

Introduction to Graph Theory

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Teaching time	Morning

Course Description: Introduction to Graph Theory

Graph theory is a field of discrete mathematics that has been rediscovered by almost every academic field of study. Mathematicians began studying graphs in the mid 1700s; computer scientists call graphs by the name of networks; sociologists call them sociograms; physicists study them as complex systems; and the 2012 Nobel prize in economics was awarded to economists who use graph theory models. This course will introduce the study of graph theory aimed at a general audience, covering the historical development of and the successful, useful and famous applications of graphs, including the 4-colour map theorem, graph planarity, the stable-matching algorithm, games on graphs, Eulerian and Hamiltonian traversals, and introductory social network analysis and bioinformatics applications.

Materials/Text:

None. Just lecture notes.

Requirements:

Prerequisites: none.

Schedule:

1. Drawing puzzles, graph traversals, Euler's Theorem
2. Graph colouring and applications to scheduling
3. Graph planarity, discovering Euler's polyhedral formula.
4. Weighted graphs, edge capacities, network flow, Ford-Fulkerson algorithm
5. Bipartite graphs and applications
6. Graph matching, stable marriage, the Gale-Shapley algorithm
7. Connecting locations cheaply: shortest paths and minimum spanning trees
8. Dijkstra's, Kruskal's, Prim's algorithms
9. Graph theory in sociology, social network analysis
10. Centrality measures, embeddedness measures, clustering coefficients
11. Bioinformatics applications
12. Computer representation of graphs
13. Software for graph theory analysis

Assignments:

1. Graph terminology: traversals, connectedness, cliques and independent sets
2. Calculating Minimum Spanning Trees
3. Calculating Maximum Flows
4. Finding maximum matchings
5. Calculating social metrics: centralities and clustering

In addition to 5 assignments, students will formulate a personal project that uses Graph Theory in an area that most interests them, whether it is music, nature, history, economics, or any field of science. Instructor will direct the project once the student submits the initial proposal.

Evaluation:

- Each assignment is worth 10% of the final grade (50% total)
- One midterm test will be worth 10%
- One final test will be worth 20%
- One personal project will be worth 20%