

CSE 565: Software Verification and Validation

Fall 2022

Instructor Info and Office Hours

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Office Hours: See Canvas for office hours

Course and Faculty Information

Course Description

Software as a standalone product or embedded within a system plays an integral role in our world today. As a consequence, it is essential that software works as expected. This requires software testing which entails answering both the verification question: “Are we building the product right?” and the validation question: “Are we building the right product?”. Understanding these questions is crucial for developing good test cases. This course is for anyone involved in testing software at any level starting from code modules to system testing. Strategies and techniques are presented for both testing software as well as planning and tracking testing efforts.

Specific topics covered include

- Testing background
- Testing process activities
- Requirements based testing techniques
- Structure based testing techniques
- System testing
- Testing tools
- Reliability models
- Statistical testing
- Test planning
- Tracking testing progress
- Test documentation
- Test process improvement

Learning Outcomes

Learners completing this course will be able to:

- Explain how testing activities fit within leading software development process models
- Understand and apply best practices for software testing

- Create test cases based on commonly used requirements-based testing techniques
- Create test cases to achieve control and data flow structure-based coverage
- Apply static analysis techniques to identify code anomalies
- Create test cases that demonstrate system-level requirements are being met
- Identify appropriate testing tools for applications
- Predict software reliability based on operational profile testing and reliability models
- Describe activities to perform for improving testing processes
- Analyze testing needs to create a plan to achieve test objectives
- Track testing progress against a plan

Assignments

- **Assignment 1:** Specification-Based Testing Part 1
- **Assignment 2:** Specification-Based Testing Part 2
- **Assignment 3:** Structured Based Testing
- **Assignment 4:** Software Quality Characteristics Based Testing

The course consists of the following elements:

- **Lecture videos:** In each module the concepts you need to know will be presented through a collection of short video lectures. You may stream these videos for playback within the browser by clicking on their titles or download the videos. You may also download the slides that go along with the videos.
- **Practice Quizzes:** Each module will include one practice quiz, intended for you to assess your understanding of the topics. You will be allowed unlimited attempts at each practice quiz. Each attempt may present a different selection of questions to you. There is no time limit on how long you take to complete each attempt at the quiz. These quizzes do not contribute toward your final score in the class.
- **Graded Quizzes:** Each module will include one graded quiz. You will be allowed two attempts per quiz. There is no time limit on how long you take to complete each attempt at the quiz.
- **Discussion Prompt:** Each module will include multiple discussion prompts. They are not graded. We will all learn from each by sharing our experiences. Please post when you have experiences to share. You will see the discussion prompt alongside other items in the lesson. Each prompt provides a space for you to respond. After responding, you can see and comment on your peers' responses. All prompts and responses are also accessible from the general discussion forum and the module discussion forum.
- **Readings:** Each module may include required readings. They were selected for you to further understand the course topics.
- **Proctored Exams:** You will have two (2) proctored exams - the midterm and final exam. RPNOW is an online proctoring service that allows students to take exams online while

ensuring the integrity of the exam for the institution. Please see the RPNOW instructions in the 'Modules' tab.

Grade Breakdown

Course Work	Quantity	Percentage of Grade
Quizzes	8 Quizzes	15%
Assignments	5 Assignments	35%
Midterm exam	1	25%
Final exam	1	25%

You must earn a cumulative grade of 70% to earn a “C” in this course.

Grading

A+	100%	to 97%
A	< 97%	to 93%
A-	< 93%	to 90%
B+	< 90%	to 87%
B	< 87%	to 80%
B-	< 80%	to 77%
C+	< 77%	to 73%
C	< 73%	to 70%
D	< 70%	to 60%
F	< 60%	to 0%

Estimated Workload/Time Commitment Per Week

Approximately 15-18 hours per week

Required Prior Knowledge and Skills

- High-level programming language
- Software development life cycle models

Technology Requirements

- **Hardware** - Standard with major OS
- **Software and Other** - To complete course projects, the following application will be required: Jupyter Notebooks, Python

Textbook and Readings

There is no required textbook for this course. Required course readings will be provided within each week these are assigned.

Course Outline

Important Note: Unless otherwise noted, assignments are due at 11:59pm AZ time. Assignment due dates are noted in Canvas.

