Feature Interaction Testing of Variability Intensive Systems

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Contact Profile

• Interests
  • Model-driven engineering, Model-based testing, Testing SPL, Testing Platforms

• Objectives / Looking for
  – Models for Variability Intensive Systems
  – Establish collaborations, Student interns
  – Success Criteria: 1 Collaboration

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Product Line

- ERPs, Internationalized portals, customizable and configurable software systems/platforms
- Systems that are not necessarily developed as product lines, but have variability
The Problem: Testing Internationalised Portals

- Large number of country specific portals
- Hundreds of channels of information
- Varying site and page layouts across portals
- Required to run on all major browsers, operating systems and devices
- Multiple software platforms
- Features changes – weekly
- Millions of visitors
Why is it interesting?

• Feature variations lead to explosion in the number of feature interactions to be tested

• Coverage of variations and feature interactions within schedule and resource constraints

• Huge testing matrix, Inability to identify impacted items

• Large prospective user base within software services industry
Current Solution

• Internationalized Portals as Software Product Lines
• Modelled as Multi-Perspective Feature Models
• Source of Variation as an extension to FM
• Country specific portal derived as product configuration
• Input models derived from set of features to be tested
• Pair-wise coverage on Input model

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Multi-Perspective Feature model (MPFM)

- A MPFM is a set of Feature Trees where each tree represents a different perspective.
- `SourceOfVariation(FeatureA, FeatureD) =>`
  - FeatureA and FeatureD belong to different perspectives
  - AND
  - FeatureD is the cause of variations in FeatureA
  - AND
  - Subfeatures of FeatureD \{S1..Sn\} are variations of FeatureA

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MPFM as an input model for CT

- Input parameters = Features to test
- Parameter values = Feature leaf nodes
- Constraints = SoV, FM constraints, Portal configurations

<table>
<thead>
<tr>
<th>#</th>
<th>Parameter</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Facebook</td>
<td>SignInMode, YourActivity, RecentActivity, Ticker</td>
</tr>
<tr>
<td>2</td>
<td>Architecture</td>
<td>LinkedList, Multi_Slot_Module, VideoModule, ImageModule, 2_column, Single_column, Blogs, Articles, Slide_shows, MoneyTheme, 3_column, AutoTheme</td>
</tr>
<tr>
<td>3</td>
<td>Browser</td>
<td>IE7, IE8, IE9, FF12, FF13, Opera</td>
</tr>
<tr>
<td>4</td>
<td>Operating System</td>
<td>Windows_7_Professional, Windows_8, Linux, Android</td>
</tr>
<tr>
<td>5</td>
<td>Device</td>
<td>Desktop, Laptop, SmartPhone</td>
</tr>
<tr>
<td>6</td>
<td>Portal</td>
<td>US, UAE, UK</td>
</tr>
</tbody>
</table>

Constraints:

\[(\text{Facebook} = \text{"SignInMode"}) \Rightarrow (\text{Architecture} = \text{"3_column"} \; \lor \; \text{Architecture} = \text{"2_column"} \; \lor \; \text{Architecture} = \text{"Single_column"})\]

\[\text{Device} = \text{"SmartPhone"} \Rightarrow (\text{Browser} = \text{"Opera"})\]

\[\text{Configuration} = \text{"UAE"} \Rightarrow (\text{Internationalization} \neq \text{"MM/DD/YYYY"})\]
Experimental results

- Site X: Feature model of over 150 features was created
- 5 Perspectives identified
  - Domain
  - Internationalization
  - Accessibility
  - Operating Environment
  - Architecture
- 6 Features selected for test generation
- Output analyzed against 1 year defect log with the help of test team
- Focus on feature interactions

<table>
<thead>
<tr>
<th></th>
<th>Total defects reported</th>
<th>Reported in live site</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Interaction</td>
</tr>
<tr>
<td>Severity 1</td>
<td>114</td>
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<tr>
<td></td>
<td>616</td>
<td>167</td>
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<td></td>
<td>104</td>
<td>78</td>
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<td>90</td>
<td>73</td>
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<tr>
<td>TOTAL</td>
<td>834</td>
<td>276</td>
</tr>
</tbody>
</table>

- 33.1% of total defects were interaction defects
- 79.2% of production defects were interaction defects
- Tests generated from FM using 2-way coverage could detect escaped defects
- 37% lesser tests as compared to manual approach
Discussion

- Establishing behaviour relevance of features
- Test Models for Variability Intensive Systems
- Reusable Domain Models
  - Internationalization, Operating Environment, Accessibility reusable
- Scalable constraint solving

- Modelling Business Processes variations induced by functionality as well multiple software systems
Potential Collaborations

• Jocelyn Simmonds, Maria Cecilia Bastaricca, Luis Silvestre, Alcides Quispe
  – Variability in Software Process Models

• Klaus Schmid
  – Variability support for Variant Rich Software Ecosystems

• John Klein, John McGregor
  – System-of-Systems Platform Scoping

• …

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Thank you!