

Syllabus: Network Flows and Graphs OA 4202

You can find handouts, notes, and the class calendar on the course home page:
<http://neddimitrov.org/teaching/201104NFG.html>

Instructor: Ned Dimitrov ned@nps.edu

Lectures: Monday through Thursday
0800-0950 Glasgow 122
1300-1450 Glasgow 122

Office Hours: Tuesday and Thursday 1130-1230, in groups
or by appointment made 24 hours in advance, in groups

Sakai: Web space for questions and discussion:
<https://cle.nps.edu/xsl-portal/site/201104nfg.html>

Course Objectives:

- 1) Learn to think creatively about network modeling
- 2) Learn basic network and algorithm definitions
- 3) Learn a handful of basic data structures and their properties
- 4) For several graph algorithms, understand:
 - a) How the algorithm works: the algorithm pseudo-code
 - b) Why the algorithm works: proof/intuition of correctness
 - c) The algorithm's basic properties: appropriate uses of the algorithm
 - d) How to apply the algorithm to real problems

Course Catalog Description: Introduction to formulation and solution of problems involving networks, such as maximum flow, shortest route, minimum cost flows, and PERT/CPM. Elements of graph theory, data structure, algorithms, and computational complexity. Applications to production and inventory, routing, scheduling, network interdiction, and personnel management. PREREQUISITE: OA3201.

Course Content:

Lectures: The class lectures are the primary method of presenting the course content. Two helpful texts from which some, but not all, of the lecture material is derived are "Network Flows: Theory, Algorithms, and Applications" by Ahuja, Magnanti, and Orlin (the main book for the class) and "Introduction to Algorithms", by Cormen, Leiserson, Rivest, and Stein (a helpful second reference). Ultimately, you will only be tested on and only be responsible for the material covered in lecture or explicitly assigned during lecture.

Assignments and Evaluation: There are three types of evaluated assignments for the course:

1. Homework assignments (31% total): There will be about 2 homework assignments per week. Usually a homework assignment will be given out on Monday and will be due on Wednesday, and a second assignment will be given on Wednesday and be due the following Monday. Some assignments will be GAMS programming assignments.

You are recommended to work with other students in the class on the homeworks, usually small groups of two or three work best. When working with other students, everyone has to turn in their own, individually written copy of the assignment. You should also place the names of your student collaborators at the top of your individual assignment.

Homeworks are not intended to be stressful, but simply to provide incentive for you to train on the lecture material. You will receive answers to the homework assignments, and some problems from each homework will be graded. Grading on the homeworks will generally be lenient... a complete assignment will receive at least 50% of the points.

No late homework assignments will be accepted, however your lowest homework assignment score will be dropped.

2. Exams (2 x 17% each and 1 x 5%): There will be 3 exams during the course. The exams are the primary way of ensuring you have learned the lecture material. Exams will have a stricter grading policy than homeworks. By the time of the exam, you are expected to know the lecture material, and certainly solve problems similar to those assigned for homework.
3. Project (30%): There will be one small group project. We'll start thinking about the project early on, but you are expected to do most of the work later in the course. The deliverables include a 20-30 minute in-class presentation and a written paper.

Class Schedule:

Sep 26: First day of class.

Oct 6: First exam.

Oct 10: No class (Columbus day)

Oct 20: Second exam.

Nov 1: Third exam.

Nov 2 to 3: Project presentations.

Nov 3: Final day of class.

Things you can do to be successful:

1. Communicate with me when you are lost, don't understand, or need help
2. Expect questions without obvious answers in the homeworks, exams, and lecture
3. Refresh the previous lecture's material in your mind before coming to class
4. Be sure you individually understand the homework solutions
5. Expect to work extensively on course material outside of class every week

Rough Course Topics Outline: We will adapt and change this as we progress. More up-to-date information will be posted on the class website.

Week 1: Graph Terms, Storing Graphs in a Computer, Intro to Shortest Path as an LP, Graph Search. HW0, HW1, GAMS prep.

Week 2: Graph Search Applications, Dijkstra's algorithm, Directed Acyclic Graphs, In depth Shortest Path as an LP. HW2, GAMS 0, EXAM 0.

Week 3: In depth Shortest Path as an LP, Interdicting Shortest Path, Benders for Interdicting Shortest Path, Intro to Max Flow. HW3.1, HW3.2.

Week 4: Max Flow – Min Cut, Ford Fulkerson, Reading primal/dual variables, Max Flow applications. HW3.3, GAMS 1, EXAM 1.

Week 5: Max Flow applications, Min Cost Flow, Min Cost Flow applications, Successive Shortest Paths HW4, HW5.

Week 6: Finish min cost flow. Exam 2, Project Presentations.