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A Comparative Analysis of Genetic Algorithms and Random Search Algorithm for the Prioritization of Test Cases

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Abstract: ***In this paper, a comparative analysis of the performance of the Genetic Algorithm (GA) and Random Search algorithm is presented. The Random method take tests from dataset and creates random permutations of a fixed length. And in genetic algorithm, the first step is to make sure that all the tests in the chromosome are unique and genetic algorithm iterates through generations, using tournament selection, mutation and crossover. The aim of the research to order tests from a pre-defined dataset in an optimal order, maximizing the Average Percentage of Faults Detected by each batch of tests.***
Keywords: Dataset, Genetic algorithms, Random search

I. INTRODUCTION

Several newer bugs get introduced into the software, while fixing one bug. To solve this problem regression testing is required. Re-execution of the test cases is required if there is any change or modification in the software, to check the functionality. But due to the lack of resources, it becomes a tedious task to re-execute all the test cases within the development period. So, it is necessary to prioritize the test cases to maintain the quality of regression testing. Test case prioritization lead to the cost-effective regression testing within limited time and resources. There are many algorithms to prioritize the test case. So, a comparative analysis of the performance of the Genetic Algorithm (GA) and Random Search algorithm is presented. Every time a random algorithm starts with a complete blank sheet. Whereas a genetic algorithm has a history, so it does not start with a blank sheet, except at the very beginning of the algorithm. In random search algorithm, a new random solution is generated in each iteration, with no memory of what happened earlier /before during the previous iterations. While in genetic algorithm, from each generation the best population is selected, mutated in some way, and advanced to the next generation. The least good members of the population are dropped in genetics. Genetic algorithms build on previous success, so it is faster than random algorithm [8].

A. Gentic Algorithm

Genetic Algorithm GAs are based on the principle of natural selection and population genetics. Although they are a class of algorithms based on this common principle, there are variations among these algorithms in terms of their implementation and application.

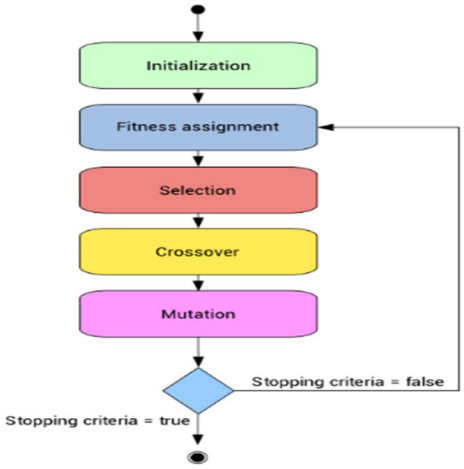

Fig.1 Genetic algorithm process

In a GA, a set or population of solutions is considered for the specific problem, and these solutions are represented in strings of characters. Genetic algorithm used in computing for searching purpose. It is used to find the exact or approximate solutions to optimization and search problems. It is used in the artificial intelligence and computing to find the optimized solution. It is a heuristic search that search the problems based on the theory of natural selection and evolutionary biology [9]. Genetic algorithm is the intelligent algorithm that is used to find the maximum fault detection rate by recording the associated test cases to the fault. Genetic algorithm is excellent for searching the large and complex datasets [6].

B. Random search algorithm

A random algorithm initiates with a completely empty sheet every time. In each Iteration, new random solution is generated. And the random solution is generated in such a way that the random solution has no knowledge of what happened before in the previous iterations [8].

II. RELATED WORK

Ahlam Ansaria et al. studied that optimized test case prioritization technique can reduce cost, effort and time taken to perform the regression testing. Regression testing validate that changes made in the one part of the software was not affecting the other part of the software. It has been concluded that Ant Colony Optimization was the best method to reduce the cost, effort and time taken to perform regression testing and to uncover maximum faults in the software [1]. M. Mohan, Tarun Shrimali introduced new proposed model for the reduction of the test cases and for their prioritization. In this study, Hybrid approach was compared with Basic Greedy approach and this research proved that performance of Hybrid approach was better than Basic Greedy approach for effective test case selection. In this Hybrid approach, only 25% of test cases were eliminated from tied test suite but still there was some tied test cases in the reduction test suite that degraded performance of the testing during the test case prioritization [2]. S. Madhumathi, C.P Indumathi studied that the rerunning of all the test cases during regression testing was very expensive as it required huge time and resources. In this study, the test case prioritization using genetic algorithm and the effectiveness was measured using APFD. The efficiency of the software testing has been improved and the aim was to reduce the cost by reducing the number of test suite after prioritization. MFTS algorithm was used to reduce the given test suite with maximum coverage and it improves the rate of fault detection effectiveness [3]. Jyoti, Kamna Solanki studied that regression testing must be performed when there were some changes in the software and the moto of the regression testing was to focus on retesting of the software. In this empirical study, there was the comparison of five different regression test optimization techniques. And that comparison was based on different qualitative and quantitative criteria. These criteria include type of testing, number of tests selected, execution time of tests, precision, user parameters [4].

