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Partial PSABC Based Test Case Prioritization Using Regression Testing In Agile Software

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***Abstract*—** The key component for assessing the software performance is how well it performs. Testing is broadly used in industry for quality assurance. Test case prioritization organizes the test cases in a test suite by ordering in such a manner that the most critical test cases are executed first thereby increasing the effectiveness of testing. Optimization techniques have been effectively used in test case generation and prioritization. In this paper a hybrid model called Partial Particle Swarm Artificial Bee Colony algorithm (Partial PSABC) has been proposed. The Partial PSABC algorithm is a combination of Particle Swarm Optimization (PSO) and Artificial Bee Colony (ABC) Algorithm. The main objective is to find the areas with highest coverage and highest usage, so that failures could be identified at an earlier stage.

Keywords- *Partial PSABC algorithm, Test cases, Statement coverage and Fault coverage, Optimization, Prioritization*

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I. INTRODUCTION

Software development methodology is a division software development work into phases containing activities with intent of better planning and management. Common methodology includes: Waterfall, prototyping, iterative and various agile methodology. Agile software development methodology is an alternative to traditional project management, used in software development. Agile software development methodology helps team to respond to unpredictability through incremental and iterative work. This software development methodology is an alternative to waterfall model. Agile software development focuses on keeping code simple, testing often and delivering functional bits of application as soon as they are ready. The goals for agile software development are: build upon small client –approved parts as project progresses and it is opposed to delivering one large application at the end of the project.

Software testing is a process of analyzing a software to detect the difference between required conditions, and to evaluate the features of the software. It is a time consuming and costly task it uses approximately 50% of the software system development resources [1]. It can also be defined as the process of verifying and evaluating it to make sure that software meets the technical and business requirements [2].

Test case is set of conditions under which a tester will determine whether an application, software system or one of its features is working as it was originally established for it to do. Regression testing is a method of re-running the test cases from the test suites to assure error-free and modified software. It is a type of software testing, that seeks to uncover new software bugs, or regression in functional and non-functional areas of a system after changes such as enhancements or configuration changes have been made to them. The purpose of doing regression testing is to ensure that changes have not introduced any new faults and determine whether a change in one part of software affects other part of software.

Testing techniques include black box (functional) and white box (structural) testing. Functional testing is based on functional requirements whereas structural testing is done on code itself. Gray box testing is a hybrid of white box testing and black box testing.

The main purpose of testing can be quality assurance, reliability estimation, validation or verification. The other objectives or software testing includes. [4]

☐ Better the testing works the more efficiently software can be tested.

☐ Better the software can be controlled more the testing can be automated and optimized.

System Testing encompasses a large number of test cases, which may not be able to get executed due to constrained time, budget and limitation of the resources. Therefore, the test cases must be prioritized in some order so that the critical and most required functionality can be tested early. Test case prioritization techniques organize the test cases in a test suite by ordering in such a manner so that the most critical test cases are executed first, therefore increasing the effectiveness of testing. Prioritization of test cases is generally performed to reduce the cost of regression testing. Prioritization of test cases is

done, so that those which are more important, by some measure, are made to run earlier in the testing phase.

One of the essential and critical tasks in software engineering process is downsizing the effort of software testing and reduce the cost & time of development as well. A number of optimization techniques had been proposed and good results has been obtained, problems such as complexity in dynamic data sets, and higher time consumption for convergence exists in the traditional optimization techniques. Optimization techniques have been effectively used in test case generation and prioritization in recent years. Thus, there is a scope of improvement for the improvement of optimization results. This research work focuses on using the appropriate optimization techniques, for test case prioritization which provides the optimal results.

This approach uses swarm intelligence based techniques for test case optimization using test case prioritization. Swarm intelligence is a known approach to problem solving which extracts inspiration from nature biological systems. A number of swarm intelligence approaches have been observed to produce significant results. This research uses a couple of recent swarm intelligence approach called as the) and Artificial Bee Colony (ABC) Algorithm, Particle Swarm Optimization Algorithm (PSO) and Particle Swarm Artificial Bee Colony Algorithm(PSABC) for Test Case Optimization [5].

Artificial Bee Colony (ABC) Algorithm:

Artificial Bee Colony Algorithm (ABC) is nature-inspired metaheuristic. ABC technique is easy to implement, has fewer control parameters, and could easily be modify and hybridized with other metaheuristic techniques. In ABC algorithm, the quality of the solution is denoted by the nectar amount of the source and the solution of the optimization problem is denoted by the position of a food source. In the initial step of ABC, the locations for the food source are generated randomly. In the solution space, each solution is a vector on the scale of its optimization parameters.

