

CSE 551 Foundations of Algorithms

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Course Description

Algorithms, or a step-by-step process to efficiently reach the desired goal, have been part of human history since the 1200s. Algorithms are a fundamental component of any computerized system. This is a "second" course in algorithms. The goal of this course is to show you some useful algorithms and explain how they work and why they are considered good, in order to

1. help you recognize situations in which you would be better off looking in the literature or asking someone knowledgeable for a good algorithm to solve your problem instead of just coding the first idea that comes to your mind, and
2. give you enough background so that you are able to understand and navigate the literature on algorithms.

In order to achieve this, you will have to work through and understand several algorithmic techniques (e.g., divide-and-conquer, dynamic programming, greedy algorithms) and the mathematical background necessary for analyzing the properties of these techniques and the algorithms based on them (e.g., recurrence relations, graph theory).

The students are expected to understand the material typically covered in CSE310 (and its prerequisites such as MAT243). In particular, you should know how quicksort and mergesort work (and be able to write and solve recurrence relations for those), you should be able to use the "bigOh" notation and you should have seen the algorithms of Dijkstra and Prim and have at least an intuitive understanding of how they work. I will also assume you know the definitions and basic properties of heaps and binary search trees. The expected background in recurrence relations (and a little more) is detailed in a separate handout available from the course web page (on myASU). All of this prerequisite material is covered in CSE310 (or an equivalent class, for graduate students), which is required as a prerequisite for this class.

Specific topics covered include:

- Algorithm design and analysis techniques
- Greedy Algorithms
- Divide-and-Conquer
- Dynamic Programming
- Amortized Analysis
- Graph Algorithms and Network Flows
- NP-completeness

Learning Outcomes

By completing this course will be able to:

- Identify and apply algorithmic techniques to solve a problem
- Apply knowledge of algorithms in multiple contexts using multiple programming languages
- Evaluate correctness and efficiencies of algorithms

Optional recommended references:

- J. Kleinberg and E. Tardos. Algorithm Design, Addison Wesley, 2006.
- Cormen, Leiserson, Rivest, and Stein. Introduction to Algorithms, 3rd edition, MIT Press.
- M. Goodrich and R. Tamassia, Algorithm Design, Wiley.
- Garey and Johnson. Computers and Intractability, Freeman, 1979.
- R.E. Tarjan, Data Structures and Network Algorithms, SIAM, 1983.
- Jeff Erickson's classnotes, available at <http://jeffe.cs.illinois.edu/teaching/algorithms/> (Links to an external site.)

Evaluation:

We will use +/- grades in this class.

Graded assignments (5 total) – 30%

Graded Quizzes (8 total) - 10%

2 Exams – (midterm and final) 30% each

Assignments, Tests, and Exams Schedule:

Assignments, Tests, and Exams Schedule have been pre-scheduled. Please check the schedule file.

Grade Disputes:

All grade disputes, for homework assignments or exams, must be submitted in writing, including a detailed description on why you believe we should reconsider the grading of your assignment or exam. If your description does not satisfactorily describe why you believe that we may have made a mistake in grading, it will not be considered. No exceptions will be granted.

Late Homework/Quizzes, Make-Up, and Attendance Policies

No late quizzes will be accepted. This is primarily due to the solutions being automatically released immediately after the due date has passed.

If you miss an exam, you must have a compelling reason and submit proof (e.g., a hospitalization report) to the instructor. At her discretion, the instructor will review each case individually and decide whether a makeup exam shall be given.

Accommodations will be made for religious observances provided that students notify the instructor at the beginning of the semester concerning those dates(1). Students who expect to miss class due

to officially university-sanctioned activities should inform the instructor early in the semester(2). Alternative arrangements will generally be made for any examinations and other graded in-classwork affected by such absences.