Course Timeline

Module
Introduction to Course
1: Software Testing Overview
2: Specification-based Testing Technique Part 1
3: Specification-based Testing Technique Part 2
Midterm Exam
4: Structural Based Testing Strategies
5: Testing Software Quality Characteristics Part 1
6: Testing Software Quality Characteristics Part 2
7: Test Management Part 1
8: Test Management Part 2
Final

Module 1: Software Testing Overview

Learning Objectives

- 1.1 Define common testing terminology
- 1.2 Describe how testing is integrated into software development
- 1.3 Define the objectives of the different levels of testing
- 1.4 Explain best practices for software testing

Module Structure

- Module 1: Testing Background
- Module 2: Testing Throughout Life Cycle
- Module 3: Testing Best Practices and Standards

Assignments

- Weekly Discussion Questions
- Weekly Quiz

Module 2: Specification-based Testing Technique Part 1

Learning Objectives

- 2.1 Contrast requirements-based versus scenario-based testing
- 2.2 Apply the equivalence partitioning testing technique
- 2.3 Apply the boundary value testing technique
- 2.4 Apply cause-effect testing technique
- 2.5 Test asynchronous events
- 2.6 Apply state-based testing technique
- 2.7 Describe model-based testing strategies

Module Structure

- Module 1: Input Sampling Techniques
- Module 2: Model-Based Testing

Assignments

- Weekly Discussion Questions
- Weekly Quiz
- Project #1 Part 1: (Due 06/02/19)
- Specification-Based Testing

Module 3: Specification-based Testing Technique Part 2

Learning Objectives

- 3.1 Apply combinatorial test coverage to assess test quality
- 3.2 Apply design of experiments to develop tests
- 3.3 Define mutation testing
- 3.4 Define fuzz testing
- 3.5 Define metamorphic testing
- 3.6 Apply defect-based testing techniques
- 3.7 Describe the role of exploratory testing

Module Structure

- Module 1: Combinatorial Testing Techniques
- Module 2: Mutation Testing
- Module 3: Fuzz Testing
- Module 4: Metamorphic Testing
- Module 5: Defect Based Testing
- Module 6: Exploratory Testing

Assignments

- Weekly Discussion Questions
- Weekly Quiz
- Project #1 Part 2: (Due 06/9/19)
- Specification-Based Testing

Module 4: Structural Based Testing Strategies

Learning Objectives

- 4.1 Develop test cases to achieve control flow coverage
- 4.2 Apply structured testing technique
- 4.3 Develop test cases to achieve data flow coverage
- 4.4 Identify static analysis techniques
- 4.5 Utilize symbolic execution

Module Structure

- Module 1: Dynamic Analysis
- Module 2: Static Analysis

Assignments

- Weekly Discussion Questions
- Weekly Quiz

Midterm Exam

Midterm Exam - Proctored – Weeks 1-4

Module 5: Testing Software Quality Characteristics Part 1

Learning Objectives

- 5.1 Utilize strategies for performance testing
- 5.2 Utilize strategies for stress testing
- 5.3 Utilize strategies for volume testing
- 5.4 Utilize strategies for configuring testing
- 5.5 Utilize various strategies for regression testing
- 5.6 Identify approaches for mobile system testing

Module Structure

- Module 1: Performance Testing
- Module 2: Stress Testing
- Module 3: Volume Testing
- Module 4: Configuration Testing
- Module 5: Regression Testing
- Module 6: Mobile Testing

Assignments

- Weekly Discussion Questions
- Weekly Graded Quiz
- Project #2: (Due 06/23/19)

Module 6: Testing Software Quality Characteristics Part 2

Learning Objectives

- 6.1 Develop error detection, recovery and serviceability tests
- 6.2 Generate usability tests
- 6.3 Identify how software reliability models work
- 6.4 Apply operational profile testing to assess software reliability
- 6.5 Identify basic security testing approaches

Module Structure

- Module 1: Error Detection, Recovery and Serviceability Testing
- Module 2: Usability Testing
- Module 3: Reliability Testing
- Module 4: Security Testing

Assignments

- Weekly Graded Discussion
- Weekly Graded Quiz

Module 7: Test Management Part 1

Learning Objectives

- 7.1 Identify the major components of a system test plan
- 7.2 Create a test schedule
- 7.3 Estimate testing effort
- 7.4 Follow a process for estimating testing effort
- 7.5 Perform risk-based testing
- 7.6 Select test exit criteria
- 7.7 Identify the different types of test documentation

Module Structure

- Module 1: Testing Plan
- Module 2: Testing Schedule
- Module 3: Estimating Testing Effort
- Module 4: Risk Based Testing
- Module 5: Test Exit Criteria
- Module 6: Test Documentation

Assignments

- Weekly Graded Discussion
- Weekly Graded Quiz

Module 8: Test Management Part 2

Learning Objectives

- 7.1 Identify additional tools that can be used to perform data visualization
- 7.2 Outline steps to load data into Tableau to quickly create data visualizations
- 7.3 Identify how to create common data visualizations with Tableau
- 7.4 Identify how to create advanced data visualizations with Tableau

Module Structure

- Module 1: Testing Plan
- Module 2: Testing Schedule
- Module 3: Estimating Testing Effort
- Module 4: Risk Based Testing
- Module 5: Test Exit Criteria
- Module 6: Test Documentation

Assignments

- Weekly Graded Discussion
- Weekly Graded Quiz
- Project #3: (Due 07/7/19)

Module 9: Final Wrap-Up

Assignments

- Final Exam (Proctored)
- Course Survey
- Optional: Portfolio Report for ASU MCS Degree

Course Access

Your ASU courses can be accessed by both my.asu.edu and <https://asu.instructure.com/>; bookmark both in the event that one site is down.

