Abstract

Software systems of recent years contain multifold functions to facilitate various services. Consequently, testing these software systems becomes more difficult due to complexities in their function. Hence there is a significant increase in the cost of testing as many test items are required. Among the types of testing, system testing is the most expensive and complex type as it involves configuring multiple complete integrated systems to closely emulate customer needs. System testing involves validating whether the system fulfill with its specified requirements. Also to minimize the cost of system testing, software testers tend to prioritize their test cases. Test case prioritization techniques organize the test cases in a test suite, allowing for an increase in the effectiveness of testing with some performance goal. To increase the effectiveness of testing, five different techniques are proposed in this research to prioritize the test cases.

The objective of this research is two fold, namely, to propose test case prioritization techniques for new and regression testing, with different goals and to propose corresponding validation metrics, to measure the effectiveness of the proposed techniques. The proposed prioritization techniques prioritize the test cases based on the requirements and coverage information, with the goals: i) to improve the rate of fault detection, ii) to improve customer satisfaction, iii) to improve the requirement coverage, and iv) to minimize the time and cost of testing.

In this research, to propose requirement based prioritization techniques, test factors that influence the requirements are identified by conducting postmortem analysis. Values are assigned to these factor values in a 10 point scale. With these factor values requirement weights are computed. Finally test
case weights are computed by mapping the test cases to their corresponding requirements. Tool support is provided for the proposed schemes with the Test Bed requirement (TBreq) tool. TBreq provides end-to-end traceability between requirements, test cases, and defects. To prioritize the test cases based on the coverage information, Genetic algorithm is used. In this proposed technique the coverage information are obtained using the tool EMMA (an open source tool).

To validate the effectiveness of the proposed prioritization techniques, three different metrics are proposed. The proposed metrics measure i) the rate of severe fault detection, ii) the average percentage of test cases executed to detect the induced faults and iii) the average requirement coverage. The proposed prioritized test cases are executed and the faults are identified. The identified faults are classified into 5 levels of severity and the rate of severe fault detection is measured. To measure the average percentage of test case execution, known faults are induced and the prioritized test cases are executed to detect these induced faults. Requirement weights are computed to measure the average requirement coverage.

The effectiveness of the proposed prioritization techniques and metrics are experimented with student projects, industrial projects and industrial case studies. The results indicate that the proposed prioritization techniques improve the rate of fault detection when compared with a random approach and other existing approaches such as statement coverage, additional statement coverage and block coverage. Finally the effectiveness of the proposed prioritization techniques are compared based on the average percentage of test cases executed to detect the induced faults.