

SER222: Design & Analysis: Data Structures and Algorithms Syllabus

Catalog Description

Data structures and related algorithms for their specification, complexity analysis, implementation and application. Sorting and searching. Professional responsibilities that are part of program development, documentation and testing.

General Information:

Instructor	Ruben Acuña, racuna1@asu.edu, (480) 727-1580 (email preferred)
Office Hours	Online only (Zoom): https://zoom.us/my/acuna . Monday and Wednesday 3:30pm-4:45pm, appointment only. 18 hour advance notice required. Use https://calendly.com/racuna1 to make an appointment.
Class Meeting Time	Online
Schedule Line Number	15858
Class Website	Canvas, GitHub, YouTube
Communication	Slack: https://asu-2221-ser222-15858.slack.com/ (Synchronous hours same as office hours.)
Final Exam Date	Tuesday, May 3

Course Coordinator	Ruben Acuña, racuna1@asu.edu, (480) 727-1580 (email preferred)
Office Hours	Ground: Peralta Hall 230Q, online: https://zoom.us/my/acuna .
	All questions regarding course material and grading must be directed to the instructor for your section of the course.

Enrollment Requirements:

Prerequisites:

- CSE205: Object-Oriented Programming and Data Structures (C or better)
- MAT243: Discrete Math Structures (with C or better)

It is your responsibility to know the background material defined by the outcomes of these courses. If you did not take these courses recently (as defined by the SE major map), or you did not do well when you took them, you will need to spend time to review the material.

Course Objectives:

The outcomes of this course are the following:

	Course Outcome	SER Outcomes	EM@FSE
CO-1	Students can understand and apply big-O analyses of algorithms. Students can analyze existing algorithms and use these techniques in designing algorithms.	PO1, PO6	
CO-2	To gain experience in the object-oriented programming paradigm. Students understand elementary data structures as objects and as being composed of objects. Students can design objects using elementary data structures.	PO-SER1	G
CO-3	To learn and to be able to judge the appropriateness of alternate implementations of elementary data structures. Students understand advantages and disadvantages of sequential implementation vs. linked implementation.	PO1, PO-SER1	Q
CO-4	To learn specification and application of elementary data structures. Students know commonly used specifications for arrays, stacks, queues, strings, sets, sequential lists, binary search trees and hashed storage.	PO-SER1	J, K

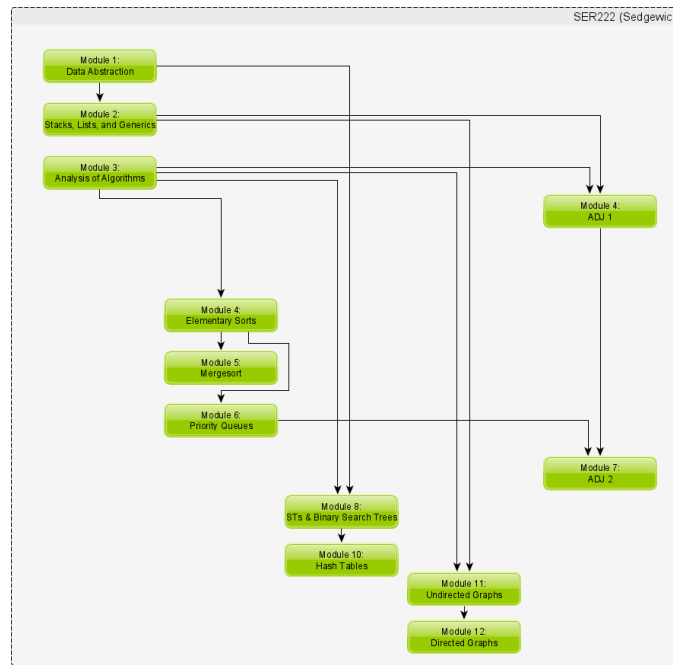
Entrepreneurial Mindset: This course is part of ASU's Entrepreneurial Mindset at Fulton Schools of Engineering (EM@FSE) initiative. This course contains assignments that, in addition to practicing technical skills, ask you to consider how the solutions you develop fit into the larger picture. The core aspects of the entrepreneurial mindset are the 3Cs: Curiosity, Connections, and Creating Value. The goal is to help you develop an entrepreneurial view of your engineering skills, to solve problems that generate value. FSE@EM goes beyond the traditional view of entrepreneurship in computing (e.g., start-ups): it's about asking questions that lead you to new places and making connections across ideas and situations.

