PHYS7332 Spring 2018 Network Science Data II: Syllabus

Course Description and Objectives:

The class is an interdisciplinary course focusing on practical exercises in real network data. In this class, students will learn how to retrieve network data from the real world, analyze network structures and properties, study dynamical processes on top of the networks, and visualize networks. The main programming used in this course is Python 3.6.x.

Prerequisites:

PHYS5116 or equivalent (e.g. CS7785); PHYS7331 or equivalent (e.g. CS5800, CS7800); otherwise please contact the instructors before enrolling to the class. Python programming experience is required. Instructors will provide extra tutorials if necessary.

Topics Overview:

    I.   Statistical, structural and content analysis of network data
    II.   Centrality Measures
    III.   Network Sampling and Network Filtering
    IV.   Dynamics on Networks
    V.   Temporal Networks
    VI.   Community Detection
   VII.   Network Visualization
 VIII.   Advanced topics (e.g. multiplex networks, big data network analysis, ..)

Instructors:

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Logistics:

Date range: Jan 8, 2018 to April 27, 2018
Time: 5pm-7:10pm
Days: Monday and Wednesday
Venue: Forsyth Building 238

Class Materials, Announcements, and Communications:

All the materials, announcements, assignments will be posted on Piazza
(https://piazza.com/northeastern/spring2018/phys7332/).

(Optional) Textbooks:

There is no required textbook for this class. Instructors will provide the required reading materials but the following textbooks are recommended:

1. *Network Science*, Barabasi, http://networksciencebook.com/
2. *Networks: an Introduction*, Newman, Oxford University Press
3. *Dynamical Processes on Complex Networks*, Barrat, Barthelemy and Vespignani, Cambridge University Press
4. *Python Data Science Handbook, Jake VanderPlas,* https://github.com/jakevdp/PythonDataScienceHandbook

Coursework:

I. In-class exercises and participation: 20%
II. In-class quizzes: 20%
III. Class project, project milestones, final presentation, and project report: 40%
IV. Final in-class exam: 20%

Class project:

➔ Students are going to study a network dataset of their choice by implementing - from scratch - some of the concepts outlined in class using Python programming language (version 3.6.x).
➔ Project milestones are going to be scheduled during the duration of the class (details will be provided in class)
➔ Students are expected to provide all the codes used and to prepare a final report about their project.
➔ An oral presentation might be required.

Project milestones:

- 0) Collect timestamped network data either via web scraping or APIs
- 1) Perform a basic analysis of your network (degree distribution, clustering, assortativity, etc..)
- 2) Look at centralities in your network
- 3) Network sampling
- 4) Dynamic processes on your network
- 5) Graph partitioning and community detection
- 6) Time-varying network analysis

In-class quizzes:

Students are going to take in-class quizzes covering the materials of the previous classes and they might be required to provide not only theoretical answers but also pseudo-code implementations of the algorithms explained in class.

Academic Integrity:

The university views academic dishonesty as one of the most serious offenses that a student can commit while in graduate school and imposes appropriate sanctions on violations. Cheating on homework will not be tolerated. Please visit http://www.northeastern.edu/osccr/academic-integrity-policy/ for more information.

Tentative schedule:

WEEK	DATE	LECTURE	TOPIC	DATE	LECTURE	TOPIC	NOTES
1	1/8/2016	1	Intro to Class / Reviewing Basic Concepts I	1/10/2016	2	Reviewing Basic Concepts II	Project Proposal
2	1/15/2016		MLK Day. No Class	1/17/2016	3	Reviewing Basic Concepts III / Network Models I	Project Proposal Revised
3	1/22/2016	4	Network Models II	1/24/2016	5	Guest Lecture: Spatial Networks/Data Visualization	Project Milestone 0
4	1/292016	6	Network Models III	1/31/2016	7	Centrality Measures I	Project Milestone 1
5	2/5/2016	8	Centrality Measures II	2/7/2016	9	Centrality Measures III	
6	2/12/2016	10	Network Sampling I	2/14/2016	11	Network Sampling II	Project Milestone 2
7	2/19/2016		President Day. No Class	2/21/2016	12	Dynamical Processes on Networks I	Project Milestone 3
8	2/26/2016	13	Dynamical Processes on Networks II	2/28/2016	14	Dynamical Processes on Networks III	
	3/5/2016		SPRING BREAK	3/7/2016		SPRING BREAK	
9	3/12/2016	15	Dynamical Processes on Networks IV	3/14/2016	16	Dynamical Processes on Networks V / Centrality Measures IV	
10	3/19/2016	17	Community Detection I	3/21/2016	18	Community Detection II	Project Milestone 4
11	3/26/2016	19	Community Detection III	3/28/2016	20	Community Detection IV	
12	4/2/2016	21	Community Detection V	4/4/2016	22	Temporal Networks I	Project Milestone 5
13	4/9/2016	23	Temporal Networks II	4/11/2016	24	TBD	Project Milestone 6
14	4/16/2016		Patriots' Day. No class	4/18/2016	25	GUEST LECTURE: Mauro Martino	
15	4/23/2016	26	FINAL EXAM	4/25/2016	27	FINAL EXAM	