CptS 422: Software Engineering Principles II

Fall 2020

Course credits: 3
Meeting time: Tuesday, Thursday, 16:20 – 17:35, August 24 – December 11
Location: Zoom@Blackboard
Course webpage: http://www.eecs.wsu.edu/~hcai/cpts422

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Office hours: Monday, Wednesday, 9:00 – 10:00, or by appointments

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Course Description

Software engineering is a subject that concerns the holistic process of software development, distilling the common principles for constructing and maintaining quality software products independent of particular programming languages used. The core of this subject is characteristics of a lifecycle model and associated methodologies, techniques, and tools that cover different phases of the software development process, including requirement analysis, software design, implementation, testing, evolution and maintenance. This course will mainly focus on software testing *(verification* and *validation*) after the software is implemented, covering topics on *dependable software systems; software verification and validation, testing; CASE environments; software management and evolution*.

Course Content Overview

The core content is the fundamentals of software testing, concerning the methodology for performing testing at different levels (e.g., unit testing, integration testing) and for different objectives (e.g., functional correctness, security). Students will learn to apply different testing techniques (e.g., boundary-value analysis, decision tables), and to evaluate the results of the tests as well as the quality of the tests.

More specifically, the content will cover the following topics:

- Fundamental software testing concepts

- Testing at different levels with varied strategies (e.g., unit testing, integration testing, system testing)
- Testing of different objectives: functionality testing, performance testing, security testing, etc.
- Testing techniques (e.g., black box, white box, mutation testing, etc.)
- Test-related measures (e.g., fault density, mutation score)
- Test planning and documentation

Course Learning Objectives

This course will help students gain the abilities to

1. Choose a testing process according to software project nature
2. Develop test cases for different testing levels
3. Generate test input data using different testing techniques
4. Perform testing for different testing objectives
5. Identify coverage and acceptance criteria for test cases developed
6. Use various testing tools for test development and evaluation

Further, these learning objectives will be achieved via the following course materials:

Objective	Topics/timeline	Assessment
1	Software testing process and fundamentals: specification-based, test-driven (Weeks 1-2)	Midterm, homework 1
2	Software testing levels: unit, integration, system (Weeks 3-6)	Midterm, final exam, homework 2, project
3	Software testing techniques: blackbox, whitebox, mutation (Weeks 7-13)	Midterm, final exam, homework 3, project
4	Software testing objectives: functionality, security, performance (Week 14)	Homework 4, final exam
5	Software testing evaluation: test coverage criteria, test quality assessment (Week 15)	Homework 4, final exam
6	Final review and project presentations	Final exam, project

Prerequisites

Students taking this course are expected to have already taken CptS 321 or CptS 323 with a grade C or better, and CptS 322 with a grade C or better (NO concurrent enrollment). Through these prerequisite courses, students should have gained a solid background in object-oriented programming (C/C++ or Java) and software engineering with emphasis on requirements analysis and software design.

Textbooks (recommended)

1. Paul Jorgensen, "Software Testing, A Craftman's Approach", CRC Press, 2013 (4th Edition).(Available on Amazon; ISBN-13: 978-1466560680)
2. Ilene Burnstein, "Practical Software Testing", Springer 2003.(Available on Amazon; ISBN-13: 978-0387951317)

Supplemental Texts

3. Imran Bashir and Amrit Goel, "Testing Object-oriented Software: Life Cycle Solutions", Springer, 1999.(Available on Amazon; ISBN-13: 978-0387988962)
4. Robert V. Binder, Testing Object-Oriented Systems - Models, Patterns, and Tools, Addison-Wesley, 1999. (Available on Amazon; ISBN-13: 078-5342809381)
5. Ian Sommerville, "Software Engineering", Addison Wesley (9th Edition). (Available on Amazon; ISBN-13: 978-0137035151)

Lecture Schedule (*Tentative*, weekly)