In support of developing an entrepreneurship mindset, EM@FSE identifies 17 indicators. As you continue your degree at ASU, you will take courses that support these indicators. In this course, we focus on four of them: g) Applies technical skills/knowledge to the development of a technology/product. j) Describes how a discovery could be scaled and/or sustained, using elements such as revenue streams, key partners, costs, and key resources. k) Defines a market and market opportunities. q) Integrates/synthesizes different kinds of knowledge.

Course Structure:

The material in this course is separated into modules. Most modules correspond to one section from the textbook. Each week typically covers two or three modules. Each module is comprised of instruction (videos or readings), followed by a cairn (to cement the basics), and a homework assignment (to really practice). The assignments have three forms: short answer, programming, and ADJs (sometimes you may only have one or two). **You are expected to engage with course using the following flow: Instruction → Cairn → Homework.**

Time to complete a module varies, but it is typically nine hours to complete instruction, cairn, and homework. Modules without a programming assignment will take considerably less time because programming is intensive. You are encouraged to do load balancing between the modules that require lots of time, and those that require less.



Course Materials:

Readings: The required text is: R. Sedgewick, and K. Wayne, *Algorithms*, 4th edition, Addison-Wesley Professional, 2011. If you're interested in other books on algorithms, the instructor can make recommendations. A used copy of the text is acceptable.

Other:

Communication: This class uses a communication tool called Slack to manage course communications. Please make Slack the first place you look for new information regarding the course. It is expected you will check Slack at least once every day, as will the instructional staff each evening. Do not expect that we will be on Slack at other times, though we may occasionally pop-in to provide help and see how you are doing. Staff will be accessible synchronously on Slack as stated on the Contact Information page in Canvas. For email and Slack messages, please allow 24 business hours for a response.

- **Canvas Note:** do not use the comment feature on any submission (e.g., short answer or programming), we do not use it because Canvas does not have a way to track what has been answered. Use Slack or email if you have questions.

<https://students.asu.edu/academic-calendar>) for details on important Registrar dates such as: adding/dropping/ withdrawing from courses, etc.

You are required to complete the Academic Integrity Agreement quiz on Canvas by the due date or you may be dropped from the course at the instructor's discretion.

Late Homework Policy: All homework is due at 11:59:00pm (Arizona Time). **Late submissions are not accepted, except as defined under Late Pass below.** Students choosing to submit on the final day of the deadline are fully responsible for any technical issues (including but not limited to: computer, internet, Canvas) that occur. Late submissions are not accepted for technical issues. Students are encouraged to submit homework several days in advance of any deadline. It is also highly suggested

that students double check that they have submitted the correct files - students who submit incorrect files will receive a grade based on what they submitted, which is likely to be a zero. Extensions are permitted only when there is a significant, and documented, event (e.g., illness or personal emergency) that prevents the student from completing the assignment. A notice must be submitted to the instructor before the due date or as soon as circumstances allow.

Late Pass: A late pass grants an extension of exactly 24 hours to a module's homework. You have TWO (2) late passes that you may use during the semester. To use a late pass, contact a member of the instructional staff via email within 12 hours of the original deadline. (This means you have until noon the following day.) They will update Canvas to reflect your personal extension. Due to logistics, the late pass may NOT be applied to homework for Module 12. Multiple late passes may not be applied to the same assignment.

Supplemental Instruction: (SI) program. SI sessions are group study opportunities, scheduled 2-3 times per week. These sessions are facilitated by your SI Leader, who is attending class and preparing SI sessions based on the course content. Students should attend SI sessions to ask questions about course content, work collaboratively with other students, and to develop learning/study strategies. Students who participate in SI sessions typically earn higher final course grades and exam grades than students who do not participate in SI. SI attendance is voluntary, and it is not a substitute for class attendance. For information about the days, times, and Zoom links for SI sessions, refer to the SI website: <https://tutoring.asu.edu/content/supplemental-instruction-si-schedule>.

