

University of Southern California  
Daniel J. Epstein Department of Industrial and Systems Engineering  
ISE 532: Network Flows – Spring 2008  
Course Syllabus

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**Instructor:**

Fernando Ordóñez  
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Office Hours: 1:30-3:30 p.m. Monday

**General:**

The course meets Monday-Wednesday from 11:00 to 12:15 pm at OHE-120.

**Course Objectives:**

The course is a graduate-level subject in the theory and practice of network flows. Network flow problems form a subclass of linear programming problems that are used to represent a broad variety of application areas, including manufacturing, transportation, logistics, project activities, and finance.

The purpose of the course is to present students with the state-of-the art in the theory and applications of network flow problems to enable the student to model and solve real systems, and analyze and develop algorithms. This course will survey the underlying concepts of graph and network problems, its theory, solution algorithms and their complexity, and various application areas.

**Prerequisites:**

ISE 330, Introduction to Operations Research or ISE 536, Linear Programming and Extensions or Departmental approval

**Course Text:**

Ravindra K. Ahuja, Thomas L. Magnanti, and James B. Orlin, *Network Flows: Theory, Algorithms, and Applications*, Prentice-Hall, 1993.

**Grading:**

The course will have almost weekly problem sets, which will consist of problems from the text and on occasion a few computational exercises. Computational exercises will be carried out using the NEOS Server for Optimization (<http://www-neos.mcs.anl.gov/>). The homeworks will be graded on a random subset of the problems, but solutions to all problems will be posted in the course's web-page. The course will also have two midterms and a final exam. The grading for the class will be determined using the following weights, homework: 30%, each midterm: 20%, and final: 30%.

**Tentative Course Outline:**

1. Introduction (3 lectures)
  - Examples of Network Flows
  - Examples of Graph problems
  - Basic algorithms and Complexity
  
2. Shortest Paths (4 lectures)
  - Optimality conditions
  - Dijkstra's algorithm
  - Label correcting algorithm
  
3. Maximum Flow Problems (5 lectures)
  - Optimality conditions
  - Generic augmenting path algorithm
  - Max Flow - Min Cut
  
4. Minimum Cost Flow (5 lectures)
  - Cycle canceling algorithm
  - Successive shortest path algorithm
  - Network simplex
  
5. Graph problems (3 lectures)
  - Assignments, matchings and covers
  - Minimum spanning/Maximal weight trees
  - Arc and vertex routing problems
  
6. Multicommodity Flows and Applications (6 lectures)
  - Formulation
  - Lagrangian relaxation
  - Column Generation
  - Applications

**Academic integrity:** “The Department of Industrial and Systems Engineering adheres to the University’s policies and procedures governing academic integrity as described in SCampus. Students are expected to be aware of and to observe the academic integrity standards described in SCampus, and to expect those standards to be enforced in this course.”

“Any Student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m. - 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.”

### Tentative Assignment Schedule:

Class	Date	Assignment	Reading
1	Jan 14		1.1 - 1.4
2	Jan 16		2.1 - 2.4
3	Jan 23	PS #1 due	3.1 - 3.5
4	Jan 28		4.1 - 4.5
5	Jan 30	PS #2 due	4.6 - 4.9
6	Feb 4		5.1 - 5.3
7	Feb 6	PS #3 due	5.5 - 5.8
8	Feb 11		6.1 - 6.4
9	Feb 13		6.5 - 6.6
10	Feb 20	<b>Midterm 1</b>	
11	Feb 25		6.7 - 6.8
12	Feb 27	PS #4 due	7.1 - 7.3
13	Mar 3		7.4 - 7.6
14	Mar 5	PS #5 due	9.1 - 9.4, C.1 - C.6
15	Mar 10		9.5 - 9.8
16	Mar 12	PS #6 due	9.9 - 9.12
17	Mar 24		10.1 - 10.3
19	Mar 26	PS #7 due	11.1 - 11.5
20	Mar 31		12.1 - 12.5
21	Apr 2	PS # 8 due	
22	Apr 7	<b>Midterm 2</b>	
18	Apr 9		13.1 - 13.6
23	Apr 14		16.1 - 16.3
24	Apr 16	PS #9 due	16.4 - 16.6
25	Apr 21		17.1 - 17.4
26	Apr 23	PS #10 due	17.5- 17.6
27	Apr 28		
28	Apr 30	PS #11 due	overview of 14, 15, 19
29	May 7	<b>Final Exam</b> , 11:00 a.m. - 1:00 p.m.	