



RESEARCH ARTICLE

Analysis of Test Case Prioritization Techniques

Manisha Sahni¹, Isha Sharma², Jasleen Kaur³

¹Department of CSE, Kurukshetra University, India

²Department of CSE, Kurukshetra University, India

³Department of CSE, Kurukshetra University, India

¹manishasahni06@gmail.com; ²ishasharma211@gmail.com; ³jkaur.1987@gmail.com

Abstract -The main aim of software industry is to provide high quality software to users. For this, it is essential to test software. Software testing involves a no of issues like test case generation, prioritization of test cases etc. The paper reviews various test case prioritization techniques. Test case prioritization techniques help to organize the test cases. This will help to reduce overall effort, cost and time. In this research paper we are reviewing research work of various authors and their different approaches to prioritize the test cases.

Keywords -Regression Testing; Test Case Prioritization; Average Percentage of Faults Detected (APFD); Model Based Testing; Test Cases

I. INTRODUCTION

In today's world, software industries are focusing on to make the development process more innovative while minimizing the cost and time of development process. Also a no. of existing software is modified to meet end user's requirements. Software maintenance is one of the main phases of SDLC (Software Development Life Cycle) and it is based on regression testing. To retest a software component regression testing is performed. Regression testing [4] is a process that verifies the functionalities that work in the previous version of the software are working in the new version or not. It is very difficult to retest every component if changes occur in the program. This may leads to wastage of time, effort and cost. There are various techniques are available to reduce the cost of regression testing.

These techniques are [6]:-

- 1) Selection of test cases
- 2) Minimization of test suites
- 3) Test case Prioritization

Test case prioritization refers to ordering of test cases. Priorities are assigned to test cases and test case which has the highest priority will be run earlier than other test cases. By using this approach we can detect faults earlier. Priorities are assigned according to some rule.

The main goal of test case prioritization is to improve

- 1) Resource utilization
- 2) Quality of product
- 3) Efficiency of regression testing
- 4) Fault detection rate
- 5) For reducing cost and time

II. MODEL BASED TESTING

In model based testing, [8] test cases are generated from different models. Model based testing provides efficient test cases and test suites. In this technique, testing process can be ongoing in the early phase of software development life cycle. Software models can be classified into two types: (a) Structural models describe various units of a class and also describe static relationship among those units. (b) Behavioral models describe dynamic relationship among various units of class.

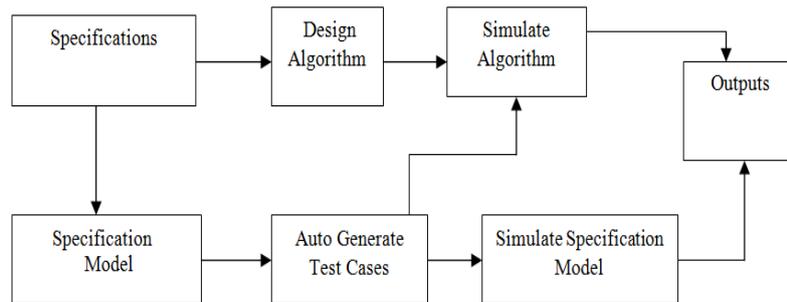


Fig. 1 Model based testing

III. TEST CASE PRIORITIZATION TECHNIQUES

Various techniques can be used to prioritize test cases [10]. These are: - Genetic Algorithm, dependency structure, Fault Exposing Potential, statement coverage etc.

Code based test case prioritization involves various techniques. But this technique has a big disadvantage i.e. it is very costly due to execution of the real code. To overcome this disadvantage system level test case prioritization technique is used. This technique is also known as Prioritization of Requirements for Test (PORT) [3]. To prioritize test cases PORT technique uses four factors: - (a) fault proneness of requirements (b) priorities assigned by customers (c) requirements volatility (d) complexity of implementation.

Genetic algorithm [14] is a type of evolutionary algorithm that helps to evolve complex structures. The general structure of genetic algorithm is:-

- Select an initial population
- Calculate fitness value of each individual
- Apply various genetic algorithm operators (selection, mutation, crossover and terminating conditions)

Dependency structure [1] is another one of the test case prioritization techniques. If one test case executes before other test case then there exist some dependency between them. Dependency structure is classified into two types:-

- 1) Open dependency structure
- 2) Close dependency structure

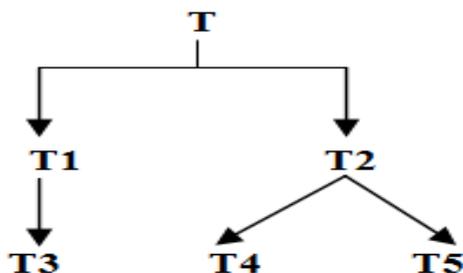


Fig. 2 Dependency Structure

Fault exposing potential [11, 13] involves mutation analysis. The ability of faults which are exposed by a test case depends on probability of faults that will cause failures for that test case as well as ability of a test case to execute those faulty statements. FEP prioritization technique may be more costly because of mutation analysis expense.

IV. REGRESSION TESTING TECHNIQUES

As per literature review, there are four techniques are available for regression testing. These techniques are [2, 9]:-

- Retest all
- Regression Test Selection
- Test Suite Reduction
- Test Case Prioritization

A. Retest all

In this method, the test cases which are no longer applied to customized version of program are rejected and the rest are applied to test the customized version.

