Ira A. Fulton Schools of Engineering
Arizona State University

CSE 565: Software Verification and Validation

Unit Testing Assignment

Purpose

Through this project, you will demonstrate your understanding of unit-level testing, ability to utilize appropriate tools, proficiency in generating effective unit-level test cases, and critically analyzing the effectiveness of using an AI-powered language model in unit-level testing.

Objectives

Learners will be able to:

- Apply unit-level testing learning to develop tests for an algorithm
- Develop unit-level test cases using a generative AI tool and unit-testing framework
- Execute the test cases generated and report the performance of unit-level test cases developed and further improve the unit test cases
- Analyze the effectiveness of a generative AI tool in performing unit-level testing

Technology Requirements

- Generative AI tool (e.g. ChatGPT)
- Unit Testing framework (of choice)
- IDE (of choice)

Project Description

This assignment focuses on deriving an algorithm's test cases using a unit testing framework.

Directions

You are asked to develop test cases using a unit testing framework of your choice, with feedback from a generative AI tool.

Task 1

You are expected to download or write code to implement **Heapsort algorithm**. You can use Java, C++, Python, or Javascript language to implement the code.

Task 2

You are expected to:

- research and identify a unit testing framework to test your code created in Task 1.
- research and use a generative AI tool to create unit-level test cases using a unit-testing framework.
- Identify and report the prompts used to generate the test cases when interacting with the generative AI tool and the results generated by the AI tool.

Task 3

You are asked to execute the test cases generated in Task 2 in an IDE of your preference and report on the output of the test cases with evidence (i.e. screenshots) showing the test execution and test results.

Task 4

You are asked to assess the validity of the test cases executed and further improve the test cases by updating them. The test cases developed by the AI tool may not be sufficient to test the code written. Based on the coverage and performance of the test cases, describe how you can update them and further improve them.

Task 5

You are expected to assess the generative AI tool as per your experience in using it in this assignment. You are asked to assess the effectiveness of the generative AI tool in creating test cases using the **unit-level testing framework**. Your assessment should explain your experience with the AI tool and discuss its performance in terms of how well they generate the unit-level test cases.

Submission Directions for Project Deliverables

You are given an unlimited number of attempts to submit your best work. The number of attempts is given to anticipate any submission errors you may have in regards to properly submitting your best work within the deadline (e.g., accidentally submitting the wrong paper). It is not meant for you to receive multiple rounds of feedback and then one (1) final submission. Only your most recent submission will be assessed.

You must submit your Software Unit Testing Framework Project deliverable in its submission space in the course. Learners may not email or use other means to submit any assignment or project for review, including feedback, and grading.

The Software Unit Testing Framework Project includes one (1) deliverable:

- **Report:** Submit your PDF report to the submission space in this course. Title your file as "yourlastname_firstname_CSE 565_UnitTestingProject".

Your report must contain:

1. **Development of an algorithm -** The report should include a screenshot of the code developed
2. **Explanation of the unit testing framework and prompt generation -** The report should describe the unit testing framework and the generative AI tool identified. It should include screenshots of the prompts tried and used for creating unit-level testing of the code.
3. **Explanation of the test cases by AI tool -** The report should describe the test cases created by the generative AI tool, and should have the result generated by the AI tool with screenshots of the results.
4. **Report out of test case execution** - The report should describe the results of the test execution of the test cases on a selected IDE. It should include screenshots showing the execution results.
5. **Assessment and further improvement of test cases -** The report should include an assessment of the validity of the test cases and a discussion of how they can be further improved. It should include screenshots of new test cases developed by the student and results showing the execution of the updated test cases.
6. **An assessment of the generative AI tool -** The report should describe the student's experience in using the AI tool in this project and should include an assessment of the AI tool's performance in terms of how well they generate the unit-level test cases using the given unit test framework.

Submission Guidelines

You may submit your deliverables as many times as needed. However, only the most recent submission will be graded.

You must submit your assignment file in the designated submission space. Learners may **not** email or use other means to submit any project for review, including feedback, and grading.

Evaluation

Your assignment will be evaluated based on the criteria (**worth 100 points total**):

1. **Development of an algorithm (5 points)**
2. **Explanation of the unit testing framework and prompt generation (10 points)**
3. **Explanation of the test cases generated by the AI tool (20 points)**
4. **Report out of test case execution (20 points)**
5. **Assessment and further improvement of test cases (25 points)**
6. **An assessment of the generative AI tool (20 points)**