Knight Foundation School of Computing and Information Sciences

Course Title: Algorithm Techniques **Date:** 12/23/2010

Course Number: COP 4534

Number of Credits: 3

Subject Area: Algorithms, programming	**Subject Area Coordinator:** Tim Downey **email:** downeyt@cis.fiu.edu
Catalog Description: Basic algorithm design, including greedy algorithms, divide-and-conquer, dynamic programming, randomization, and backtracking. Graph, string, numerical, geometric, and optimization algorithms.	
Textbook: *Introduction to Algorithms 3rd ed*, by Cormen, Leiserson, Rivest, and Stein	
References: *Algorithm Design*, by Kleinberg and Tardos *Data Structures and Algorithm Analysis in Java 2nd ed*, by Weiss *Algorithms in Java*, by Sedgewick	
Prerequisite Courses: COP 3530	
Corequisite Courses:	

Type: Set 1 Elective

Prerequisites Topics:

- Be familiar with basic techniques of algorithm analysis
- Be familiar with writing recursive methods
- Master the implementation of linked data structures such as linked lists and binary trees
- Be familiar with advanced data structures such as balanced search trees, hash tables, priority queues and the disjoint set union/find data structure
- Be familiar with several sub-quadratic sorting algorithms including quicksort, mergesort and heapsort
- Be familiar with some graph algorithms such as shortest path and minimum spanning tree
- Master the standard data structure library of a major programming language (e.g. java.util in Java 5)

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Course Outcomes:

O1. Be familiar with standard algorithm techniques including dynamic programming, greedy algorithms, divide and conquer, backtracking, and randomized algorithms

O2. Be familiar with some graph algorithms, computational geometry algorithms, numerical algorithms, combinatorial optimization algorithms, and string algorithms

O3. Be able to synthesize the knowledge of algorithmic strategies to analyze and design solutions to new and challenging problems

Relationship between Course Outcomes and Program Outcomes

BS in CS: Program Outcomes	**Course Outcomes**
a) Demonstrate proficiency in the foundation areas of Computer Science including mathematics, discrete structures, logic and the theory of algorithms	**O1, O2, O3**
b) Demonstrate proficiency in various areas of Computer Science including data structures and algorithms, concepts of programming languages and computer systems.	**O1, O2, O3**
c) Demonstrate proficiency in problem solving and application of software engineering techniques	**O1, O2, O3**
d) Demonstrate mastery of at least one modern programming language and proficiency in at least one other.	**O1, O2, O3**
(other outcomes)	

Assessment Plan for the Course & how Data in the Course are used to assess Program Outcomes

Student and Instructor Course Outcome Surveys are administered at the conclusion of each offering, and are evaluated as described in the School's Assessment Plan: https://abet.cs.fiu.edu/csassessment/

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Outline[1]

Topic	Hours	Outcome
• String Algorithms o Knuth-Morris Pratt, Rabin-Karp, Boyer-Moore o Suffix trees o Regular expressions o String and pattern matching libraries	4	O1, O2, O3
• Greedy Algorithms o Huffman Codes o Approximate Bin Packing o Simple Job Scheduling	3	O1, O3
• Divide-And-Conquer Algorithms o Multiplication o Closest Points o FFT	3	O1, O3
• Dynamic Programming o edit distance o string pattern matching o reconstructing paths o optimization application	3	O1, O2, O3
• Randomized Algorithms o Introduction to random numbers o Skip Lists and Treaps o Nuts and Bolts Problem	3	O1, O3
• Number Theory o prime numbers o divisibility o modular arithmetic applications o congruences o number theoretic libraries	4	O1, O2, O3
• Backtracking o constructing subsets o constructing permutations o pruning search o puzzle solving	5	O1, O3
• Graph Algorithms o graph theory o depth first and breadth first search o minimum spanning trees o shortest paths o network flows and bipartite matching	7	O1, O2, O3
• Combinatorial Optimization	3	O1, O2, O3

[1] Other algorithms topics such as computational geometry may be substituted by instructor.

o gaussian elimination o linear programming		

Course Outcomes Emphasized in Laboratory Projects / Assignments

Outcome	Number of Weeks
O1	5 assignments, 2 weeks each
O2	
O3	

Oral and Written Communication:

None

Social and Ethical Implications of Computing Topics:

None

Approximate number of credit hours devoted to fundamental CS topics

Topic	Core Hours	Advanced Hours
Algorithms:	0	2.5
Software Design:	0	0.0
Computer Organization and Architecture:	0	0.0
Data Structures:	0	0.0
Concepts of Programming Languages:	0	0.5

Theoretical Contents:

None

Problem Analysis Experiences:

5 assignments

Solution Design Experiences:

None

The Coverage of Knowledge Units within Computer Science Body of Knowledge

Knowledge Unit	Topic	Lecture Hours
AL1	Divide and Conquer	1
AL2	Greedy algorithms, divide and conquer, dynamic programming, randomized algorithms, backtracking	17
AL3	String Algorithms, Graph Algorithms, Numerical Algorithms, Combinatorial Optimization Algorithms, Computational Geometry Algorithms	18
AL 8	Dynamic programming, randomized algorithms, combinatorial optimization, approximate bin packing (online/offline algorithms)	10
AL 10	Closest Pairs	1
DS 5	Graph Algorithms	7