CSE 551: Foundations of Algorithms

Instructor: Email:	Ali Altunkaya aaltunka@asu.edu
Teaching Assistant:	TBA
NOTE:	When emailing Instructor or TA directly about this class, please always use the prefix “CSE 551” in the subject line of your message. Also use your ASU email address.

****Any information in this syllabus may be subject to change with reasonable advance notice.**

Note: The instructor runs a pre-packaged course developed by Dr. Andrea Richa with all lectures pre-recorded and delivered on-line.

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).

This is a theoretical computer science course, and will focus more on concepts and arguments rather than implementations and coding. There are no official prerequisites, but students are expected to understand the material typically covered in CSE310 (and its prerequisites such as MAT243). In particular, you should know how to write a mathematical proof, understand 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 (module 0). All of this prerequisite material is covered in CSE310 (or an equivalent class, for graduate students), and it assumed graduate students will be familiar with this material.

Course Overview:

This course contains a total of eight (8) modules. For each of these modules there will be a series of pre-recorded lecture videos presented by Dr. Andrea W. Richa. After watching these lectures, you will be tasked with two deliverables:

The first deliverable is called the *Graded Assignment*. For this deliverable, you will be given a prompt based on the lecture materials. You are encouraged to write out solutions to the given prompt, but they will not be collected or evaluated. Instead you will take a short quiz based on the prompt called the *Graded Assignment Quiz* that tests how thoroughly you thought about the prompt. These quizzes are multiple choice, and are typically around 5 questions long, but there is some variance. There is no time limit for these quizzes, though they will automatically submit at the time of the due date. Feel free to open the quiz as you are thinking about the prompt to help guide your thoughts. Also, feel free to discuss the prompt with other students, but do not share graded assignment quiz solutions under any circumstances. Detailed solutions will be provided after the due date of the module.

The second deliverable is called the *Graded Quiz*, and it is a more general assessment of your understanding of the material for that module. The graded quiz is timed for 2 hours, and thus I recommend learning the material well before starting. The difficulty of each question varies, but some take some considerable thought. Typically quizzes have an average of roughly 10 multiple choice questions, but this can vary slightly. The only notable exception is the first graded quiz, which is shorter to reflect the shorter module. Graded Quizzes are individual efforts. You should not share your solutions with anyone. Detailed solutions will be provided after the due date of the module.

There are a number of supplemental materials for each module. The item students tend to find most helpful is the *Practice Quiz.* This quiz is intended to prepare students for the corresponding graded quiz, and provides questions similar (though sometimes slightly less difficult) to those found on the corresponding graded quiz. Detailed solutions for the practice quizzes are available immediately on release of the module. I recommend reading them carefully before starting the graded quiz. Use office hours to absolve any doubts regarding the practice quiz. There are also quizzes called *Knowledge Check Quizzes*. These quizzes are simply intended to check your understanding of the lecture, and can be completed quickly without much effort. Practice quizzes and knowledge check quizzes are optional and not graded.

Modules will be available one-at-a-time, and the next module is typically made available around the due date of the previous module. The first module is available immediately. The following is a list of all modules in the order they will be presented with their respective due dates:

1. Stable Matching (~1 week) [Due Friday, … at 11:59pm]
2. Greedy Algorithms (2 weeks) [Due Friday, … at 11:59pm]
3. Amortized Analysis and Splay Trees (2 weeks) [Due Friday, … at 11:59pm]
4. Divide-and-Conquer Algorithms (2 weeks) [Due Friday, … at 11:59pm]
5. Dynamic Programming (2 weeks) [Due Friday, … at 11:59pm]
6. Network Flows (2 weeks) [Due Friday, …. at 11:59pm]
7. Intractability and NP Completeness (2 weeks) [Due Friday, … at 11:59pm]
8. Brief Introduction to Randomized and Approximation Algorithms (1.5 weeks) [Due Monday, … at 11:59pm]

In case you must review the required prerequisite material, we have provided you with module 0 that will help you. Also included is a self-assessment review quiz that you may use to test your knowledge. This will not be collected or graded.

Exams:

Exams will be given at specific dates and times strictly in the classroom in-person, in an online setting, you will bring your laptop to the classroom. Please plan ahead for these requirements. Further details regarding exams are forthcoming.

The following are the dates we have scheduled for each exam. These dates are non-negotiable. If you cannot be present at these dates and times, please drop the course immediately.

- Exam 1 […..]: Covers Modules 1-3.
- Exam 2 [….]: Covers Modules 4-6.
- Final Exam [….]: Comprehensive with emphasis on modules 7 and 8.

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

Textbook (Not Required):

J. Kleinberg and E. Tardos. Algorithm Design, Addison Wesley, 2006.

Other recommended references:

• 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/

Evaluation:

We will use +/- grades in this class.

