



Survey on Testing of BPEL Processes

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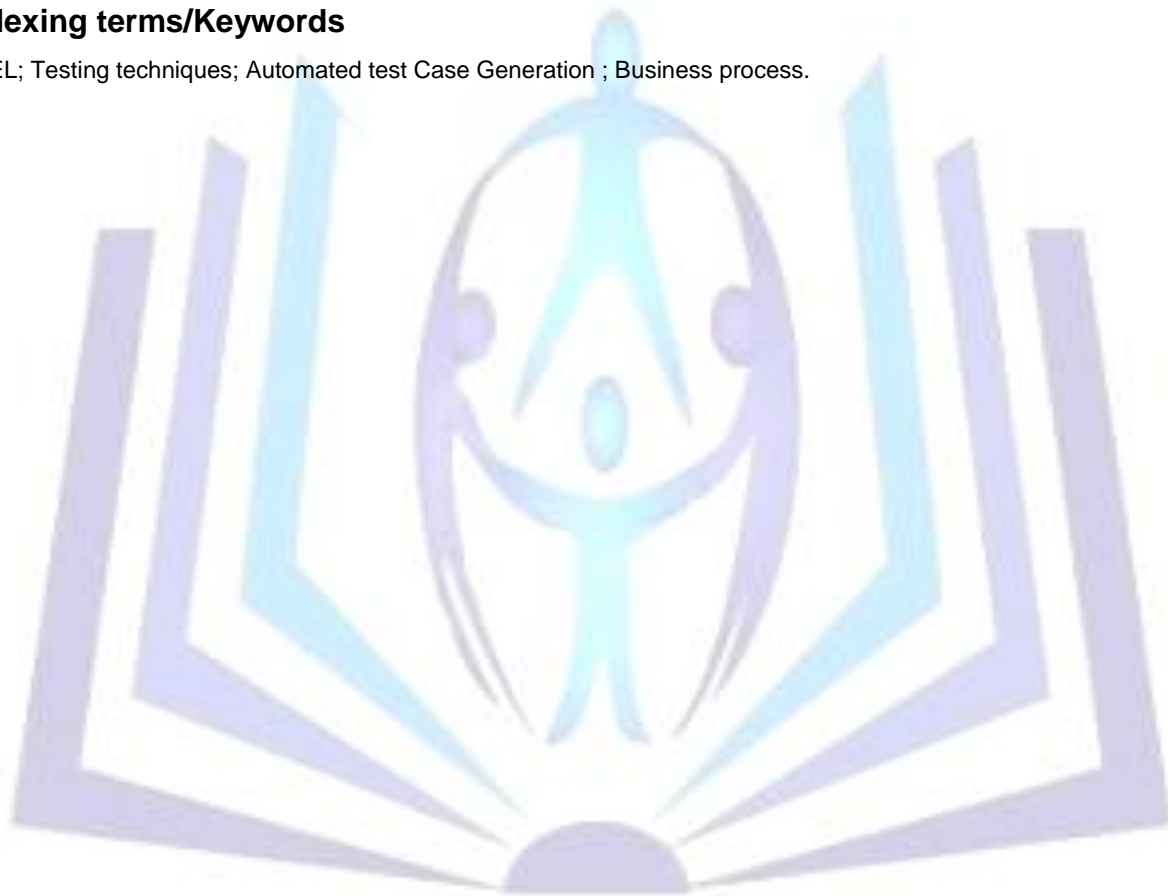
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ABSTRACT

Software testing is very important phase in any development Life Cycle. The test Case generation is critical task in any type of testing. The automation of test case generation is necessary to reduce cost and effort incurred in the testing of large software. Testing of the BPEL processes is new area of research and the automation of the test cases is necessary in order to find bugs in the processes and reduce the cost of the testing business processes. This paper focuses on the survey of the testing techniques used to test the BPEL processes

Indexing terms/Keywords

BPEL; Testing techniques; Automated test Case Generation ; Business process.



