SWE-637 – Software Testing

Master of Science in Computer Science

Course Information

Course Section:
Course Term:

PROGRAM OBJECTIVES

1) **Foundations of Computer Science**: apply mathematical foundations and algorithmic principles in the modeling and design of computing systems.
2) **Computer Systems Fundamentals**: apply fundamental concepts in computer systems to model, design, and implement a computer-based system, process, or program that meets desired needs.
3) **Information Processing Fundamentals**: apply fundamental concepts in information processing to model, design, and implement a computer-based system, process, or program that meets desired needs.
4) **Advanced Computer Systems**: use advanced concepts in computer systems to design, implement, and evaluate a computer-based system, process, component, or program.
5) **Advanced Information Processing**: use advanced information processing concepts to design, implement, and evaluate a computer-based system, process, component, or program.

COURSE DESCRIPTION

Students learn the theory behind criteria-based test design and how to apply that theory in practice to design high quality tests during all phases of software development. Topics include test design, test automation, test coverage criteria, and how to test software in cutting-edge software development environments.

Prerequisites: SWE 619 is highly recommended. While this course provides extremely practical skills, it is, at heart, an applied math course. You will need knowledge of discrete math, programming, data structures and basic software engineering. Most examples will be in Java and many assignments will require JUnit tests, so Java experience is important.

COURSE METHODOLOGY

Each week, learners will:

- Study content in Blackboard, including video lectures, tutorials, and interactive media.
- Practice writing code, checking results, and updating code as needed
- Work on assignments (when due)

COURSE OBJECTIVES

After completing the course, learners will be able to:

- Summarize the benefits of agile testing and create automated software tests.
- Identify a software component's input domain characteristics and create test requirements to satisfy input domain test criteria.
- Generate a graph representation of source code and create test requirements to satisfy graph coverage test criteria.
- Identify predicates and clauses in source code, determine implicant clauses using Karnaugh maps, and create test cases to satisfy logic test criteria.

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- Predict the software mutants generated by mutation operators, judge whether they are equivalent, and create test cases to satisfy mutation test criteria.
- Evaluate and critique recent software testing literature.

Instructor Information

Refer to the Blackboard course shell for section-specific instructor contact, biography, and office hours information.

Course Resources

TEXTBOOKS AND READINGS

REQUIRED

Textbook— *Introduction to Software Testing*, 2nd Edition, Paul Ammann and Jeff Offutt, Cambridge University Press, ISBN 9781107172012

At the GMU bookstore On Amazon.com Electronic version from publisher
Book Website: https://cs.gmu.edu/~offutt/softwaretest/

COMPUTER REQUIREMENTS

HARDWARE

You will need access to a Windows, Linux, or Macintosh computer and to a fast, reliable broadband Internet connection (e.g., cable, DSL). Computer speakers or headphones are recommended for recorded content. A headset microphone is recommended for live audio sessions using course tools like Blackboard Collaborate. Computer hard disk space must allow for:

- Installing the required and recommended software.
- Saving your course assignments.

For hardware and software purchases, visit Patriot Computers.

You are strongly encouraged to back up all contents of your computer on a regular basis. Loss of data will not excuse late or unsubmitted assignments.

SOFTWARE

Software applications include the following:

- Web browser (See Blackboard Support for supported web browsers)
- Adobe Acrobat Reader (free download)
- Microsoft Office (purchase)
- Blackboard Collaborate (select from the course menu)
- Eclipse, Visual Studio Code, or another integrated development environment (IDE) of your choice
- Java JDK 8 or later

UPDATING YOUR COMPUTER

Please be sure to update your computer and prepare yourself to begin using the online format BEFORE the first day of class.

Grading Information

GRADING SCALE

The following table describes the grading system:

GRADE	PERCENTAGE
A+	97 or higher
A	90 - 96
B+	85 -89
B	80 - 84
C	70 – 79
F	Below 70

LETTER GRADING DESCRIPTIONS:

Listed below are grades and academic standards for each grade awarded.

A+: Consistently far exceeds the course/assignment requirements
A: Consistently exceeds the course/assignment requirements
B+: Meets and occasionally exceeds the course/assignment requirements
B: Consistently meets the course/assignment requirements
C: Minimally meets the course/assignment requirements
F: Fails to meet minimum course/assignment requirements

CATEGORIES AND WEIGHTS

The following table lists the types of graded activities in this course and each category's weight in the final course grade.

