International Journal of Engineering & Technology, 7 (4.39) (2018) 177-180

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Prioritization Regression Testing Techniques: a Review

Nitin Sondhi[1], Vimal Singh[2]

[1,2]G L Bajaj Institute of Technology & Management, Greater Noida
**Corresponding author E-mail: nitin.sondhi@gmail.com*

Abstract

Regression Testing is very important method that is being performed once the software is live and afterward comes for some changes. It is a testing techniques that ensures that the previously developed software still works as expected after performing changes in it. Whenever any change is being performed in the software, regression testing is being performed to make sure that previously working module works fine even after the change is being made. Complete Regression Testing is practically impossible. So one alternative is to minimize the regression test cases. In the paper various regression testing techniques has been compared and then the conclusion has been drawn about which one is better based on the problem at hand.

Keywords: *Regression Testing, Regression Test Selection, Test Case Prioritizing*

1. Introduction

Any software when undergo some changes the immediate step afterward is to perform Regression Test. The objective of Regression Testing (RT) is to make sure that the previously working module works fine as per user requirement even after performing a change in the software. In any software with version A, suppose a change is being performed and after performing a change suppose we come up with version B. Now for testing version B we write some new test cases. Now these new test cases along with older test cases are run and tested. Basic advantage of Regression Testing is that it makes the build stable and the core functionalities are working as per clients expectations. With regression testing testers can only concentrate on new functionalities which in-turn increase the productivity of the tester. Regression Testing makes software Testing process automated. Regression Testing ensures delivery of quality software.

Regression testing [1] is a paramount and imperative activity conducted on modified software assuring that the modifications do not have adverse influence on working of software and perform as likely and also that the unaffected part of the software do not adversely exaggerated by the updations. Number of Regression Selection (RTS) techniques has been proposed by researchers. For example, RTS techniques [2],[3],[4] selects small portion of all the test cases available that are more important and then these test cases are again run on the modified software to lessen the regression test cost. Test case prioritization [5],[6],[7] aims at arranging the test cases in a way such that the test cases that are to be executed in a particular order aims at enhancing their usefulness for meeting some performance objective.

2. Related Work

RT is a testing method which is very expensive and is performed post delivery of the software that is it is performed whenever any change is being made in the software. In order to save time and cost one needs to prioritize test cases based on some criteria. Several techniques have been proposed by researchers for prioritization of regression testing.

An algorithms proposed by Bryce and Colbourl [8] concentrate on regenerating prioritize test cases. Initially the value that is associated with each value of each factor is associated with set of weights and then test suit is prepared accordingly which is based on these weights. One method is based on prioritization reorder existing CIT test suite and then reuse the concrete test cases and artifacts from previous version.

D. Marijan etal. [9], Proposed a technique called ROCKET which is implemented by a tool. This method depends on historic failure data as well as testing time constraints. This method is based on historical fault data, so it requires memory also. In this method priority is decided using a weighted function.

Some prioritization method does not require memory as historical test cases are not used for comparison where as in some cases historical test cases are required. Historical test cases plays a key role while detecting faults [10].

An empirical study is being performed by X. Qu et al which focuses on three subjects. At the first step focus is on regeneration and then two way and three way CIT is applied for the purpose of doing pure prioritization. Then perform comparison to determine the effectiveness of the method used . Secondly one can examine many multiple ways by which prioritization can be controlled and lastly use condition coverage method before release to weight interactions. The result of the research showed that three way prioritization is more efficient than two way prioritization[7, 11]. But when there is a lack of code coverage information, two way is the best choice.

RT efficiency can be improved by using RT methodologies. The primary focus of RT technique is to select the test cases, prioritize the test cases, retest all test cases and so on [12]. Whenever any software system is updated, the test suite will contain the test cases which are the original test cases and the modified test cases. RT prioritization separates the modified test suite and the optimal test cases [13].

Genetic Algorithm is another method for prioritizing test cases which uses an exact mathematical value for for test case prioritization. Genetic algorithm performs two operation Crossover and Mutation [15]. Individualize test cases are created then mutation and cross over is performed on it to select a new population and this process repeat it self until a termination condition is made. Genetic algorithms helps to achieve global optimal solution. A comparison is being made between meta heuristic genetic algorithms with other algorithms by N. Sharma et al [16]. His research work shows the efficiency of genetic algorithm over the other algorithms.

Researcher proposed a number of test case prioritization algorithms Example. meta heuristic search and greedy algorithms. A greedy algorithm is simple but it provides less efficient solution when it comes to test case prioritization because it gives local optimum solution. Using greedy algorithms maximum weight can be selected using criteria such as branch coverage, function coverage, statement coverage and fault coverage. Meta heuristic search technique such as hill climbing and Genetic Algorithms are more efficient method when it comes to test case prioritization as they are based on global optimum.