Grading:

Performance will be assessed by homework, cairns, and three exams. Their weights are:

Total Points	1000 (base points) + TBD (extra credit)
HW: Programming	412 + TBD (EC)
HW: Analysis, Design, and Justification	95
Cairns	88 + 5 (EC)
Exam 1	135
Exam 2	135
Exam 3	135

The final letter grade will be determined according to the points obtained as follows:

E	D	C	C+	B-	B	B+	A-	A	A+
0-599	600-699	700-769	770-799	800-829	830-869	870-899	900-929	930-969	970-1000

Homework Drops: No homework will be dropped.

Cairn Policies: Cairns should be completed as you finish the instruction in the course. They are meant to keep you on track, to enable you to check your understanding as you proceed, and to emphasize the relationship between topics in the course. They have a relatively low weight and simpler questions than the main homework so that they can be used to develop your skills without worrying too much about your final grade. Do not treat them as simply "more homework", but as an opportunity to try applying concepts before doing a heavily weighted homework, and receive feedback in terms of a solution. Assuming you paid attention during lecture/video, cairns should **not** take more than 20-30 minutes to complete (depending on number of attempts). **No cairn questions require a compiler or doing online research** - in fact, doing either of those things will hinder your learning experiences. Remember that as a learner, your goal is to learn the material well, not simply to maximize your points.

- Although cairns are associated with a particular module, they will contain two (2) questions from the previous module as well. One question will be based purely on the previous module, and one will combine application of the current and previous module's topics. The remaining questions will focus on the current module.
- You will be allowed **two attempts** on each cairn. The same questions will be shown both times, and you will be able to see the points you have earned on each question (but not the complete solution). The final attempt will be used for grading purposes.
- The cairn solutions will be released after the due date.

Short Answer Homework Policies: For each homework submission, click the "save and submit" button when you have completed all the questions. You may submit any number of times before the deadline, **but we grade only the latest version. No late submissions are accepted.**

Programming Homework Policies: Read the assignment PDF for specifics on what your programming submissions should look like. In addition:

- Double check your submissions to ensure they contain source files (e.g., .java, .c) and that every file requested is attached. Your submission file(s) will be put in a folder with the base files attached to the assignment - there is no need to resubmit them.
- You are allowed unlimited submissions, **only the newest submission will be graded.** If you try to view the homework after submitting it from the Homework page rather than Grades, you may cause a new submission to be made. This will override your proper submission! **No late submissions are accepted.**

Standard programming deductions:

- If your program fails to compile out-of-the-box, we will deduct 20% from the graded total.
- If you do not follow the file submission standards (e.g., the submission contains project files, lacks a proper header), we will deduct 10% off of the graded total.

Select assignments will be graded using Gradescope. Note that these two standard programming deductions do not apply as-is to Gradescope graded assignments. See individual assignment PDF for more information.

Grade Appeals:

Students may appeal a scored assessment within three days release announcement, whichever is sooner. Appeals are in written form only (including email) and must point to specific evidence of why the grade should be revised. discarded without a response. The instructor reserves the right to assign a lower score on appeal. For additional information on ASU's grade appeal policy, see <https://catalog.asu.edu/appeal>.

Absence Policies:

Students unable to take exams, or complete assignments due to a medical condition must present a doctor's signed excuse and notify the instructor as soon as the condition affects the student's work.

Accommodations will be made for religious observances provided that students notify the instructor at the beginning of the semester concerning those dates. Students who expect to miss class due to officially university-sanctioned activities should inform the instructor early in the semester. Alternative arrangements will generally be made for any examinations and other graded in-class work affected by such absences. The conditions under which assigned work and/or tests can be made up, include: a) Excused absences related to religious observances/practices that are in accord with <https://www.asu.edu/aad/manuals/acd/acd304-04.html> b) Excused absences related to university sanctioned events/activities that are in accord with <https://www.asu.edu/aad/manuals/acd/acd304-02.html> c) Excused absences related to missed class due

to military line-of-duty activities that are in accord with <https://www.asu.edu/aad/manuals/acd/acd304-11.html>

Per SSM 201-02, an instructor may drop a face to face student for nonattendance during the first week of the semester. For an online course, a drop may be initiated for students who do not log into the course shell during the first week.