Week	Topics	Readings (book index in [ ])	Deliverables
W1	Syllabus, testing fundamentals	- Ch. 1, 3 [1] - Ch. 1, 2 [2]	Project milestone 0 (project selection, team info)
W2	Testing fundamentals, testing processes/models	- Ch. 22 [1] - Ch. 8, 24 [5]	
W3	Unit testing	- Ch. 6 [2] - Ch. 8 [5]	Homework 1
W4	Unit testing		
W5	Unit testing; integration testing	- Ch. 13 [1]	Project milestone 1
W6	Integration testing; system testing	- Ch.14 [1]	Homework 2

W7	Black box testing techniques; midterm review	- Ch. 5, 6 [1]	midterm
W8	Black box testing techniques	- Ch. 7 [1]	
W9	Black box testing techniques	- Ch. 4 [2]	
W10	White box testing techniques	- Ch. 8, 9, 10 [1]	Project milestone 2
W11	White box testing techniques	- Ch. 5 [2]	
W12	White box testing techniques		Homework 3
W13	Fault-based testing techniques: mutation testing	- Ch.12 [1] - Ch. 7 [4] - Ch. 21 [1]	
W14	Thanksgiving vacation		Homework 4
W15	Test evaluation; testing tools	- Ch. 21 [1] - Ch. 23 [1]	Project milestone 3
W16	Project presentations; final exam review		
W17			Final exam

Grading

The final course grade will be calculated using the following breakdown and be converted from numeric numbers to letter grades using the scale mapping as follows. In addition to these basic components of grade, extra/bonus points can be earned through quizzes and *extended* class participation. There are three forms of extended class participation: in-class discussion, activities on Blackboard Discussion Forums, and office-hour attendance. It is at the instructor's discretion to calculate the extra/bonus points by the end of the semester.

Breakdown *Scale mapping*

Participation	5%		Score	*Grade*	Score	*Grade*	Score	*Grade*
Homework	10%		>=93	*A*	[80,83)	*B-*	[66,70)	*D+*
Midterm	15%		[90,93)	*A-*	[77,80)	*C+*	[60,66)	*D*

Project	50%		[87,90)	*B+*	[73,77)	*C*	<60	*F*
Final exam	20%		[83,87)	*B*	[70,73)	*C-*		

Communication

We will communicate announcements and lecture notes as well as off-class Q&A and extended discussion through Discussion Forums on Blackboard, which will also be used for project deliverables submission and grading. For questions on course materials, lectures, and course project milestones, contact the instructor/TA on Discussion Forums by sending posts instead of by emails, so as to facilitate communication management. You have options for sending private (anonymous) posts.

Participation

Class attendance is mandatory. Although supplementary slides and assigned readings will be posted online, these materials as well as the recommended textbooks are only used as references by the instructor in developing the lectures. Thus, studying these materials and textbooks serves the purpose of getting better prepared for attending in-class lectures, but would by no means substitute for class attendance. Also, the course project requires each team member to be responsible and collaborative as well as to contribute equally; thus, missing lectures without justifiable reasons and then relying on other team members to catch up missed topics is not acceptable. You are also expected to participate in class discussions, which aids learning and provides valuable feedback on the lecture. Lectures will be delivered through whiteboard and Powerpoints. It is the students' responsibility to take their own notes during lectures. Taking notes in class is crucial as these notes form the basis for doing well with assignments and exams.

If you know you will miss a lecture for a justifiable reason such as a university activity, religious holiday, military service, or a medical appointment, notify the instructor by email or phone call at least 12 hours before the lecture. If you are participating in a university activity the supervisor of the activity should provide you with documentation. Others should provide a written explanation in their own words by email -- documentation from medical personnel is not required but you must document the absence. If you are unexpectedly sick or otherwise unable to attend due to an emergency, contact the instructor as soon as possible. If you miss a class for these justifiable reasons, arrange with a fellow student to get and digest the corresponding notes, and go to the instructor’s office hours for further help if needed.

While attendance will not be taken in every class, it will be sampled randomly at the discretion of the instructor. The basic participation credit that accounts for 5% in the final grading will be calculated using the sampled attendance records. Bonus points can be earned through the extended participation as described in the section on grading above.

