

CSE 2320-003: Algorithms & Data Structures

Spring 2018: TR 3:30 - 4:50 p.m., Nedderman 229

Instructor: Bob Weems, Associate Professor

Office: 627 ERB (weems@uta.edu, <http://ranger.uta.edu/~weems>)

Hours: TR 1:30 - 3:00, 5:30-6:45 p.m.

GTA: Contact information will be on my personal webpage

Prerequisites: C programming (CSE 1320, including basic UNIX competence)
Discrete Structures (CSE 2315, including combinatorics, trees, and graphs)

Objectives: In future design situations, students will be capable of developing, applying, and evaluating algorithmic solutions.

Outcomes:

1. Understanding of classic approaches to algorithm design - decomposition, dynamic programming, and greedy methods.
2. Understanding of particular algorithms and data structures that have wide applicability.
3. Understanding of basic algorithm analysis concepts by applying math skills to worst-case and expected time using recurrences and asymptotic notation.
4. Improved programming skills - especially data structures, recursion, and graphs.

Textbook: Cormen, Leiserson, Rivest, Stein, *Introduction to Algorithms*, 3rd ed., MIT Press, 2009. (Henceforth known as CLRS)

Reference: R. Sedgewick, *Algorithms in C, Parts 1-5*, 3rd ed., Addison-Wesley, 2003.

Readings: Indicated on calendar later in syllabus.

Homeworks: Three homeworks with answers will be on the course web page.

Grade: Based on the following weights:

Exams: 82% divided evenly among 3 exams.

Exam 3: Thursday, May 10, 2:00 - 4:30 p.m.

Programs: 18% divided among six assignments.

Final grade cut-offs: A - 85, B - 73, C - 61, D - 50

Policies:

1. Regular attendance is expected. The lectures are being recorded and will have a link from Blackboard, but no availability guarantee is made (e.g. this is not a “distance” course).
2. Lecture notes and sample code for various algorithms are on the course web page
<http://ranger.uta.edu/~weems/NOTES2320/cse2320.html>.
3. You are expected to have read the assigned readings by the specified date. Lectures will review and augment the material, but will also consider exercises from the book.
4. **CHEATING - YOU ARE EXPECTED TO KNOW UNIVERSITY POLICIES.** If you are suspected of cheating, the matter must go through university channels outside of 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 programs are penalized according to the following schedule. Labs will be due at 3:15 PM on the due date. After the due time, assistance will be limited.

| <u>Degree of lateness</u> | <u>Penalty</u> |
|---------------------------|----------------|
| Up to 3:15 next day | 5 pts |
| Up to 3:15 two days | 15 pts |
| Up to 3:15 three days | 30 pts |
| Up to 3:15 four days | 60 pts |

Please note that lab 6 will be due during Final Review Week.

7. Each lab is graded on a 100-point scale as follows:

Some Issues

- | | | |
|----------------------|-----|---|
| a. Output/Code | 60% | If you know that your program has problems, you should let the GTA know what parts are functional. Test cases that demonstrate the limited functionality are useful. |
| b. Internal Comments | 6% | Beginning of file including main() should identify the assignment and who you are, along with giving a high-level description. Each function: identify each argument, describe processing, and each return. You may reference notes and text. Excess line-by-line comments are not needed, but the processing for each iteration of a (significant) loop should be explained. |
| c. Modularity | 6% | Functions are used appropriately. main() is kept simple. |
| d. Structure | 6% | Code is not unnecessarily complicated or long. It is often better to rewrite code rather than patching several times. |

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|---------------|-----|---|
| e. Names | 6% | Should indicate the purpose of the function, variable/field, or type. Cute or misleading names will be penalized. |
| f. Spacing | 6% | Indenting, blank lines, placement of {}. Be consistent. |
| g. Generality | 10% | Program is not unnecessarily limited. |

All programs must be written in standard C to compile and execute on omega.uta.edu. Execution on other platforms (e.g. Visual Studio) does not assure compliance.

You are responsible for correctly submitting each programming assignment on Blackboard.

No points will be awarded for programs that do not compile. *Points for b-g will not be awarded to submissions that are not substantially complete and perform **significant** processing.* Submissions not reflecting algorithmic problem-solving techniques will not receive credit.

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. Messages will also be archived on the course web page.