Faculty recording of class sessions

Note that class sessions may be recorded (or broadcast live) to accommodate students with ASU documented need, and recordings provided to those students. If you have concerns about being recorded, please contact the course instructor.

Classroom Behavior:

Students are expected to participate in the educational process and not be a disruptive element with regard to the learning of others. Safety, self-discipline and respect for others are necessary elements in the educational processes employed in this course. All students should be familiar with the Student Code of Conduct, which can be found at <http://www.asu.edu/studentlife/judicial/> as well as ASU's Netiquette Policy.

Academic Integrity:

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 the ASU Academic Integrity 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.

Specific academic integrity rules for this class are: The Student Academic Integrity Policy of Arizona State University requires each student to act with honesty and integrity and to respect the rights of others in carrying out all academic assignments. There are a number of actions that constitute a violation of the policy. These actions in this course include, but are not limited to:

- 1) practicing any form of academic deceit;
- 2) referring to materials or sources or employing devices (e.g., audio recorders, crib sheets, calculators, solution manuals, or commercial research services) not specifically authorized by the instructor for use during tests, quizzes, homework, and class activities;
- 3) acting as a substitute for another person in any academic evaluation or using a substitute in any academic evaluation;
- 4) possessing, buying, selling, or otherwise obtaining or using, without appropriate authorization, a copy of any materials intended to be used for academic evaluation in advance of its administration;
- 5) depending on the aid of others to the extent that the work is not representative that this aid is not authorized by the instructor;
- 6) providing inappropriate aid to another person, knowing or having good reason to believe the aid is not authorized by the instructor;
- 7) submitting the ideas or work of another person or persons without customary and proper acknowledgment of sources (i.e., engaging in plagiarism);
- 8) permitting one's own ideas or work to be submitted by another person any academic evaluation or record for reasons having no relevance to class achievement.

- 9) turning in work/code done by someone else or another pair/group
- 10) copying work/code done by someone else or another pair/group
- 11) writing code together with someone else or with another pair/group (unless expressly allowed by the instructor)

A common question in programming courses is the use of code that is "googled" or found on popular sites such as StackOverflow. Items 5 and 7 pertain to this situation. Most programmers use reference examples, found in print or online. This is fine as a practice but is not acceptable in situations where you are using code to proxy your understanding of the coding concepts applied in that assessment (i.e. lab or in-class activity). First, if you are uncertain if it is allowable or not, verify directly with the instructor before submitting the assignment. Second, if it is allowable, you are still required to a) adhere to all originating author's constraints on the use and licensing of the code, and b) provide proper attribution (full URL to the code snippet or bibliographic reference to a print item). Failure to do so constitutes a violation of this Academic Integrity Policy.

Students may be allowed to work in small teams on lab and in-class assessments. You are to work with your partners and only your partners as directed by the instructor; receiving assistance from anyone else other than your partners, the graders, teaching assistants, approved tutors or the instructor is considered a violation of this Academic Integrity Policy. Further, on any paired/group assessments you remain individually responsible be no differentiated grades awarded between the individuals in the pair/group. From an ethics standpoint, you have a professional responsibility to your partner to give your best effort on each programming assignment. Failure to do so will be considered an ethics violation.

The penalty for an Academic Integrity Violation (cheating) on an in-class assessment or lab will be a reduction of a course letter grade for the first offense, and failure of the course for a second offense. The penalty for an Academic Integrity Violation (cheating) on an exam is immediate failure of the course. The penalty for an ethics violation will be a zero for the in-class assessment or lab. All violations will be referred to the Dean's Office of the Ira A. Fulton Schools of Engineering.

