C S 5970 – Network Science

Instructor: Dr. Sridhar Radhakrishnan, Sridhar@ou.edu, DEH 244
Office Hours: 9:00 AM to 10:30 AM (Monday and Wednesday)
Course Timings: 4:30 PM to 5:45 PM (Monday and Wednesday)
Course Location: 336 Felgar Hall

Catalog Description:

Prerequisite: C S 4413 or DSA 4413 or permission of instructor. Topics that will be covered include fundamental algorithms for network analysis, investigating properties of networks, learning community detection methods, understanding network inference methods, understanding dynamics of networks for explain percolation, resilience, spreading phenomenon, social influence, and cascades. A variety of application context will be used including physical, informational, biological, cognitive, and social systems. (F)

Course Objectives:

Network science is discipline at the intersection of graph theory and complex systems that deal with interaction among its components. Examples of such as system are common in areas of Biology, Ecology, Economics, Epidemiology, Finance, Neuroscience, Sociology, and many others. In this course we will model the interactions of complex components as a network structure and study the structure of these networks to reason and understand these complex systems.

In this course, first, we will begin with the study of various complex system and the unique interactions among their components. We will study social, information, economic, financial, and biological networks. Second, we will learn the fundamental network theory including properties of networks, measures and metrics such as centrality, transitivity, reciprocity, homophily, and others. We will also study concepts such as small-world effects, modularity, degree distributions, and assortive mixing. Third, algorithms on graph including traversals, graph partitioning, and coloring will be explained. Fourth, we will study random graphs models together with graph cluster coefficient, small and giant components, power-law distribution, and others. Fifth, we will study the concepts of percolation and network reliance, epidemics, and dynamical systems.

Students at the end of the system will have gained knowledge to analyze complex systems by modeling interaction among the components as a network. Students will also learn to analyze these networks by implementing various algorithms and visualizing the results of the algorithms.

Course Textbook and other Resources:

Required Textbook:

Other Reference Books:
Software Systems:

- Python
- Language R and R-Studio
- igraph library
- Visualization Tools: Gephi, GraphViz, InfoMap, Cytoscape, Pajek, Statnet

Course Requirements:

1. Students will be required to complete a project that will involve design and analysis of networks with a software system that they will develop. For example, students will take a published paper and write the algorithm specified in the paper and perform analysis on a variety of networks. The project will be finalized by the middle of the semester in consultation with the course instructor. At the end of the semester, the student will give a presentation that describes their analysis and the software system they have developed.

2. In addition to the final project, students will be required to complete three programming projects that may involve network analysis on existing networks using software systems such as igraph library, Gephi, GraphViz, Cytoscape, and others.

3. There will be one exam that will cover topics from graph algorithms and terminologies associated with network analysis.

Course Grading:

The course letter grade will be assigned based on the overall percentage: 
- >= 90 (A), >=80 and < 89 (B), >= 70 and < 80 (C), >=60 and < 70 (D), and < 60 (F). The allocation of percentages is given below:
  - Midterm (25%)
  - Programming Homework (3@10% each - 30%)
  - Project (30%)
  - Presentation (10%)
  - Class Participation (5%)

Late Policy:

All assignments will be considered late if not turned in when due, although assignments can be turned in early. Assignments submitted within five days after due date will get partial credit; however, assignments submitted more than five days after due date will get 0 point for assignment.

Course Policy and Academic Integrity:

Cheating is strictly prohibited at the University of Oklahoma. As a member of the OU community it is your responsibility to protect your educational investment by knowing and following the rules. Should you see someone else engaging in this behavior, I encourage you to report it to myself or directly to the Office of Academic Integrity Programs. That student is devaluing not only their
degree, but yours, too. Be aware that it is my professional obligation to report academic misconduct, which I will not hesitate to do. Sanctions for academic misconduct can include expulsion from the University and an F in this course, so don’t cheat. It’s simply not worth it. For specific definitions on what constitutes cheating, review the Student’s Guide to Academic Integrity at http://integrity.ou.edu/students_guide.html

Reasonable Accommodation Policy:

Students requiring academic accommodation should contact the Disability Resource Center for assistance at (405) 325-3852 or TDD: (405) 325-4173. For more information please see the Disability Resource Center website http://www.ou.edu/drc/home.html. Any student in this course who has a disability that may prevent him or her from fully demonstrating his or her abilities should contact me personally as soon as possible so we can discuss accommodations necessary to ensure full participation and facilitate your educational opportunities.

Religious Observance:

It is the policy of the University to excuse the absences of students that result from religious observances and to reschedule examinations and additional required classwork that may fall on religious holidays, without penalty.

Adjustments for Pregnancy/Childbirth:

Should you need adjustments to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact me or call the Disability Resource Center at 405/325-3852 as soon as possible. http://www.ou.edu/eco/faqs/pregnancy-faqs.html

Title IX Resources and Reporting Requirement:

For concerns regarding gender-based discrimination, sexual harassment, sexual misconduct, stalking, or intimate partner violence, the University offers a variety of resources, including advocates on call 24/7. To learn more or to report an incident, please contact the Sexual Misconduct Office at 405-325-2215 (8 to 5, M-F) or call OU Advocates at 405-615-0013 (24/7). For more information, please see http://www.ou.edu/edu.