Fitness Calculation Approach for Nested If-Else Construct in Evolutionary Testing

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ABSTRACT

This poster paper addresses the fitness calculation problem for nested if-else constructs. A new term "optimism level" is incorporated into the fitness function to assess the branch distance of nested branches for a given test data.

Categories and Subject Descriptors

D.2.4 [**Software Engineering**]: Validation

General Terms

Algorithms, Verification

Keywords

Nested If-else Construct, Fitness Function

1. INTRODUCTION

The main idea of Evolutionary Testing is to reformulate the generation of test data as an evolutionary search under the guidance of fitness function. Fitness function is employed to evaluate the worth of a candidate solution with a value indicating how close they are between the candidate solution and the target [1]. In structural testing, previous work [1] has argued a fitness function shown in formula (1), where approximation level(appr level) and branch distance(d) evaluate the candidate test data in the light of the control flow and data flow of the program under test respectively. By minimizing this fitness function to its minimal value 0 during the optimization process, the desired test data can be obtained.

$$f(x) = approximation\ \ level\ +\ 1 - 1.001^{-d} \qquad (1)$$

2. FITNESS CALCULATION PROBLEM AND THE SOLUTION

In the presence of the nested if-else construct, restricted to the existing fitness function, test data cannot be evaluated at the 'inner' branch conditions until the 'outer' branch conditions are satisfied. For example, in Figure 1, if the value of the variable x in the input vector was not equal to 0, the fitness value of the test data will be evaluated at the branch condition numbered 2 directly, leaving the variable y not assessed. Apparently, nested if-else constructs lead to a problem that test data cannot be completely assessed with the existing fitness function, and thus the fitness value cannot essentially reflect the worth of the test data.

```
1.  void nestedIfExp(int x, int y){
2.    if (x == 0)
3.      if (y == 3){
4.        ...  //target }
5.  }
```

Figure 1: An example with nested if-else construct

McMinn et al.[2] addressed a testability transformation approach to solve this problem. This approach, however, only retained the branch distance but abandoned the approximation level in formula (1), resulting in a loss of the evaluation information of the test data on the control flow which should be an essential information of the test data.

Ideally, all nested branches can be evaluated by the fitness function with the approximation level retained. In this paper, a new term "optimism level" is introduced to assess the branch distance of nested branches for a given test data. Formula (2) shows how "optimism level" is calculated. And our new fitness function with the normalized "optimism level" is shown in formula (3).

Definition 1. Optimism Level: *The sum of branch distances of all the uncovered branches on which the target branch control depends in the nested if-else construct.*

$$optimism\ \ level = \sum (branch\ \ distance) \qquad (2)$$

$$f(x) = appr\ \ level + (1 - 1.001^{-d}) + (1 - 1.001^{-optimism\ \ level}) \qquad (3)$$

3. CONCLUSION

With the new incorporated term "optimism level", the fitness function can completely evaluate the test data for programs with nested if-else constructs.

4. REFERENCES

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