Andreea Vescan et al. examined that Regression testing was the testing activity that performed after changes occurred on software. The aim of this study was to increase confidence that achieved software adjustments had no negative impact on the already functional parts of the software. An evolutionary algorithm was used to construct the re-ordering of test cases, considered as optimization objectives fault detection and cost [5].

Esha Khana described that by using the regression testing re-execution of the test cases, validates the changes made in the software. It has been proposed a genetic algorithm-based prioritization technique that intelligently reordered the test cases on basis of maximum fault detection rate. This technique would be helpful to both researchers and practitioners if the testing had to be stopped prematurely due to lack of resources [6].

Harsh Bhasin, Manoj studied that regression testing calls for the execution of all the test cases tested before a change made in the software. The proposed technique prioritizes original test suite by assigning fitness value to each of the test cases and after that applying the Genetic Algorithms so that the new suite will had a superior rate of fault detection when compared to the rates of randomly prioritized test suites. The fitness value that was assigned to the test cases was judged based on coupling. If a module had an undesirable coupling, it was liable to be a source of errors, so the smaller value assign to that test case and vice versa [7].

III. RESEARCH METHODOLOGY

The present research is based on the ongoing research in the field of software testing. The theoretical study has been done from research papers, books and online data. Using theoretical study, we learn functioning of various software testing techniques that how they work, what are their important characteristics and how they are used to prioritize the test cases. Simulation has been done using Spider tool. Spyder is used to write python programs under a packet manager ANACONDA.

IV. RESULT AND DISCUSSION

On different datasets (small dataset and large dataset) the genetic and random search algorithm is compared. The Random method take tests from dataset and creates random permutations of a fixed length. And in genetic algorithm, the first step is to make sure that all the tests in the chromosome are unique and genetic algorithm iterates through generations, using tournament selection, mutation and crossover. All the operations have an associated probability parameter.

The fitness outputs of both random and genetic algorithm are observed in the Fig.2, Fig.3, Fig.4 and Fig. 5.

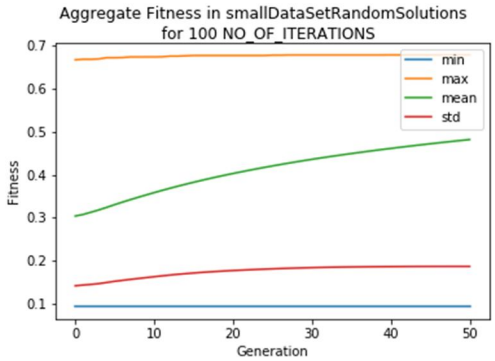

Fig.2 Aggregate fitness in small dataset using Random Search algorithm

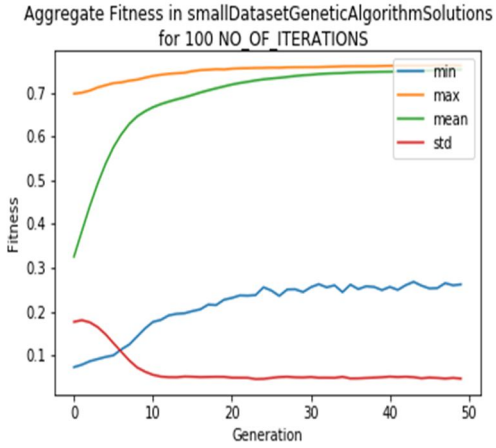

Fig.3 Aggregate fitness in small dataset using Genetic algorithm

In the small data set, genetic algorithm has more reliable value than random, because in genetic algorithm the deviation is falling frequently, where in the random method the deviation is rising. In case of random, min and max value is fixed and in genetic algorithm it is varying. The difference in the performance of random search and genetic algorithm can be explained clearly in the big dataset.

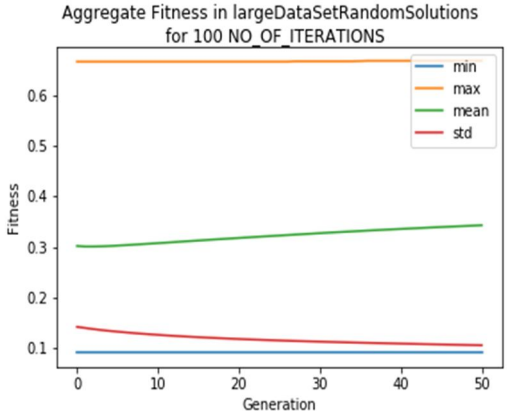

Fig.4 Aggregate fitness in big dataset using Random Search algorithm

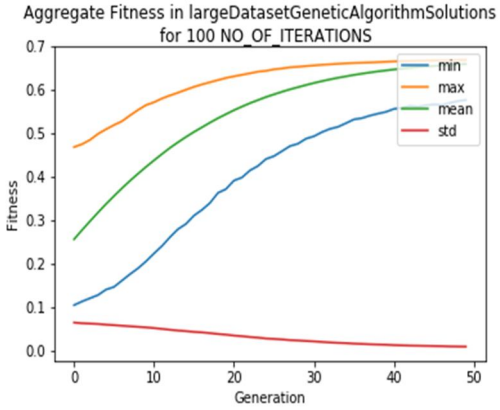

Fig.5 Aggregate fitness in big dataset using Genetic algorithm

In big dataset, the Genetic algorithm has more reliable value than random. Because form fig 4 and fig 5, it is found that mean value is rising in both the cases either random or genetic but in genetic algorithm there is a much higher rise than random method. In genetic algorithm there is fall in the standard deviation as compare to random method. So, genetic algorithm has more reliable value than random.

