

CptS 583: Software Quality

Spring 2022

Course credits: 3

Meeting time: Tuesday, Thursday, 12:05 pm – 13:20 pm, Jan 10 – April 29

Location: Sloan 163

Course webpage: <http://www.eecs.wsu.edu/~hcai/cpts583>

Instructor: Haipeng Cai

Office location: EME B47; and Zoom (<https://wsu.zoom.us/my/hcaiwsu>)

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Office hours: Tuesday, Thursday, 11:00 am – 12:00 pm, or by appointments

Course Description

Software engineering concerns a holistic process of software development, with a focus and central goal of quality which underlies the key principles in the process. Quality control is an essential umbrella activity throughout all phases of any software process, rather than only concerning software code in the construction phase. The core of this subject lies in the concepts and principles as well as methodologies and techniques for achieving software quality and realizing software quality assurance (SQA). The state of the art and practice of SQA, including practical SQA tools, will also be covered in this course. Of peculiar importance, learning of the SQA principles from this course will be complemented and enhanced by applying the principles to software engineering practice through diverse course projects and managed team collaborations.

Course Content Overview

The core content of this course addresses the various facets of software quality engineering, including the process of software quality assurance (SQA), quality metrics and models, quality measurement and management, and SQA methodologies and techniques. The focus is on how to perform SQA *throughout the entire software process*, ranging from analysis and design to construction and deployment, as opposed to software testing which mainly focuses on the quality during software construction and maintenance. The key topics to be covered include the following:

- Software quality overview and key concepts
- The cost, value, factors, and tradeoffs of software quality
- Software quality planning
- Software quality models
- Measurement theory and fundamentals

- Product quality metrics and measurement
- Process quality metrics and measurement
- SQA methodologies and techniques
- Software analysis, testing, debugging

Course Learning Objectives

Students will gain knowledge and expertise on the core content of this course, so embodied through their ability to define appropriate, specific quality goals and develop actionable plans to realize the goals. Students will learn techniques that enable and empower software quality management, defining concrete quality metrics and evaluating software quality using the defined metrics. In addition, students will also sharpen valuable skills necessary for software engineering practices, including the use of modern software engineering tools, collaborating in a software development team, and technical communication and peer evaluation. Students will participate in a semester long group project to gain hands-on experiences applying the principles and techniques learned.

Specifically, this course will help students acquire the ability to:

- Measure the degree to which software artifacts achieve desired quality.
- Explain tradeoffs among cost, schedule, and quality.
- Defining specific quality goals, and estimating the effort and schedule of software quality activities.
- Determine how software quality is affected by the software process used.
- Select and use standards in the quality management process.
- Explain the process of and conduct different activities to manage software quality such as reviews, audits, and walkthroughs.
- Measure and relate the software quality to appropriate quality attributes.
- Use software analysis techniques to assess and verify software quality.

Prerequisites

Students taking this course are expected to have already taken undergraduate courses (e.g., *Software Engineering*, *Software Design*, etc.) that cover the general software process models and methodologies, as well as requirements analysis and software design methods and principles. Students should have also gained a solid background in data structures and object-oriented programming (C/C++ or Java) through relevant courses to prepare them for realizing implementation and testing tasks.

Textbook

- Daniel Galin, [*Software Quality Assurance: From Theory to Implementation*](#), Pearson Education Limited, 2004. ISBN-13: 978-0201709452.
- Stephen H. Kan, [*Metrics and Models in Software Quality Engineering*](#), 2nd ed., Addison- Wesley, 2002. ISBN-13: 978-0133988086.
- (ASU) Aho, A.V., Sethi, R., and Ullman, J. D., *Compilers: Principles, Practices and Techniques*, Addison-Wesley, 1986.

Supplemental Materials

- IEEE Standards. 1028-2008, *Software Reviews and Audits*, IEEE, 2008. (Available on the IEEE Digital Library, freely accessible via WSU Libraries.)
- Jeff Tian, [*Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement*](#), Wiley-IEEE Computer Society Press, 2005. ISBN: 978-0-471-71345-6.

