University of Massachusetts, Amherst
Department of Electrical & Computer Engineering

ECE 665 ALGORITHMS
Spring 2014

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Lecture time	Tu. Th. 11:15 – 12:30
Lecture location	Hasbrouck 20
Course web site:	Moodle

Course Objective

Introduction to the design and analysis of computer algorithms. Topics include basic algorithmic paradigms (divide-and-conquer, dynamic programming, greedy approach, and randomization), their application to core problems in graph theory and optimization, as well as analysis of time and space complexity.

Course Description

This course provides an introduction to the design and analysis of computer algorithms and data structures. We will discuss classic problems (e.g., sorting), classic algorithm design strategies (e.g., divide-and-conquer, greedy approaches), and classic algorithms and data structures (e.g., hash tables, Dijkstra's algorithm). We will also analyze algorithm complexity throughout. We will cover topics from a spectrum of discrete algorithm design and analysis, including the following:

1. *Design and analysis of algorithms*, including asymptotic notation, worst-case analysis.
2. *Algorithmic design patterns*, including greedy method, divide-and-conquer, dynamic programming and branch-and-bound.
3. *Algorithmic frameworks*, including NP-completeness, approximation algorithms.
4. *Data structures*, including lists, vectors, trees, priority queues
5. *Combinatorial algorithms*, including heap-sort, quick-sort, merge-sort, selection.
6. *Graph algorithms*, including traversals (DFS and BFS), topological sorting, shortest paths (all-pairs and single-source), minimum spanning tree, maximum flow, minimum-cost flow, and matching.

Prerequisites

Basic understanding of elementary data structures, such as arrays and linked lists. Familiarity with a high level programming language, such as C, C++, or Java.

Textbook

Algorithm Design, Foundations, Analysis and Internet Examples

M. T. Goodrich, R. Tamassia, John Wiley & Sons Inc, 2002, ISBN: 0-471-38365-1

Course Outline

- Algorithm Analysis: methodologies for analyzing algorithms.
- Basic Data Structures: stacks, queues, trees, heaps.
- Search Trees.
- Sorting: Merge sort, Quick sort, Bucket sort, Radix sort.
- Fundamental Techniques: Greedy method, Divide & Conquer, Dynamic programming.
- Graphs: Graph traversal, Directed Graphs.
- Weighted Graphs: Shortest Paths, Minimum Spanning Trees.
- Network Flow and Matching: Flows and Cuts, Maximum Flow, Minimum-Cost Flow.
- Basic Mathematical Programming techniques: LP, ILP, duality
- Applications to VLSI CAD, computer networks, and physics.

Grading

- Homework and programming assignments - 30%
- Midterm exam - 30%
- Final exam - 40%