

**INFO I590**

# **Network Science**

**Yong-Yeol (YY) Ahn**

yyahn@iu.edu

Spring 2017 Online.

Office hours: Tuesday 1:30-2:30pm (or on Slack)

## **Assistant Instructor**

Nathaniel Rodriguez (njrodrig@umail.iu.edu)

Office Hours: Thursday 4:00-5:00pm

## **COURSE HOMEPAGE AND COMMUNICATION**

We use Canvas and Slack for sharing course materials, announcements, discussion, and communication. The URL for the course Slack site is: <https://iu-netsci-online.slack.com> You can create an account without permission if you use either one of the following email addresses: indiana.edu, umail.iu.edu, iu.edu, iupui.edu. If you have any issues joining Slack, please contact us.

## **COURSE DESCRIPTION**

Networks provide a unifying framework to study complex systems across biological, social, and information systems. This course focuses on the fundamentals and key applications of network science, addressing the following questions: why do networks matter? What are the fundamental frameworks and theories to understand the structure and dynamics of networks? How has network framework been applied to other fields? What are the frontiers of the research?

## COURSE OBJECTIVES

By the end of the course, you will be able to both mathematically and conceptually explain the key concepts and findings of network science. You will be able to identify, construct, visualize, and analyze networks by choosing and applying appropriate methods and algorithms.

## PREREQUISITES

The course will require good foundation of mathematics and programming, although there is no formal prerequisite. Key prerequisites 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. Contact the instructor if you are uncertain about your background.

## REQUIREMENTS

Students are required to read assigned readings, watch the lectures, complete quizzes and assignments, and engage in online discussions. In addition, each student will finish a (replication) project.

## BOOKS AND KEY MATERIALS

We will closely follow the [Network Science](#) by Albert-László Barabási. The following books can be helpful:

*Python and data analysis*

1. [Dive Into Python](#) by Mark Pilgrim (available online): a good Python book.
2. [Learnpython.org](#): A web-based interactive tutorial.
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

## Network Science

1. [Networks: An Introduction](#) by Mark Newman.

## 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> 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>.
2. *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.
3. *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.
4. 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: 30%
- Exams: 20%
- Project: 20%

## COURSE SCHEDULE

(The schedule is subject to change)

*Week 1 (1/9-): Get ready! Why do we care?*

*Week 2 (1/16-): Friendship paradox: a life lesson*

*Week 3 (1/23-): "What a small world!"*

*Week 4 (1/30-): Strength of weak ties*

*Week 5 (2/6-): Scale-free networks*

*Week 6 (2/13-): Power-law or not?*

*Week 7 (2/20-): Network centralities*

*Week 8 (2/27-): Communities*

*Week 9 (3/6-): More communities*

*Week 10 (3/13-): Spring break*

*Week 11 (3/20-): Theory of random graphs*

*Week 12 (3/27-): Network epidemics*

*Week 13 (4/3-): Robustness*

*Week 14 (4/10-): Social influence*

*Week 15 (4/17-): Information diffusion*

*Week 16 (4/24-): What makes it viral?*

*Week 17 (5/1-5/5): Final Week*