post of the week so that there will be only one thread for each week.
- In class
  - o Everyone is expected to contribute to discussions.

Leading discussion:

Each student is expected to lead discussions at least once throughout the semester. The actual assignments of topics will be decided in the first class meeting based upon student's own interest and the size of the class.
The discussion leader is expected to do the following tasks:
- One week before the discussion
  - o If you like to make suggestions to the course instructors about selection of reading materials, please do so at least one week before the class meeting for the topic.
  - o Expand the instructor-provided reading list with latest literature (published in the past 1-2 years) on the topic of the week.
- In class
  - o 20-minute oral presentation
  - o Provide a list of discussion questions to everyone in class.
  - o Lead the discussion of that topic

Final Project and Research Paper

(1). Write a 1-2 pages proposal of a project that involves GeoAI/ML technique(s). Instructors will provide feedback on the proposed project idea.

(2). Finish the proposed project and submit a scientific paper of it.

(3). Make a final presentation of the project

Developing a **research paper** is an important part of the seminar. Each student can choose any GeoAI or machine learning research topic of his/her own interest. Students are encouraged to discuss with the instructor at the earliest convenience regarding the research paper topic.
- Deadlines of a research outline, a preliminary write-up, and the final write-up due dates are observed strictly.
- Paper quality and style: refer to publishable journal paper
- Length: 20-30 pages, double-spaced, 12 pt Times New Roman font on 8.5" by 11" page.
- Format: Your name, course number should appear on the cover page. Stapled in the upper left corner.

Grading Policy

- Class participation (discussion and pre-class critique) 30%
- Leading discussion 30%
- Final research paper 40% (outline 5%, prelim 10%, presentation 10%, paper 15%)

Completion of all work warrants a passing grade. Absence from class (except that is due to medical/family emergency with proper documentation) will be counted against your class participation. Beyond that, an objective approach with weighting outlined above will be used to establish a ranking of students on an A-F scale.

Due Dates: All Assignments must be completed on time. Submittal of assignments after due dates is accepted but with a penalty as 10% of the percentage grade for each day they are late. Late in-class assignments will not be accepted. In each case, exceptions are possible only with documentation of a medical or family emergency.

Academic Honesty: Cheating and plagiarism will automatically earn zero (0) points for the assignment or exam. All academic work must meet the standards contained in "A Culture of Honesty." Each student is responsible to inform themselves about those standards before performing any academic work.

Absence
Excused absence from class is given for emergency or medical reasons only. However, each student has one wild card for other legitimate reasons.

Course Schedule

(General plan, subject to fine-tuning)

Week	Date	Topic	Module	Discussion Leader(s)
Week 1	01 / 9	Introduction and discernment of interest		
Week 2	01 / 16	Overview of AI and ML Techniques	Module-1. Overview of AI & ML for geospatial research	
Week 3	01 / 23	GeoAI -what is special about it?		
Week 4	01 / 30	Applications in geospatial research		
Week 5	02 / 6	Types of learning	Module-2. Spatial Classification and Clustering	
Week 6	02 / 13	ML techniques and applications for spatial classification		
Week 7	02 / 20	ML techniques and applications for spatial clustering		
Week 8	02 / 27	Word Embedding Basic	Module-3 Word Embedding & Place Embedding	
Enjoy the Spring Break				
Week 9	03 / 12	Place Embedding		
Week 10	03 / 19	Regional Embedding		
Week 11	03 / 26	Graph Neural Network Basic	Module-4 Graph Neural Network	
Week 12	04 / 02	Graph Convolutional Network for Place Characteristics Prediction		
Week 13	04 / 9	Graph Attention Network and Location Encoding		
Week 14	04 / 16	Guest speaker? – TBA		
Week 15	04 / 23	Work on the final project		
May 7, 12 – 3 pm Final Project Presentation				