Topics Outline and *Tentative Lecture Schedule*

Week	Lecture Topics
1	Course overview and introduction to software quality and SQA; Software quality concepts (I)
2	Software quality concepts (II); Software quality planning (I)
3	Software quality planning (II); Value and cost of software quality
4	Quality factors and tradeoffs; Quality models (I): general frameworks
5	Quality models (II): reliability model; Quality metrics and measurement (I): overview, theory
6	Quality metrics and measurement (II): measurement fundamentals; Quality metrics and measurement (III): software metrics, quality metrics and measurement
7	Software product quality metrics and measurement (I): size metrics; <i>Midterm exam: February 24th, Thursday (12:05-1:20pm)</i>
8	Software product quality metrics and measurement (I): size metrics; Software product quality metrics and measurement (II): customer metrics, quality attribute metrics, time/cost/complexity metrics
9	Software product quality metrics and measurement (III): analysis and design metrics;

	Software process quality metrics and measurement (I)
10	<i>Spring break</i>
11	Software process quality metrics and measurement (II); SQA: overview, concepts, and process (I)
12	SQA: overview, concepts, and process (II); SQA: verification/validation, configuration, documentation (I)
13	SQA: verification/validation, configuration, documentation (II); Software analysis: program representations
14	Software analysis: data/control flow analysis; Software analysis: symbolic execution
15	Software testing: random testing, test generation; Software testing: delta debugging
16	<i>Final review</i> <i>Project presentations</i>
17	<i>Final exam: May 5, Thursday (10:30am-12:30pm)</i>

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.

Breakdown		Scale mapping						
Coursework	Weights	Score	Grade	Score	Grade	Score	Grade	
Participation	5%	>=93	A	[80,83)	B-	[66,70)	D+	
Project	60%	[90,93)	A-	[77,80)	C+	[60,66)	D	
Midterm exam	15%	[87,90)	B+	[73,77)	C	<60	F	
Final exam	20%	[83,87)	B	[70,73)	C-			

Course Project

A key component of the coursework is a semester-long group project. The progress of this group project will be measured by deliverables. The objectives, requirements, and due date of each deliverable will be communicated well prior to the due date such that each group will have reasonably enough time to complete the tasks required for the

deliverable. For each deliverable, each group will be required to submit a written report and/or code (along with test cases) to demonstrate the progress of the group. 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 period. A list of sample project topics along with the concrete details on the deliverables will be given in a separate document (e.g., *project description*), typically distributed in the first week. Students are encouraged to choose different topics of their own, but should be approved by the instructor before starting the project.

Unless specified otherwise, each project deliverable shall be created and submitted electronically as a *single PDF* on Canvas prior to the deadline which is 11:59 pm of the posted due date. Any late submission will receive a zero if no notice is sent to the instructor about the expected delay **prior to** the deadline; if a notice is sent to the instructor prior to the deadline, then the penalty of the late submission is a flat *10% point deduction* for every day after the original due date until the submission is received or the point left becomes zero. Note that by the end of the semester, missing any project deliverable will lead to an "*I*" (*incomplete*) grade except for extenuating cases communicated to the instructor in advance -- the *I* grade for a student means the student does not complete the course. Students missing an exam by the end of the semester will also receive an '*I*' grade for this course.

Communication

We will communicate announcements, assignments, lecture materials and other learning resources all on Canvas. In particular, we will host off-class Q&A through the *Discussion Board* on Canvas. Canvas is also the portal to be used for project deliverables submission and grading. For questions on course materials, lectures, and course project milestones, contact the instructor on the Discussion Board by sending posts instead of by emails, so as to facilitate communication. You have options for sending *private (anonymous)* posts. Make sure you **subscribe to each** of the forums there so that you won't be missing important information about the course logistics and extended lecture discussions initiated by questions raised by other students.

Participation

Class attendance is required at all lectures. Although lecture slides and other supplementary learning materials 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. If you know you will miss a lecture for a justifiable reason such as a university activity or a medical appointment, notify the instructor by email at least 12 hours before the lecture. 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% of the final grade will be calculated using the sampled attendance records (in addition to active participation in classroom discussion).

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

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 1-2 hours outside class for each lecture equivalent (or 2-4 hours per week), including the time for working on 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/wsuhonorcode/>. 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.