Beyond Unit Testing

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About Us

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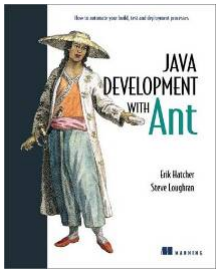
Apache Ant & Axis committer

Co-author of
Java Development with Ant

Behind schedule on the 2nd edition



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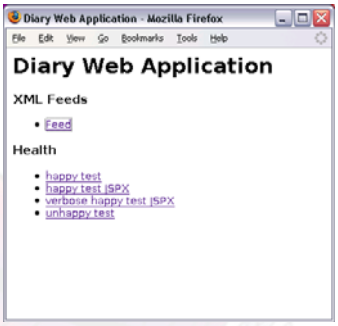
two different distributed systems

CERN Large Hadron Collider



Multi-tier webapp

How do you show it works?

- Europe's high-end server farms
- Years of simulations
- Nobel Prize winners, Computer Scientists and physics PhD students

- An old laptop nobody wants
- Any spare time before you ship
- You

Classic unit tests

- Run in a test harness
- Don’t stress the system
- Don’t run on real servers
- Don't run with real data

A modest proposal

Write less Unit Tests!

Apply Formal Methods!

- Integrating *Formal Methods* with XP development.
- How to use *axiomatic theorem proofs* to verify correctness in a large-scale distributed system.
- How Milner's *π-calculus* is the underpinnings for the BPEL workflow language.
- *Continuations* vs. *bisimilar state machines* -which is better for correctness proofs?
- How relaxing your *concurrency constraints* results in higher throughput.

Or:
System Testing

System Tests

- Deploy the app
- Add a real dataset
- Use the app server
- Remotely test from other sites/hosts
- Test in the client
- Are big, complex and distributed

How to test big systems

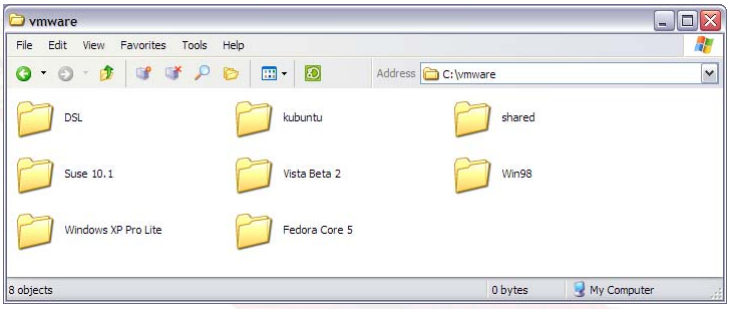
- Simulate the production system.
- Automate deployment
- Write functional tests
- Remote test from clients

Embrace Virtualization

- VMWare player free; workstation for $£€
- Create VM images that resemble production configurations.
- Deploy and test into virtual machines
- Host continuous integration server in VMs
- Simulate complex/broken networks

Download VMware Player

…and become a cluster admin



- PXE System Installers: linuxcoe.sf.net
- Auto-rollback images during test *and* production
- Isolate insecure platforms on virtual network

Simulate the production system
Automate deployment
Write functional tests
Remote test from clients

Automate app deployment

- RPM/APT/.msi packages pushed out to hosts
- *SmartFrog*: http://smartfrog.org/
- *Cargo*: http://cargo.codehaus.org
- Shell Scripts
- Ant build files using scp, ssh

Database setup

- Data setup is too time consuming to do every test
- Use the same DB that production will have.
- Automated set up of the database
- keep this DB snapshot and revert to it after a run. (or the entire virtual machine image)

```
<mysql-admin>
  CREATE DATABASE diary;
  GRANT ALL PRIVILEGES ON diary.*
    TO 'diary'@'localhost';
  SET PASSWORD FOR 'diary'@'localhost' =
    PASSWORD('${mysql.diary.pass}');
</mysql-admin>
```

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What to test?

- system health tests
- In-container unit tests
- Remote web service/HTML tests
- In-browser GUI testing
- Load tests
- Network failure simulations

...

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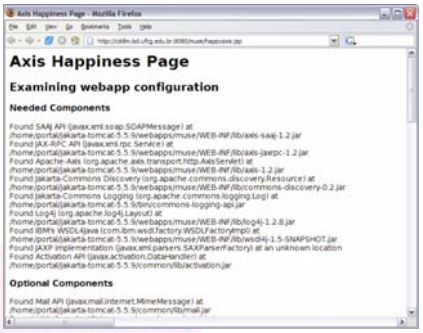
Health Test: “happy pages”

```
<%@ taglib uri="/WEB-INF/diary.tld"
prefix="h" %>
<body>
<ha:happy
 classMustExist="org.jdom.JDOMException"
 errorText="JDom missing"/>
We are happy
</body>
</html>
```



Delegate to machines:

```
<waitfor maxwait="30" maxwaitunit="second"
    timeoutproperty="unhappy">
  <http url="http://server/happyaxis.jsp"/>
</waitfor>
<fail if="unhappy"/>
```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Test in-container with cactus