Graded Assignment Quizzes (8 total) – 10%

Graded Quizzes (8 total) - 15%

3 Exams – (midterm 1, midterm 2, final) 25% each

Cutoffs:

>=97%	A+
>=92%	A
>=90%	A-
>=87%	B+
>=82%	B
>=80%	B-
>=77%	C+
>=72%	C
>=70%	C-
<70	D

Exams will not be graded on a curve, but the cutoffs for particular letter grades may be adjusted very slightly depending on course performance.

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 his discretion, the instructor will review each case individually and decide whether a makeup exam shall be given.

The exam dates are given above, and if you cannot be present online for these dates and times, you should drop the course immediately. However, there are circumstances wherein an assignment or exam can be made up, and these are as follows:

1. excused absences related to religious observances/practices that are in accord with ACD 304–04, “Accommodation for Religious Practices”
2. excused absences related to university sanctioned events/activities that are in accord with ACD 304–02, “Missed Classes Due to University-Sanctioned Activities”
3. Excused absences related to missed class due to military line-of-duty activities that are in accord with ACD 304–11, “Missed Class Due to Military Line-of-Duty Activities,” and SSM 201–18, “Accommodating Active Duty Military”

Academic Integrity :

Students in this class must adhere to ASU’s academic integrity policy, which can be found at https://provost.asu.edu/academic-integrity/policy). 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 and the Fulton Schools of Engineering Honor Code. 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.

All quizzes, homework assignments and exams given in this class are strictly an individual effort. For graded assignments, high level ideas related to the prompt may be discussed with other students, but one should limit the amount of information disclosed. All quizzes and exams are strictly individual efforts. If we suspect any instance of academic dishonesty, the quiz or exam in question will be given a tentative grade of a zero and the incident will be reported to the Academic Integrity Office (AIO). If the student is found at fault, we will recommend to the AIO that the zero remain the permanent mark. Note that more severe sanctions may apply depending on the circumstances.

Copyright

All course content and materials, including lectures (Zoom recorded lectures included), are copyrighted materials and students may not share outside the class, upload to online websites not approved by the instructor, sell, or distribute course content or notes taken during the conduct of the course (see ACD 304–06, “Commercial Note Taking Services” and ABOR Policy 5-308 F.14

Links to an external site.
for more information).

You must refrain from uploading to any course shell, discussion board, or website used by the course instructor or other course forum, material that is not the student's original work, unless the students first comply with all applicable copyright laws; faculty members reserve the right to delete materials on the grounds of suspected copyright infringement.

Policy against threatening behavior, per the Student Services Manual, SSM 104–02

Students, faculty, staff, and other individuals do not have an unqualified right of access to university grounds, property, or services. Interfering with the peaceful conduct of university-related business or activities or remaining on campus grounds after a request to leave may be considered a crime. All incidents and allegations of violent or threatening conduct by an ASU student (whether on- or off-campus) must be reported to the ASU Police Department (ASU PD) and the Office of the Dean of Students.

Disability Accommodations

Suitable accommodations will be made for students having disabilities. Students needing accommodations must register with the ASU Disabilities Resource Center and provide documentation of that registration to the instructor. Students should communicate the need for an accommodation in sufficient time for it to be properly arranged. See ACD 304-08 Classroom and Testing Accommodations for Students with Disabilities.

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 harassed on the basis of sex or sexually assaulted, you can find information and resources at https://sexualviolenceprevention.asu.edu/faqs.

Mandated sexual harassment reporter: As a mandated reporter, I am obligated to report any information I become aware of regarding alleged acts of sexual discrimination, including sexual violence and dating violence. ASU Counseling Services, https://eoss.asu.edu/counseling, is available if you wish discuss any concerns confidentially and privately.

Course Creator

Andrea Richa

Professor Andrea W. Richa joined Arizona State University (ASU) in 1998. She is currently an Associate Faculty at the Biodesign Institute Center for Biocomputation, Security and Society, CHART at the Global Security Initiative, and the Biomimicry Center at ASU. Professor Richa's main areas of expertise are in distributed/network algorithms and computing in general. More recently, she has focused on developing the algorithmic foundations on what has been coined as programmable matter, through her work on self-organizing particle systems (SOPS) (see sops.engineering.asu.edu). Her work has been widely cited, and includes, besides SOPS, work on bio-inspired distributed algorithms, distributed load balancing, packet routing, wireless network modeling and topology control, wireless jamming, data mule networks, underwater optical networking, and distributed hash tables (DHTs).

Richa received the 2017 Best Senior Researcher award from the School of Computing and Augmented Intelligence (SCAI) and the 2021 ASU Faculty Women's Association (FWA) Outstanding Faculty Mentor Award. She was the recipient of an NSF CAREER Award in 1999, an associate editor of IEEE Transactions on Mobile Computing, and the keynote speaker and program\general chair of several prestigious conferences. In particular, Professor Richa was the Program Committee chair of the 31st International Symposium on Distributed Computing (DISC), 2017, one of the top two conferences in distributed computing. Richa has also delivered several invited talks both nationally and internationally. In 2022, Richa was named President's Professor, one of the highest honors at Arizona State University.