Pioneer
academics

Networks: from Searching the World Wide Web to Slowing the Spread of Infectious Diseases

Pioneer Syllabus

Term: Spring 2020

Program topic description:
This program will cover the foundations of network theory and its applications, which range from searching the Web to analyzing friendship patterns on Facebook to slowing the spread of diseases. It will also provide an introduction to the python programming language and basic techniques of computer science for efficiently analyzing networks with millions of connections on a laptop computer.

Professor title and background:
Eric Friedman (Ph.D. UC Berkeley)
Senior Researcher at the International Computer Science Institute and Lecturer in Computer Science at UC Berkeley.

Contact method:
All communication outside of meeting-times will be conducted on the Pioneer LMS (Learning Management System). As per the student agreement, use of email to communicate with the professor mentor during the program is strictly prohibited. If you have problems using the Pioneer LMS, contact your designated Pioneer program manager.

Pioneer LMS link: www.pioneeracademics.schoology.com

Required Textbook:
Networks, Crowds, and Markets: Reasoning About a Highly Connected World, by David Easley and Jon Kleinberg. Download from:
http://www.cs.cornell.edu/home/kleinber/networks-book/networks-book.pdf

Required Software:
Anaconda software -- https://www.continuum.io/downloads -- use the graphical installer and python **version 3.6**

Program topics:

1. Networks and triadic closure – "how friendly are my friends"
2. Networkx and Python programming.
3. Small worlds – "six degrees of separation"
4. The www and ranking nodes – "how google finds good webpages"

5. Epidemics and phase transitions – "how small changes in networks can cause large changes in disease spread"

Assignments and milestones:

Session 1: Overview of networks and computing with networks
Session 2: Basic network metrics and breadth first search (PS1 due)
Session 3: Clustering coefficients and small worldness (PS2 due)
Session 4: The WWW, directed Networks, pagerank and web searching (PS3 due)
Session 5: Models of disease spread and phase transitions in networks (PS4 due)

Note: PS5 is due within 2 weeks after Session 5.

Session 6: Project meeting – discuss research topics
Session 7: Project meeting – preliminary research on topics
Session 8: Project meeting – final choice of topic and research strategy
Session 9: Project meeting – technical discussion on project
Session 10: Project meeting – detailed discussion of project

Final deadline: within one week of Session 10

Problem sets:

Problem sets are due 48 hours before each class section.

Grading policy:

5%: Class participation, including attendance
10%: Problem sets for the first 5 classes
5%: Peer feedback
80%: Final project

Final Project: The project will be a computational analysis of some network topic chosen by the student and approved by the professor. It will consist of 5-10 pages of written text, plus additional figures and graphs as well as a .zip file containing all data and programs used in the project. The text will have the following sections:

1. Introduction -- why is this interesting?
2. Review – What is already known about this topic?
3. Model – What exactly are you analyzing and how?
4. Analysis – What did you learn/discover?
5. Conclusions – Summarize what you did and what you didn't do but wish you had done.

Peer review component (5%)

While each research project will be done individually, peers can provide useful feedback on one another's work, and seeing other students' work can bring new ideas about a student's own project. To that end, students will be asked to share their work with their peers, to prepare feedback for peers, and to meet to discuss their progress and feedback. Students will be graded on attendance and participation in both videoconferencing sessions, and the quality of the peer review form they prepare for each peer.

Students will discuss preliminary research plans during the final group session, Session 5

Between Sessions 6 and 7, students will exchange research plans and literature reviews, and will arrange a time to meet through the videoconferencing software to discuss their research. Students should come prepared to talk about their own projects, and also to provide helpful feedback about peers' projects.

Between Sessions 8 and 9, students should provide the current draft of their final papers to each other, and should complete the Peer Review Feedback Form for each peer. They then should meet through the videoconferencing system to discuss their feedback.

Important notes: Students are responsible for arranging the meeting times with their classmates. Students must inform their program manager so Pioneer can check the automatic recording to confirm the meeting took place. Students also must turn in their peer review forms to the professor after the second meeting.

Learning Goals

- demonstrate understanding of the scientific method used to explore natural phenomena, including observation, hypothesis development, measurement and collection of data, experimentation, evaluation of evidence
- demonstrate how fundamental elements of mathematical, logical and statistical knowledge are applied to solve real-world problems

- apply the methods and processes of scientific inquiry
- Recognize the limits of mathematical and statistical methods
- Utilize current scientific literature to formulate new research questions and appropriately cite sources in discussion of results

Pioneer Writing Center:

All students can use the Pioneer Writing Center to review up to four drafts of their paper. The Pioneer Writing Center guarantees feedback within 48 hours of submission. Students can submit drafts by sending their work to writingcenter@pioneeracademics.com.

Pioneer research support trainings:

All students are required to take part in the research support trainings. The research support trainings will cover the following topics:

Research Support Training 1:

How to better interact with a professor

Tips on how to get the most out of the program Topics covered in research support training #2:

Good research practices

How to evaluate the credibility of online sources

How to access and use the Oberlin College Library and Databases

What is a literature review?

How to use the Pioneer Writing Center Topics covered in Research Support Training #3:

How to write a research proposal

How to write a thesis statement

How to write an effective paper outline

How to cite sources and write a bibliography

How to avoid plagiarism Research Support Training 4:

TBD based on progress of and questions from students

Technical support:

For any technical issues relating to program software, the Pioneer LMS or the Oberlin College library system that are not urgent, students should contact their designated program manager. For all issues that require immediate attention, message Pioneer Academics on WeChat. A Pioneer staff member will respond to help resolve any problem quickly.

Rescheduling sessions:

Group sessions cannot be rescheduled once confirmed by the student in writing. If a student misses a group session, Pioneer will endeavor to make a recording of the session available to the student. However, Pioneer cannot guarantee a recording will be available due to occasional technical issues.

During the one-on-one sessions, a student can request up to two sessions be rescheduled if he or she provides a written request to both Pioneer and his or her professor with more than 48 hours notice before the meeting time. Cases of student illness or other emergencies will also be considered with less than 48 hours notice. Once a student has altered two meeting times, he or she may not alter other agreed- upon meeting times in advance of the meetings, regardless of whether he or she continues to provide notice.