Students should not release (to GitHub, friends, etc.) any of their completed assignments, in order to ensure that they do not cause an AIP violation during a future semester. If a student in a later class submits your work, you and they will be held accountable.

Copyright:

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 student first complies with all applicable copyright laws; faculty members reserve the right to delete materials on the grounds of suspected copyright infringement.

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 <https://www.asu.edu/aad/manuals/acd/acd304-06.html> 5-308 F.14 for more information).

You may not post any course material (including but not limited to slides, cairns, and assignments), even excerpts, to an external site without the instructor's written permission. If this occurs, you may be penalized for Academic Dishonesty or IP infringement.

Policy against threatening behavior, per the Student Services Manual, SSM

Students, faculty, staff, and other individuals do not have an unqualified right of access to university grounds, property, or services (see SSM 104-02). 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>.

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 to discuss any concerns confidentially and privately. ASU online students may access 360 Life Services, <https://goto.asuonline.asu.edu/success/online-resources.html>.

Change Notice:

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

Schedule

In this course, we will be covering approximately twelve sections from Sedgewick (skipping a few subsections here and there). **Keep in mind that this is not a fixed schedule and topics/assignments may change. All dates, including exams, are subject to change until officially released.**

This course is released using modules. At the beginning of the course, the first week of modules will be made available. Additional content will be released in segments of a week, typically on Monday, to give you around 7 days to work on the material before its due date (the following Monday or Tuesday). Material will not be released early as it is being continuously updated before release. Be sure to review the Canvas schedule after each week is released to ensure you are aware of all due dates.

Week	Item	Due Date
Week 1	M0 Introduction, M1 Data Abstraction, M2 Stacks/Lists/Generic	
	M0: Exercise, Prereq AND M0: Exercise, Syllabus	3/20
	M0: Academic Integrity Agreement	3/20
	M1: Cairn	3/20
	M2: Cairn	3/20
	M1: Homework (two parts)	3/21
	M2: Homework (one part)	3/21
Week 2	M3 Analysis of Algorithms, M4 ADJ I	
	M3: Cairn	3/27
	M4: Cairn	3/27
	M3: Homework (two parts)	3/28
	M4: Homework (one part)	3/28
Week 3	Exam 1, M5 Elementary Sorts	
	<u>Exam 1 (tentative)</u>	4/2
	M5: Cairn	4/3
	M5: Homework (two parts)	4/4
Week 4	M6 Mergesort, M7 Priority Queues, M8 ADJ II	
	M6: Cairn	4/10
	M7: Cairn	4/10
	M8: Cairn	4/10
	M6: Homework (one part)	4/11
	M7: Homework (one part)	4/11
	M8: Homework (one part)	4/11
Week 5	Exam 2, M9 Symbol Tables & Binary Search Trees	
	<u>Exam 2 (tentative)</u>	4/16
	M9: Cairn	4/17
	M9: Homework (one part)	4/18
Week 6	M10 Hashtables, M11 Undirected Graphs	
	M10: Cairn	4/24
	M11: Cairn	4/24
	M10: Homework (one part)	4/25
	M11: Homework (two parts)	4/25
Week 7	M12 Directed Graphs, Exam 3	
	M12: Cairn	5/1
	M12: Homework (two parts)	5/2
	<u>Exam 3 (TUESDAY NOT SATURDAY)</u>	5/3

1 Online Course Notices

This course is being offered through an online modality with ASU's EdPlus. Course material will be delivered electronically over Canvas. Course materials and expectations are aligned with those used in face to face classes but have been adapted for online.

1.1 Communicating With the Instructor

This course uses a combination of tools for synchronous and asynchronous communication. ASU email is the official means of communication among students, faculty, and staff. Instructors use email to communicate important class information on a regular basis. Students are expected to read and act upon email in a timely fashion. Students bear the responsibility of missed messages and should check their ASU-assigned email regularly. Students wishing to communicate with the instructor should read the following guidelines:

- **Email**

Use email to direct questions of a personal or grade nature to the instructor or assigned TA. You can expect a response within 24 hours during the work week. **Note that the majority of faculty and staff communication will occur during Arizona business hours.** If you are in another timezone, or working on the weekend, communication may take longer due to availability differences. **All instructor correspondence will be sent to your ASU email account. Grade related information will only be sent to ASU addresses.**

Questions regarding course material are more suitable for Slack, since students can receive input from the instructor as well as discuss it with peers. We highly encourage discussions on Slack since publicly available answers benefit everyone in the course.

