ORIE 6330 Network Flows

Course Information

August 28, 2012

1 Instructor Information

Instructor:	Prof. David Williamson
Office:	236 Rhodes Hall
Office hours:	Mondays 1:30-2:30, Wednesdays 11-12, and by appt.
Email:	`dpw@cs.cornell.edu`
Phone:	(607) 255-4883
Course web site:	`www.orie.cornell.edu/~dpw/orie6330/`

2 Lectures

Lectures will be Tuesday/Thursday 10:10-11:25 in ~~Phillips 213~~ Upson 215.

Because we missed the first class of the term, and may miss one later in the term, there is a possibility we will try to make up some lectures during reading period.

3 Prerequisites

There is no formal prerequisite. In practice, I will be assuming some previous exposure either to algorithms or combinatorial optimization. I will also be using some basic knowledge of linear programming on occasion, but have a handout on the website covering the needed material. Please talk to me if you have questions about whether you have the necessary background.

4 Textbooks

There are now several good textbooks in combinatorial optimization in general and network flows in particular; the end of the handout lists many that are available. Some of the material I will cover is in them, but some is not, and I will not be referring to any one book with regularity. Hence no book is required, but I will try to mention good sources for the material as we go along.

Course notes from a previous time I taught the course are available on the class website. There will be substantial overlap between this iteration of the course and that one, so this is a good resource.

I am in the process of trying to write up some of this material in book form. A PDF of the current version is accessible on Blackboard; I am not posting it on the website because I do not want it publicly available, and I request that you not circulate the PDF. It is likely to be buggy, typo-filled, and constantly updated throughout the semester. If you read it and find errors, I would appreciate it if you point them out to me.

5 Requirements

There will be 5 problem sets, handed out and collected on a biweekly basis.

There will also be a take-home final exam. I will allow students to substitute a final project in place of the take-home final should they so desire. The project can involve implementing algorithms given in class and comparing their performance on various types of graphs; another possibility would be writing a 10+ page survey of flow algorithms or problems not presented in class. If you are interested in this option, you must give me an initial proposal by the mid-October, and we must have reached agreement on the nature of the project by the beginning of November.

6 Collaboration

You may collaborate with other students on the solution of problem sets. However, you must write up solutions on your own independently, and acknowledge your collaborators. If you use papers or books to help obtain your solution, you must cite those sources.

7 Bibliography

Here is a list of books and other materials in the area that I will be drawing on for the course.

- Ravindra K. Ahuja, Thomas L. Magnanti, James B. Orlin, *Network Flows: Theory, Algorithms, and Applications*, Prentice-Hall, 1993.
- William J. Cook, William H. Cunningham, William R. Pulleyblank, Alexander Schrijver, *Combinatorial Optimization*, John Wiley & Sons, 1998.
- Bernhard Korte, Jens Vygen, *Combinatorial Optimization: Theory and Algorithms*, Fifth Edition, Springer-Verlag, 2012.
- Eugene Lawler, *Combinatorial Optimization: Networks and Matroids*, Holt, Rinehart, and Winston, 1976 (Reprinted by Dover Publications, 2001).
- Christos H. Papadimitriou, Kenneth Steiglitz, *Combinatorial Optimization: Algorithms and Complexity*, Prentice-Hall, 1982 (Reprinted by Dover Publications, 1998).
- Alexander Schrijver, *Combinatorial Optimization: Polyhedra and Efficiency*, Springer-Verlag, 2003.

8 Schedule

Here is a rough schedule for the course, which is subject to change without notice. This may be a bit ambitious; we will probably cover less material than is listed here. “Advanced topics” are likely to include some subset of edge-disjoint paths, unsplittable flow, parametric maximum flow, submodular function minimization, and network coding.

Aug	28, 30	Overview. Maximum flows; minimum s-t cuts. Optimality conditions. Applications of max flow. Problem set 1 out.
Sept	4, 6	Polynomial-time augmenting path algorithms. The push/relabel algorithm for max flow.
Sept	11, 13	Finding global minimum cuts: Hao-Orlin, MA orderings. Problem set 1 due. Problem set 2 due.
Sept	18, 20	Finding global minimum cuts: MA orderings, contraction algorithm. Blocking flows and the Goldberg-Rao algorithm.
Sept	25, 27	Blocking flows and the Goldberg-Rao algorithm. Minimum-cost circulations: optimality conditions. Problem set 2 due. Problem set 3 out.
Oct	2, 4	Minimum-cost circulations: Cycle cancelling algorithms, strong polynomiality, cost-scaling.
Oct	9	Fall break.
Oct	11	Minimum-cost circulations: network simplex. Problem set 3 due. Problem set 4 out.
Oct	16, 18	Generalized flow: optimality conditions. Generalized flow algorithms. Initial project proposal due.
Oct	23, 25	Multicommodity flow: Definitions, two-commodity flow. The Garg-Könemann algorithm. Problem set 4 due. Problem set 5 out.
Oct Nov	30 1	Multicommodity flow: the Awerbuch-Leighton algorithm.
Nov	6, 8	Flows over time: Maximum dynamic flows. Quickest transhipment. Problem set 5 due.
Nov	13, 15	Advanced topic.
Nov	20	Advanced topic.
Nov	23	Thanksgiving.
Nov	27, 29	Advanced topic. Take-home exam (or project due).