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Advanced Testing

Testing Tools

Plan

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Testing activities and tools

Some open source testing tools

Some commercial/closed source testing tools

Summary

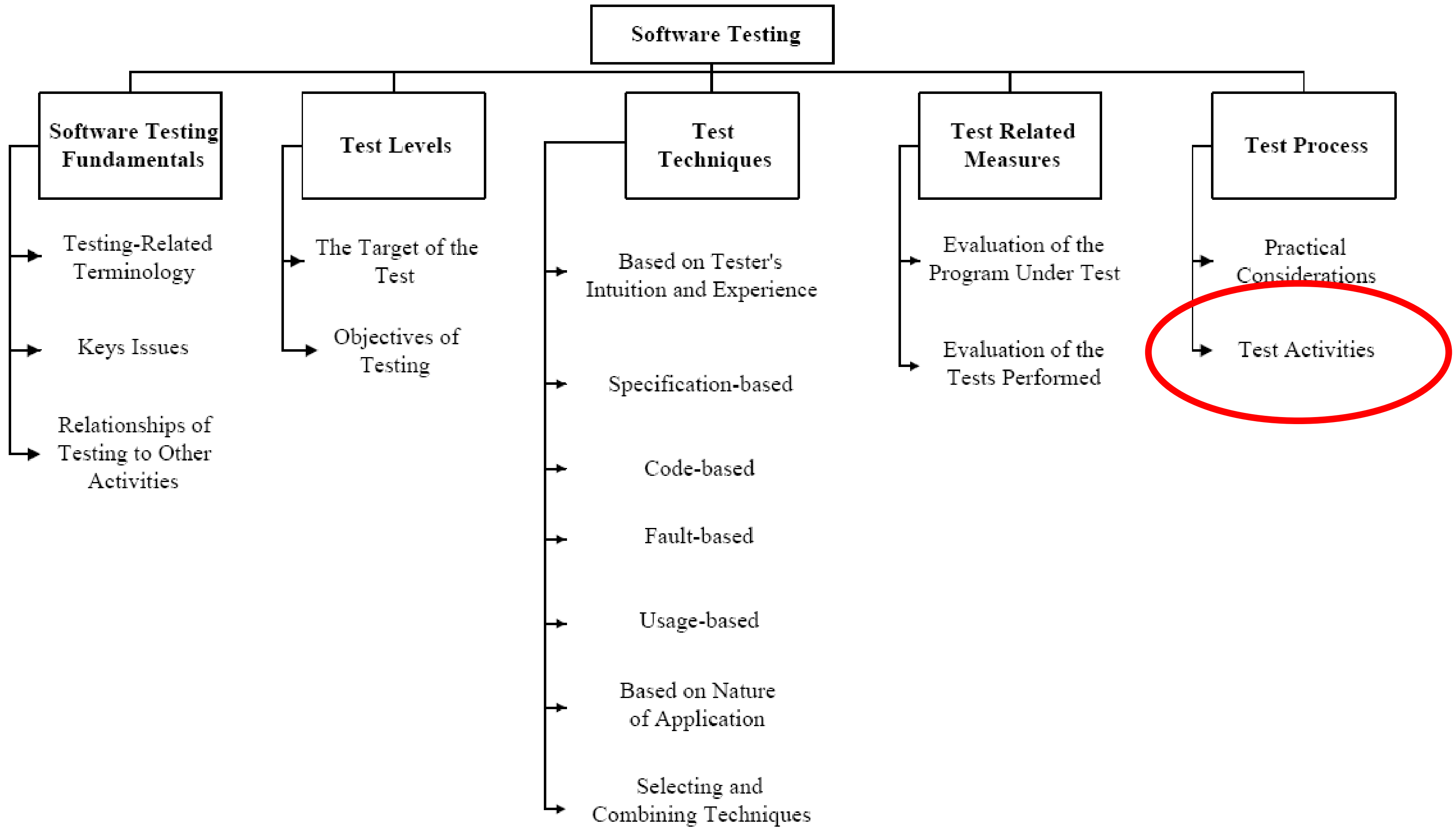
Motivation

Use tools to

- Reduce time and cost of testing
- Increase quality of testing

Ultimately get better quality software for the same amount of money

[Abrain and Moore, 2004]