Combinatorial interaction testing is a black box testing technique for constructing an effective interaction test suite and also identify faults. The faults so obtained are the results from interaction among parameters. Then one needs to find test case order using prioritization techniques. Random Prioritization is simple but it is not effective. So one can go for more efficient test case prioritization techniques known as adoptive random prioritizatioin. R. Huang et al investigated ARP stategy which is an improvement over RP strategy. The best part of ARP is that it prioritize test case without the need of sourse code related information. Performance vise ARP is better than RP and also it saves test case prioritization time.

Prioritizatiion could be code based or module based [17]. In code based prioritization techniques, test cases are prioritized on the basis of lines of code covered by the software system where as in model based prioritization system models are used. Model based technique is very helpful in detecting early faults from the software and it is also an inexpensive method and is sensitive to correct or incorrect information retrieve from testers or developers [17].

In this paper an analysis is done for some of the existing test case prioritization methods related to requirements, coverage and model based.

3. Techniques for Prioritization:

Prioritization techniques are broadly classified into three types and they are requirement based technique ,coverage based technique and model based technique. In this research paper a survey is being conducted on various prioritization techniques. Fig 1 shows various prioritization techniques. Requirement based prioritization concentrates to prioritize test cases based on clients requirements. Coverage based prioritization attempts to prioritize test cases based on condition coverage, statement coverage and fault coverage. The details of various prioritization techniques are given in the following subsection.

3.1 Requirement Based Test Case Prioritization:

Quality of the software can be adjudge on the basis of the fact that weather it meets user requirement or not. A quality software always meet clients requirements.

On the basis of requirement, test cases are prioritized based on user's or client's requirement. In this method test cases are retrieved and are saved, based on some changes made on the requirement of software system. After retrieving the test cases, the job of the tester to find out the effect of the changes of requirements on the test cases stored in a database. Test cases are ranked based on the frequency of requirement change and accordingly test plan is prepared [18]. Prioritizing test cases based on requirements depends on following factors-

a) Client assigned the priority for each of the requirements. The highest priority test cases are those with high requirements priority assigned by the clients.

b) Frequency of requirement change- the more frequently there is a change in the requirements, the higher is its priority.

c) Complexity in implementing requirements- the complex requirements have higher priority.

d) The requirement with more fault proneness is given higher priority [18].

e) In [18] AHP is used to rank test cases steps performed are as follows

1) Document storage related to software testing- storing documents involves – indexing test cases and finding its weight. Index can be created by using set of words to represent documents and weight of the index can be used to find out index values.

2) Retrieval of test case : Testers write the test cases and they fire the query to access only those test cases which are affected by the change in requirement of software system. Then a comparison is made between the indexes of each test case from a query and test case stored in a database.

3) Test Case Ranking – Using AHP process one can determine the ranking of each test case, the steps are find out the test cases that are affected by the change in the requirement, rank the test cases, compare the test cases as per their importance, and then find out the weight of each test case and analyses the result of change in requirements.

4) Proposed Method Evaluation- In [19] concept of genetic algorithm is used to give requirement based system for test case prioritization. The aim is to detect the fault during the early phase of Software Development Life Cycle to improve the quality of the software. They suggested six factors based on which one can prioritize the test case and they are priority of the customer, complexity of implementation of proposed software system, completeness and requirement changes, effect of fault and tractability. In [19] two application are used. This method is more effective in finding severe faults and also less number of test case are required to check and detect injected faults.