- **Office Hours**

Office hours for this course are available online via *Zoom*. Zoom (zoom.us) is a free software conference tool that enables voice and text communication, together with desktop streaming. During office hours you can speak with the instructor to discuss the materials being presented in class or other related interests you have. You are encouraged to ask questions about the assignments or the course content.

Office hours are also held by the course coordinators of each course. Course coordinators are the individual faculty responsible for course content and consistency across sections and semesters. These hours provide an avenue for you to provide course feedback in a direct manner, ask about the software engineering program, ask about professional development, as well to get help on course material.

1.2 Communicating With Classmates

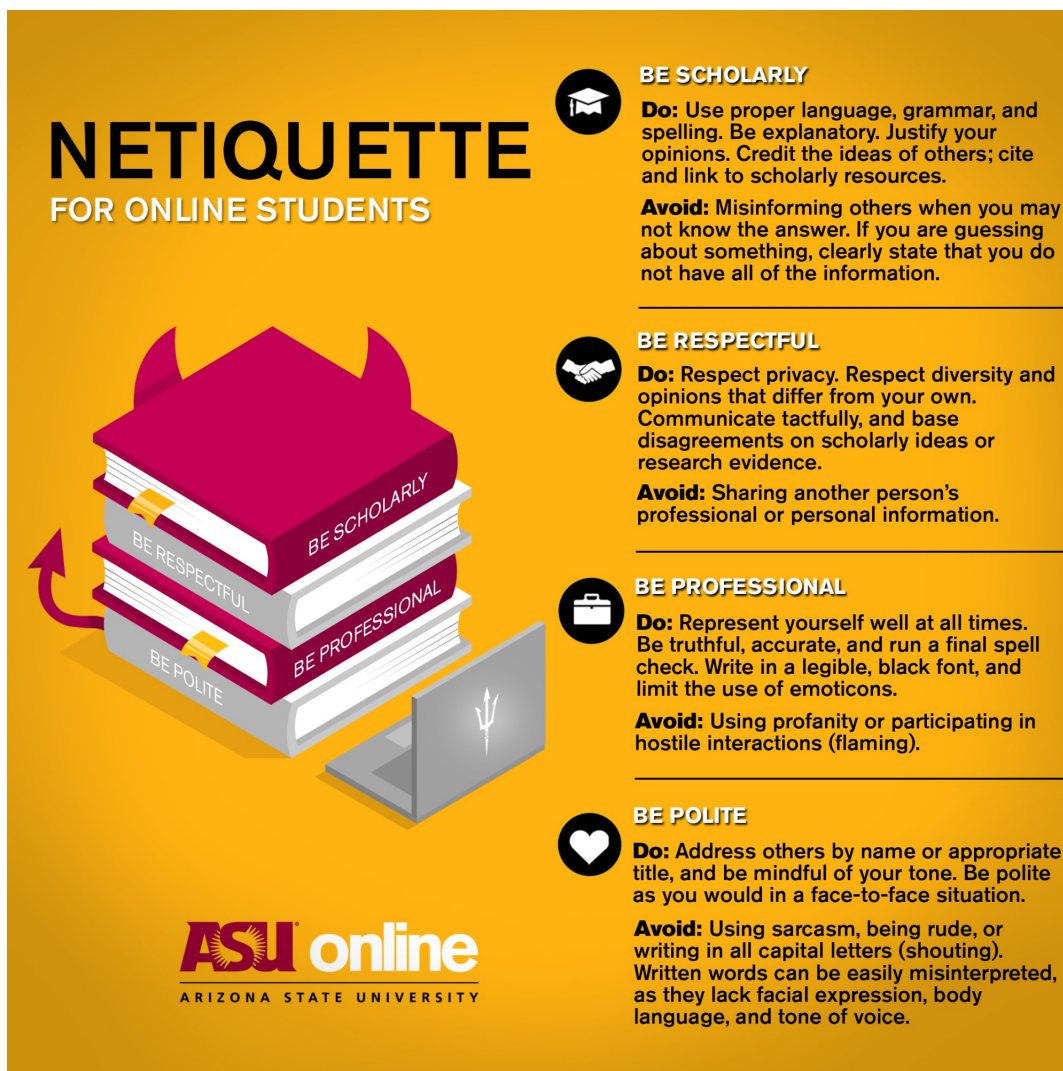
This course uses a combination of tools for synchronous and asynchronous communication. The primary communication method is email. This course uses a discussion tool called Slack for general questions about the course. Prior to posting a question, please check the syllabus, announcements, and existing posts. If you do not find an answer, post your question. Both instructors and TAs will check the class channel regularly. On these platforms, you are encouraged to respond to the questions of your classmates. However, these platforms are not appropriate for you to publicly post solutions (or partial solutions) to course assignments.

