Graphs and Networks	
Course Description and Mechanics	
Lecturer: Daniel A. Spielman	September 6, 2007

1 Registration

If you plan to take this class, please sign up on the Classes V2 server. This is how you will receive class-related announcements.

2 Overview

The purpose of this class is to introduce many types of graphs and graph phenomena that are studied in the sciences and engineering.

The types of graphs that we will study included social networks (who knows who), the web graph (which page links to which), the internet graph (which router links to which), citation graphs (who references whose papers), planar graphs (which country is next to which), well-shaped meshes (pretty pictures with triangles), geometric graphs (who is near who), random graphs (whichever), random power-law graphs, algebraically defined graphs (links determined by mathematician), and probably some biologically motivated graphs.

The phenomena what we will study will include ranking (which web page is better), clustering (which people go together), spread of epidemics (drawbacks of knowing too many whos), random walks (a monkey surfing the web), conductance (electrify your graph), distributed synchronization (how we all agree), navigation (how to figure out if I know someone who knows someone who), exploration (discovering whos), percolation (who's left after we break connections) and diffusion (spilling coffee on your graph).

I intend for this class to expose students to a mix of theory and practice. The theoretical part will mainly be presented in the theorem-proof style.

3 Required background

To take this class, one should probably have had courses in discrete mathematics, probability, and linear algebra. Some more advanced courses in mathematics, statistics, or computer science would help. I will try to cover background material as it is needed.

4   Course Materials

I have not ordered a book for this class, since I cannot find a good book that covers even a small fraction of the material we will discuss. Instead, I will place links to readings and my lecture notes on the course homepage.

With the exception of solutions to problem sets, this is the only paper handout I will create. Everything else will be found on the course webpage: `http://www.cs.yale.edu/homes/spielman/462/`.

5   Work for the course

There will be 5 or 6 problem sets during the semester. The problem sets will be mostly theoretical, although I hope to create optional experimental parts for some of them.

Students have the option of doing course projects instead of some of the problem sets. Typical projects will be worth 1 or 2 problem sets, depending on the difficulty and the number of students collaborating. The details are to be negotiated with me.

The difference between the undergraduate and graduate versions will be that the graduate students will be assigned some difficult extra problems. I will also supply the material that one needs to learn to solve these problems, and I expect the graduate students to collaborate to learn the extra material and solve the problems. Mathematically sophisticated undergraduates are also welcome to participate.

6   Motivation

I believe that Graph Theory is the new Calculus. Researchers in many fields of science, engineering, and social science have spent much of the last decade actively applying graph theory. My goal in this class is to introduce you to some of these applications, and to give you the background you will need to understand the rest. There are more applications than I can possibly cover, so I'm just going to pick those I understand best.

This class is designed in opposition to standard classes in graph theory, which are typically based on a book originally written in the 1970's, and which makes no reference to uses of graph theory outside of combinatorics and theoretical computer science.

7   Disclaimer

This class is my attempt to create a sub-discipline. To the best of my knowledge, there are related classes at other universities, but no classes that are really close to it. So, I've had to make most of it up. This is only the second time that I am teaching this class, and I still consider it to be an experiment.