Graphs and Networks
AMTH/CPSC 462/562
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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…) games, percolation (I prefer espresso) and diffusion (spilling coffee on your graph).

Course Materials:

I have ordered the book "Modern Graph Theory" by Bollobas for the course. If you do not already own a book on graph theory, buy it. If you do already own a book on graph theory, you might not find it necessary. We will only use about 20% of the book, and most of the material we cover in the class will not be in the book. I ordered this book because it had more of the material I wanted to cover than any other book.

The rest of the material from the course will come from papers available on the web, and my lecture notes.

Evaluation:

Problem sets will be the means of evaluation in this class. I expect to write 5-6 problem sets. There will be no tests. If students are interested, there will be optional class projects. These could be substituted for one to two problem sets, depending on the difficulty and the number of students collaborating.

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.

Hidden Motivation:

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 computer science. This drives me nuts. It is also intended to cure a deficiency prevalent among scientists who use graph theory: they typically can only imagine the graphs that occur in their own fields. This leads them to make provincial statements about graphs which are false in general, and also drives me crazy.

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