A first approach to test case generation for BPEL compositions of web services using Scatter Search

Search-Based Software Testing
April 1, 2009, Denver

Raquel Blanco, José García-Fanjul, Javier Tuya
[rblanco, jgfanjul, tuya]@uniovi.es

This work is supported by the Ministry of Science and Innovation (Spain).
National Program for Research, Development and Innovation.
Projects Test4SOA (TIN2007-67843-C06-01) and RePRIS (TIN2007-30391-E)

Introduction

- **Previous works:**
  - Generation of test cases for BPEL specification using Model Checking [García-Fanjul et al., 2006]
  - Generation of test cases for structural testing using Scatter Search (TCSS-LS) [Blanco et al., 2009]

- **Objective:** Scatter Search based algorithm to automatically generate test cases for BPEL business processes

- **BPEL specification:** behaviour of business processes based on web service compositions
- **Adequacy criterion:** transition coverage
BPEL business processes

- XML documents with two parts:
  - Declarations
    - Services that interact with the business process
  - Specifications of the business process
    - Set of activities
      - sequence
      - while
      - flow
  - Business process
    - can invoke and receive invocations of web services
    - can update the value of the variables

Problem approach

- **Objective**: to generate test cases that allow all transitions of the business process to be covered

- **Input variables**: variables received from the web services
- **Test case**: input variables + transitions of business process
Problem approach

TCSS-LS State Graph

- Objective: all the transitions to have at least one element in their set $S_k$

Search process
Treatment of the unfixed number of values of an input variable

- Web service invocation inside a loop → the input variable can take an unknown number of values
- When a partner needs more values:
  - TCSS-LS searches new diverse values among the solutions of the set $S_k$ of the transition in evaluation
  - The vector of the input variable is increased
- When the business process finishes:
  - TCSS-LS drops the values that have not been used
  - The vector of the input variable is decreased
- Generation of new solutions
  - Solutions to combine have vectors of input variables with different size

Case studies

- **Examples**
  - Loan Approval
  - Shipping Service
- **Comparative**
  - TCSS-LS
  - Random
- **Experiments**
  - Stop conditions: 100% transition coverage or 200000 test cases
  - Input variables:
    - Type: integer
    - Range: 16 bits
Case studies: results

<table>
<thead>
<tr>
<th>Number of Test Cases</th>
<th>Time in Seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loan Approval</td>
<td></td>
</tr>
<tr>
<td>Shipping Service</td>
<td></td>
</tr>
</tbody>
</table>

**Conclusions**

- **Conclusions:**
  - Business process modelled as a state graph
  - TCSS-LS handles a set $S_k$ in each transitions of the graph
  - Subgoals
  - TCSS-LS provides mechanisms to handle the unfixed number of values of the input variables
  - TCSS-LS can be applied to the test case generation of BPEL business processes

- **Future works:**
  - To use other adequacy criteria
  - To handle the concurrent execution of activities
  - the experimentation with real-life specifications
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