Course Content (in chronological order)

1. (1, 2) Algorithmic Concepts - Selection Sort, Insertion Sort, Divide and Conquer, Mergesort (trivial recursion tree), Binary Search (with and without duplicates)
2. (3) Growth of Functions - Asymptotic Notation (O , Ω , Θ), Upper Bounds, Lower Bounds
3. (appendix A) Summations - Geometric Series, Harmonic Series, Math Induction, Integrals
4. (4.3, 4.4) Recurrences - Substitution Method, General Recursion Trees
5. (6.1-6.5) Heapsort/Priority Queues - Properties, Building a Heap, Sorting, Integrating with Other Data Structures
6. (16.1-16.3) Greedy Algorithms - Quality-of-Solution Issues, Unweighted Interval Scheduling, Knapsack, Huffman Codes
7. (15.1-15.4) Dynamic Programming - Weighted Interval Scheduling, Optimal Matrix Multiplication, Longest Common Subsequence, Longest Increasing Subsequence, Subset Sum, Knapsack/Memoization

Exam 1: Items 1.-7.?

8. (7.1-7.2, 9.2, 8.1-8.3) Quicksort - PARTITION, Selection/Ranking, Lower Bounds - Decision Tree Model, Stability, Counting and Radix Sorts
9. (10.2) Linked Lists - Use in Dictionaries, Headers, Sentinels, Circular Lists, Double Linking
10. (10.1) Stacks/Queues - Policies and Applications
11. (10.4, 12.1-12.3, 14.1, 13.2) Rooted Trees - Structure, Traversals, Binary Search Trees - Properties, Operations
12. (13.1, 13.3) Balanced Binary Search Trees - Structural Properties, Rotations, Insertions

Exam 2: Items 7.?.-12.

13. (11.1-11.4) Hashing - Concepts, Chaining, Open Addressing
 14. (22.1-22.5) Graph Representations - Adjacency Matrices, Adjacency Lists, Compressed Adjacency Lists, Search - Breadth-First, Depth-First, Search-Based Algorithms - Topological Sort, Strong Components
 15. (21.3, 23.1-23.2) Minimum Spanning Trees - Three Versions of Prim's MST, Disjoint Subsets, Kruskal's MST
 16. (24.3, 25.2) Shortest Paths - Dijkstra's Algorithm, Warshall's Algorithm, Floyd-Warshall Algorithm
 17. (26.1-26.3) Network Flows and Bipartite Matching - Concepts, Augmenting Paths, Residual Network, Cuts, Max-flow Min-cut Theorem, Implementation, Performance Issues
- Exam 3: Items 13.-17.

| January | | | | February | | | | March | | | |
|---------|----------|----|-----|----------|--------|----|--------|-------|--------|----|-------|
| 16 | Syllabus | 18 | 1. | | | 1 | 3. | | | 1 | |
| 23 | | 25 | 2. | 6 | 4. | 8 | | 6 | 8. | 8 | |
| 30 | | | | 13 | 5. | 15 | 6. | 13 | SPRING | 15 | BREAK |
| | | | | 20 | 7. | 22 | | 20 | 9. | 22 | 10. |
| | | | | 27 | Exam 1 | | | 27 | 11. | 29 | 12. |
| | | | | | | | | | | | |
| April | | | | May | | | | | | | |
| 3 | 13. | 5 | 14. | 1 | | 3 | | | | | |
| 10 | Exam 2 | 12 | | | | 10 | Exam 3 | | | | |
| 17 | 15. | 19 | 16. | | | | | | | | |
| 24 | 17. | 26 | | | | | | | | | |

March 30 is last day to drop; submit requests to major advisor prior to 4:00 p.m.

Messages/disclaimers/fine print from our sponsor:

Drop Policy: Students may drop or swap (adding and dropping a class concurrently) classes through self-service in MyMav from the beginning of the registration period through the late registration period. After the late registration period, students must see their academic advisor to drop a class or withdraw. Undeclared students must see an advisor in the University Advising Center. Drops can continue through a point two-thirds of the way through the term or session. It is the student's responsibility to officially withdraw if they do not plan to attend after registering. **Students will not be automatically dropped for non-attendance.** Repayment of certain types of financial aid administered through the University may be required as the result of dropping classes or withdrawing. For more information, contact the Office of Financial Aid and Scholarships (<http://wwwb.uta.edu/aao/fao/>).

Disability Accommodations: UT Arlington is on record as being committed to both the spirit and letter of all federal equal opportunity legislation, including *The Americans with Disabilities Act (ADA)*, *The Americans with Disabilities Amendments Act (ADAAA)*, and *Section 504 of the Rehabilitation Act*. All instructors at UT Arlington are required by law to provide “reasonable accommodations” to students with disabilities, so as not to discriminate on the basis of disability. Students are responsible for providing the instructor with official notification in the form of a letter certified by the **Office for Students with Disabilities (OSD)**. Students experiencing a range of conditions (Physical, Learning, Chronic Health, Mental Health, and Sensory) that may cause diminished academic performance or other barriers to learning may seek services and/or accommodations by contacting:

The Office for Students with Disabilities, (OSD) www.uta.edu/disability or calling 817-272-3364.

