Rapid GUI Development on Legacy Systems

-- A Runtime Model-Based Solution

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Lero: The Irish Software Engineering Research Centre
Future City Group, SCSS, Trinity College Dublin
Smart Cities Research in Lero@TCD

- Water management
- Urban traffic control
- City watch
- Community energy management

Dynamic optimization of urban resources
Dependability, trustworthy, privacy...
Data brokerage and simulation
Data Access

Diversity of data-usage based on software

- Monitoring
- Awareness
- Allocation
- Testing
- Adaptation

Plenty of real-time real-world (legacy) data source
MRT for Data Processing

Monitoring  
Awareness  
Allocation  
Testing  
Adaptation

Models @ Runtime as an intermediate data representation
MRT for Data Processing

• Advantage
  ▪ Separation of concerns
  ▪ Self-descriptive: clear meta-models

• Difference
  ▪ Modeling data instances, not types
    o Directly reading and editing
    o Causally connected
  ▪ Abstraction of data, not software
    o Data elements, not software class hierarchy
Metro1:Metronome
state = TIC

Metro2:Metronome
state = TOC

metro1:Group

Existing Frameworks

GridLAB-D
An MRT-Based Rapid Dev. Process

Access model
Domain model
Graph model
SM@RT
GMF
Generation Framework
Runtime Model Engine
Visualization Engine

Rapid development loops
specification
automated generation
automated generation

API
specification
automated generation

target system
API
runtime model
graphical view

Rapid development loops
• Non-Intrusive
• MOF/EMF
• DSL+Code generation
The Framework

Event/API DSL

Event/API description

Meta-model

MOF

Generation Engine

EMF

Runtime Engine

Language

The Framework

Generation

Model users

Runtime operations

System

event invocation

Language

Event/API description

Model users

Event/API DSL

Event/API description

MOF

System

Runtime

Model users

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Event/API description

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System

Runtime

Model users

Language
**Casino Foyer:** Hui Song, Gang Huang, Yihan Wu: SM@RT: Supporting Models at Run-Time (Key Lab of High Confidence Software Technologies, Peking University, China)
SM@RT on GridLAB-D

```java
invocation GetState{
    operation get SimuElement-* {
        feature.EType.name = 'Double'
    }
    invoke returning String {
        val url = new URL("http://localhost:10001/" +
            element.name + "/" + feature.name)
        connection.setRequestMethod("GET");
        val in = ... //get a BufferedReader
        var s : String
        while ((s = in.readLine()) != null)
            if(s.contains('value'))
                return value //skip string parsing
    }
    post (Double d) {current.eSet(feature,d) }
}
```
Result runtime model
Model Visualization via GMF

GMF Dashboard

Derive

Domain Model mindmap.ecore
Select / Edit / Create

Derive

Graphical Def Model mindmap.gmfgraph
Select / Edit / Create

Combine

Mapping Model mindmap.gmfmap
Select / Edit / Create

RCP Transform 'Lite' transform

Domain Gen Model mindmap.genmodel
Select / Edit / Reload

Tooling Def Model mindmap.gmftool
Select / Edit / Create

Diagram Editor Gen Model mindmap.gmfgen
Select / Edit / Create
Generate 'lite' diagram editor
Generate diagram editor

Project: org.eclipse.gmf.examples.mindmap.lite
Progress: 100% done

Models @ Runtime 2012
Model Visualization via GMF

Some snapshots
Final GUI

TRMH2
+13738.1 Wh
+1287 W
+119.531-120.202d V

TRNH2

NH3

TRNH3

NH4

NH3 to NH4

TH3

EV1
WORK
+0.925706 unit

WH1

H1
+73.9206 degF

TRMHI
+6518.12 Wh
+385 W
+119.807-0.108223d V

House

<table>
<thead>
<tr>
<th>Core</th>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Adj heating</td>
<td>0</td>
</tr>
<tr>
<td>A3</td>
<td>Adj heating</td>
<td>-0.0579</td>
</tr>
<tr>
<td>A4</td>
<td>Air change</td>
<td>-0.5</td>
</tr>
<tr>
<td>A4</td>
<td>Air change</td>
<td>-176.547 Btu/h</td>
</tr>
<tr>
<td>A4</td>
<td>Air heat cap</td>
<td>1059.28 Btu/h</td>
</tr>
<tr>
<td>A4</td>
<td>Air heat flow</td>
<td>0 pu</td>
</tr>
<tr>
<td>A4</td>
<td>Air mass</td>
<td>1470 lb</td>
</tr>
<tr>
<td>A4</td>
<td>Air temperature</td>
<td>25.0288 degF</td>
</tr>
<tr>
<td>A4</td>
<td>Air volume</td>
<td>300000 ft^3</td>
</tr>
</tbody>
</table>