Software Testing
Software Testing Fundamentals
Testing-Related Terminology
Keys Issues
Relationships of Testing to Other Activities
Test Levels
The Target of the Test
Objectives of Testing
Test Techniques
Based on Tester's Intuition and Experience
Specification-based
Code-based
Fault-based
Usage-based
Based on Nature of Application
Selecting and Combining Techniques
Test Related Measures
Evaluation of the Program Under Test
Evaluation of the Tests Performed
Test Process
Practical Considerations
Test Activities

Tools for all test activities…

Planning
- Coordinate of personnel, test facilities and equipment, ...

Test-case generation
- Defined test cases based on level of testing and testing techniques

Test environment development
- Support development and execution of test cases, logging, recovery, ...

Execution
- Run the actual test cases in the test environment

Test results evaluation
- Determine whether the test has been successful

Problem reporting/Test log
- Record relevant information on test

Defect tracking
- Track defects to improve and measure development process

Some commercial tools

Some Jolt Awards and finalists

2006
- Award
  - VMTN Subscription 2005 (VMware)
- Runner-ups
  - Agitator 3.0 (Agitar Software)
  - AQtime 4.7 (AutomatedQA)
  - Clover 1.3 (Cenqua)
  - *Parasoft Jtest 7.0 (Parasoft)*
  - TestComplete 4.0 (AutomatedQA)

Previous
- 2005: Agitator and Dashboard 2.0, FogBugz
- 2004: TestComplete 3.0
- 2003: TestTrack Pro
- 2002: JProbe Suite
- 2000: Parasoft Jtest
- 1997: SQA Suite

JTest

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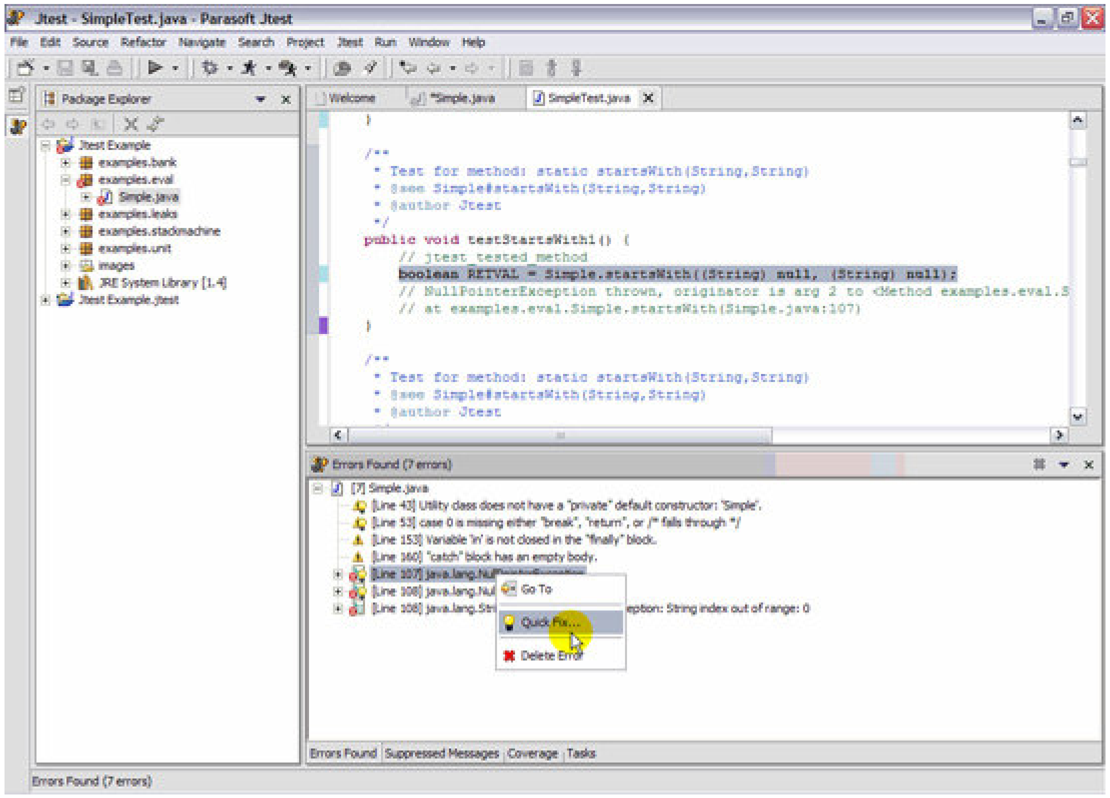


```
    }

    /**
     * Test for method: static startsWith(String,String)
     * @see Simple#startsWith(String,String)
     * @author Jtest
     */
    public void testStartsWith1() {
        // jtest_tested_method
        boolean RETVAL = Simple.startsWith((String) null, (String) null);
        // NullPointerException thrown, originator is arg 2 to <Method examples.eval.S
        // at examples.eval.Simple.startsWith(Simple.java:107)
    }

    /**
     * Test for method: static startsWith(String,String)
     * @see Simple#startsWith(String,String)
     * @author Jtest
```

```
Errors Found (7 errors)
[7] Simple.java
    [Line 43] Utility class does not have a "private" default constructor: 'Simple'.
    [Line 53] case 0 is missing either "break", "return", or /* falls through */
    [Line 153] Variable 'in' is not closed in the "finally" block.
    [Line 160] "catch" block has an empty body.
    [Line 107] java.lang.NullPointerException
    [Line 108] java.lang.Nul
    [Line 108] java.lang.Stri                    eption: String index out of range: 0
```

