Course Description
CMPS 312

Algorithm Analysis and Design

Catalog Description:

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.

Prerequisite:

CMPS 223 and CMPS 295/300

Units:

5

Instructor:

Marc Thomas

ACM/IEEE Body of Knowledge Topics:

(CS/CE-AL1) Basic algorithmic analysis.

(CS/CE-AL2) Algorithmic strategies.

(CS/CE-AL3) Fundamental computing algorithms.

(CS/CE-AL4) An introduction to distributed algorithms.

(CE-AL5) Algorithmic complexity.

(Laboratory) Become proficient in writing programs implementing algorithms, understanding memory usage, user and system time, and impact of caches and virtual memory on performance.

Texts:

Required: Anany Levitin *Introduction to the Design and Analysis of Algorithms* (3rd edition, `ISBN-10: 0-13-231681-1`)

Topics (roughly) by Week:

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

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

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

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

(4.1–4.3) insertion sort, topological sorting, and combinatorial considerations.

(4.4) binary search (5.1–5.2) mergesort and quicksort.

(5.3–5.4) binary tree traversals.

(6.2–6.4) Gaussian elimination, AVL and 2–3 search trees, and heapsort.

(6.5) Horner's rule (7.3–7.4) hashing and B-trees.

Additional topics (e.g. multi-threaded code, and distributed algorithms).

Laboratory:

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`, `prof`) routines.

ABET Outcome Coverage:

3a. *An ability to apply knowledge of computing and mathematics appropriate to the discipline. An ability to understand how computer science relates to mathematics and the physical sciences.* Laboratory/homework assignments and questions on the midterms and final require direct applications of the mathematical theory of algorithms pertinent to computer science.

3b. *An ability to analyze a problem, and identify and define the computing requirements and specifications appropriate to its 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.

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.* 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/homework assignments and will be tested on the exams.

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%.

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.

Students in this course may ask the tutors for assistance on assignments. The tutors are not allowed to solve the assignment for you, but they can assist with problems like cryptic compiler errors.