This technique may be quite expensive because test cases are used to test the program again.

B. Regression test selection

This technique is better than Retest all technique because in this technique our main focus is on modified program, for testing test cases are selected from subset of test cases.

C. Test suite Reduction

When we add new functionality to the program some test cases become duplicate. To remove duplicate test cases this technique is used. The main advantage of this technique is that it manages test suites and reduces cost of validation. But a big disadvantage of this technique is that it might reduce the capability of fault detection with the test suite size.

D. Test case Prioritization

In this technique, a priority is assigned to each test case according to some principle. Test case which has highest priority is executed first.

V. REGRESSION TEST SELECTION (RTS) TECHNIQUES

The techniques [5] for RTS are:-

- Design model based technique
- Firewall based techniques
- Specification based techniques
- Program model based techniques

A. Design Model Based Techniques

Design model based technique is based on analysis of UML models. This technique is used for model driven environment. The main idea which is used in this technique is that traceability exists among source code, test cases and design models. This technique is more efficient for systems with large test suites.

B. Firewall Based Techniques

In this technique, we basically examine the dependencies among various modules of a program. This technique is computationally efficient than other techniques.

C. Specification Based Techniques

In specification based technique we analyze the specifications of models. We assume that there exists inclusive traceability from requirements to the test cases. This main advantage of this technique is that techniques are platform independent.

D. Program Model Based Techniques

Program model based technique is based on analysis of dependencies among various units of class. This technique is more expensive than other techniques.

VI. AVERAGE PERCENTAGE OF FAULTS DETECTED (APFD)

APFD [12] is the metric to analyze the effectiveness of prioritization techniques. To analyze the fault detection rate of test suite we use this metric. In this metric we consider the weighted average of no. of faults contained in the program. APFD uses the following notations:-

$$APFD = 1 - \frac{TF_1 + TF_2 + \dots + TF_m}{nm} + \frac{1}{2n}$$

- Where T --> Test Suite
- m --> number of faults detected during the execution of test suite
- n- -> total no of test cases
- TF_i --> position of the initial test in test suite T that detects fault i

This formula shows that we can calculate APFD only when we have prior knowledge of faults contained in the program.

VII. CONCLUSIONS

In this paper, our aim is to study the research on regression testing and test case prioritization techniques. We can work on sophisticated and improved algorithms to get more efficient results. The new algorithm is based on these research techniques but with new innovative idea so that we can reduce the effort, cost and time of development process.

ACKNOWLEDGEMENT

I would like to express my gratitude to Ms. Isha Sharma and Ms. Jasleen Kaur, faculty members of Computer Science & Engineering Department of GNI, Mullana for their guidance and help in completing this work successfully.

REFERENCES

- [1] Shifa-e-Zehra Haidry and Tim Miller, “Using Dependency Structures For Prioritization Of Functional Test Suites,” IEEE Transaction on software Engineering ,vol. 39,no. 2, Feb 2013.
- [2] Shin Yoo and Mark Harman, “Regression Testing Minimization Selection And Prioritization: A Survey,” WC2R 2LS, UK.
- [3] Hema Srikanth, Laurie Williams, Jason Osborne, “System Test Case Prioritization Of New And Regression Test Cases” NC 27695, Raleigh.

- [4] Xuan Lin, “*Regression Testing in Research And Practice*” 1-402-472-4058, Lincoln.
- [5] Swarnendu Biswas And Rajib Mall, “*Regression Test Selection Techniques: A Survey*” Informatica 35, 2011.
- [6] Prateeva Mahali and Arup Abhinna Acharya, “*Model Based Test Case Prioritization Using UML Activity Diagram And Evolutionary Algorithm*” IJCSI vol. 3, Issue 2, 2013.
- [7] Xiaobo Han, Hongwei Zeng and Honghao gao, “*A Heuristic Model Based Test Prioritization Method For Regression Testing*” International Symposium on Computer, Consumer and Contro, 2012.
- [8] Quart-ul-an-farooq, Mohammad Zohaib Z. Iqbal, Zafar I Malik and Matthias Riebish, “*A Model Based Regression Testing Approach For Evolving Software Systems With Flexible Tool Support*”.
- [9] Siripong Roongruangsuwan and Jirapun Daengdej, “*Test Case Prioritization Techniques*” JATIT & LLS.
- [10] Gregg Rothermel, Roland H. Untch and Mary Jean Harrold, “*Prioritizing Test Cases For Regression Testing*” IEEE vol. 27 no.10, 2001.
- [11] Sebastian Elbaum, Alexy G Malishevsky, Gregg Rothermel, “*Prioritizing Test Cases For Regression Testing*” International Symposium of Software Testing and Analysis, 102-112, August 2000.
- [12] Praveen Ranjan Srivastava, “*Test Case Prioritization*” Journal of Theoretical and Applied Information Technology.
- [13] Gurinder Singh and Dinesh Gupta, “*Regression Based Test Case Selection: An Empirical Study*” International Journal for Science and Emerging Technologies with Latest Trends.
- [14] Chayanika Sharma, Sangeeta Sabharwal, Ritu Sibal, “*A Survey on Software Testing Techniques using Genetic Algorithm*” IJCSI International Journal of Computer Science Issues, Vol. 10, Issue 1, No 1, January 2013.