CSCI/CMPE 3333-01
Algorithms and Data Structures

Course Information

<table>
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<tr>
<th>Instructor:</th>
<th>Robert Schweller</th>
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<td>Contact:</td>
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<tr>
<td>Office: ENGR 3.294</td>
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<tr>
<td>Office Hours:</td>
<td>TR 10:00am - 12:00am</td>
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<tr>
<td>Schedule:</td>
<td>Lecture: MW, 10:50 - 12:05pm, ENGR 1.268</td>
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<tr>
<td>Textbook:</td>
<td>(Required) Data Structures and Algorithm Analysis in C++ (fourth edition), by Mark A. Weiss, AddisonWesley</td>
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<td>(Not required, but a good book to have) Introduction to Algorithms (second or third edition), by Cormen, Leiserson, Rivest, Stein, publisher- McGraw Hill.</td>
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<td>Course Website:</td>
<td><a href="http://faculty.utrgv.edu/robert.schweller/CS3333/CS3333.html">http://faculty.utrgv.edu/robert.schweller/CS3333/CS3333.html</a></td>
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Course Description

CSCI/CMPE 3333 - Data Structures and Algorithms: This course is a continuation of data structures topics covered in CSCI/CMPE 2380. Content includes theoretical topics in
Algorithmic efficiency and complexity, along with abstract data types, including graphs, networks, trees, and priority queues. Search topics, including hashing, trees, external search trees (B-trees), and sorting algorithms including external sorting are introduced and compared. Computational complexity topics include the Class P and NP, NP completeness and Reducibility, NP-completeness Proofs, and NP-complete Problems. Prerequisites: CSCI/CMPE 2380 and CSCI 3310.

Course Topics
CSCI/CMPE 3333 teaches you algorithms, data structures, and software principles. It emphasizes fundamental questions of computer science: how to organize large amounts of data and how to design algorithms to process large amounts of data efficiently in time and space. It covers the following topics:

- Algorithm design and analysis: greedy algorithms, divide and conquer, dynamic programming, randomized algorithms, graph algorithms, computational complexity, NP-completeness.
- Data structures: lists, stacks, queues, priority queues, trees, hash tables, and graphs.
- Hashing: hashing functions, quadratic probing, separate chaining.
- Sorting: various methods including heapsort, mergesort, quicksort, and radix sort.

Course Objectives
After completing this course, a student should be able to:
1. Understand basic data structures and abstract data types.
2. Gain an appreciation of the variety, theoretical nature, and practical uses of data structures.
3. Select appropriate data structures for uses in computer programs.
4. Understand the basic techniques of algorithm design and analysis.
5. Understand the basic concepts of computational complexity.
6. Design and implement efficient algorithms based on the selected data structures.

Learning Outcomes
Level 3: Synthesis and Evaluation. Level 3 outcomes are those in which the students can apply the materials in new situations. This is the highest level of mastery. Upon successful completion of this course, students will be able to:
- specify data structures and operations associated with abstract data types
- define the signature and pre- and post-conditions for operations of an abstract data type
• Given a scenario, describe the abstract data types that could be created
• identify, implement, and use the following data structures as appropriate for a given problem:
  – lists implemented as arrays or linked lists
  – stacks
  – queues
  – binary trees and binary search trees
  – simple hashes
• implement binary trees and binary search trees, using pre-, post-, or in-order traversals as appropriate for a given situation
• judge which data model (list, tree, graph, or set) is appropriate for solving a problem
• justify the choice of a data structure to solve a problem based on issues such as time, space, and of the data structure.
  judge which implementations are best suited for an application that requires a list data model: lists, circular lists, circular queues, or generalized list
• judge whether an array or linked implementation is best suited or an application that requires a data model
• judge which graph representations (adjacency list, adjacency matrix, edge list) are appropriate for solving a problem
• develop algorithms that are based on depth- and breadth-first traversals of general trees, binary trees and graphs
• judge which sort algorithms (insertion, selection, mergesort, heapsort, quicksort, radix) is appropriate for solving a problem
• judge which search algorithm and data structure is appropriate for solving a problem
• implement a recursive solution to a problem

Level 2: Application and Analysis

Level 2 outcomes are those in which the students can apply the materials in familiar situations, e.g., can work a problem of familiar structure with minor changes in the details. Upon successful completion of this course, students will be able to:
• use Big-O notation to express the best-, average-, and worst-case behaviors of an algorithm
• explain the structure and use of activation records
• determine the best-, average- and worst-case behaviors of an algorithm
• assess time and space trade-offs in algorithms
• explain, code, and use quadratic and $O(n \log n)$ sorting algorithms
• implement recursive algorithms over natural numbers, lists, and trees
• define and use classes, subclasses, and inheritance
• describe the importance of encapsulation and information hiding
• implement applications and simulations using data structures identified above
• implement simple sequential and binary search algorithms
• implement a set of searching/sorting algorithms
• categorize algorithms based on programming strategy, i.e., divided-and-conquer, greedy, backtracking, and dynamic programming strategies
• analyze iterative and recursive algorithms with respect to time and space
• describe the applications for a dictionary/map ADT, e.g., the application of symbol table
• Give representations for and operations on a binary tree, general tree, threaded tree, heap, binary search tree, B-tree, quadtree, and graph
• determine the order for a B-tree based on memory issues

Level 1: Knowledge and Comprehension
Level 1 outcomes are those in which the students have been exposed to the terms and concepts at a basic level and can apply basic definitions. The materials have been presented only at a superficial level. Upon successful completion of this course, students will be able to:

• recognize the standard terms associated with particular data structures, e.g., head/tail, push/pop
• understand the big-O, Theta, Omega notations understand the concepts of time/space complexity
• understand the basic tree concepts
• understand the basic searching/sorting methods
• recognize the standard terms of graphs

ABET Outcomes for CSCI 3333
1. An ability to apply knowledge of computing and mathematics appropriate to the discipline.
2. An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.
3. An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs
4. Recognition of the need for and an ability to engage in continuing professional development.
5. An ability to use current techniques, skills, and tools necessary for computing practice.
6. 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.
7. An ability to apply design and development principles in the construction of software systems of varying complexity.

