CSE 5311-001: ADVANCED ALGORITHMS

Summer 2013: TR 6:00 p.m. - 7:50 p.m.

Instructor: Bob Weems, Associate Professor
Office: 627 ERB (weems@uta.edu, http://ranger.uta.edu/~weems)
Hours: MW 9:15 - 10:15 a.m.

GTA:          
Office:       
Email:        
Hours:        

Prerequisites:  
Algorithms & Data Structures (CSE 2320)
Theoretical Computer Science (CSE 3315)

Objectives:  Deeper study of algorithms, data structures, and complexity classes.

Outcomes:  
1. Exposure to more sophisticated analysis techniques, e.g. amortized complexity.
2. Exposure to specialized data structures and algorithms.
3. Exposure to models of algorithm design.


References:  


N. Wirth, *Algorithms + Data Structures = Programs*, Prentice-Hall.

Homework: Two assignments - NOT GRADED

Grade: Your grade will be based on the following weights:

- **Exams:** 80% (Test 1: 40%; Test 2: 40%, August 13, 6:00 p.m. - 8:00 p.m.)
- **Labs:** 20% (Three labs, equal weight)

Policies:

1. Attendance is not required, but is highly encouraged. Consult me in advance if you must miss class for a good reason.

2. You are expected to have at least skimmed the new material by the day we start that material in class. The material will be covered in the order given later.
3. Homeworks, with solutions, are available from the course web page.

4. CHEATING - YOU ARE EXPECTED TO KNOW UNIVERSITY POLICIES. All cases of plagiarism will be processed through University channels outside the CSE department.

   a. **Academic Integrity Policy:** It is the policy of the University of Texas at Arlington to uphold and support standards of personal honesty and integrity for all students consistent with the goals of a community of scholars and students seeking knowledge and truth. Furthermore, it is the policy of the University to enforce these standards through fair and objective procedures governing instances of alleged dishonesty, cheating, and other academic/non-academic misconduct.

   You can assume responsibility in two ways. **First,** if you choose to take the risk associated with scholastic dishonesty and any other violation of the Code of Student Conduct and Discipline, you must assume responsibility for your behaviors and accept the consequences. In an academic community, the standards for integrity are high. **Second,** if you are aware of scholastic dishonesty and any other conduct violations on the part of others, you have the responsibility to report it to the professor or assistant dean of students/director of student judicial affairs. The decision to do so is another moral dilemma to be faced as you define who you are. Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and dismissal from the University. Since dishonesty harms the individual, all students, and the integrity of the University, policies on scholastic dishonesty will be strictly enforced.

   b. **Statement on Ethics, Professionalism, and Conduct of Engineering Students:** The statement is attached. Continued failure to sign the statement will result in 1) late penalty on programming assignments and 2) failure on exams.

5. Any request for special consideration must be appropriately documented in advance. (Special consideration does not include giving a higher grade than has been earned.)

6. Late labs are penalized 30% per day, i.e. up to 3:15 p.m.. After the due date neither I, nor the GTA, will provide assistance.

7. Each student will have available one 48-hour no-penalty extension that may be applied to one of the lab assignments. To use your extension you must send an email to the grader before the due time.

   RESUBMISSIONS BEFORE THE DUE TIME ARE PENALIZED 10 POINTS EACH. NO RESUBMISSIONS AFTER THE DUE TIME.

8. If you require a reasonable accommodation for a disability, please contact me no later than the second week of this semester. Further details are available at http://www.uta.edu/disability.

9. Occasional class-wide email messages (e.g. weather situations, clarifications) may be sent to the addresses recorded by MyMav. These will also be archived on the course web page.

**Course Outline**

Starred (*) topics are not in CLRS
0. Selective review of dynamic programming (CSE 2320 notes 7)
1. Mathematical Preliminaries
   Recurrences - Master Method (4.5-4.6.1)
   Probability and Randomized Algorithms (5)
2. Binary Search Trees
   Red-Black Trees - Review (13)
   AVL Trees*
   Treaps (problem 13-4)
   Augmenting Data Structures (14)
3. Amortized Analysis (17)
4. Self-Organizing Linear Search (Computing Surveys*, problem 17-5)
5. Trees
   Optimal Binary Search Trees (15.5)
   Self-Adjusting Binary Search Trees (Splay trees/amortized analysis) (JACM)*
6. Skip Lists*
7.a. Priority Queues - Review (6.5)
    Binary Trees, Binary Heaps, d-heaps*, Leftist Heaps*
    Binomial Heaps (problem 19-2)
    Fibonacci Heaps (19)
7.b. van Emde Boas Trees (20)
8. Disjoint Sets (union-find trees) (21)
9. Hashing
   Review (11.2-11.4)
   Brent's Rehash*, Cuckoo Hashing*
   Perfect Hashing (11.5)
   Optimal Hashing*
   Bloom Filters*
10. Medians/Selection (9.3)
11. Minimum Spanning Trees (23)
    Brief review of Prim
    Review of Kruskal's Algorithm and extension to detecting non-unique MST
    Boruvka's Algorithm*
TEST 1
12. Max-Flow/Bipartite Matching (26)
    Ford-Fulkerson - review, maximum capacity* paths
    Push-relabel methods
    Vertex and edge connectivity*
18. Intractability (34, 35)
    Sample Intractable Problems
    Complexity Classes
    Reductions
    Polynomial-Time Approximation
16. Matrices
    Strassen's Matrix Multiplication (4.2)
    Binary Matrix Multiplication and Four Russians Trick*
17. Computational Geometry (33)
    Fundamental Predicates
    Closest Pairs
Convex Hulls
Sweepline Algorithms
15. Sequences
Pattern Preprocessing Search
  Rabin-Karp Algorithm (32.2)
  Gusfield's Z Algorithm*
  Knuth-Morris-Pratt Algorithm (32.4)
Text Preprocessing - Suffix Arrays*
Longest Common Subsequences
  Dynamic Programming - Review and Linear Space* Version
  Four Russians for LCS*
  Longest Strictly Increasing Subsequence Approach*

TEST 2

Calendar - with subject numbers from course content

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Thursday, July 18 is the last day to withdraw.