Data Structures and Algorithms
Syllabus

Instructor

Martine Ceberio
Office: Computer Science 202 C
Phone: 747-6950 / Fax: 747-5030
E-mail: mceberio@cs.utep.edu
Website: http://www.cs.utep.edu/mceberio

Office hours: Tuesday-Thursday 10:30am - noon
Classes: MWF 11:30-12:20, CS 321

Textbook

Data Structures and Problem-Solving Using Java, *3rd edition*
by: Mark Allen Weiss
Addison-Wesley

1 Course description

This course is a survey of classic algorithms and data structures, useful for sorting, manipulating graphs, storing data collections and mappings. Students will acquire an understanding of generalization techniques for evaluating the complexity of these algorithms, and they will be able to apply these algorithms to a wide range of computer science problems.

Introductory techniques for determining correctness and evaluating complexity will be presented. Students are expected to master basic skills and to develop an intuitive understanding of how the surveyes analysis techniques are commonly used.

1.1 Objectives of the course

- asymptotic analysis of algorithms
- methods for proving correctness
- survey of data structures (abstract data types) and algorithms
- implementation of algorithms

examples of data structures and algorithms:

- trees (e.g., B-trees, AVL-trees), heaps, hash tables, graphs
- binary search, tree traversal, heapsort, quicksort, graph algorithms

1.2 Outcomes of the course

- understand, apply and prove mathematical claims about space and time requirements of algorithms, and about correctness of algorithms
- detailed knowledge of a number of standard algorithms, and data structures, including knowledge of time and space complexity
- ability to prove properties of data structures and associated algorithms
- ability to implement these algorithms
- ability to design and analyze significant software systems
- ability to apply computer science principles and practices to a variety of problems

More specifically, the following core algorithms and data structures will be covered in this course:

- collections: adjacency matrices and lists, hash tables, self-balancing trees (B-trees, AVL trees, Red-Black trees), priority queues
- search and sort algorithms: in particular, the binary search, the insertion sort, bubble sort, heap-sort, quick-sort, merge-sort
- tree traversals: pre-order, post-order, in-order, depth-first search, breadth-first search
- graph algorithms: single-source shortest path, all-pairs shortest path, minimum spanning tree, coloring problem, topological sort

The skills of the students after passing the class can be divided into the following three categories:

- level 3: mastery to the extent of being able to apply them to new situations:
  - describe the characteristics of surveyed data structures
  - appropriate and justified choice of data structures, including the definition of the pre- and post-conditions for operations on these data types
  - application of surveyed data structures to algorithms and data structures to a range of computer science problems
  - implement and be able to make appropriate choices of sorting algorithms
  - mapping of a range of problems to graphs
  - basic skills in algorithm analysis: in particular, they should know the inverse relationship between log and exponentiation
- level 2: mastery of the following:
  - meaning of time and space complexity metrics

  - meaning and importance of the "big O" notation
  - understanding of the correctness of an algorithm, and how to prove it
  - generation of a recurrence complexity relation for a simple recursive algorithm
  - at least one approach for evaluating and/or establishin bounds for recurrence relations

- level 1: familiarity with the following topics:
  - amortized analysis
  - operations to keep a tree balanced
  - proof of precise mathematical claims about time and space complexity

Prerequisite: CS 2401 and MATH 2300 each with a grade of C or better.

2 Homework, exams, etc.

Homework, quizzes

Students will be given homework and quizzes on a regular basis. Homework may not be graded all the time, but students are expected to work hard on them for they constitute a good training for succeeding at the exams. Quizzes are likely to be **unannounced**, so students are expected to work on the lecture material on a regular basis to make sure they come prepared to classes.

Homework will be checked and/or exercises will be given about once a week in class.

Programming assignments

This course is associated with a lab session. Programming assignments will be given and students are expected to complete (turn in) all the programming assignments, and be graded at least D on all these assignments. Turning in **ALL** programming assignments with a **grade D or better** is a **strong requirement** for the students to pass the class.

Mid-terms and final exams

There will be 3 "mid-terms" during the semester. The tentative schedule is as follows:

- 1st mid-term 4th week of classes
- 2nd mid-term 9th week of classes
- 3rd mid-term 13th week of classes

The date of the final exam will be posted on my website as soon as possible.

3 Grading

The semester grade will be based on a combination of quizzes, project, midterms, and a final exam. The approximate percentages are as follows:

- 12% Homework / Quizzes
- 23% Programming assignments/tutorials
- 45% Mid-terms (3 mid-terms, 15% each)
- 20% Final exam

Letter grades

- $\geq$ 85% is an A
- $75 - 84\%$ is a B
- $65 - 74\%$ is a C
- $56 - 64\%$ is a D
- $\leq$ 55% is a F

4 Course policies

Communication

Students are required to check their e-mail and visit the webpage of the class (reachable from http://www.cs.utep.edu/mceberio/), to keep up to date about possible new annoucements, on a daily basis.

Standards of conduct

Students are expected to conduct themselves in a professional and courteous manner, as prescribed in the Standards of Conduct:

http://it.utep.edu/hoop/Student_Affairs_Index_Page_HOP.htm

Graded work, *e.g.,* homework and tests, is to be completed independently and should be unmistakably your own work (or, in the case of group work, your team's work), although you may discuss your projects or homework with other students in a general way. You may not present as your own work material that is transcribed or copied from another person, book, or other source, *e.g.,* a web page. Professors are required to - and therefore will - report academic dishonesty and any other violation of the Standards of Conduct to the Dean of Students.

In addition to this, note that eating or drinking in the classroom will not be tolerated.

Attendance policy

At most three absences are allowed. Three tardies will count as one absence, and will be recorded each time a student shows up ten minutes after the start of class. Above three absences, the final grade will be lowered by one point for each unexcused absence.

Disabilities

If you feel that you may have a disability that requires accomodation, contact the Disabled Student Services Office at 747-51 84, go to Room 106E Union, or e-mail dss@utep.edu.