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Automated Generation of Independent Paths and Test Suite Optimization Using Artificial Bee Colony

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Abstract

Software test suite optimization is one of the most important problems in software engineering research. This paper deals with Automatic Generation of Feasible Independent Paths and Software Test Suite Optimization using Artificial Bee Colony (ABC) based novel search technique. In this approach, ABC combines both global search methods done by scout bees and local search method done by employed bees and onlooker bees. The parallel behavior of these three bees makes generation of feasible independent paths and software test suite optimization faster. Test Cases are generated using Test Path Sequence Comparison Method as the fitness value objective function. This paper also presents an approach for the automated generation of feasible independent test path based on the priority of all edge coverage criteria. Finally, this paper compares the efficiency of ABC based approach with various approaches.

Keywords: Automatic Test Data Generation; Artificial Bee Colony; Ant Colony Optimization; Fitness Function; Genetic Algorithm

1. Introduction

Software engineering process is to achieve a high quality, high reliable software and always follows a software development life cycle process. One of the major activity in every software development life cycle is the software testing. Software testing process requires much effort with a human interface. So, this paper mainly gives foundation for generating automated testing by the automated generation of independent test paths[1] and test suite optimization. Software testing [2] mainly includes two major

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methods i.e., is black box testing and white box testing. White box testing (or structural testing) is to test thoroughly the internals of the particular program module.

Test data generation is an un-decidable problem and can be non-deterministic (NP-hard) [3, 4] or a solution exists which is not practical. The highly non-linear structure of software presents a challenge to search algorithms for finding optimal and efficient test data from a complex, discontinuous, nonlinear input search space. The basic approach for evaluating input value sets in dynamic structural test data generation methods [5] can be summarized as -- (1) Represent a set of input values as an initial solution, (2) Apply these input values to the code and observe the generated path, and (3) Compare the generated path with the desired path and calculate fitness values.

This paper presents an ABC based search algorithm to generate test data. In this research work, the functionality of the bee is extended to do the testing and monitoring activity so that it reduces the manual work and improves the confidence on the software by testing it with the coverage of the given software.*Bee colony* consists of three types of bees, namely scout bees, which randomly searches for the food sources, onlookerbee decides which food sources to be explored next from the list food sources given by scout bees, and lastly employee bees will search for new food source in neighborhood of exhausted food source[6, 7].Further explanation about bee colony is given in proposed strategy.

This paper includes back ground work in section (II), Proposed strategy for generation of independent test paths and test suite optimization in section (III), Analysis of proposed approach in section (IV), Case study in section(V), Comparison with existing works like ACO, Genetic algorithm and Tabu search in section (VI), Conclusion and future work in section (VII).

2. Background Work

The research on software testing problems has centered mainly on the Independent Path Generation and Software Test Suite Optimization. Many intelligent swarm computing software test techniques are extensively proposed and every algorithm has its own strengths and weaknesses.

The major observations derived as part of the background study are:

- Neural Networks has difficulties in programming and algorithmic complexity and is a black-box data processing structure.
- Tabu search has difficulties in the amount of memory required to avoid stuck up at local optima and short term memory to remember all the test cases in the current search [8].
- Genetic Algorithms has difficulties in giving stable results (stuck up at local optima); the convergence is slow and has non-explicit memorization of best individuals [9].
- Ant Colony Optimization has drawbacks of higher length test sequences and repetition of nodes within the same sequence [1, 2]. In initial stages, it starts searching slowly, lacks pheromone and easily tends to local optimum, has premature convergence when quantity is too high [10, 11].

3. Proposed Strategy

This proposed strategy section mainly contains optimized approach for control flow based testing. This section basically contains two proposed strategies using Artificial Bee Colony algorithm. The first one is feasible independent path generation using ABC and the second one is test suite optimization using ABC.