Models @ Runtime 2012

hui.song@scss.tcd.ie
## Development process

<table>
<thead>
<tr>
<th>Trunk-version GUI</th>
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<tbody>
<tr>
<td>Scale</td>
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<tr>
<td>Sample</td>
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<tr>
<td>Performance</td>
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<table>
<thead>
<tr>
<th>Development process</th>
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<tbody>
<tr>
<td>Coding</td>
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<tr>
<td>Others</td>
</tr>
<tr>
<td>Vertical versions</td>
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<tr>
<td>Horizontal versions</td>
</tr>
</tbody>
</table>
Conclusion

• Runtime model as an intermediate representation of data
• “World model” at runtime for data rather than software
• Runtime model for (just) visualization
• SM@RT to support such runtime models
Future work

• On GridLAB-D: New usage of runtime model
  ▪ Self-adaptation with end-user preference
  ▪ Runtime-model + constraint-solving + dynamic ranking

• On GUI development
  ▪ Connect runtime model with real GUI frameworks
    ○ Android, SWT... Discussing with Olivier Moises on Wazaabi

• On data processing
  ▪ On real sensor-based data and system logs

• On the multi-views of data
  ▪ jQVT (compiled QVT engine) for live transformation
Thank You

This work was supported, in part, by Science Foundation Ireland grant 03/CE2/I303_1 to Lero—the Irish Software Engineering Research Centre (www.lero.ie)
Debugging

AttributeNotFoundException

Getting Instance of MBean service in JBOSS AS 7.1.1 - Stack Overflow
stackoverflow.com/.../getting-instance-of-mbean-service-in-jb...
3 answers - 12 Jun

AttributeNotFoundException: No such attribute: Instance at com.sun.jmx.mbeanserver.PerlInterface.getAttribute(PerlInterface.java:63) at ...

com.sun.jmx.mbeanserver: public class: Introspector
www.docjar.com › openjdk-7
getReadMethod(clazz, element); } if (readMethod != null) return readMethod.
invoke(complex); throw new AttributeNotFoundException( "Could not find the getter ...
Using summoning snippets for debug

• Target bugs:
  ▪ Illegal use of generic API on specific data
  ▪ Cause: did not know the illegal invoke might happen
  ▪ Find such bugs: enumerate all the possible paths

• Summoning snippet for debugging
  ▪ Comparing the summoning snippets with the data meta-model
Source code evolution

• Scenario: programming from examples/test cases
  ▪ A common programming practice
  ▪ No so “pragmatic” for big code on specific data through generic APIs
  ▪ Provide summoning snippets as an intuitive assistant

• Things to do
  ▪ IDE integration
  ▪ Traceability
  ▪ Refactoring primitives
    ○ Copy, move, merge, split…
```java
try {
    echo("\nINSTANCE: ");
    ObjectName name = new ObjectName("org.exist.management." + instanceStats + ";name=" + instanceStats);
    MBeanServerConnection connection = (MBeanServerConnection) MBeanServerFactory.newMBeanServerConnection(name); 
    memReserved = (Long) connection.getAttribute(name, "Reserved memory");
    memCache = (Long) connection.getAttribute(name, "Cache memory");
    memCollCache = (Long) connection.getAttribute(name, "Collection cache memory");
    ObjectValues attrs = connection.getAttributeNames("MaxBrokers", "AvailableBrokers", "ActiveBrokers");
    ObjectValues cols = (ObjectValues) connection.getAttributeValues(name, cols[]);
    TabularData table = (TabularData) connection.getAttributes(name, cols[]);
    if (table.size() > 0) {
        echo("\nCurrently active threads:");
        for (Iterator i = table.values().iterator(); i.hasNext(); ) {
            CompositeData data = (CompositeData) i.next();
            echo(String.format("%s: %d", data.get("owner"), data.get("data")));
        }
    }
}
```