Graphs and Network Flows
IE411

Preliminaries

Dr. Ted Ralphs

Introductory Stuff

- Welcome!
- Class Meeting Time
- Office Hours TR 4–5??

What will this class be about?

- Using graphs and network flows as a modeling abstraction.
- Optimization problems that arise in the study of graphs and network flows.
- The design, anaylsis, and implementation of algorithms to solve these optimization problems.
- The empricial analysis of these algorithms.

What do I expect you to know?

- Things I expect you to know or pick up "along the way":
  - Undergraduate mathematics
    - Logic and proof
    - Linear algebra
  - Basic optimization theory (linear programming)
  - Basic computer programming (we will use Python)

What are the goals for the course?

After this course, you should be able to:

- Recognize when an optimization problem has an underlying graph or network flow structure and develop an appropriate model.
- Choose appropriately from among available algorithms to solve the problem using algorithm analysis.
- Implement the chosen algorithm and solve the problem.
- Perform appropriate post-processing, such as sensitivity analysis.

Approximate Syllabus

Week	**Topics**
1	Introduction to Graphs and Flows
2	Python and Graph Representations
3	Algorithm Design and Analysis
4	Graph Search
5	Minimum Spanning Trees
6–7	Shortest Path Problem
8	*Mid-term*
9–10	Maximum Flow Problem
11–12	Minimum Cost Flow Problem
13	Network Simplex Algorithm
14	Advanced Topics
Date TBD	Final Exam

Course Requirements

- Attendance
- Participation
- Reading
- Homework
- Exams

Homework and Final Project

- There will be problem sets approximately every 2 weeks.
- Problem sets should be turned in electronically according to the procedure in the syllabus.
- There will also be a comprehensive final project worth 10% of your grade.
- Homework is due at the beginning of class.
- Lateness policy is in the handout.
- I encourage working together, but you must write up the homework yourself (unless it is a group assignment).
- Please reference the work of others.
- Basic problem types:
  - Modeling
  - Mathematical Proofs
  - Algorithms
  - Programming

Grading

- Your grade will correspond to your learning and understanding of the course material.
- Some areas to keep in mind
  - Good proof technique
  - Level of detail and rigor
  - Accurate self-assessment
  - Class participation
- I will be randomly grading selected problems. Detailed solutions for selected problems will be distributed.
- I encourage you to assess your solutions to all assigned problems.
- Approximate weighting
  - 30% Homework
  - 20% Mid-term
  - 20% Final Project
  - 20% Final Exam
  - 10% Class Participation

Class Web Site

- The class Web site will be at

  http://coral.ie.lehigh.edu/~ted/teaching/ie411/

- I will post lecture slides before class so you can use them to take notes.
- The slides will be in PDF format.
- All handouts for the class will also be available.
- There will also be links to other relevant sites and reference materials.

Textbook

- The primary text is Sedgewick.
- I may also take material out of some other texts.
- There is an abundance of reference material on the Web.
- Check the Web site for links.
- Please let me know if you want additional supplementary material.

My Approach to Lectures

- Lectures should be as interactive as possible.
- You will get more out of this course if you ask questions during lecture.
- The pace and structure of the lectures can be adjusted.
- I need feedback from you to adjust appropriately.

Some More Notes

- This course will be quite mathematically rigorous.
- If you are having trouble, let me know.
- Please pay attention to the policy regarding citing the work of others in the syllabus.
- I take this policy very seriously.

Questions?