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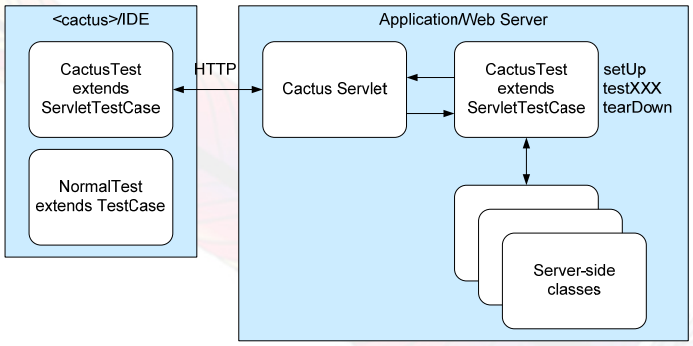

Cactus Test Case

Simulate the production system
Automate deployment
Write functional tests
Remote test from clients

```
public class CactusPersistTest extends ServletTestCase {
    private static int counter = 0;
    private SessionFactory factory;

    public void testPersist() throws Exception {
        Event event = createTestEvent();
        Session session = factory.openSession();
        try {
            session.persist(event);
        } finally {
            session.close();
        }
        assertEventIsInDB(event);
    }
}
```

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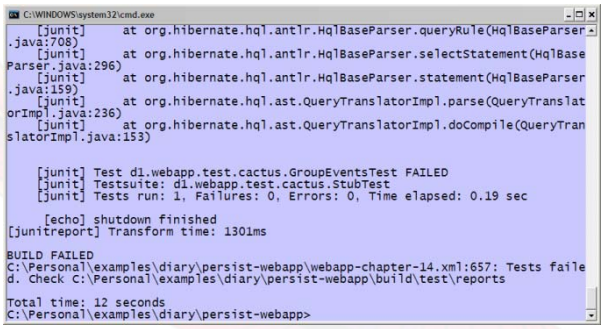
<cactus> task *choreographs*

```
<cactus:cactus warfile="${cactus.war}"
  errorProperty="cactus.failed" failureProperty="cactus.failed">
  <containerset>
    <generic name="server" port="8080">
      <startup>
        <copy file="${cactus.war}" tofile="${cactus.destfile}"
          overwrite="true"/>
      </startup>
      <shutdown>
        <delete file="${cactus.destfile}"/>
      </shutdown>
    </generic>
  </containerset>
  <classpath><path refid="test.classpath"/></classpath>
  <formatter type="xml"/>
  <batchtest todir="${test.data.dir}">
    <fileset dir="test" includes="**/*Test.java">
  </batchtest>
</cactus:cactus>
```


Cactus Demo



- Needs classpath right for client and server
- cactus servlet is possible security risk

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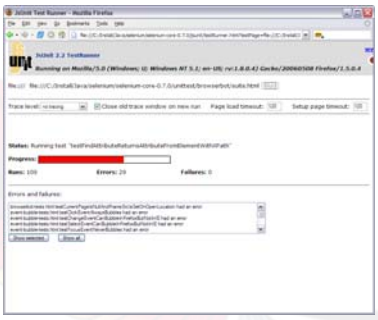
GUI testing hurts

- Static HTML is the easiest (HttpUnit)
- Swing, DHTML, SWT, Flash hard.
- Most people stop at the “model”
- Whoever does a new GUI -fix this!

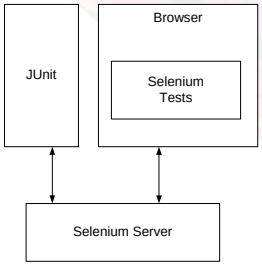
jsUnit is JUnit for JavaScript

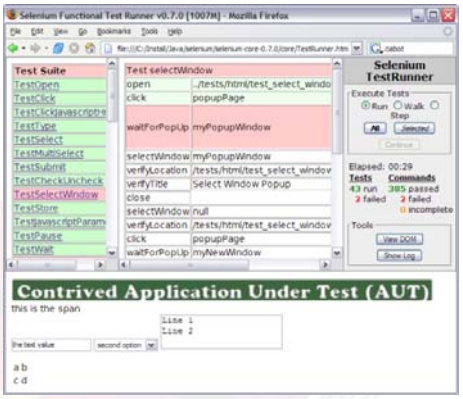
```
function test3() {
  var buffer = top.testManager.documentLoader.buffer();
  var emps = buffer.document.getElementsByTagName('employee');
  assert('expected 5 employees, not ' + emps.length,
    emps.length == 5);
  var empid = emps[0].getElementsByTagName('employeeId');
  assert('employeeId[0] was  '
    + empid[0].firstChild.data,
    empid[0].firstChild.data == 'EMP0001');
}
```



Selenium: tests in a table

```
<tr>
  <td>verifyTitle</td>
  <td>Click Page Target</td>
  <td> </td>
</tr>
```





http://www.openqa.org/selenium/

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WS Interop Testing

Simulate the production system
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- Use the real client API/classes
- Pass down URLs via system properties

```
protected String getOption(String property,
      boolean required) {
  String option = System.getProperty(property);
  if (required && option== null) {
    fail("No property " + property);
  }
  return option;
}
```

