ITIS 6520/8520, DSBA 6520: Network Science
Fall 2022
Dr. Siddharth Krishnan

Contact Information:

Email: skrishnan at uncc.edu
Office: Woodward Hall 403B
Office phone: 704-687-6170
Office Hours: T: 3:00 pm – 5:00 pm or by appointment (or via Zoom or phone)

Course Description:

Prerequisite:
- *Knowledge of basic computer science principles at a level sufficient to write a reasonably non-trivial computer program.*
- *Familiarity with the basic probability theory.*
- *Familiarity with the basic linear algebra*

Networks are a fundamental tool for modeling complex social, technological, and biological systems. Coupled with emergence of online social networks and large-scale data availability, this course focuses on the analysis of massive networks which provide many computational, algorithmic, and modeling challenges. The course will cover recent research on the structure and analysis of such *large networks* and on models and algorithms that abstract their basic properties. Network science helps students design faster, more resilient communication networks; revise infrastructure systems such as electrical power grids, telecommunications networks, and airline routes; model market dynamics; understand synchronization in biological systems; and analyze social interactions among people. It examines the various kinds of networks (regular, random, small-world, influence, scale-free, and social) and applies network processes and behaviors to emergence, epidemics, synchrony, and risk.

Topics include: how information spreads through society; robustness and fragility of food webs and financial markets; algorithms for the World Wide Web; friend prediction in online social networks; disease or idea outbreak detection.

Schedule of Topics:

List of topics that will be covered: (**subject to change**)

1. Introduction and Structure of Graphs
2. Web as a Graph and the Random Graph Model
3. The Small World Phenomena
4. Decentralized search in small-world and P2P networks
5. Applications of Social Network Analysis
6. Networks with Signed Edges
7. Cascading Behavior: Decision Based Models of Cascades
8. Cascading Behavior: Probabilistic Models of Information Flow
9. Influence Maximization
10. Outbreak Detection
11. Power-laws and Preferential attachment
12. Models of evolving networks
13. Link Analysis: HITS and PageRank
14. Strength of weak ties and Community structure in networks
15. Network community detection: Spectral Clustering
16. Overlapping communities in networks
17. Graph Databases (Neo4j)
18. Representation Learning on Graphs

Instructional Method:

Materials presented in this course will be covered through lectures, in-class exercises, assignments, and a project. In the end, students will have both the theoretical understanding of network science concepts and concrete experience of putting such concepts and principles into practice.

Textbooks:

There is **no required textbook** for the class, however the following reference books are *highly recommended*:

- **Networks, Crowds, and Markets: Reasoning About a Highly Connected World by David Easley and Jon Kleinberg.**
- Networks: An introduction by Mark Newman.

Course Requirements and Grading Policy:

Course project	40%
Exams/Quizzes (2)	20%
Assignments (2)	15%
Paper Readings	15%
Class participation	10%

Project Details

One of the class' main goals is to prepare you to apply state-of-the-art network analysis tools and algorithms to an application. If you are interested in research, this course will also leave you well-qualified to do network science research. The class's final project will offer you an opportunity to do exactly this.

Students will work individually on projects or if the scope of the project is ambitious enough, in groups of 2.

There will be four deliverables for the project:
1. Project proposal (20% of the project grade)
2. Project milestone report (20% of the project grade)
3. Final project report (45% of the project grade)
4. Final project presentation (15% of the project grade)

The details of how to tackle the course project (with examples of how the submission for each milestone should look like) will be made available on Canvas.

Additional Policies:

Attendance:

Students are expected to attend all class meetings. Class topics are integrated, with each week building on prior weeks. Most of the coursework and conceptual instruction will be delivered via F2F sessions. The times scheduled for lecture sessions will also be used for questions on the material, problem-solving, project-work, and programming exercises.

Grade Discussions:

The instructor will discuss grades only on in person, (and not via e-mail) and only with the student (not with parents, spouses, etc). Office hours are listed in the syllabus.

Academic Integrity:

All students are expected to adhere to the UNC Charlotte Code of Student Academic Integrity (http://legal.uncc.edu/policies/ps-105.html) as specified in the current Catalog (http://catalog.uncc.edu/). Among other things, this code forbids cheating, fabrication or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonesty.

Diversity Statement

No student will be discriminated against in the class based upon age, race, nationality, religion, sexual orientation, gender identity/expression, veteran's status, country of origin, or group affiliation. Likewise, all participants in this class will be expected to respect other members who fall into these categories. Any student who does not behave in a respectful manor with their classmates will be withdrawn from the class.

Special Needs:

If you have a documented disability and require accommodation in this course, contact Disability Services, Fretwell 230, phone: 687 4355 voice/TDD) the first week of the

semester. Information about available services may be found at
http://legal.uncc.edu/policies/ps-51.html. Accommodations for learning will be arranged
by that office and communicated to the Instructor. If you speak English as a second
language, please inform the instructor.

Religious Accommodation:

It is the obligation of students to provide faculty with reasonable notice of the dates of religious
observances on which they will be absent by submitting a Request for Religious Accommodation
Form to their instructor prior to the census date for enrollment for a given semester
http://legal.uncc.edu/policies/ps-134.html . The census date for each semester (typically the
tenth day of instruction) can be found in UNC Charlotte's Academic
Calendar (http://registrar.uncc.edu/calendars/calendar.htm) .

Inclement Weather:

University Policy Statement #13 states the University is open unless the Chancellor
announces that the University is closed. The inclement weather hotline number to call is
704-786-2877. **In the event of inclement weather, check your email the morning of
class.** The instructors will use their best judgment as to whether class should be held
understanding that some of you commute from far away and the instructors will notify
you by email if class is cancelled.