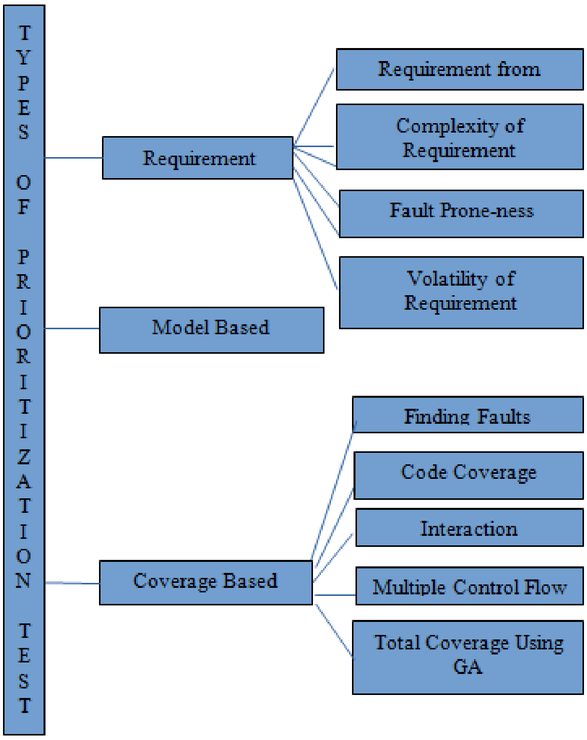

Fig 1: Regression Testing Prioritizing Techniques

3.2 Model Based Test Case Prioritization:

Model Based Test Case Prioritization uses systems model to prioritize the test cases. System model first of all finds out how a system behaves and then based on behavior of the system prioritize the test cases. Model Based Test Case Prioritization is cheaper as compared to code based prioritization and also it is executed much faster than code based prioritization. Accuracy of Model Based Test Case Prioritization depends upon the information given by developer or tester. In [20] an experimental study is conducted to evaluate code based and model based test prioritization. Both the methods are more effective if the fault is detected earlier. Code based prioritization is based on statement coverage in this work, it is called as heuristic one. Model Based Test Case Prioritization is called heuristic two. In model based prioritization change to code is made on the basis of model elements defind by the developers that are related to these changes . In [21] it is proved by experiment that Model Based Test Case Prioritization is more effective in early fault detection as compared to code based prioritization as it execute faster.

In [22], Harish and Naresh introduces a test case prioritization technique which is based on module coupling effect. In this paper a couping method is the parameter based on which priority of the test case is being decided. If modules are strongly coupled with one other then they have higher priority over test cases as compared to the module that are weakly coupled. In their research work they have performed case study of software with ten modules.

Sanjupta et al. [23] advised a new approach which priorotize the test cases for Component Based Software System (CBSS). Here UML diagram is used to clarify the changes in the software. Then Component Interaction Graph (CIG) is used to implement it. CIG demonstrate the interrelations between different components. CIG serves as an input to prioritization algorithms. This algorithms maximize the objective function and minimize regeneration testing cost.

Various types of test case prioritization have been reviewed in this research paper. Test case prioritization are categorize as requirement based , coverage based and model based. Model Based algorithms are faster than other prioritization algorithms. Selection of any test case prioritization algorithms depends upon cost, earlier fault detection and priority criteria

3.3 Coverage Based Test Case Prioritization-

Coverage Based Test Case Prioritization aims at finding the subset of test cases from the available test cases. The criteria for the selection of test case is based on coverage which could be branch coverage, statement coverage, fault coverage and interaction coverage etc. The test cases that covers the more lines of code is given higher priority than the ones that covers less lines of code.

In [24] a new test case prioritization techniques known as Fault Aware Test Case Prioritization (FATCP) has been proposed that concentrates on coverage and historical fault information by introducing fault localization method. The test cases with high coverage has higher priority. This method also helps in debugging as it can easily isolate the fault location. FATCP concentrate on fault localization and coverage based test case but this method is quite expensive. The cost can be reduce by using some automation tools.

4. Conclusion and Future Work

Test case prioritizing aims at simplifying the regression testing process by selecting only a small portion of test cases based on some criteria. It also aims at early detection of faults so that reliability of software can be increased and in-turn produce a quality software.. The test cases are arranged in such a manner such that the cases that covers critical bugs are addressed first then the one that covers the major bugs and so on. In this research paper three type of test case prioritization technique have discussed viz requirement, coverage and model based.

Many test case prioritizing techniques have been proposed by different authors, some of the techniques are based on Genetic Algorithm while others are based on multi objective swarn optimization. All the techniques discussed basically complement each other. The type of regression test selection techniques depend upon the users requirements. The techniques which is based on users requirement is known requirement based technique. One can also choose model based on code based test cases. In code based technique code coverage is used as the major to prioritize test cases. Code coverage , statement coverage, branch coverage etc. In future one may be include lots of criteria in code coverage which could be code coverage based on distributed databases and the ways using which one can extract test cases from distributed databases and also structured them.

References

[1] Presitha Aarthi M, Nandini V (2015), A Survey On Test Case Selection and Prioritization ,´ in Proceedings of International Journal of Advanced Research in Computer Science and Software Engineering, Volume 5, Issue 1, January .2015.

[2] Orso, N. Shi, and M. J. Harrold, 3Scaling regression testing to large software systems,´ in Proceedings of the International Symposium on Foundations of Software Engineering, Nov.2004.

[3] X. Ren, F. Shah, F. Tip, B. G. Ryder, and O. Chesley, 3Chianti: A tool for change impact analysis of Java programs,´ in Proceedings of the International Conference on Object- Oriented Programming Systems, Languages, and Applications, Oct. 2004, pp. 432±448.

