GEOG 8200 - Frontiers in Geographic Information Science: Spatial Data Science

Autumn 2017

Time: Friday 12:00 - 2:48 PM
Location: 1116 Derby Hall
Course URL: http://carmen.osu.edu

Instructor: Professor Ningchuan Xiao
Office: 1132 Derby Hall
Phone: 292-4072
E-mail: xiao.37@osu.edu
Office Hours: Monday 11 AM to 12 PM, or by appointment

The past few years saw the rapid rise of big data that come in from a variety of sources such as social media, all kinds of censors and monitors, surveys and censuses, remote sensing, and the Internet of Things. Much of such data are spatial and temporal, and they have greatly changed the way of scientific research. In many cases we find ourselves in a situation of *hacking* the data: we need to have intimate knowledge about the data, know how to find them and how to organize them, know how to effectively and faithfully show them to the others, and know how to make sense of them. On top of all these, we need to do everything quickly because the large volume makes it time consuming to process and there is always more to come.

In this seminar, we develop skills that will enable us to hack big spatial and temporal data. We will examine the theory, techniques, and applications of spatial data science. More specifically, we focus on the following crucial dimensions of spatial data science:

- **Data and databases**: features and applications of big spatial and temporal data, and effective organization of these data sets.
- **Visualization**: theory, methods and application of information and spatial data visualization, and human perception of graphic symbols.
- **Machine learning**: recent advances in artificial intelligence and machine learning, including the theories and applications of clustering, network analysis, deep learning neural networks, and evolutionary algorithms.
- **High performance computing**: cutting edge advances in hardware and software for parallel and high performance information processing.

The course is organized around two major activities. First, we will read and discuss a wide spectrum of research articles on topics listed above and beyond. Each student will choose papers and book chapters of their interests and prepare for a presentation and discussion. Second, there will be four (or more) hands-on workshops that cover some of the important topics. We will use Python as the main programming language for this course. After a short introduction to Python, we will learn about some very useful packages such as pandas, fiona, matplotlib, scikit-learn, TensorFlow, and multiprocessing. Through the workshops, students will develop comfortable skills in using these packages.

Schedule

Below is a tentative schedule. Actual contents will change.

Week	Date	Topic	Details
1	8/25	Introduction	Software preparation
2	9/1	Data	Big data papers
3	9/8		Pandas (workshop)
4	9/15	Visualization	Symbolism and perception

5	9/22		Visualization methods
6	9/29		fiona and matplotlib (workshop)
7	10/6	Machine learning	Introduction
8	10/13		No class - Autumn break
9	10/20		Neural networks
10	10/27		Deep learning
11	11/3		Genetic algorithms
12	11/10		No class - Veteran's Day
13	11/17	HPC	multiprocessing (workshop)
14	11/24		No class - Thanksgiving
15	12/1	Presentations	
16	12/8	Final papers due	

The grade of the course will be weighted by two components: participation and a final paper. First, all students should actively participate in the discussion and workshop sessions. Participation will have be worth 20 percent of the final grade. Each student will sign up to lead discussions in the first week of class. Each week students who present should include the context of the reading materials with respect to the general theme of this class, some details from the reading, and critical thoughts about the topic. After the presentation, each student should also discuss the questions/comments posted by the other students. The other students who are not leading the discussion must carefully read the papers/chapters and post questions and comments on the Carmen discussion board. Each student (not leading discussion) must post at least one question/comment for each paper. Questions and comments should be intellectually stimulating and/or critical. We will not accept trivial questions such as "what do you think of this paper?" or "what are the contributions of this paper?"

The rest of the grade will be based on a final paper. To complete the course, each student should either write a review paper about the topics in a certain research area, or a research paper that reports a final project related to the topics. On **December 1**, students will present the review paper or the final project to the class. The final paper is due on **December 8**.

Student with Disabilities

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. You are also welcome to register with Student Life Disability Services to establish reasonable accommodations. 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; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

Policy on Plagiarism and 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. 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. 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. 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 at http://studentlife.osu.edu/csc/.