MATH 7233: Graph Theory

Northeastern University, Fall 2017

• **Instructor:** Gábor Lippner (email: g.lippner@neu.edu)

• **Time and place:** Mondays/Wednesdays 3:30-5:00pm in Ryder 153.

• **Office hours:** Tuesday 2pm-5pm (subject to change!!), or by appointment; in 547LA, phone ext: 5651.

• **Prerequisites:** No explicit requirements, but knowledge of some linear algebra (eigenvalues, eigenvectors) and basic probability theory will be assumed.

• **Texts:**
  - Handouts (problems sets and solution sheets) during the semester
  - Online lecture notes by Dan Spielman available at http://www.cs.yale.edu/homes/spielman/561/
  - *Graph Theory*, R. Diestel. Available freely online at http://diestel-graph-theory.com/basic.html (for reference only)

• **Grade:** Based on homework, and occasionally on class participation.

**Course description**  The first half of the semester will be a brief introduction to various classical topics in graph theory. In the second half we will look at linear algebraic methods in more detail. There will be a strong emphasis on problem solving, and learning to give clear explanations both in writing and at the board. A typical lesson will consist of roughly equal parts of a) on-the-spot problem solving in groups, b) discussion of solutions, and c) lecture.

**Homework and grading**  Homework will be assigned and scored throughout the semester. Your grade will largely depend on your homework score. There will be two types of homework, each type contributing 50% to your final score.

- writing up solutions to problems (mostly ones that were discussed in class, but occasionally you will expected to find solutions by yourself)
- computer assignments in MatLab (e.g. implement an algorithm or method that you learned about, and run it on some kind of data). I will be happy to help with MatLab basics in case you haven’t used it before.

**The final grade**  will be determined according to the following scale: A from 90.0%, A- from 85.0%, B+ from 80.0%, B from 75.0%, B- from 70.0%, C+ from 65.0%, and so on...

**Topics**

- Classical concepts:
  1. Paths, cycles, trees.
  2. Bipartite graphs and matchings.
3. Planar graphs.
4. Random graphs.

- Linear algebra methods:
  1. Random walks and electric networks
  2. Adjacency and Laplace matrices
  3. Eigenvalues, spectral gap, expander graphs
  4. Graph partitioning