

Chapter 7

Test Suite Minimization in Regression Testing Using Hybrid Approach of ACO and GA

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ABSTRACT

This article describes about the application of search-based techniques in regression testing and compares the performance of various search-based techniques for software testing. Test cases tend to increase exponentially as the software is modified. It is essential to remove redundant test cases from the existing test suite. Regression testing is very costly and must be performed in restricted ways to ensure the validity of the existing software. There exist different methods to improve the quality of test cases in terms of the number of faults covered, opposed to the number of statements covered in a minimum time. Different methods exist for this purpose, such as minimization, test case selection, and test case prioritization. In this article, search-based methods are applied to improve the quality of the test suite in order to select a minimum set of test cases which covers all the statements in a minimum time. The whole approach is named search based regression testing. In this paper, the performance of different metaheuristics for test suite minimization problem is also compared with a hybrid approach of ant colony optimization algorithm and genetic algorithm.

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INTRODUCTION

Software engineering tasks are laborious and time consuming. Among all software engineering tasks, software-testing accounts for almost 50% of the total cost (Myers, 1979). Automation of software testing tasks could significantly reduce the time and cost of development of software (Miller & Spooner, 1976). Automating software engineering tasks has always been the area of research among research communities (Korel, 1990). Software engineering and testing tasks often requires satisfying conflicting objectives. This requires optimization of certain software engineering tasks to satisfy conflicting objectives. Many of the software testing problems requires solutions with conflicting objectives such as what is the minimum set of test data which achieves maximum coverage criteria?

Search based software engineering is a term coined by Harman & Jones (2001) and is concerned to reformulate the software engineering problems as an optimization problem. Considering the broader aspect of search based software engineering (SBSE), many applications, models have been proposed still enhancement of quality of test cases, and measuring the efficiency of test cases is yet to achieve the best results. Test suite optimization is required in various software applications including cloud computing and smart cities application. It saves various computing resources and gives the optimized solution. The principal reason of such scope of results is due to the presence of different set of constraints during the output phase for different software applications.

Evolutionary methods as mentioned earlier could be a major motivation due to its heuristic properties of search towards different test cases. To find the quality test cases among several test cases, the test data archived from nature-inspired metaheuristic algorithms provides a good approach towards problem solving. This research also figures out conventional evolutionary testing like genetic algorithm but major emphasis has been given to develop meta heuristic and heuristic based search algorithms primarily to be a random search so that without having knowledge of evolutionary method, the process can be applied. Among all software engineering tasks, testing is the most studied topic (McMinn, 2004). Search based software testing is concerned to find the solution of testing problem using search based techniques (Harman & McMinn, 2010).

Regression testing is performed in maintenance phase (Rothermel & Harrold, 1996). Among all regression-testing problem, test suite minimization is widely studied topic. Test suite minimization is NP hard, therefore no deterministic algorithm exists that give exact solution. Test suite minimization has been reformulated as minimum set cover problem that too is NP complete. Therefore, metaheuristic algorithms are natural choice to solve these problems. In the maintenance phase too, software testing is done in order to gain the confidence in the software.

Regression testing is a domain of maintenance phase of the software development life cycle. If any modifications are done during the maintenance phase, then the entire software has to be tested to ensure the validity of the modified software. The most time-consuming approach to ensure the validity of the modified software is to run all the test cases in the test suites again and again. This method of testing is known as retest all in the literature. New software development paradigms such as agile methods, extreme programming also poses lot of restriction for the regression testing. Regression testing must be done using the limited resources of computing and time. A number of different approaches are discussed in regression testing literature. This falls mainly in three techniques such as test suite minimization, test case selection and test case prioritization. Test suite minimization identifies the redundant set of test cases and eliminates them in organized way. Test suite selection deals with problem of selecting the subset of the test cases in order to achieve higher statements or branch coverage which results in higher

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