Council for Innovative Research

Peer Review Research Publishing System

Journal: INTERNATIONAL JOURNAL OF COMPUTERS AND TECHNOLOGY

Vol. 13, No. 7

editorijctonline@gmail.com

www.ijctonline.com, www.cirworld.com

INTRODUCTION

Software testing is an important task in the development life cycle for the production of efficient and reliable software. On the average of 50% of the total cost of the software is concerned with the software testing process [1]. Software Testing is the process that is intended to find the errors in the program of the software. Test Case Generation is important and critical task in the testing activity. A lot of research has been done in the automation of the test case generation. For the automation of the test case generation search based techniques have been applied. Search Based Software Testing is the field in software engineering in which the search based techniques have been applied to testing problems. Search Based software engineering Techniques intend to use search based metaheuristic techniques for the optimization of the problems that are NP hard or NP Complete. The Service Oriented Architecture is the computing paradigm that is widely adopted for the distributed application development. Its vision is preferably implemented using web services which are built and deployed on the heterogeneous platforms and orchestrated to achieve a particular business goal [2]. There arises a huge interest in the research work related to SOA because of new issues posted by SOA [3]. Since web services are the new paradigm for deploying and developing the business process the composition and the testing of web service composition is new challenge. The enterprise wrap their internal business process as a web service and publish it into the public directory so that new enterprise can combine them to add more value added services. BPEL is the standard for web services composition as standardized by OASIS. Testing the BPEL service composition is the new challenge that attracted the researchers to develop new automated testing techniques in order to reduce the cost and time of the testing the business processes. So the researchers start applying metaheuristic techniques for the automate test case generation and optimization in BPEL processes.

OVERVIEW ON BPEL PROCESSES

BPEL is the process execution language that is used for the web service composition. It is an XML based language and it provides XML semantics for specifying business behavior based on web services. It is defined in terms of its interaction with the partner processes. BPEL is designed to address the composition requirements in the web service environment. BPEL language supports both paradigms as orchestration and choreography. The Executable Processes follow the orchestration paradigm because they specify the exact detail of the interaction between the services. The choreography paradigm is followed by the Abstract business processes as these lack the interaction details. The specification of BPEL includes the composition model and the XML composition language. It has nothing to do with the development and the runtime environment. The services which are intended to be composed by the BPEL process are needed to be invoked. As mentioned above that the BPEL process is defined in terms of its partners, hence partners play important in BPEL processes. Any web service that interacts with the business process is called the partner of that process. The partner can interact with the process in any way i.e. it can invoke the process or invoked by the process. The BPEL process is defined in XML document. The BPEL document consists of two parts: Declarations and Specification. The partner links and the port types are defined in the declaration part. The variables which store the intermediate values and the services are represented by the partner link. Port type define the interaction between the processes. Some of the important concepts in BPEL are:

- Partner Links: it represents the service and provides the communication channel to remote web services. The partner link has a name which is to be used throughout the process. The partner link definition does not specify where to find partner it is assumed that BPEL middleware handles binding the partner links.
- Variables: These store the message data of the web service interaction and control data of the process. The variable must be declared before use with name and type. The type of variable is WSDL message. The variables can be declared global or local.
- Basic activities: These perform the basic functions of the business process. These are receive, invoke, reply, assign, wait.
- Structured Activities: These define the block oriented control flow. It also defines the parallel execution, conditional branching, receipt of the message, links that represent the synchronization between two activities.
- Handlers: These are defined to deal with the exceptional situations. These are used to specify deadlines on the process level. To find the internal fault, the fault handler is used.

The example for the business process is the purchase process as:

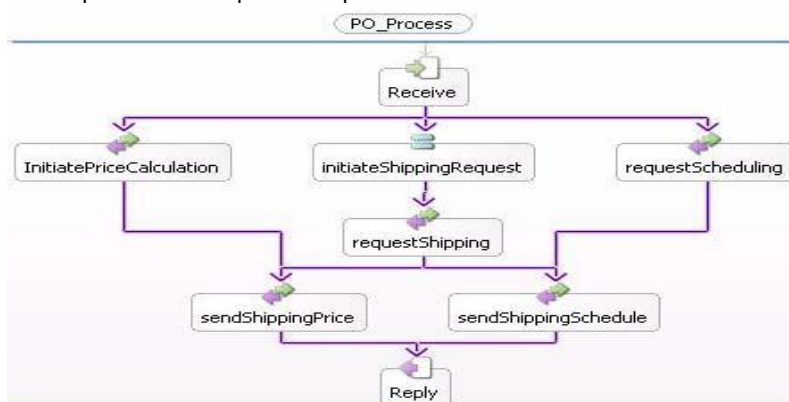


Fig 1: Purchase Process [4]

On receiving the purchase order from the customer, calculating the price, selecting shipper, scheduling the production and shipment of the order processes are initiated concurrently. The purchase process has four partner processes: Customer, pricing, shipping and scheduling. Another example of BPEL process is the Loan approval process

```
<process name="loanapproval" [...]>
  <!-- declarations -->
  <variables>
    <variable name="riskAssessment"
      messageType=
        "asns:riskAssessmentMessage"/>
    [...]
  </variables>
  <partners>
    <partner name="customer" [...]/>
    <partner name="assessor" [...]/>
    <partner name="approver" [...]/>
  </partners>
  <!-- behaviour of the business process -->
  <flow>
    <links>
      <link name="receive-to-assess"/>
      <link name="assess-to-setMessage"/>
      [...]
    </links>
    <receive name="receivel"
      partner="customer" [...]>
      [...]
    </receive>
    <invoke name="invokeAssessor"
      partner="assessor"
      portType="asns:riskAssessmentPT"
      operation="check"
      inputVariable="request"
      outputVariable="riskAssessment">
      <target linkName="receive-to-assess"/>
      <source linkName="assess-to-setMessage"
        transitionCondition=
          "bpws:getVariableData
            ('riskAssessment','risk') ='low'"/>
      <source linkName="assess-to-approval"
        transitionCondition="
          bpws:getVariableData
            ('riskAssessment','risk') !='low'"/>
    </invoke> [...]
  </flow>
</process>
```