ACTIVITY	% OF OVERALL COURSE GRADE
Weekly Quizzes	40%
Homework Assignments	25%
Class Participation	10%
Final Exam	25%
TOTAL:	**100%**

UNGRADED ITEM DESCRIPTIONS

UNGRADED DISCUSSIONS 00%

Three non-graded discussion forums are included in this course. *While participating in ungraded discussions does not directly affect your course grade, those who regularly participate in the discussions historically perform better in the course and final exam.* Building connections with others and learning from others are keys to deeper understanding.

Course Q and A Forum
Participate in this discussion to ask, view, and respond to questions of the instructor about the course material. Doing so creates a resource of information and insights. Often, even students who may not initially have a question will find a question and answer they didn't know to ask. Instructors and GTAs can provide help and insights in this forum. This is also the place to post articles on software engineering topics that your classmates may find interesting. Relevant and meaningful questions (at the instructor's discretion) or answers to other students' questions earn one participation point. References to articles must be relevant to software testing, software security, or software engineering in general, and must be accompanied by your own short (one paragraph) summary of the article.

Assignment Collaboration Forum
Participate in this forum for open discussions about the homework assignments. Homework assignments may be done as group work and asking/answering questions or discussing the assignments is allowed and encouraged.

Cyber Café Forum
Participate in this forum to discuss things that are not directly related to the course. Use this space to socialize, network, and to discuss topics of mutual interest beyond the instructional content of the course. Building personal connections, even when not directly related to course content, improves the learning experience.

GRADED ITEM DESCRIPTIONS

A submission is considered on time if submitted electronically on Blackboard on or before required submission date/time. The following are descriptions of the five assignment categories:

WEEKLY QUIZZES 40%
Weekly quizzes will be done electronically on Blackboard. Quizzes are open-book/open-notes but must be taken individually without help from anyone else. Quizzes typically have a 45-minute time limit, but occasionally the time may vary. Quiz topics will be taken from course material from one or more previous sessions as well as prior exercises and discussions. Each quiz is graded on a 100-point scale, and quizzes may have a bonus question to allow you to demonstrate in-depth understanding. There is no midterm exam.

Overall quiz grading will be based on your ten highest quiz grades; your three lowest quiz scores (including missed quizzes) will be dropped. There will be no quiz re-take or makeup opportunities. Contact the professor regarding exceptional situations that cause you to miss two or more quizzes.

There have been cases where students have exited Blackboard quizzes due to network or browser glitches, or when Blackboard did not properly record the answers to all questions. Check your work *immediately after submission* and if this occurs, please notify the professor and/or GTA immediately. If evidence supports it, you will have an opportunity to complete or re-take the quiz.

HOMEWORK ASSIGNMENTS 25%
There will be six homework assignments. These assignments stress the practical application of techniques discussed during lectures. Assignments must be submitted on Blackboard before the end of the day on the due date. Late assignments will be reduced in score by 10% for each day that they are late, up to 5 days late. Assignments will be given a score of zero afterwards.

Assignments (except for the first) may be done collaboratively in teams of one to four students. Every person in the group will earn the same grade. Online discussion of assignments is welcome! Assignments become more complex during the semester, and later assignments are weighted more heavily than early ones:

ASSIGNMENT	% OF OVERALL COURSE GRADE
Assignment 1 – Writing JUnit Tests	2%
Assignment 2 – RankingService Test Doubles	3%
Assignment 3 – CalMutants Input Space Partitioning	4%
Assignment 4 – LinkedList Statement Coverage	5%
Assignment 5 – Testing the 737 MAX MCAS System	7%
Assignment 6 – Software Testing Literature Review	4%
TOTAL:	**25%**

CLASS PARTICIPATION 10%
Various graded discussion forums are included in this course. See Blackboard for information about what to post to these forums. Participate in this discussion to post your work from the weekly discussion topics in the learning units. This is primarily an opportunity for you to exercise your skills in the subject matter, and after you complete your post you will be able to see the instructor's solution as well as the posts from other students. Your work does not need to be complete or correct to earn credit, but you must show a good-faith effort.

Posts to these forums are graded on a pass/fail basis; a meaningful post earns credit. For full class participation credit, you must participate in at least 75% of the discussions.

MIDTERM EXAM 0%
There will be no midterm exam.

FINAL EXAM 25%
The final exam will be electronic and will be open-book/open-notes but must be completed individually. The exam is cumulative and may contain content from any portion of the course. University policy specifies that missing the final exam without previous notice is an automatic F. If you are unable to make it to class for the final exam, please coordinate with the professor before the exam. This exam is due in Module 15.

