COMPUTER SCIENCE 361
ALGORITHMS & DATA STRUCTURES

I. Introduction

A. Catalog Description

This is a course in advanced data structures, the algorithms needed to manipulate these data structures, proofs that the algorithms are correct, and a runtime analysis of the algorithms. Students will study advanced data structures such as Red-Black Trees, 2-3 Trees, Heaps and Graphs. Students will also study algorithm design techniques including Greedy Algorithms, Divide and Conquer, Dynamic Programming, and Backtracking. They will also learn about NP-Complete problems. *Prerequisites: CSCI 281, and either MATH 211 or Math232 (Math232 may be taken concurrently).* Satisfies a writing requirement in major contracts.

B. Learning Objectives

Students will learn about advanced data structures, the algorithms needed to manipulate those data structures, and the tools for the analysis of those algorithms. CSCI361 extends the knowledge the student gained in CSCI 261 (Computer Science II) to a more mathematical description of data structures and algorithms.

C. Prerequisites

CSCI 261, CSCI 281 (may be taken concurrently) and Math 211 or Math 232 (Math 232 may be taken concurrently). A grade of C- or better is required in prerequisite courses.

II. Suggested Topics

A. Algorithm Design Techniques

1. Divide and conquer
2. Dynamic programming
3. Greedy algorithms
4. Backtracking

B. Searching and sorting

1. Red-black Trees
2. 2-3 Trees
3. Splay Trees
4. Binary, Leftist and Skew Heaps
5. Quicksort, Heapsort, and Shellsort

C. Graphs and Graph Algorithm

1. Depth-first and Breadth-first Search
2. Prim and Kruskal's algorithm for minimal spanning trees
3. Warshall and Dijkstra's shortest-path algorithms

II. Suggested Topics (continued)

D. Miscellaneous

1. String matching
2. Evaluating polynomials
3. Fast Fourier Transform

E. Algorithm Analysis

1. Lower bounds
2. Adversary arguments
3. Amortized analysis

E. NP-Complete Problems

1. Definition of P and NP
2. Polynomial reduction
3. Approximation algorithms

V. Bibliography

Aho, Hopcroft, & Ullman,	Data Structures and Algorithms
Basse and Gelder,	Computer Algorithms
David Gries,	Science of Programming
Donald Knuth,	The Art of Computer Programming, Vol I, II, III
Horowitz, Sahni, & Mehta,	Fundamentals of Data Structures in C++
Thomas Standish,	Data Structure Techniques
Mark Allen Weiss,	Data Structures & Algorithm Analysis in Java
Nicklaus Wirth,	Algorithms + Data Structures = Programs
CD ROM	Dr. Dobb's Essential Books on Algorithms and Data Structures