

MATH 7233: Graph Theory

Northeastern University, Fall 2019

- **Instructor:** Gábor Lippner (email: g.lippner@northeastern.edu, office: 547 LA)
- **Time and place:** MW 3:30-5:00pm in Ryder 157.
- **Office hours:** MT 9-10am, W 1-2pm, or by appointment; in
- **TA:** Jonier Antunes (email: antunes.j@husky.neu.edu, office: 575 LA)
- **TA office hours:** MT 1:30-3pm
- **Prerequisites:** No explicit requirements, but knowledge of some linear algebra (eigenvalues, eigenvectors) and basic probability theory will be useful.
- **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)
- **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 of 2-3**, b) discussion of solutions, and c) lecture.
- **Grading:** Your grade will consist of 5 components, each worth 20%:
 1. Group work with oral “presentations”. Basically each group will have to present solutions to at least 5 problems during the semester, with priority given to those groups with fewer points. **Details will be given in class.**
 2. Written homework (to be done in groups)
 3. Coding assignments (to be done in groups)
 4. Four 20 minute long quizzes (to be done individually, 5% each)
 5. One 90 minute test (to be done individually)
 6. No finals.
- **Dates:**
 - Quiz dates: Sept 18, Oct 9, Oct 30, Nov 20.
 - Test date: Nov 6.
- **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...

- **Homework, coding, quizzes, test:**

- There will be three homework sets during the semester that involve writing up solutions to problems that were discussed in class. There will be 20 such problems in total, each contributing 1%. (One submission per group.)
- Two larger computer assignments consisting of 2 parts each (so 5% per part) 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. (One submission per group.)
- Partial credit **will not** be given for either the homework or the coding assignments, but you will have a 2nd attempt to improve solution after feedback if the first attempt didn't pass.
- Quizzes will be checking your understanding of basic concepts. You may have to give examples of a certain type of object, or decide whether a given object possesses a certain property.
- The test will be similar to homework in that you will have to write down solutions to problems previously encountered (or very similar to that) in class. However, you will not be able to use your notes, and will have to finish within 90 minutes.

- **Topics:**

- Classical concepts:
 1. paths, cycles, trees
 2. bipartite graphs and matchings
 3. Ramsey theory
 4. planar graphs
 5. 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.