Fig 2. Extract from the "loan approval" BPEL specification [5]

TESTING TECHNIQUES

Automated Test Case Generation

Random methods for test case generation are exhaustive, time consuming and unreliable .So the test case generation technique must be automated .Size and complexity are main issues in testing problems. By applying the metaheuristic techniques to the problems these issues can be solved. Many researchers have put forward different techniques for the automation of test case generation in the testing process. They applied the heuristic to provide the solution for the computational problems that are NP Hard and NP Complete. The general idea behind the automated test case generation is that the set of test cases forms the search space and adequacy criterion is coded as fitness function [6].The literature survey on automated test case generation techniques is as:

Miller and Spooner[7]use the numerical maximization as the technique for test case generation .They are attributed to apply the optimization technique for the first time. Xanthakis et al.[8] attributed to apply optimization technique to software engineering for the first time. It used the GA's to generate test data for the structural coverage. Davie et al .[9]developed GA based approach for test case generation for an expert system. The High Level Petri Nets have been utilized by the authors to model BPEL business process and generate test case[21]. Korel[10]proposed an highly effective and efficient AVM(Alternative Variable Method). Tonella [11] proposed a GA based test case Generation technique for unit testing of the classes in Object Oriented Software . Roberiroet al.[12]use GP approach for automated test Case generation for Object Oriented software. Liaskos et al. [18] use the artificial Immune system for path testing of object Oriented Software .Li et al. [14]applied an ACO based approach for automatic test Case generation in the state base software testing. Guo et al.prosed heuristic technique to optimize the fault isolation and identification process in FSM testing. Lefticaru, R. and Ipate, F. apply GA to state diagrams. R. Krishnamoorthi has proposed a new test case prioritization technique using Genetic Algorithm (GA)[15]. Dr. Arvinder Kaur has proposed an approach for regression test suite prioritization based on BCO algorithm[16].

Testing of BPEL processes

In the past years many researchers have proposed frameworks and techniques for testing of the BPEL processes. The framework BPEL4WS unit testing has been proposed[4].this framework is useful for manual testing, tool implementation and test case generation. The authors [18] proposed a graph based approach for BPEL test case generation to deal with BPEL concurrency semantics. In this approach an extension of CFG is defined to represent a BPEL program in graphical model. In [19],a method to test composite web service was proposed which used model checking. A model checker SPIN



had exploited by the authors [20]. In this the transition coverage criterion is used for choosing the test case. The authors in [17] has surveyed the approaches to support test case generation for BPEL processes and the tool is presented for test case generation that is based on the design and implementation of data dependency. The developers define the data dependency using XPath expression.

The authors used Category Partition Method (CPM) to generate test cases on the basis of possible paths [22]. Since many techniques and approaches have been developed or proposed by many authors. But the use of metaheuristic techniques for automated test case generation in BPEL testing has not gained much attention of the researchers.

Automated Test case Generation approach in BPEL processes

The first approach for automatic test case generation based on metaheuristic technique was proposed in [23]. The authors proposed a scatter search based method to generate test case for BPEL processes. In this the adequacy criterion used is transition coverage. Taking similar approach for formal model and generation of the test data but the difference is only in the application of the algorithm the authors [24] proposed a new approach for automatic test case generation [ABC based]. They transform BPEL into static graph according to some rules and use ABC algorithm to work on the state graph. Artificial Bee Colony Optimization is a nature inspired optimization technique which is based on the foraging behaviour of the bees to find the solutions in hand. ABC algorithm mixes local search method carried out by employed bees with global search method managed by onlooker and scouts.

CONCLUSION

Testing of BPEL processes is important and critical issue. To reduce the cost of the business process these must be tested. The test cases are to be generated automatically. For the optimization of the test cases for BPEL processes the application of the metaheuristic techniques to the problem is new challenge. Though we have studied many approaches for the testing of BPEL process still there are open challenges in automatically testing the business processes. In this paper the overview of the BPEL processes and the testing techniques have been given. However some metaheuristic techniques have been applied for test case generation in testing of the BPEL processes, still there are many search based algorithms that can be applied to these processes.

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