CMPS 312 Algorithm Analysis and Design

Catalog Description

CMPS 312 Algorithm Analysis and Design (5)

Algorithm analysis, asymptotic notation, hashing, hash tables, scatter tables, and AVL and B-trees, brute-force and greedy algorithms, divide-and-conquer algorithms, dynamic programming, randomized algorithms, graphs and graph algorithms, and distributed algorithms. Each week lecture meets for 200 minutes and lab meets for 150 minutes. Prerequisite: CMPS 295/300 and CMPS 223.

Prerequisites by Topic

Discrete Structures

Data Structures

Units and Contact Time

5 quarter units. 4 units lecture (200 minutes), 1 unit lab (150 minutes).

Type

Required for Computer Science

Required Textbook

Introduction to the Design and Analysis of Algorithms, 3rd edition, Anany Levitin, Pearson, 2012, ISBN-10: 0-13-231681-1; ISBN-13: 978-0-13-231681-1.

Recommended Textbook and other Supplemental Materials

None

Coordinator(s)

Marc Thomas, Donna Meyers

Student Learning Outcomes

This course covers the following ACM/IEEE Body of Knowledge student learning outcomes:

(CC-AL1) Basic algorithmic analysis.

(CC-AL2) Algorithmic strategies.

(CC-AL3) Fundamental computing algorithms.

(CC-AL4) An introduction to distributed algorithms.

(CE-ALG5) Algorithmic complexity.

ABET Outcome Coverage

This course maps to the following performance indicators for Computer Science (CAC/ABET):

(CAC PIa1): *3a. An ability to apply knowledge of computing and mathematics appropriate to the discipline: PIa1. Apply and perform the correct mathematical analysis.*

Laboratory/homework assignments and questions on the midterms and final require direct applications of the mathematical theory of algorithms pertinent to computer science.

(CAC PIb1): *3b. An ability to analyze a problem, and identify and define the computing requirements and specifications appropriate to its solution: PIb1. Identify key components and algorithms necessary for a solution.*

Implementation on actual hardware and the ability to analyze performance (e.g. the roles of caches, virtual memory, use of multi-threaded code) will be required for successful completion of laboratory/homework assignements and will be tested on the exams.

(CAC PIj1): *3j. An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices: PIj1. Understand performance and cost as these relate to software/firmware-based and hardware-based implementations.*

Implementation and performance analysis of different algorithms (e.g. direct, recursive, etc.) which solve the same problem will be required for successful completion of laboratory and homework assignments and will be tested on the exams.

Lecture Topics and Rough Schedule (Sections by Week)

W1: (1.1–1.4 and Appendix A) introduction, basic issues with examples, useful formulas, important problem types, and review of data structures.

W2: (2.1–2.3) input size, order of growth and big-O notation, analysis and examples of non-recursive algorithms,

W3: (2.4, Appendix B, and 3.1–3.2) analysis and examples of recursive algorithms, searching, sorting, and string matching.

W4: (3.3–3.4) closest-pair, convex hull problems, and exhaustive search (traveling salesman, knapsack).

W5: (4.1) insertion sort, (4.2) topological sorting, and (4.3) combinatorial considerations.

W6: (4.4) binary search, (4.5) Lomuto partitioning, (5.1) mergesort, and (5.2) quicksort.

W7: (5.3–5.4) binary tree traversals. (6.2) Gaussian elimination.

W8: (6.3) AVL and 2–3 search trees and (6.4) heapsort.

W9: (6.5) Horner's rule, (7.3) hashing, and (7.4) B-trees.

W10: Additional topics (e.g. P and NP, multi-threaded code, and distributed algorithms).

Laboratory Topics

The laboratory session will parallel the lecture, illustrating the principles and familiarizing the student with actual coding and hardware performance. Coding will be in **both** the `C` and `C++` languages and we will cover the use of timing (`user`, `system`) routines.

Estimated ABET Category Content

Math and Basic Sciences

Fundamental Computing

Advanced Computing

Design Content Description

Not applicable to this course.

Prepared by

Marc Thomas on October 21, 2013.

Approval

Approved by CEE/CS Department ______________________

Effective Fall 2013

CMPS 312 Addendum to Syllabus

Grading:

Two midterms will be given, each worth 25%. I do not give make-up midterms; for an excused absence I count the other grades proportionately higher. One final exam, comprehensive but emphasizing the later material, will be given. It is mandatory and worth 25%. Homework and lab work are together worth the remaining 25%.

Final Exam:

The final exam is mandatory and should be taken at the scheduled time which is posted on the CSUB campus main web page. Making travel arrangements on or before the date of the final exam will **not** be considered a valid excuse for being able to take the final exam at a different time.

Attendance Policy:

Students are responsible for their own attendance. Course materials and assignments will be posted on the course website:
`http://www.cs.csubak.edu/~marc/code/cs312.html`

Academic Integrity Policy:

Homeworks and labs may be worked on and strategy discussed in groups. However, unless otherwise stated, all assignments are *individual* assignments in that each student must turn in his/her own work; **no** direct copying is allowed. Refer to the Academic Integrity policy printed in the campus catalog and class schedule.

Tutoring Center:

The Tutoring Center in Sci III 324 is available for use by students in this course outside of class time on a first come, first serve basis. Priority in the lab is given to students who are completing assignments for department courses. The hours for the Tutoring Center are posted on the department website.