CSE 5311 (Advanced Algorithms) SYLLABUS

(Summer 1998: TTh 6:00-7:50, Nedderman 110)

Instructor: Bob Weems, Associate Professor (weems@cse.uta.edu)
Office: 341 NEB, 272-2337
Hours: TTh 3:15-5:40
GTA: TBA

Prerequisite: Essential: Algorithms & Data Structures (CSE 2320)
Desirable: Theoretical Computer Science (CSE 3315)

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

Goals:
1. Exposure to more sophisticated analysis techniques, e.g. amortized complexity
2. Exposure to specialized data structures and algorithms
3. Exposure to parallel and randomized models of computation

Textbook: Cormen, Leiserson, Rivest, ***Introduction to Algorithms***, MIT Press, 1990. (Henceforth known as CLR)

References: S. Baase, ***Computer Algorithms, Introduction to Design and Analysis***, 2nd edition, Addison-Wesley, 1988.

R.L. Graham, D.E. Knuth, and O. Patashnik. ***Concrete Mathematics***, Addison-Wesley, 1989.

D. Gusfield. ***Algorithms on Strings, Trees, and Sequences: Computer Science and Computational Geometry***, Cambridge University Press, 1997.

D. Gusfield and R. Irving. ***The Stable Marriage Problem: Structure and Algorithms***, MIT Press, 1989.

E. Horowitz and S. Sahni. ***Fundamentals of Computer Algorithms***, Computer Science Press, 1978.

D.E. Knuth, ***The Art of Computer Programming***, Vols. 1 and 3, Addison-Wesley.

R. Sedgewick, ***Algorithms***, 2nd ed., Addison-Wesley, 1988.

T. Standish, ***Data Structure Techniques***, Addison-Wesley, 1980.

C.J. Van Wyk, ***Data Structures and C Programs***, Addison-Wesley, 1988.

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

Exams: 2 exams, weighted equally

Homework: Three assignments - NOT GRADED.

Project: A project should highlight a particular algorithm, but should also present the context (e.g. other algorithms). Implementation is not required, but could be useful in gaining insight. Some tired (or trivial) topics (e.g sequential sorting, convex hulls, FFT, traveling salesperson) will NOT be

acceptable. Besides the write-up (nominally 15 pages), each student must give a 10-minute presentation (i.e. enough time for one example) on August 4 (6:00-10:00), August 5 (7:00-10:00), or August 6 (6:00-10:00).

Milestone	Due Date	Weight
Topic 1	July 7	5%
Topic 2	July 16	20%
Presentation	August 4-6	25%
Paper	August 6	50%

Recent books, conference proceedings (e.g. IEEE FOCS) or journals (*J.ACM*, *SIAM J. on Computing*, *Information Processing Letters*) will be useful resources in developing a topic. Time spent finding a good topic will reap benefits later . . .

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

Exams:	70% (Both count equally, Test 2: Monday, August 11, 6:00-7:50 pm)
Labs:	10% (Two labs, equal weight)
Project:	20%

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. A due date will be given for each homework. On the due date the solutions will be available in the copy center. The GTA will assist with homework questions.

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

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 lab/project documents are penalized 30% per day. After the due date neither I, nor the GTA will provide assistance.

7. Personal extensions will never exceed the amount of time remaining until the due date. (If you are having trouble, don't wait to request an extension.) I will ask to see the work you have already done.

8. Phone calls. I will not answer my phone during office hours if someone is in my office. After the third ring the call is switched to the CSE office, so please leave a message with the secretary.

9. Electronic mail is preferable to phone calls. I usually check for messages at least twice a day, but sporadically on the weekend. Send messages to weems@cse.

10. I reserve the right to give surprise quizzes. Each quiz will take the place of 2 points of the 70 points assigned to tests.

Course Outline

Starred (*) topics are not in CLR

1. Mathematical Preliminaries
    - Recurrences - Master Method (4.3-4.4)
    - Probability (6.3-6.6)
    - Coupon collecting*
2. Selective Review and Extensions of Data Structures
    - Self-Organizing Linear Search (Computing Surveys)*
    - AVL Trees*
    - Red-Black Trees - Review (14)
    - Augmenting Data Structures (15)
    - Skip Lists*
    - Amortized Analysis (18)
    - Optimal Binary Search Trees (dynamic programming)*
    - Self-Adjusting Binary Search Trees (Splay trees/amortized analysis) (JACM)*
    - Priority Queues - Review (7)
    - Binomial Heaps (20)
    - Fibonacci Heaps (21)
    - Disjoint Sets (union-find trees) (22)
    - Hashing - Brent's Rehash*, Perfect Hashing*
3. Medians/Selection (10)
4. Graph Algorithms
    - Minimum Spanning Trees (24)
        - Review of Prim
        - Kruskal's Algorithm (application of union-find trees)
    - Max-Flow/Bipartite Matching (27.1-27.5)
        - Review of Ford-Fulkerson
        - Preflow-push methods
        - Vertex and edge connectivity
        - Hopcroft-Karp bipartite matching*
    - Depth-First Search
        - Biconnected Components
        - Graph Triangulation*
5. Stable Marriages* - Sedgewick handout, stable marriage lattice/rotations
   Introduction to stable roommates

TEST 1

6. String Matching
    - Knuth-Morris-Pratt Algorithm (34.4)
    - Rabin-Karp Algorithm (34.2)
    - Suffix Trees
7. Matrices
    - Strassen's Matrix Multiplication (31.2)
    - LUP decomposition (31.4)
8. Computational Geometry (35)
9. Intractability (36)
    - Sample Intractable Problems
    - Complexity Classes
    - Reductions
    - Polynomial-Time Approximation
10. Parallel Algorithms/P-Completeness*
11. Randomized Algorithms*

Concepts/Definitions
Miller's Primality Test
Luby's Maximal Independent Set
Bipartite Perfect Matching
List Ranking
TEST 2

Calendar/Topics

	June				July		
2	Syllabus	4	1.			2	6.
9	2.	11	2.	7	7.	9	TEST 1
16	2.	18	2./3.	14	8.	16	9.
23	4.	25	4.	21	9.	23	10.
30	5.			28	11.		

	August		
4		6	
11	TEST 2		

CSE 5311 Survey

(Please submit by the end of the second lecture)

Name:

Home Phone:

Work Phone (& Hours):

Other Courses this Semester:

Special Circumstances Affecting your Performance:

CS Related Experience/Undergraduate Degree:

(Optional) What do you hope to gain from this course?