Chapter 32
Optimized Test Case Generation for Object Oriented Systems Using Weka Open Source Software

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ABSTRACT

Detection of fault proneness classes helps software testers to generate effective class level test cases. In this article, a novel technique is presented for an optimized test case generation for ant-1.7 open source software. Class level object oriented (OO) metrics are considered as effective means to find fault proneness classes. The open source software ant-1.7 is considered for the evaluation of proposed techniques as a case study. The proposed mathematical model is the first of its kind generated using Weka open source software to select effective OO metrics. Effective and ineffective OO metrics are identified using feature selection techniques for generating test cases to cover fault proneness classes. In this methodology, only effective metrics are considered for assigning weights to test paths. The results indicate that the proposed methodology is effective and efficient as the average fault exposition potential of generated test cases is 90.16% and test cases execution time saving is 45.11%.

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1. INTRODUCTION

According to IEEE glossary definition, software testing is executing any software with an intent to find errors. Every system is prone to hidden faults which causes the system failure, if executed. So, the effective test cases are generated to discover maximum unrevealed faults from the software. For this purpose, the test cases are generated considering the factors which help in revealing maximum faults during software testing. A good number of researchers are working in the area of generating optimized test cases. In their methods, the researchers' select test cases based on specified criteria e.g. execution time, fault exposing potential of test cases.

Test cases play the decisive role in testing of software systems. Today's epoch is the era of generating selected test cases for testing software systems to save time and resources. Software testing is performed to reveal maximum faults by running selected test cases. Further these fault-prone classes are identified using effective object oriented (OO) metrics.

Machine learning techniques are helpful in delivering software systems to the user with maximum accuracy. In this paper, linear regression methods and feature selection techniques such as Boruta, Regsubset, Fselector, e.g., random forest, linear correlation, rank correlation, and information gain) are used for categorizing OO metrics in two categories namely effective and ineffective metrics for finding fault-prone classes.

Waikato environment for knowledge analysis (Weka) developed at university of Waikato, New Zealand is written in Java. It is open source software which contains powerful machine learning techniques for data cleaning, classification, clustering, regression, rules mining for association and visualization of data (Weka, 2018). This tool is used for implementation of proposed methodology because of the following salient features (1) easy to use due to user friendly interface, (2) freely available in public domain, (3) comprising of powerful built-in machine learning algorithms for mathematical modeling, (4) easily applicable to deep learning and big data analysis i.e. supports large volume of data cleaning, (5) easy to build mathematical model.

Weka's main user interfaces are the explorer and component-based knowledge flow interface which also supports command line. Experimenter enables the user to conduct systematic comparison of prophetical performance of machine learning algorithms. The explorer interface features several panels enabling the user to interact easily with the components of workbench. These panels are (i) Preprocess panel that provides facility to import database, coma separated values (CSV) file, etc., and preprocessing filtering algorithms used to transform data, for example, converting numeric attributes into discrete ones, (ii) Classify panel provides classification and regression algorithms, accuracy of resulting predictive mathematical model. (iii) Associate panel enables association rule learners to identify all important interrelationships between attributes in the data. (iv) Cluster panel provides access to clustering techniques of Weka. (v) Select attributes panel provides access to select effective attributes in dataset. (vi) Visualize panel shows visual plots of data to be visualize.

Each of the developed software has to undergo testing before it could be put to use which is important phase of software development life cycle. Test case generation is time consuming and important step in software testing. To reduce the time a good number of researchers are currently working on the optimized test case generation techniques so as to achieve optimizing time, improved efficiency and effectiveness. Further, machine learning can also be used in optimized test case generation by using Weka tool. This gives the motivation to explore the possibilities in this area.