1.3 Timezones

All published due dates (for assignments, exams, office hours, etc.) are Arizona Mountain Standard time. Be aware that that Arizona does not observe daylight savings time. It is your responsibility during the course to track how your local time relates to Arizona.

1.4 Netiquette

During all communication, across platforms, students are expected to follow netiquette policy. The netiquette policy for the course is ASU's netiquette policy, also shown in the infographic below. Further, specific ASU netiquette policies concerning Discussion Board behavior are in effect. All students are expected to be familiar with, and maintain compliance to, these policies.



1.5 Accessibility Statement

In compliance with the Rehabilitation Act of 1973, Section 504, and the Americans with Disabilities Act as amended (ADAAA) of 2008, professional disability specialists and support staff at the Disability Resource Center (DRC) facilitate a comprehensive range of academic support services and accommodations for qualified students with disabilities.

Qualified students with disabilities may be eligible to receive academic support services and accommodations. Eligibility is based on qualifying disability documentation and assessment of individual need.

Students who believe they have a current and essential need for disability accommodations are responsible for requesting accommodations and providing qualifying documentation to the DRC. Every effort is made to provide reasonable accommodations for qualified students with disabilities.

Qualified students who wish to request an accommodation for a disability should contact the DRC by going to <https://eoss.asu.edu/drc>, calling (480) 965-1234 or emailing DRC@asu.edu. To speak with a specific office, please use the following information:

ASU Online and Downtown Phoenix Campus

University Center Building, Suite 160 602-496-4321 (Voice)

Polytechnic Campus

480-727-1165 (Voice)

West Campus

University Center Building (UCB), Room 130 602-543-8145 (Voice)

Tempe Campus

480-965-1234 (Voice)

1.6 Computer Requirements

This course requires a computer with reliable Internet access and the following:

- Web browsers (Chrome, Internet Explorer, Mozilla Firefox, or Safari)
 - For exams, will be required to use Chrome.
 - Must be capable of streaming video (e.g., YouTube).
- Adobe Acrobat Reader (free)
- Adobe Flash Player (free)
- Microphone (for office hours) and speakers
- Honorlock (or other proctor software as directed by the instructor)

During a course, students may be asked to install relevant software, which have specific recommended system requirements. Students are encouraged to review the course syllabus and content to determine what software they will be expected to use.

Students using proctoring software are required to have access to a private environment satisfying exam rules.

1.7 Technical Support

This course uses Canvas to deliver content. It can be accessed through MyASU at <http://my.asu.edu> or the Canvas home page at asu.instructure.com/.

To monitor the status of campus networks and services, visit the System Health Portal at <http://syshealth.asu.edu/>.

To contact the help desk call toll-free at 1-855-278-5080.

1.8 Student Success

This is an online course. To be successful:

- carefully read all instructions provided
- check the course daily
- read announcements
- read and respond to course email messages as needed
- complete assignments by the due dates specified
- communicate regularly with your instructor and peers
- create a study and/or assignment schedule to stay on track