CSE 5311-001: ADVANCED ALGORITHMS

Summer 2014: TR 10:30 - 12:20, ERB 130

Instructor: Bob Weems, Associate Professor
Office: 627 ERB (weems@uta.edu, http://ranger.uta.edu/~weems/)
Hours: MW 3:00 - 4:00, TR 12:30 - 1:30

GTA: Information will be posted on web page

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.

(Henceforth known as CLRS)


C.M. Grinstead and J.L. Snell, *Introduction to Probability*,


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 12, 10:30 - 12:20)
- 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. The lectures are being recorded and will have a link on the web page, but no availability guarantee is made (e.g. this is not a “distance” course).
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 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.

   http://www.uta.edu/conduct/

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 10:15 a.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.

8. If you require a reasonable accomodation 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)

   TEST 1

11. Minimum Spanning Trees (23)
    Brief review of Prim
    Review of Kruskal's Algorithm and extension to detecting non-unique MST
    Boruvka's Algorithm*

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 17 is the last day to withdraw.