Particle Swarm Optimization Algorithm (PSO):

Particle swarm optimization (PSO) is a computational method that optimizes a problem by iteratively trying to improve a candidate solution with regard to a given measure of quality. PSO commonly known as metaheuristics as they make few or no assumptions about the problem being optimized. Metaheuristics such as PSO do not guarantee an optimal solution. PSO does not require for the optimization problem to be differentiable as is required by classic optimization methods. PSO can also be used on optimization problems that are partially irregular, noisy, change over time, etc.

Particle Swarm Artificial Bee Colony (PSABC) Algorithm:

In this approach, a combined model of PSO algorithm and ABC algorithm is used for optimizing the Test Cases. In this methodology each test case symbolize a food source of the bees and the objective of this method is to find a best food source that refers to the test cases with maximum coverage. The food source position of the bees corresponds to a potential solution of the optimization problem and the nectar amount match to the fitness of the associated solution.

II. RELATED WORK

Ant Colony Optimization (ACO) is a technique based on the real life behaviour of ants. This approach clearly explains the nature of ACO in identifying the possible paths and chooses the optimal solution from those paths. Results show that ACO leads to solutions that are in close proximity with optimal solutions. In [3] presented a paper on the implementation of an already introduced Ant Colony Optimization Algorithm for Test Case Selection and Prioritization.ACO is a probabilistic technique useful in problems that deal with finding better paths through graphs. In Non Deterministic polynomial time- hard (NP-hard) problems, high-quality solutions are required at a faster rate, but ACO focuses only on quality of solutions.

Bee Colony Optimization (BCO) has been applied to solve "Travelling Salesman Problem" which is a NP-Hard combinatorial problem where an optimal path is to be searched from source to destination. Arvinder Kaur et al [10] presented the Bee Colony Optimization (BCO) algorithm for the fault coverage of a regression test suite. The BCO algorithm is designed to attain maximum fault coverage in minimal units of execution time of each test case.

The **Artificial Bee Colony (ABC)** algorithm is an optimization algorithm used to find an optimal solution to the problem in [3].

The main drawbacks of ABC are:

☐ Slow convergence rate.

☐ As the random number is stochastic in basic ABC, certain good solutions are predictable to be skipped.

Particle Swarm Optimization (PSO) is more appropriate to process static, simple optimization problems [9]. In PSO, it is hard to adapt to non-metric problem domains.

Particle Swarm Artificial Bee Colony (PSABC) is easy to implement. Highly applicable, even in complex functions, or with continuous, discrete or mixed variables.

Due to the drawbacks of the above said optimization algorithms, an optimization algorithm which provides less complexity, best convergence rate, higher accuracy is required to solve the test case prioritization problem.

III. PROPOSED WORK

The proposed model Partial PSABC is based on PSABC algorithm. In the proposed methodology each test case would symbolize a food source of the bees. In this approach, the program on which test cases has to be applied are split into small modules and then test cases are simultaneously applied on these modules. The objective of this method is to find best food source that refers to the test cases with maximum coverage with minimum time taken. And, hence cost coverage is minimized.

PSO- ABC Hybrid Algorithm (PSABC):

ABC runs until its stopping condition reaches to the maximum number of iterations. The end value of the iteration is considered

to be an optimal value of the individuals. The optimal values of individuals produced by the ABC algorithm are given to the PSO algorithm as an input . By this the PSO algorithm is initialized its position. In PSABC, ABC and PSO both work with same population. In this algorithm the population is randomly generated at first. Then, in each cycle, after the fitness of all bees in same population is calculated, the employed bees are mark and we enhance them by PSO. By performing PSO solution on the employed bee, we increase the search ability.

The following is the detailed algorithm:

1. Initialize the test case performed by the search bee in the algorithm.
2. Evaluate the test cases.
3. Initialize the current traversal path, set cycle=1
4. Repeat the cycle
5. Generate the initial population and select the half part of bees as employed with PSO
6. For the initialized population ,evaluate the fitness value.
7. Calculate the new test cases for each employee bee and
8. by applying greedy process, find the fitness value for
9. that new solution.
10. Probability value for the new solution is calculated.
11. Above two processes is repeated for the onlooker bee,
12. then replace it with the obtained new solution, which
13. will be randomly produced and it is stored.
14. 11. Add the test case to the optimal repository.
15. 12. In the next iteration scouts generate the new test data.

IV. SYSTEM ARCHITECTURE

System architecture for Partial PSABC based Test Case prioritization is shown in Figure-1. Figure-1 explains the basic idea of attaining a minimized (optimized) test suite which would help to reduce the number of test cases in testing and thus result in the reduced time and cost in testing efforts.