ABET Outcomes for CMPE 3333
1. an ability to apply knowledge of mathematics, science, and engineering.
2. an ability to design and conduct experiments, as well as to analyze and interpret data.
• an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
4. an ability to identify, formulate, and solve engineering problems.
5. a recognition of the need for, and an ability to engage in life-long learning.
6. a knowledge of contemporary issues.
7. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Course Requirements
Labs: There will be a weekly lab during this course relevant to the topic being covered. Each lab will be graded based on participation and completion of the lab.
Quizzes: There will be daily quizzes given throughout this course that will be a part of your grading.
Assignments: Students are expected to have assignments completed at the beginning of class (or when specified) on the due date. This may include selected readings from the textbook.

Exams: The material in this course is naturally cumulative, with each week’s topics building on all the prior material. Therefore, each exam will focus on the material covered since the previous exam, however, the student is expected to understand and apply all previous course material.

Scoring and Grading
The purpose of the labs is to increase your hands-on experience with the material, and to provide you with another avenue to demonstrate what you have learned.

<table>
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<tr>
<th>Grade Breakdown</th>
<th>Final Grade</th>
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<tr>
<td>Labs 15%</td>
<td>90%-100%</td>
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<tr>
<td>Quizzes 15%</td>
<td>80%-89%</td>
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<tr>
<td>Assignments 15%</td>
<td>70%-79%</td>
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<tr>
<td>Exams 55%</td>
<td>60%-69%</td>
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<td></td>
<td>0%-59%</td>
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Total possible score (max): 100%

Note: Grades may be curved to reflect the overall performance of the class. The exact breakdown of grades is subject to change.

Course Policies
Attendance: Students are expected to attend all scheduled classes and may be dropped from the course for excessive absences. UTRGV’s attendance policy excuses students from attending class if they are participating in officially sponsored university activities, such as athletics; for observance of religious holy days; or for military service. Students should contact the instructor in advance of the excused absence and arrange to make up missed work or examinations.

Drop Class Policy: According to UTRGV policy, students may drop any class without penalty earning a grade of DR until the official drop date. Following that date, students must be assigned a letter grade and can no longer drop the class. Students considering dropping
the class should be aware of the 3-peat rule and the 6-drop rule so they can recognize how dropped classes may affect their academic success. The 6-drop rule refers to Texas law that dictates that undergraduate students may not drop more than six courses during their undergraduate career. Courses dropped at other Texas public higher education institutions will count toward the six-course drop limit. The 3-peat rule refers to additional fees charged to students who take the same class for the third time.

Computer Use Policy: Please read and be aware of University policies for computer use, which can be found at: http://www.utpa.edu/policies/UTPAAcceptableUse.pdf

Late Work Policy: All assignments must be turned in on time to receive credit. In some cases, assignments may be turned in early for extra credit.

Make-up Policy: No make-up exams will be given except for university sanctioned excused absences. If you need to miss an exam, it is your responsibility to contact me before the exam, or as soon after the exam as possible. Missing an exam without an approved (by the university or me) excuse will result in a zero.

Academic Integrity Policy: As members of a community dedicated to Honesty, Integrity and Respect, students are reminded that those who engage in scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and expulsion from the University. Scholastic dishonesty includes but is not limited to: cheating, plagiarism, and collusion; submission for credit of any work or materials that are attributable in whole or in part to another person; taking an examination for another person; any act designed to give unfair advantage to a student; or the attempt to commit such acts. Since scholastic dishonesty harms the individual, all students and the integrity of the University, policies on scholastic dishonesty will be strictly enforced (Board of Regents Rules and Regulations and UTRGV Academic Integrity Guidelines). All scholastic dishonesty incidents will be reported to the Dean of Students.

Course Evaluation: Students are required to complete an ONLINE evaluation of this course, accessed through your UTRGV account (http://my.utrgv.edu); you will be contacted through email with further instructions. Online evaluations will be available Nov. 18 Dec. 9, 2015. Students who complete their evaluations will have priority access to their grades.

Sexual Harassment, discrimination, and violence
In accordance with UT System regulations, your instructor is a “responsible employee” for reporting purposes under Title IX regulations and so must report any instance, occurring during a students time in college, of sexual assault, stalking, dating violence, domestic violence, or sexual harassment about which she/he becomes aware during this course
through writing, discussion, or personal disclosure. More information can be found at www.utrgv.edu/equity, including confidential resources available on campus. The faculty and staff of UTRGV actively strive to provide a learning, working, and living environment that promotes personal integrity, civility, and mutual respect in an environment free from sexual misconduct and discrimination.

**Note to Students with Disabilities**

If you have a documented disability (physical, psychological, learning, or other disability which affects your academic performance) and would like to receive academic accommodations, please inform your instructor and contact Student Accessibility Services to schedule an appointment to initiate services. It is recommended that you schedule an appointment with Student Accessibility Services before classes start. However, accommodations can be provided at any time. Edinburg Campus: Student Accessibility Services is located in 108 University Center and can be contacted by phone at (956) 665-7005 (Voice), (956) 665-3840 (Fax), or via email at accessibility@utrgv.edu.