[4] S. Elbaum, A. Malishevsky, and G. Rothermel, 3Prioritizing test cases for regression testing,´ in Proceedings of the International Symposium on Software Testing and Analysis, Aug. 2000, pp. 102±112.

[5] A. Srivastava and J. Thiagarajan, 3 Effectively prioritizing tests in development environment,´in Proceedings of the International Symposium on Software Testing and Analysis, Jul. 2002, pp. 97±106.

[6] W. E. Wong, J. R. Horgan, S. London, and H. Agrawal, 3A study of effective regression testing in practice,´ in Proceedings of the International Symposium on Software Reliability Engineering, Nov. 1997, pp. 230±238.

[7] Xiao Q.,Cohen M.(2013), A Study in Prioritization for Higher Strength Combinatorial Testing, 2013 IEEE Sixth International Conference on Software Testing, Verification and Validation Workshops.

[8] Bryce R. and Colbourn C.(2006), "Prioritized interaction testing for pair-wise coverage with seeding and constraints," Journal of Information and Software Technology, vol. 48, no. 10, pp.960–970, 2006.

[9] Xiaofang Z. Changhai B. ,Xu Q.(2007), Test Case Prioritization based On Varying Testing Requirement Priorities and Test Case Costs, Seventh Inernational Conference on Quality Software (QSIC 2007) 0-7695-3035- 4/07 $25.00 © 2007 IEEE.

[10] Fazlalizadeh Y., Khalilian A., Abdollahi Azgomi M. and Parsa S.(2009), Prioritizing Test Cases for Resource Constraint Environments Using Historical Test Case Performance Data, 978-1-4244-4520-2/09/$25.00 ©2009 IEEE.

[11] Suri B, Nayyar P.(2011), COVERAGE BASED TEST SUITE AUGMENTATION TECHNIQUES-A SURVEY, International Journal of Advances in Engineering & Technology, May 2011.

[12] Dima Suleiman, Marwah Alian, Amjad Hudaib. A survey on prioritization regression testingtest case, 8th International Conference on Information Technology (ICIT), 2017.

[13] Dobuneh M., Jawawi D., Malakooti M.(2013), Web Application Regression Testing: A Session Based Test Case Prioritization Approach, ISBN: 978-0-9891305-1-6 ©2013 SDIWC.

[14] Elanthiraiyan N.,Arumugam C.(2014),"Parallelized ACO Algorithm for Regression Testing Prioritization in Hadoop Framework",Advanced Communication Control and Computing Technologies (ICACCCT), 2014 International Conference. IEEE.

[15] Sharma N., Sujata, N. Purohit (2014),Test Case Prioritization Techniques An Empirical Study", High Performance Computing and Applications (ICHPCA), 2014 International Conference, IEEE.

[16] Sharma N., Sujata, N. Purohit (2014),Test Case Prioritization Techniques An Empirical Study", High Performance Computing and Applications (ICHPCA), 2014 International Conference, IEEE.

[17] Mohanty S., Acharya A.,Mohapatra D.(2011), A MODEL BASED PRIORITIZATION TECHNIQUE FOR COMPONENT, 978-1-4244-8679-3/11 ©2011 IEEE.

[18] Klindee P. ,Prompoon K. , Test Cases Prioritization for Software Regression Testing Using Analytic Hierarchy Process, 2015 12th International Joint Conference on Computer Science and Software Engineering (JCSSE).

[19] Uma R.(2012), Factors Oriented Test Case Prioritization Technique in Regression Testing using Genetic Algorithm, EUROPEAN JOURNAL OF SCIENTIFIC RESEARCH · APRIL 2012.

[20] Korel B., Koutsogiannakis G.(2009), "Experimental Comparsion of Code Based and Model model Based Test prioritization," IEEE 2009.

[21] Sun F.(2014), Regression Testing Prioritization Based on Model Checking for Safety-Crucial Embedded Systems, 2014 .

[22] Kumar H., Chauhan N.(2015) "A Coupling Effect Based Test Case Prioritization Technique",2015.

[23] Mohanty S., Acharya A.,Mohapatra D.(2011), A MODEL BASED PRIORITIZATION TECHNIQUE FOR COMPONENT, 978-1-4244-8679-3/11 ©2011 IEEE.

[24] Kim S., Baik J.(2010), An Effective Fault Aware Test Case Prioritization by Incorporating a Fault Localization Technique, ESEM'10, September 16–17, 2010, Bolzano-Bozen, Italy. Copyright 2010 ACM 978-1-4503-0039-01/10/0910.00. $