The basic steps of prioritization involves starting the test case prioritization technique . Test Case Generation (TCG) is the process of automatically generating a collection of test-cases which are applied to a system under test.The test suite is generated which is a complete set of all possible test cases. The test suite thus generated and reduced should satisfy the testing requirement criteria as defined by the tester. Some of the test cases in the generated test suite may be redundant with respect to the testing criteria. Those test cases will be analyzed and removed when applying reduction techniques. After test cases are generated , Partial PSABC is applied so as to optimize them. Now through test case reduction technique it is tested whether the test cases are reduced or not . The redundant test cases will be analyzed and removed by applying reduction techniques. The iteration is continued till optimized result is generated or maximum value for iteration (maximum no. of the cycle) is completed. When reduced set of test cases are generated, best prioritization technique is applied, so that those which are more important, by some measure, run earlier in the testing phase.

V. RESULT

The experiment is implemented in MATLAB. This section compares the performance of the proposed Partial PSABC approach with the other optimization approaches such as ABC, PSO and PSABC, in terms of statement coverage cost.

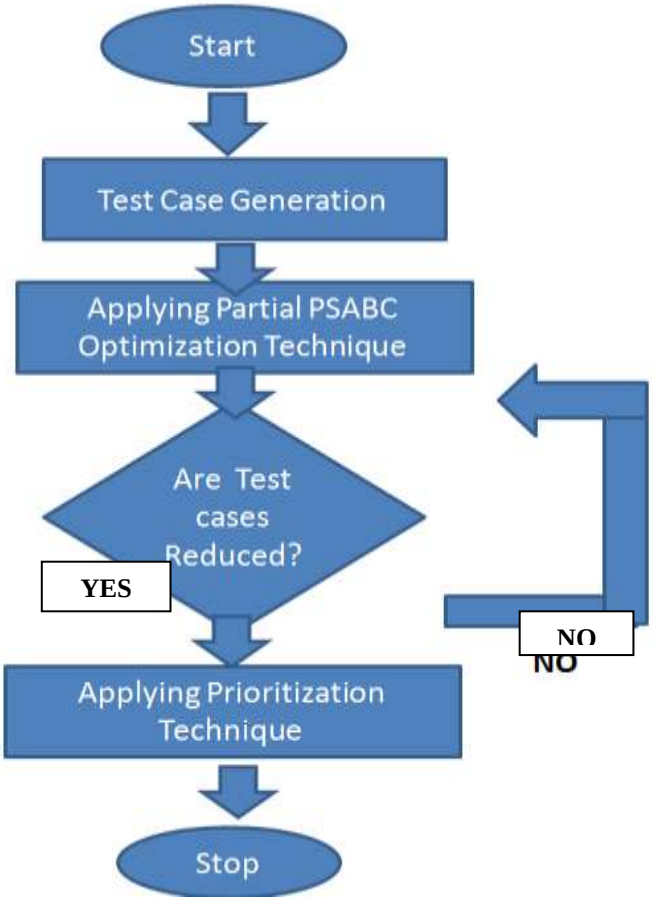

Figure 1: Basic steps to attain Test Case Prioritization

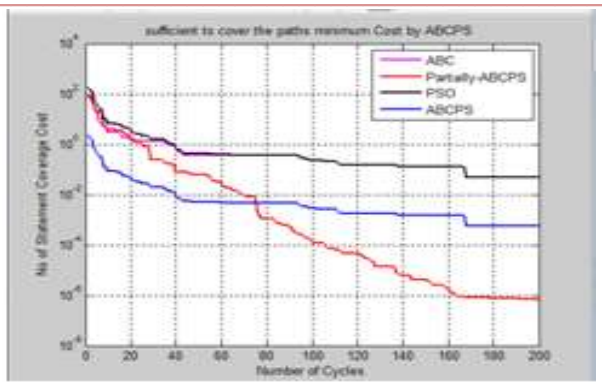

Figure 2:No. of Cycles Vs Statement Coverage Cost

The test case prioritization technique's basic evaluation is to have maximum number of faults covered and statement covered with minimum time taken and statement coverage cost with minimum number of test cases required.

VI. CONCLUSION

Effectual generation of test cases and prioritization of test cases has to be addressed in the field of Software Testing. Factors like

effort, time and cost of the testing are factors influencing these as well. A number of research work have been proposed in the literature for test case prioritization. The main aim for prioritization of test cases is to minimize the cost and time of regression testing. The objectives considered in this research work are statement coverage, fault coverage and statement coverage cost within a minimum execution time. This research work aims in attaining test case prioritization results using Partial PSABC. It is observed from the experimental results that the proposed Partial PSABC based test case prioritization based approach provides better results when compared with ABC, PSO and PSABC.

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