Algorithmic Approach for Test Scenario Generation from UML Composite Structure Diagram

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Testing of object-oriented software requires a lot of effort and cost. Integration testing is an important phase in a software testing process. The unified modelling language (UML) is the widely used language to document object-oriented designs. UML composite structure diagram is an important source of test scenario generation for integration testing. In integration testing, all the individual components are tested by combining them into groups. This paper proposes a method to generate test scenarios from UML composite structure diagram. In our approach, we first draw the UML composite structure diagram using IBM Rational Software Architect (RSA). We export the XML metadata interchange (XMI) in IBM Rational Software Architect. Then, we parse the XMI code and generate the Component Structure Graph (CSG) automatically. Next, we use our approach Top-Down Test Scenario Generation Algorithm (TDTSGA) to generate test scenarios for Top-Down integration approach. We also propose Bottom-Up Test Scenario Generation Algorithm (BUTSGA) to generate test scenarios for Bottom-Up integration approach. The two algorithms have been realized and illustrated by case studies.

Keywords: Composite Structure Diagram, XML Metadata Interchange (XMI), Unit Testing, Integration Testing, Component-Based Software.

1. INTRODUCTION

Unit testing is the first step in software testing process. Unit testing ensures that each component is developed correctly [1]. In software testing, most of the bugs goes unidentified even after unit testing is performed successfully. When the components are integrated, they may not perform as per the requirement, due to badly designed interface. So efficient test scenario need to be generated in order to identify the bugs when two or more components are combined together. Once unit testing is done, integration testing is performed to find errors in component interface when they interact with each other. The Unified Modeling Language (UML) composite structure diagram is a suitable diagram for describing the interactions between system components. UML is a standard language for specifying, visualizing and documenting the software [2]. This language is mainly used with object-oriented software. UML is most widely used in industry for modeling the software artifacts [3]. The UML 2.0 has fourteen diagrams, including composite structure diagram. These diagrams are used to model different software artifacts. The increase in its popularity encourages us to use these models as an important source for test case generation [4].

The components are written in different programming languages, and executes on various platforms [5]. Components interact with each other by passing messages [6]. Component perform correctly when tested individually. But when integrated with new component unexpected result may occur [5]. Testing methodology are categorized into two types: black box and white box. Black box testing is testing the
6. CONCLUSIONS AND FUTURE WORK

In this paper, we discussed a methodology to automatically generate test scenarios from UML composite structure diagram. The proposed methodology is completely model-based and suitable for integration testing. We developed a parser (CSDExtractor) to generate the composite structure graph automatically from input composite structure diagram. We implemented two proposed algorithm, Top-Down Test Scenario Generation Algorithm (TDTSGA) and Bottom-Up Test Scenario generation algorithm (BUTSGA) to generate test scenarios for Top-Down and Bottom-Up Integration. The generated test scenarios are sufficient enough to find the component in which probability of bug presence is maximum. In future, we plan to use coupling measure to detect the fault prone components.

REFERENCES


Figure 8. Test Scenarios generated for Top-Down and Bottom-Up Integration Testing
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