Prior to each lecture, students are expected to complete the assigned reading. The reading materials for each lecture can be found in the Lecture Schedule above. Most of these readings are the primary textbooks' sections that are closely related to the lecture topic, but some readings are chosen from other sources such as the supplementary materials specified. Note that the schedule is subject to change, and it is the responsibility of students to regularly check out the updated schedule. In addition, students are expected to maintain a professional and respectful classroom environment, for which students are suggested to:

- silence personal electronics (non-disruptive ones may be used during class)
- arrive on time and attend the entire class session

Exams and Assignments

There will be one midterm exam and one final exam. There will be four homework assignments each expected to take 1-2 weeks to complete. There may also be assignments in the form of quizzes from which bonus points can be earned. These assignments with respective due dates will be announced in class and posted on Blackboard.

Other than these exams and quizzes, the coursework is focused on a semester-long group project, which will be measured by milestones/deliverables. The objectives, requirements, and deadline of each milestone/deliverable will be communicated in class or/and on Blackboard. For each milestone, your group will be required to submit a written report, code, and/or test cases to demonstrate the project progress. Each member of the group will initially receive the same credit based on the quality and timeliness of group submissions, and will be later adjusted according to in-group peer evaluation by the end of the project. More details on the course project selection, milestones/deliverables, and evaluation method are provided in two dedicated documents ("*project description*" and "*suggested project topics*").

You are encouraged to take advantage of office hours offered by both the instructor and TA if you have questions for homework/project assignments.

You must take each exam during the assigned test period. Failure to do so will result in a score of zero. However, in extraordinary circumstances and at the discretion of the

instructor, a make-up exam and other time accommodations may be offered. An advanced notice must be given to the instructor beforehand. Unless posted otherwise, assignment documents shall be submitted electronically. Typically, each submission to Blackboard will be a single PDF document; code and test cases will be submitted directly on the project repository.

Late Submission Policy

Late penalty is a flat 10% deduction per day. Late assignments may be turned up to one week after the original due date. An advanced notice must be given to the instructor via email at least 24 hours before the deadline for a late submission. The instructor may allow for late submissions without penalty if extenuating cases are explained in the notice email sent to the instructor.

Expected Effort

Beyond the time for lecture attendance, students in this class are expected to invest a minimum of 2-3 hours outside class for each lecture equivalent (or 4-6 hours per week), including the time for working on homework assignments and the course project.

COVID-19 Policy

During the Covid-19 pandemic, necessary accommodations will be offered as well on a case-by-case basis according to the specific personal requests from students and the world/nation/state-wide pandemic development and orders.

Students are expected to abide by all current COVID-19 related university policies and public health directives, which could include wearing a cloth face covering, physically distancing, self-attestations, and sanitizing common use spaces. All current COVID-19 related university policies and public health directives are located at https://wsu.edu/covid-19/. Students who do not comply with these directives may be required to leave the classroom; in egregious or repetitive cases, students may be referred to the Center for Community Standards for university disciplinary action.

Academic Integrity / Honor Code

Academic integrity is the cornerstone of higher education. As such, all members of the university community share responsibility for maintaining and promoting the principles of integrity in all activities, including academic integrity and honest scholarship. Academic integrity will be strongly enforced in this course. Students who violate WSU's Academic Integrity Policy (identified in Washington Administrative Code (WAC) 504-26-010(4) will receive a *fail* grade for the course, will not have the option to withdraw from the course pending an appeal, and will be reported to the Center for Community Standards.

Cheating includes, but is not limited to, plagiarism and unauthorized collaboration as defined in the Standards of Conduct for Students, WAC 504-26-010(3). You need to read and understand all of the definitions of cheating. If you have any questions about what is and is not allowed in this course, you should ask course instructors before proceeding. If you wish to appeal a faculty member's decision relating to academic integrity, please use the form available at communitystandards.wsu.edu. Make sure you submit your appeal within 21 calendar days of the faculty member's decision.