Policies and Services

MASON HONOR CODE

To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University community and with the desire for greater academic and personal achievement, we, the student members of the university community, have set forth this honor code:

Student members of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work.

You are expected to familiarize yourself with and adhere to the Honor Code. Student members of the George Mason University community pledge not to cheat, plagiarize, steal, and/or lie in matters related to academic work.

For additional important information, including the Honor Code definitions of cheating, plagiarism, stealing, and lying, see the George Mason University Academic Integrity page.

All students are expected to abide by the GMU Honor Code and the CS Department Honor Code. This policy is rigorously enforced. All class-related assignments are considered individual efforts unless explicitly expressed otherwise (in

writing). Review the university honor code and present any questions regarding the policies to instructor. Cheating on any assignment will be prosecuted and result in a notification of the Honor Committee as outlined in the GMU Honor Code.

ACADEMIC INTEGRITY EXPECTATIONS

1. Working online requires dedication and organization. Proper preparation is expected every week. You are expected to log in to the course each week and complete the assignments and activities on or before the due dates.
2. Students must check their GMU email messages on a daily basis for course announcements, which may include reminders, revisions, and updates.
3. It is expected that you will familiarize yourself with and adhere to the Honor Code. Student members of the George Mason University community pledge not to cheat, plagiarize, steal, and/or lie in matters related to academic work.
4. It is essential that you promptly communicate any questions or problems to the instructor.
5. While the use of online resources is encouraged, "cheat sites" that post content from past offerings of the course (whether in-person or online) are not permitted. Use of such sites is considered cheating.
6. The use of artificial intelligence (AI) content-generation tools (such as ChatGPT) is prohibited unless otherwise stated. Any content generated by such tools is not accepted in this class as "the student's own work," and so will be considered similarly to text published on paper or online or text composed or significantly edited/altered by another person. The use of such text without proper attribution is a violation of academic integrity.

INDIVIDUALS WITH DISABILITIES

The university is committed to providing equal access to employment and educational opportunities for people with disabilities.

Mason recognizes that individuals with disabilities may need reasonable accommodations to have equally effective opportunities to participate in or benefit from the university educational programs, services, and activities, and have equal employment opportunities. The university will adhere to all applicable federal and state laws, regulations, and guidelines with respect to providing reasonable accommodations as necessary to afford equal employment opportunity and equal access to programs for qualified people with disabilities.

Applicants for admission and students requesting reasonable accommodation for a disability should call the Office of Disability Services at 703-993-2474. Employees and applicants for employment should call the Office of Equity and Diversity Services at 703-993-8730. Questions regarding reasonable accommodations and discrimination on the basis of disability should be directed to the Americans with Disabilities Act (ADA) coordinator in the Office of Equity and Diversity Services.

EMAIL POLICY

Web: masonlive.gmu.edu

Mason uses electronic mail to provide official information to students. Examples include notices from the library, notices about academic standing, financial aid information, class materials, assignments, questions, and instructor feedback. Students are responsible for the content of university communication sent to their Mason e-mail account and are required to activate that account and check it regularly.

Students are also expected to maintain an active and accurate mailing address in order to receive communications sent through the United States Postal Service

ADDITIONAL SERVICES AND POLICIES

UNIVERSITY POLICIES
Students must follow the university policies. See University Policies.

DIVERSITY
George Mason University promotes a living and learning environment for outstanding growth and productivity among its students, faculty and staff. Through its curriculum, programs, policies, procedures, services and resources, Mason strives to maintain a quality environment for work, study and personal growth.

RESPONSIBLE USE OF COMPUTING
You are expected to adhere to the university policy for Responsible Use of Computing. See University Policies/Computing.

STUDENTS WITH DISABILITIES
Students with disabilities who seek accommodations in a course must be registered with the George Mason University Office of Disability Services (ODS) and inform their instructor, in writing, at the beginning of the semester.

UNIVERSITY LIBRARIES
University Libraries provides Library services for distance students.

WRITING CENTER
The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing.

You can now sign up for an Online Writing Lab (OWL) session just as you may sign up for a face-to-face session in the Writing Center, which means YOU set the date and time of the appointment.

COUNSELING AND PSYCHOLOGICAL SERVICES (CAPS)
The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance.

FAMILY EDUCATIONAL RIGHTS AND PRIVACY ACT (FERPA)
The Family Educational Rights and Privacy Act of 1974 (FERPA), also known as the "Buckley Amendment," is a federal law that gives protection to student educational records and provides students with certain rights.

Course Schedule

Please check the course website for schedule and updates.