Counseling and Psychological Services, (CAPS) www.uta.edu/caps/ or calling 817-272-3671.

Only those students who have officially documented a need for an accommodation will have their request honored. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at www.uta.edu/disability or by calling the Office for Students with Disabilities at (817) 272-3364.

Title IX Policy: The University of Texas at Arlington (“University”) is committed to maintaining a learning and working environment that is free from discrimination based on sex in accordance with Title IX of the Higher Education Amendments of 1972 (Title IX), which prohibits discrimination on the basis of sex in educational programs or activities; Title VII of the Civil Rights Act of 1964 (Title VII), which prohibits sex discrimination in employment; and the Campus Sexual Violence Elimination Act (SaVE Act). Sexual misconduct is a form of sex discrimination and will not be tolerated. *For information regarding Title IX, visit www.uta.edu/titleIX or contact Ms. Jean Hood, Vice President and Title IX Coordinator at (817) 272-7091 or jmhood@uta.edu.*

Academic Integrity: Students enrolled all UT Arlington courses are expected to adhere to the UT Arlington Honor Code:

I pledge, on my honor, to uphold UT Arlington's tradition of academic integrity, a tradition that values hard work and honest effort in the pursuit of academic excellence.

I promise that I will submit only work that I personally create or contribute to group collaborations, and I will appropriately reference any work from other sources. I will follow the highest standards of integrity and uphold the spirit of the Honor Code.

UT Arlington faculty members may employ the Honor Code as they see fit in their courses, including (but not limited to) having students acknowledge the honor code as part of an examination or requiring students to incorporate the honor code into any work submitted. Per UT System *Regents' Rule* 50101, §2.2, suspected violations of university's standards for academic integrity (including the Honor Code) will be referred to the Office of Student Conduct. Violators will be disciplined in accordance with University policy, which may result in the student's suspension or expulsion from the University.

Electronic Communication: UT Arlington has adopted MavMail as its official means to communicate with students about important deadlines and events, as well as to transact university-related business regarding financial aid, tuition, grades, graduation, etc. All students are assigned a MavMail account and are responsible for checking the inbox regularly. There is no additional charge to students for using this account, which remains active even after graduation. Information about activating and using MavMail is available at <http://www.uta.edu/oit/cs/email/mavmail.php>.

Campus Carry: Effective August 1, 2016, the Campus Carry law (Senate Bill 11) allows those licensed individuals to carry a concealed handgun in buildings on public university campuses, except in locations the University establishes as prohibited. Under the new law, openly carrying handguns is not allowed on college campuses. For more information, visit <http://www.uta.edu/news/info/campus-carry/>

Student Feedback Survey: At the end of each term, students enrolled in classes categorized as "lecture," "seminar," or "laboratory" shall be directed to complete an online Student Feedback Survey (SFS). Instructions on how to access the SFS for this course will be sent directly to each student through MavMail approximately 10 days before the end of the term. Each student's feedback enters the SFS database anonymously and is aggregated with that of other students enrolled in the course. UT Arlington's effort to solicit, gather, tabulate, and publish student feedback is required by state law; students are strongly urged to participate. For more information, visit <http://www.uta.edu/sfs>.

Final Review Week: A period of five class days prior to the first day of final examinations in the long sessions shall be designated as Final Review Week. The purpose of this week is to allow students sufficient time to prepare for final examinations. During this week, there shall be no scheduled activities such as required field trips or performances; and no instructor shall assign any themes, research problems or exercises of similar scope that have a completion date during or following this week *unless specified in the class syllabus*. During Final Review Week, an instructor shall not give any examinations constituting 10% or more of the final grade, except makeup tests and laboratory examinations. In addition, no instructor shall give any portion of the final examination during Final Review Week. During this week, classes are held as scheduled. In addition, instructors are not required to limit content to topics that have been previously covered; they may introduce new concepts as appropriate.

Emergency Exit Procedures: Should we experience an emergency event that requires us to vacate the building, students should exit the room and move toward the nearest exit. When exiting the building during an emergency, one should never take an elevator but should use the stairwells. Faculty members and instructional staff will assist students in selecting the safest route for evacuation and will make arrangements to assist individuals with disabilities.