INFO 1606

Network Science

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Spring 2018
Office hours: TBD (or on Slack)

Assistant Instructor
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Office Hours: TBD

COURSE DESCRIPTION

Networks, or graphs, provide a unifying framework to study complex systems, such as biological, social, and technological systems. This graduate-level course focuses on the fundamental network concepts and statistics as well as key applications of network science. The course will cover recent advancement of network science, with respect to statistical properties and models of real-world networks, network algorithms, and practical applications. Topics include: how information and diseases spread in our society, PageRank and other algorithms for quantifying importance, community detection, and link prediction.

COURSE OBJECTIVES

By the end of the course, students are expected to be able to identify, construct, and analyze networks by choosing and applying appropriate methods and algorithms. Students are also expected to be able to explain, both mathematically and conceptually, the key network concepts and statistical properties, and their implications.
COMMUNICATION

We use Slack as the main communication channel. The URL for the course Slack site is: https://iu-netsci-online.slack.com You can create an account by using one of the following IU email addresses: indiana.edu, umail.iu.edu, iu.edu, iupui.edu. If you have any issues joining Slack, please contact us.

PREREQUISITES

The course will require good foundation of mathematics and programming, although there is no formal prerequisite. Key prerequisite topics are: probability, statistics, linear algebra, data structures, and algorithms. Python is used as the main programming language and it will be helpful to be proficient in Python. Please contact the instructor if you are uncertain about your background.

REQUIREMENTS AND EVALUATION

Students are required to read assigned readings, attend (watch) the lectures, complete quizzes and assignments, and engage in (online) discussions.

Final evaluation will be based on a class project. The project can be conducted individually or by forming a small team. Students may choose any network-related topics that involve network analysis and modeling, although it is strongly encouraged to discuss with the instructor about the project topics.

BOOKS AND KEY MATERIALS

We will closely follow the Network Science by Albert-László Barabási and Networks: An Introduction by Mark Newman. The following books can be helpful:

Python and data analysis

1. Dive Into Python by Mark Pilgrim (available online): a good Python book.
3. An introduction to statistics (with Python) by Thomas Haslwanter (available online): this book uses Python to explain basic statistics. It also contains a succinct tutorial for Python and data visualization using Python.
4. *Learning IPython for Interactive Computing and Data Visualization* by Cyrille Rossant: Introduction to IPython as well as lots of advanced analysis

POLICIES

1. *Disabilities.* Every attempt will be made to accommodate qualified students with disabilities (e.g. mental health, learning, chronic health, physical, hearing, vision, neurological, etc.). You must have established your eligibility for support services through Disability Services for Students. Note that services are confidential, may take time to put into place, and are not retroactive. Captions and alternate media for print materials may take three or more weeks to get produced. Please contact Disability Services for Students at [http://disabilityservices.indiana.edu](http://disabilityservices.indiana.edu) or 812-855-7578 as soon as possible if accommodations are needed. The office is located on the third floor, west tower, of the Wells Library (Room W302). Walk-ins are welcome 8 AM to 5 PM, Monday through Friday. You can also locate a variety of campus resources for students and visitors who need assistance at [http://www.iu.edu/~ada/index.shtml](http://www.iu.edu/~ada/index.shtml).

2. *Sexual misconduct and Title IX.* As your instructor, one of my responsibilities is to create a positive learning environment for all students. Title IX and IU’s Sexual Misconduct Policy prohibit sexual misconduct in any form, including sexual harassment, sexual assault, stalking, and dating and domestic violence. If you have experienced sexual misconduct, or know someone who has, the University can help. If you are seeking help and would like to speak to someone confidentially, you can make an appointment with:

   a) The Sexual Assault Crisis Services (SACS) at (812) 855-8900 (counseling services)

   b) Confidential Victim Advocates (CVA) at (812) 856-2469 (advocacy and advice services)

   c) IU Health Center at (812) 855-4011 (health and medical services)

It is also important that you know that Title IX and University policy require me to share any information brought to my attention about potential sexual misconduct, with the campus Deputy Title IX Coordinator or IU’s Title IX Coordinator. In that event, those individuals will work to ensure that appropriate measures are taken and resources are made available. Protecting student privacy is of utmost concern, and information will only be shared with those that need
to know to ensure the University can respond and assist. I encourage you to visit stopsexualviolence.iu.edu to learn more.

3. **Be honest.** Your assignments and papers should be your own work. First, if you find useful resources for your assignments, share them and cite them. If your friends helped you, acknowledge them. Second, feel free to discuss both online and offline, but you should not show your code (papers) nor see other’s. Any cases of academic misconduct (cheating, fabrication, plagiarism, etc) will be immediately reported to the School and the Dean of Students, following the standard procedure. Cheating is not cool.

4. **You have the responsibility of backing up all your data and code.** Always use at least Box, Dropbox, or Google Drive. Ideally, learn version control systems and use https://github.iu.edu or https://github.com. Loss of data, code, or papers due to various reasons (e.g. malfunction of your laptop) is not an acceptable excuse for delayed or missing submission.

5. If you have any mental health issues, don’t hesitate to contact IU’s Counseling and Psychological Services.

**GRADING**

- Participation (quizzes and discussions): 30%
- Assignments: 40%
- Project: 30%

**COURSE SCHEDULE**

(The schedule is subject to change)
Week 1: Get ready! Why do we care?
Week 2: Friendship paradox: a life lesson
Week 3: “What a small world!”
Week 4: Strength of weak ties
Week 5: Scale-free networks—Power-law or not?
Week 6: Network centralities
Week 7: Network structure I: communities and other properties
Week 8: Network structure II: communities and other properties
Week 9: Theory of random graphs
Week 10: Spring break
Week 11: Network epidemics
Week 12: Social influence and information diffusion
Week 13: What makes it viral?
Week 14: Robustness
Week 15: Link prediction
Week 16: Dynamic networks
Week 17: Final Week