Academic Integrity and Copyright Laws:

Academic Integrity and Copyright Laws Students in this class must adhere to ASU's academic integrity policy (4). Students are responsible for reviewing this policy and understanding each of the areas in which academic dishonesty can occur. In addition, all engineering students are expected to adhere to both the ASU Academic Integrity Honor Code(5) and the Fulton Schools of Engineering Honor Code (6). All academic integrity violations will be reported to the Fulton Schools of Engineering Academic Integrity Office (AIO). The AIO maintains record of all violations and has access to academic integrity violations committed in all other ASU college/schools.

Any incidence of cheating in this class will be severely dealt with. This applies to all assignments, quizzes, and tests. The minimum penalty for cheating will be that the student will not obtain any credit for that particular assignment. (This means that if in a test or assignment a student is found to have cheated, they will receive a zero for that test/assignment.) For the homework assignments students are encouraged to discuss the problems with others, but one is expected to turn in the results of one's own effort (not the results of a friend's efforts). Graded quizzes are a strictly individual effort, and one may only use the course materials provided and the required textbook to complete them. One tends to get very suspicious if two identically wrong results show up in the homework assignment and/or tests. The names of the offenders will be maintained in the departmental files. Repeat offenders may be debarred from the University.

Copyright

Course content — including lectures, notes, and assignments — are copyrighted materials that students may not share outside the class, upload to online websites not approved by the instructor, sell, or distribute. Students may not record lectures (7). The Fulton Schools of Engineering reserve the right to delete materials found online on the grounds of suspected copyright infringement.

Disability Accommodations

Suitable accommodations will be made for students having disabilities. Students seeking accommodations should register with the ASU Disability Resource Center⁸ and request accommodations through their forms. Students should communicate the need for an accommodation in sufficient time for it to be properly arranged.

Harassment and Sexual Discrimination

Arizona State University is committed to providing an environment free of discrimination, harassment, or retaliation for the entire university community, including all students, faculty members, staff employees, and guests. ASU expressly prohibits discrimination, harassment, and retaliation by employees, students, contractors, or agents of the university based on any protected status: race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, and genetic information. Title IX is a federal law that provides that no person be excluded on the basis of sex from participation in, be denied benefits of, or be subjected to discrimination under any

education program or activity. Both Title IX and university policy make clear that sexual violence and harassment based on sex is prohibited. An individual who believes they have been subjected to sexual violence or harassed on the basis of sex can seek support, including counseling and academic support, from the university. If you or someone you know has been sexually harassed or assaulted, ASU encourages you to consult the ASU Sexual Violence FAQs(9) for information and resources. Please be aware that many university officials (including the instructor) are obligated to report any incidents of sexual discrimination, harassment, or assault they become aware of or have reason-able basis to believe occurred to the Offices of Student and University Rights and Responsibilities. If you would instead like to report an incident confidentially, trained professionals at ASU Health and Counseling Services(10) are available to you.

Note: Any information in this syllabus (other than grading and absence policies) may be subject to change with reasonable advance notice.

References:

- (1) ACD 304-04: Accommodation for Religious Practices. <https://www.asu.edu/aad/manuals/acd/acd304-04.html>
- (2) ACD 304-02: Missed Classes Due to University-Sanctioned Activities. <https://www.asu.edu/aad/manuals/acd/acd304-02.html>
- (3) SSM 104–02: Handling Disruptive, Threatening, or Violent Individuals on Campus. <https://www.asu.edu/aad/manuals/ssm/ssm104-02.html>
- (4) ASU’s Academic Integrity Policy. <https://provost.asu.edu/academic-integrity/policy>
- (5) ASU’s Academic Integrity Honor Code. <https://provost.asu.edu/academic-integrity/honor-code>
- (6) Fulton Schools of Engineering Honor Code. <https://engineering.asu.edu/ira-a-fulton-schools-of-engineering-honor-code/>
- (7) ACD 304–06: Commercial Note-Taking Services. <https://www.asu.edu/aad/manuals/acd/acd304-06.html>
- (8) ASU Disability Resource Center. <https://eoss.asu.edu/drc>
- (9) ASU Sexual Violence FAQs. <https://sexualviolenceprevention.asu.edu/faqs>
- (10) ASU Health and Counseling Services. <https://eoss.asu.edu/counseling>