- Test different endpoints in parallel processes
- Include timeouts; proxy support
- Log for blame assignment

ex: http://deployapi.iseran.com:8080/logs/

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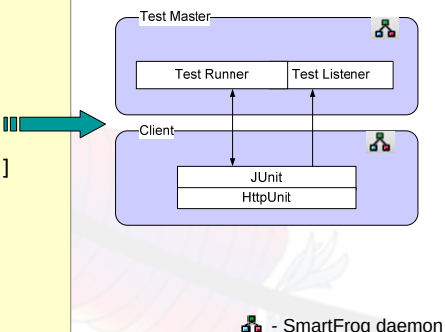
Distributed Testing

- Allocate & configure test systems
- Deploy application across nodes
- Deploy tests on other nodes
- Collect and correlate results
- Try to understand what went wrong

SmartFrog

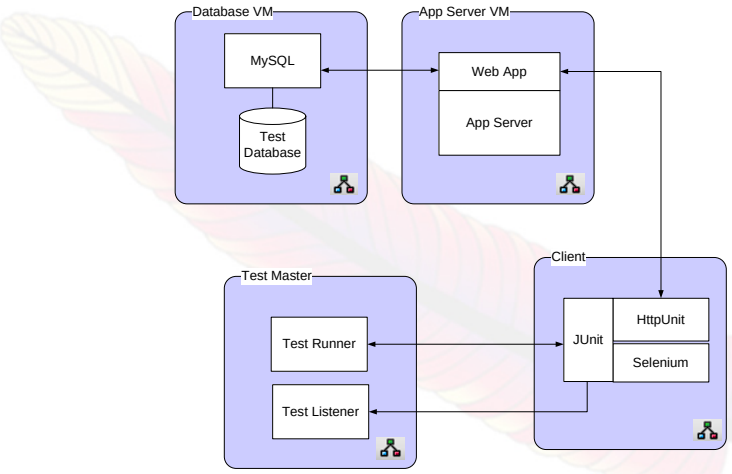
A framework for describing, deploying and managing distributed service components.

```
HttpUnitTests extends JUnitTestSuite {
 package "d1.webapp.test";
    name "HttpUnitTests";
  server.url TBD;
  sfProcessHost "client";
  properties [
    ["server.url",server.url],
    ["cactus.contextURL",server.url]
  ];
  classes [
    "EventFeedTest",
    "HappyTagTest",
    "IndexTest"
    ];
}
```



http://smartfrog.org/

Distributed Deployment of App & JUnit



- SmartFrog daemon

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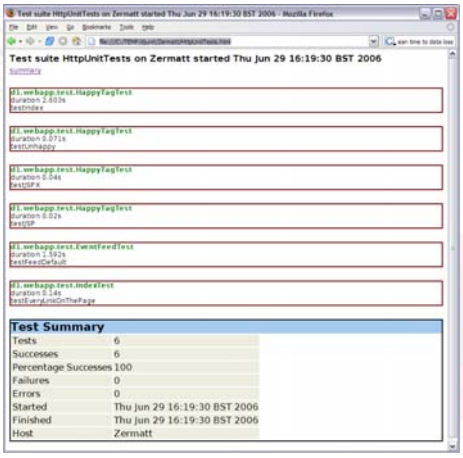
XHTML output of test results



+ ~live output
+ log capture
- no x-system summary
- no merging of logs from different systems
- no notification

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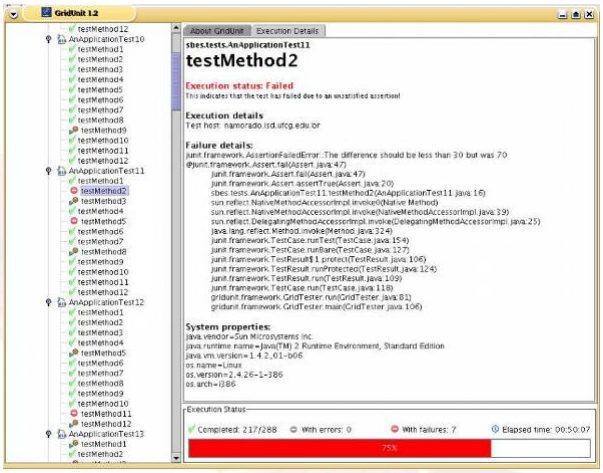
Future GUI? GridUnit

- Swing GUI for testing on OurGrid
- Unit test across many different machines
- But not (yet) distributed applications
- Aggregate view of results
- “partial” success
- Common JUnit wire format



http://gridunit.sourceforge.net/

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Call to Action

- Focus on system tests
- Embrace Virtualization: VMWare, Xen
- Use Cactus for in-container testing
- Use Selenium/jsUnit for browser tests
- Join us in distributed system testing

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Junit4?

- Java5 only
- Extension tools not there yet
- Integration with Ant, Maven coming along.
- Ant 1.7 <junit> will work with junit4.jar
- JUnit team plan their own task (Ant team are working with them)