

1. INTRODUCTION

- (a) Graphs and Graph Theory
- (b) Some Typical Applications
- (c) Outline of the Course

2. DEFINITIONS & NOTATION

- (a) Labeled and Unlabeled Graphs
- (b) Invariants of a Graph
- (c) Order, Size, Degree,
- (d) Computer representation of graphs/digraphs
 - i. Adjacency and incidence matrices
 - ii. Adjacency and incidence lists
 - iii. Introduction to GMPX, PG, and Nauty
- (e) Graphical Sequence
 - i. A characterization of graphical sequences
- (f) Walks, Trails, Paths, Cycles
- (g) Subgraphs of a Graph
- (h) Induced Subgraphs
- (i) Spanning Subgraphs

3. SPECIAL GRAPHS

- (a) Connected and Disconnected Graphs/Digraphs
- (b) Trees and Forests
- (c) Complete Graphs & Tournaments
- (d) Bipartite Graphs
 - i. A characterization of bipartite graphs
- (e) Hamiltonian Graphs
- (f) Eulerian Graphs/Digraphs
 - i. A characterization of Eulerian graphs
- (g) Iterative Graphs
- (h) Random Graphs
- (i) Other Special Graphs

4. TREES

- (a) Some Properties of Trees
- (b) Spanning Trees of a Graph
- (c) Optimal Spanning Trees
- (d) Different Optimality Criteria
- (e) Finding Optimal Spanning Trees
- (f) Some Applications

5. DIRECTED TREES

- (a) Some Properties of Directed Trees

6. COUNTING TREES

- (a) Counting Spanning Trees of a Labeled Graph

7. SEARCHING TECHNIQUES

- (a) Depth-First Search
 - i. Properties of DFS
- (b) Breadth-First Search
 - i. Properties of BFS
- (c) Some Applications

8. SHORTEST-PATHS PROBLEMS

- (a) Problem Description
- (b) Single-Source Single-Destination Problem
- (c) Single-Source Multiple-Destination Problem
- (d) Multiple Source-Destination Problem
- (e) Some Applications

9. MAXIMUM FLOW

- (a) Problem Description
- (b) Evolution of Maximum-Flow Algorithms
- (c) Ford-Fulkerson Results
- (d) Edmond-Karp Algorithm
- (e) MPM Algorithm
- (f) Other MFAs

10. APPLICATIONS OF MAXIMUM-FLOW

- (a) Finding Arc-Disjoint paths
- (b) Finding edge-disjoint Paths
- (c) Finding vertex-disjoint paths

11. GRAPH CONNECTIVITIES

- (a) Problem Description
- (b) Evolution of Connectivity Algorithms
- (c) Computing λ of a Graph
- (d) Computing κ of a Graph
- (e) Computing λ of a Digraph

12. CONNECTIVITY GENERALIZATIONS

- (a) Problem Description
- (b) Conditional Connectivities
- (c) Restricted Connectivities
- (d) Some Applications

13. MATCHINGS

- (a) Problem Description
- (b) Matching Algorithms
- (c) Some Application