V. CONCLUSION AND FUTURE SCOPE

From the above result it has been observed that the performance of genetic algorithm is better than the random search algorithm. Every time a random algorithm starts with a empty blank sheet. Whereas a genetic algorithm has a history, so it does not start with a blank sheet, except at the very beginning of the algorithm. In random search algorithm, a new random solution is generated in each iteration, with no memory of what happened before during the previous iterations. While in genetic algorithm, from each generation the best population is selected, mutated in some way, and advanced to the next generation. Genetic algorithms build on previous success, so it is faster than random algorithm.

For future scope the same algorithms can be run on different datasets and another tool can be used instead of Spider to analyse the performance of algorithms. The impact of change in number of iteration in algorithms can also be observed.

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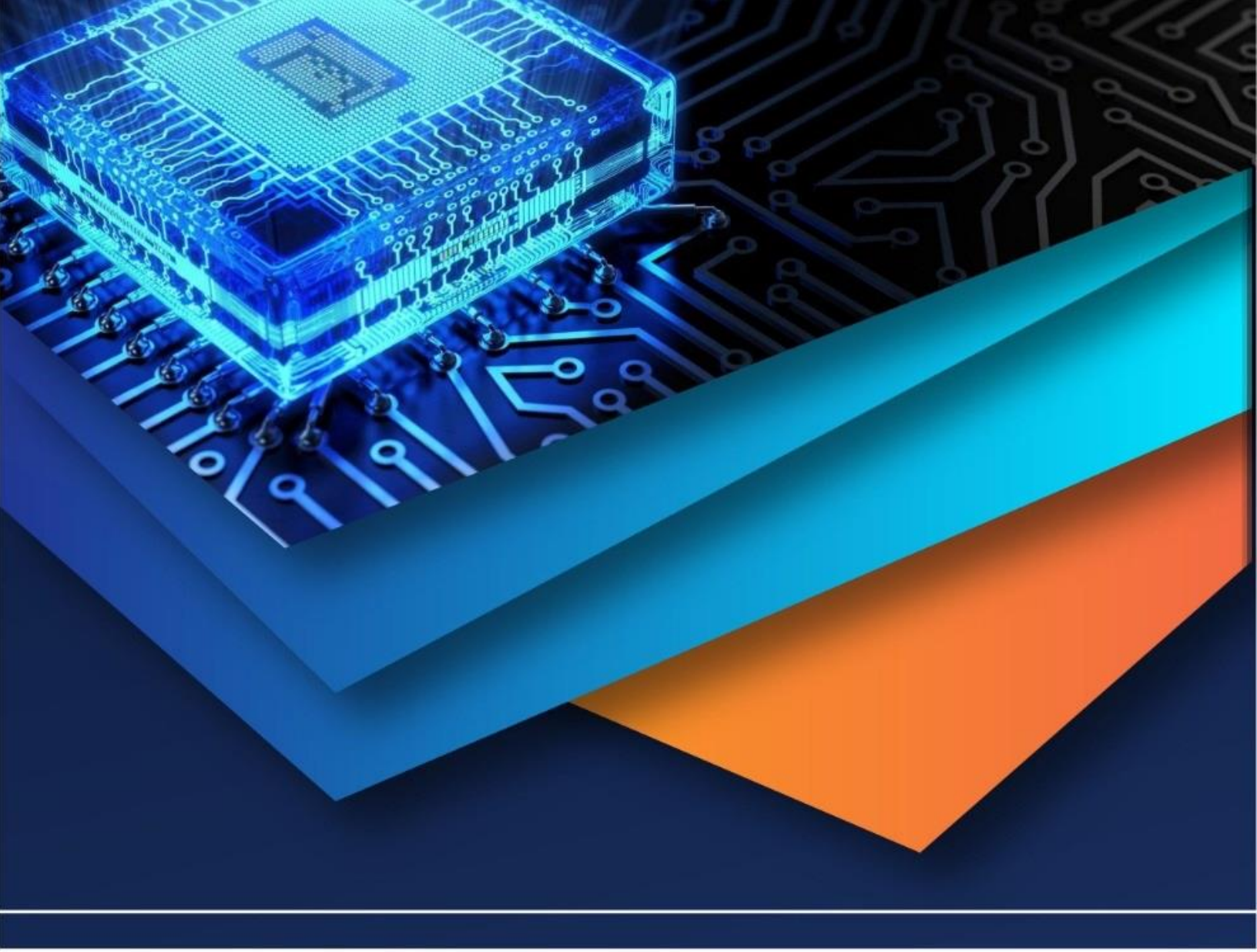

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