ECE 365: Data Structures & Algorithms II
Department of Electrical Engineering, School of Engineering, Cooper Union
Fall 2022

Course Website: http://faculty.cooper.edu/sable2/courses/fall2022/ece365/

Catalog Description:
A continuation of ECE 264, also with an emphasis on practical implementation issues and good programming methodology. Topics include graphs, graph-related algorithms and dynamic programming techniques. Also an introduction to some advanced topics such as Turing machines, computability and NP-complete systems. Assignments include programming projects and problem sets.

2 credits. Prerequisite: ECE 264

Instructor Info:
Prof. Carl Sable
Office: Rm. 614
Email: carl.sable@cooper.edu
Instructor website: faculty.cooper.edu/sable2

Fall 2022 Office Hours:
Wednesdays, 1-2 pm
Thursdays, 1-3 pm

More information about office hours is available on my instructor website.

Textbook: "Data Structures and Algorithm Analysis in C++", 4th Edition, by Mark Allen Weiss

Goals & Outcomes:
This course will provide both a theoretical understanding of advanced data structures and algorithms as well as practical knowledge as to when each is the most appropriate for a specific task. Students will be comfortable implementing important data structures and algorithms from scratch or using publicly available implementations to solve more general problems. The course will also provide insight into advanced computer science topics, including Turing machines, computability, and complexity theory.

Students will attain:
    I.   In depth understanding of advanced data structures and algorithms.
    II.   Ability to efficiently implement data structures and algorithms from scratch.
    III.   Ability to apply data structures and algorithms to solve complex problems.
    IV.   Insight into advanced topics related to theoretical computer science.

Grading:
- Four programming assignments: 12.5% each
- Two exams: 25% each

All assignments will be posted on the course website when they are assigned, and they will be discussed in class.

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Topics:
I.   Review of topics from ECE264.
II.   Priority queues: binary heaps, leftist heaps, binomial trees.
III.   Graph algorithms: representations of graphs; graph applications; topological sort; shortest path algorithms (Dijkstra's algorithm and the Bellman-Ford algorithm); minimum spanning trees (Prim's algorithm); network flow problems; maximum-flow problems (the Ford-Fulkerson method); the maximum-bipartite-matching problem; applications of depth-first search.
IV.   Algorithm strategies: greedy algorithms (heuristics, tries, Huffman codes); divide-and-conquer (recursion, mergesort, Tower of Hanoi); dynamic programming (top-down versus bottom-up, memoization, the longest-common-subsequence problem); randomized algorithms (random number generators, the 8-queens puzzle); exhaustive search (backtracking, pruning).
V.   Theoretical computer science: Gödel's theorem, Turing machines, computability, the $P = NP$? question, and complexity theory.

See the course website for the specific schedule, indicating the planned dates that each topic will be discussed.

Late Penalties:
My official late penalty for individual programming projects is 5 points per day late. I reserve the right to take off fewer points as I see fit, but I won't take off more. No program may be handed in after the last official day of the semester.

Extensions:
I don't typically give extensions without late penalties (see above). If there are extenuating circumstances, I may consider it. In such cases, please get in touch with me well before the deadline for the program you are asking the extension for. Email is best, because then I have it on record. Explain the reason for the request, and the amount of time you are requesting.

Extra Credit and Resubmissions:
I never allow extra credit assignments, and I never allow resubmissions of assignments that have already been graded. I don't think it is fair.

Accommodations:
Students seeking accommodations due to a condition covered by the Americans with Disabilities Act are required to formally self-identify through the Office of Dean of Students. The Dean of Students will work with the students to clarify requested accommodations. It is the student's responsibility to speak directly to me to see how their accommodations can be met. If you are entitled to receive extra time for an assignment, please speak to me well in advance, preferably at the start of the semester, but at the latest, immediately after a problem set or program is assigned.