Computer Requirements

This is a fully online course; therefore, it requires a computer with internet access and the following technologies:

- Web browsers ([Chrome](#), [Mozilla Firefox](#), or [Safari](#))
- [Adobe Acrobat Reader](#) (free)
- [Adobe Flash Player](#) (free)
- Webcam, microphone, headset/earbuds, and speaker
- Microsoft Office ([Microsoft 365 is free](#) for all currently-enrolled ASU students)
- Reliable broadband internet connection (DSL or cable) to stream videos.

Note: A smartphone, iPad, Chromebook, etc. will not be sufficient for completing your work in ASU Online courses. While you will be able to access course content with mobile devices, you must use a computer for all assignments, quizzes, and virtual labs.

Student Success

To be successful:

- 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
- access [ASU Online Student Resources](#)

Submitting Assignments

All assignments, unless otherwise announced, **MUST** be submitted to the designated area of Canvas. Do not submit an assignment via email.

Assignment due dates follow Arizona Standard time. Click the following link to access the [Time Converter](#) to ensure you account for the difference in Time Zones. Note: Arizona does not observe daylight savings time.

Grading Procedure

Grades reflect your performance on assignments and adherence to deadlines. Grades on assignments will be available within the Gradebook.

Late or Missed Assignments

Notify the instructor **BEFORE** an assignment is due if an urgent situation arises and you are unable to submit the assignment on time.

Follow the appropriate University policies to request an [accommodation for religious practices](#) or to accommodate a missed assignment [due to University-sanctioned activities](#).

Communicating With the Instructor

Discussion Board

This course uses discussion boards for general questions and comments about the course. Prior to posting a question or comment, check the syllabus, announcements, and existing posts to ensure it's not redundant. You are encouraged to respond to the questions of your classmates.

Email questions of a personal nature to your instructor.

Email

ASU email is an [official means of communication](#) among students, faculty, and staff. 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.

All instructor correspondence will be sent to your ASU email account.

Course Policies

Mask Policy

Until further notice, [per ASU policy](#), ALL faculty, staff, students and visitors, are required to wear face coverings in classrooms, labs, and offices.

ASU Online Course Policies

View the [ASU Online Course Policies](#)

Accessibility Statements

View the Accessibility section to review accessibility statements for common tools and resources used in ASU Online courses. If any other tools are used in this course, links to the accessibility statements will be listed below this sentence.

Attendance and Makeup Policies:

Attendance and participation in class activities is an essential part of the learning process, and students are expected to attend class regularly. Some absences are, however, unavoidable. Excused absences for classes will be given without penalty to the grade in the case of (1) a university-sanctioned event [ACD 304-02]; (2) religious holidays [ACD 304-04; a list can be found here <https://eoss.asu.edu/cora/holidays>]; (3) work performed in the line-of-duty according [SSM 201-18]; and (4) illness, quarantine or self-isolation related to illness as documented by a health professional.

Anticipated absences for university-sanctioned events, religious holidays, or line-of-duty activity must be communicated to the instructor by email at least 10 days before the expected absence.

Absences for illness, quarantine or self-isolation related to illness must be documented by a health professional and communicated to the instructor as soon as possible by email.

Excused absences do not relieve students from responsibility for any part of the course work required during the period of absence. Faculty will provide accommodations that

may include participation in classes remotely, access to recordings of class activities, and make-up work.

If there is a disagreement as to whether an absence should be accommodated, the instructor and student should contact the academic unit chair immediately for resolution.

In case you cannot attend class in person as a result of illness or possible exposure to infectious disease, you may participate in this class remotely via ASU Sync. **To participate remotely, you must notify your instructor in advance to receive a zoom link.** Note that all students should bring a mobile device to class regularly to allow participation with colleagues via ASU Sync as necessary.

Statement on Accommodations:

The [Disability Resource Center](#) (480-965-1234; Matthews Center; email: disability-q@asu.edu) is the central location for students requiring accommodation. Any student requiring accommodation must contact and register with the Center before any accommodation requests can be granted by the instructor. If you require accommodation, please contact the Center as soon as possible so the instructor can work with you to ensure your success.

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.

Waiting for an Absent Instructor:

Students are obliged to wait at least 15 minutes for class sessions lasting 90 minutes or less, and 30 minutes for class sessions lasting more than 90 minutes. Students may be directed to wait longer by someone from the academic unit if they know the instructor will arrive shortly.

Syllabus Disclaimer

The syllabus is a statement of intent and serves as an implicit agreement between the instructor and the student. Every effort will be made to avoid changing the course schedule but the possibility exists that unforeseen events will make syllabus changes necessary. Remember to check your ASU email and the course site often.