# PHYS7331 2017 Network Science Data: 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 2.7.x.

## Prerequisites:

PHYS5116 or equivalent; otherwise please contact the instructors before enrolling to the class.
Programming experience is required. Instructors will provide extra tutorials if necessary.

## Topics Overview:

    I.    Review of the basics
    II.    Fetching data and data analysis
    III.    Statistical, structural and content analysis of network data
    IV.    Dynamics on networks
    V.    Network data visualization
    VI.    Advanced topics

## Instructors:

Dr. Matteo Chinazzi, m.chinazzi@northeastern.edu
Office hours: Wednesday 2pm-3pm or by appointment.
Location (off campus): 10th floor, 177 Huntington Avenue, Boston, MA 02115, USA

Dr. Qian Zhang, qi.zhang@northeastern.edu
Office hours: by appointment.
Location (off campus): 10th floor, 177 Huntington Avenue, Boston, MA 02115, USA

## Logistics:

**Date range:** Jan 10, 2017 to April 27, 2017
**Time:** 5pm-7:10pm
**Days:** Tuesday and Thursday
**Venue:** Behrakis Health Sciences Cntr 210

## Class Materials, Announcements, and Communications:

All the materials, announcements, assignments will be posted on Piazza (https://piazza.com/northeastern/spring2017/phys7331/).

# (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://barabasilab.com/networksciencebook/
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. 10/12 weekly problem sets: 50%
II. In-class quizzes: 20%
III. Final exam(s): In-class 15% + Take-home 15%

## Problem sets:

➔ Students are going to implement - from scratch - some of the concepts outlined in class using Python programming language (version 2.7.x).
➔ Instructions on how to submit the assignments is going to be provided in class.
➔ Each problem set will be posted on Thursday after the class, and due on the next Tuesday 11:59PM EST. Late submissions will be penalized by deducting 20% for every 8 hours.

## 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.

## Final exams:

The final exam will consists of two parts:

➔ In-class written examination;
➔ Take-home programming examination.

# 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 | NOTES | DATE | LECTURE | TOPIC | NOTES |
|---|---|---|---|---|---|---|---|---|
| 1 | 1/10/2016 | 1 | Introduction to the course | | 1/12/2016 | 2 | Intro to Python | Problem set 0 |
| 2 | 1/17/2016 | 3 | Reviewing Basic Concepts in Graph Theory in Python I | Problem set 0 due | 1/19/2016 | 4 | Reviewing Basic Concepts in Graph Theory in Python II | Problem set 1 |
| 3 | 1/24/2016 | 5 | Reviewing Basic Concepts in Graph Theory in Python III | Problem set 1 due | 1/26/2016 | 6 | Fetching Data from the Web: HTML Parsing | Problem set 2 |
| 4 | 1/312016 | 7 | Fetching Data from the Web: API theory | Problem set 2 due | 2/2/2016 | 8 | Fetching Data from the Web: Twitter/Facebook API | Problem set 3 |
| 5 | 2/7/2016 | 9 | Centrality Measures I | Problem set 3 due | 2/9/2016 | 10 | Centrality Measures II | Problem set 4 |
| 6 | 2/14/2016 | 11 | Centrality Measures III | Problem set 4 due | 2/16/2016 | 12 | Network Sampling | Problem set 5 |
| 7 | 2/21/2016 | 13 | Network Filtering | Problem set 5 due | 2/23/2016 | 14 | Community Detection I | Problem set 6 |
| 8 | 2/28/2016 | 15 | Community Detection II | Problem set 6 due | 3/2/2016 | 16 | Community Detection III | |
| | 3/7/2016 | | SPRING BREAK | | 3/9/2016 | | SPRING BREAK | |
| 9 | 3/14/2016 | 17 | Dynamical Processes on Networks I | | 3/16/2016 | 18 | Dynamical Processes on Networks II | Problem set 7 |
| 10 | 3/21/2016 | 19 | Dynamical Processes on Networks III | Problem set 7 due | 3/23/2016 | 20 | Dynamical Processes on Networks IV | Problem set 8 |
| 11 | 3/28/2016 | 21 | Dynamical Processes on Networks V/ Temporal Networks I | Problem set 8 due | 3/30/2016 | 22 | Temporal Networks II | Problem set 9 |
| 12 | 4/4/2016 | 23 | Pandas, Geopandas, and friends, Git | Problem set 9 due | 4/6/2016 | 24 | GUEST LECTURE: Network Visualization | Problem set 10 |
| 13 | 4/11/2016 | 25 | Intro to MapReduce, Network analysis with Hadoop on the Cloud | Problem set 10 due | 4/13/2016 | 26 | TBD | |
| 14 | 4/18/2016 | 27 | TBD | | 4/20/2016 | 28 | TBD | |
| 15 | 4/25/2016 | 29 | FINAL EXAM | | 4/27/2016 | 30 | FINAL EXAM | |