In particular, the fundamental requirement for all student work in this class is: Unless otherwise explicitly permitted by the instructor, all work you turn in must be your own. It is dishonest not only to copy another student's work, but to permit another student to copy yours. Nevertheless, realizing that students can assist each other in understanding general course material, there are limited ways in which student collaboration is permitted:

1) You may communicate verbally with another student, as long as you do not communicate the answer or the content of what you are going to turn in, whether it be code or text. A good way to work in this regard is for the student providing help to ask guiding questions of the student needing help, letting them arrive at the answer themselves.
2) You may draw diagrams and such on a whiteboard, chalkboard, or piece of blank paper to illustrate the verbal points made in 1), as long as you do not write what you are going to turn in.

It will be up to the discretion of the grader (if applicable) and instructor to determine if any assignment shows evidence of collaboration beyond these limits. Any attempt to circumvent the spirit of these rules will be treated as a violation of the fundamental requirement. If you are in doubt, do not give help to or request it from another student: That's what office hours are set for. Information on WSU Academic Integrity can be found at www.academicintegrity.wsu.edu/ and conduct.wsu.edu/, and the WSU Honor code is on https://provost.wsu.edu/tag/wsu-honor-code/. Please also read the EECS Academic Integrity Policy carefully. Use these resources to ensure that you do not inadvertently violate WSU's standard of conduct.

Students with Disabilities

Reasonable accommodations are available for students with documented disabilities or chronic medical or psychological conditions. If you have a disability and need accommodations to fully participate in this class, please visit your campus' Access

Center/Services website to follow published procedures to request accommodations. Students may also contact their campus offices to schedule an appointment with a Disability Specialist. All disability related accommodations are to be approved through the Access Center/Services on your campus. It is a university expectation that students visit with instructors (via email, Zoom, or in person) to discuss logistics within two weeks after they have officially requested their accommodations.
For more information contact a Disability Specialist on your home campus:

- Pullman, WSU Global Campus, Everett, Bremerton, and Puyallup: 509-335-3417 Access Center (https://www.accesscenter.wsu.edu) or email at access.center@wsu.edu
- Spokane: 509-358-7816 Access Services (https://spokane.wsu.edu/studentaffairs/access-resources/) or email j.schneider@wsu.edu
- Tri-Cities: Access Services (http://www.tricity.wsu.edu/disability/) or email g.hormel@wsu.edu
- Vancouver: 360-546-9238 Access Center (https://studentaffairs.vancouver.wsu.edu/student-wellness-center/access-center) or email van.access.center@wsu.edu

Accommodation for Religious Observances or Activities
Washington State University reasonably accommodates absences allowing for students to take holidays for reasons of faith or conscience or organized activities conducted under the auspices of a religious denomination, church, or religious organization. Reasonable accommodation requires the student to coordinate with the instructor on scheduling examinations or other activities necessary for course completion. Students requesting accommodation must provide written notification within the first two weeks of the beginning of the course and include specific dates for absences. Approved accommodations for absences will not adversely impact student grades. Absence from classes or examinations for religious reasons does not relieve students from responsibility for any part of the course work required during the period of absence. Students who feel they have been treated unfairly in terms of this accommodation may refer to Academic Regulation 104 – Academic Complaint Procedures.

Safety and Emergency Information
The Campus Safety Plan (http://safetyplan.wsu.edu) contains a comprehensive listing of university policies, procedures, statistics, and information relating to campus safety. The

University emergency management website (http://oem.wsu.edu/) provides campus safety and emergency information. The emergency alternative site (http://alert.wsu.edu) provides information about emergencies and communication resources WSU will use to provide warning and notification during emergencies.

Classroom safety is also of paramount importance at Washington State University, and is the shared responsibility of the entire campus population. WSU urges students to follow the "Alert, Assess, Act" protocol for all types of emergencies and the "Run, Hide, Fight" response for an active shooter incident. Remain ALERT (through direct observation or emergency notification), ASSESS your specific situation, and act in most appropriate way to assure your own safety (and the safety of others if you are able). Please sign up for emergency alerts on your account at MyWSU.