

Math 4/52021
Exam II Review

Exam II will be given in class on **Thursday, November 5, 2009**. It will cover §§3.1–3.2 and §§4.1–4.3, Homework #5–#7, and material from class October 1 through October 29. The problems will be similar to homework problems.

Listed below are the basic terminology and results you should be familiar with and the types of problems and skills to be tested. Proofs of basic results related to the listed terminology and theorems may be included. Statements of definitions/theorems and proofs of theorems will *not* be on the exam.

Terminology

§3.1: tree, root, leaf, internal vertex, forest, balanced tree, parent, child, second cousin, level, height, m -ary tree, labeled tree, Prüfer sequence

§3.2: depth-first search, breadth-first search, preorder traversal, postorder traversal, adjacency matrix, spanning tree

§4.1: weighted graph, (undirected) network

§4.2: minimum spanning tree

§4.3: (directed) network, capacity, source, sink, flow (including required conditions), value (or strength) of a flow, cut, capacity of a cut, saturated edge, slack, unit flow path, unit flow chain, maximum flow, minimum cut

Theorems

Chapter 3:

- In a tree, $e = v - 1$.
- In an m -ary tree with n vertices, i internal, $n = mi + 1$.
- Bijection between labeled trees and Prüfer sequences.
- It is impossible to see the forest for the trees.
- Graph is connected if and only if a spanning tree exists.
- Cannibals should not outnumber missionaries, unless there are no missionaries.

Chapter 4:

- Shortest Path Algorithm.
- Prim's Algorithm.
- Kruskal's Algorithm.
- Flow out of source equals flow into sink.
- For any flow f and cut (P, \bar{P}) , $|f| \leq k(P, \bar{P})$.
- Conditions for $|f| = k(P, \bar{P})$.
- Max Flow/Min Cut Theorem.
- Augmenting Flow Algorithm (i.e., Max Flow/Min Cut Algorithm).

Types of Problems

Chapter 3:

- Give examples illustrating terms.
- Proofs of basic results on trees (as in §3.1 problems).
- Construct Prüfer sequence given a labeled tree; construct labeled tree given a Prüfer sequence.
- Find preorder and postorder traversals.
- Draw a graph given an adjacency matrix.
- Find spanning tree by a depth-first or breadth-first search.
- Test a graph for connectedness.

Chapter 4:

- Find the shortest path between two vertices of a weighted tree (including variations, such as using or not using a specified edge or vertex).
- Find a minimum spanning tree in a weighted graph using Prim's Algorithm or Kruskal's Algorithm.
- Complete a given partial flow in a network.
- Find a maximum flow and minimum cut in a given network.