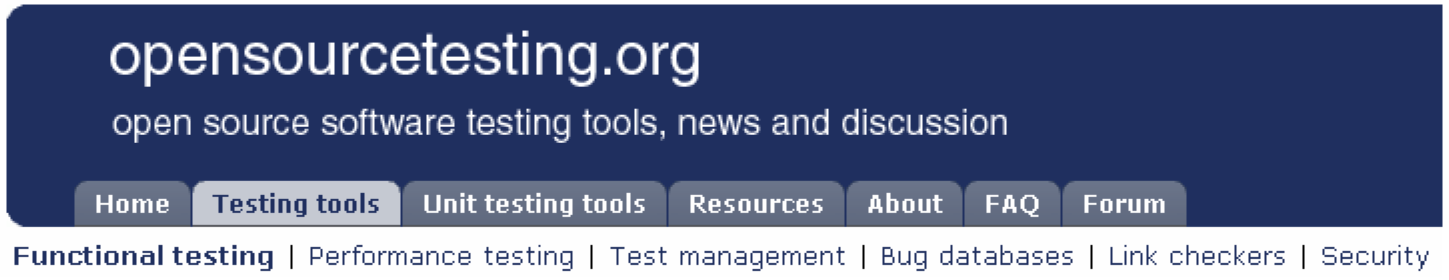
Demonstration

– http://www.parasoft.com/jsp/products/support/presentation/flash/jtest/demo/7.0/JTD.html

Some open source testing tools

http://www.opensourcetesting.org lists 280 tools...

– A great variety, e.g.,
  - HttpUnit
  - JMeter
  - Mock objects
  - FitNesse
  - JIRA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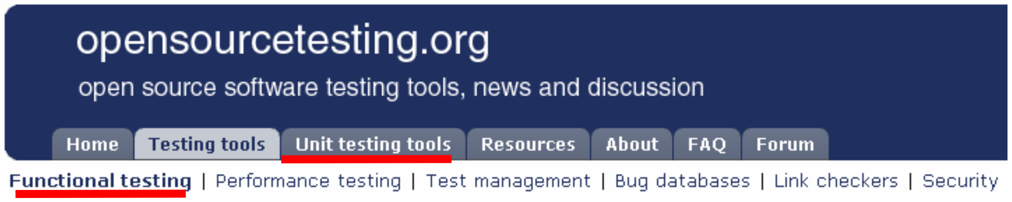

HttpUnit

http://httpunit.sourceforge.net/

- Java framework for integration, and system testing of web applications
- Supports test-driven development for web applications

Emulates relevant portions of browser behaviour

- E.g., form submissions and JavaScript

Example...

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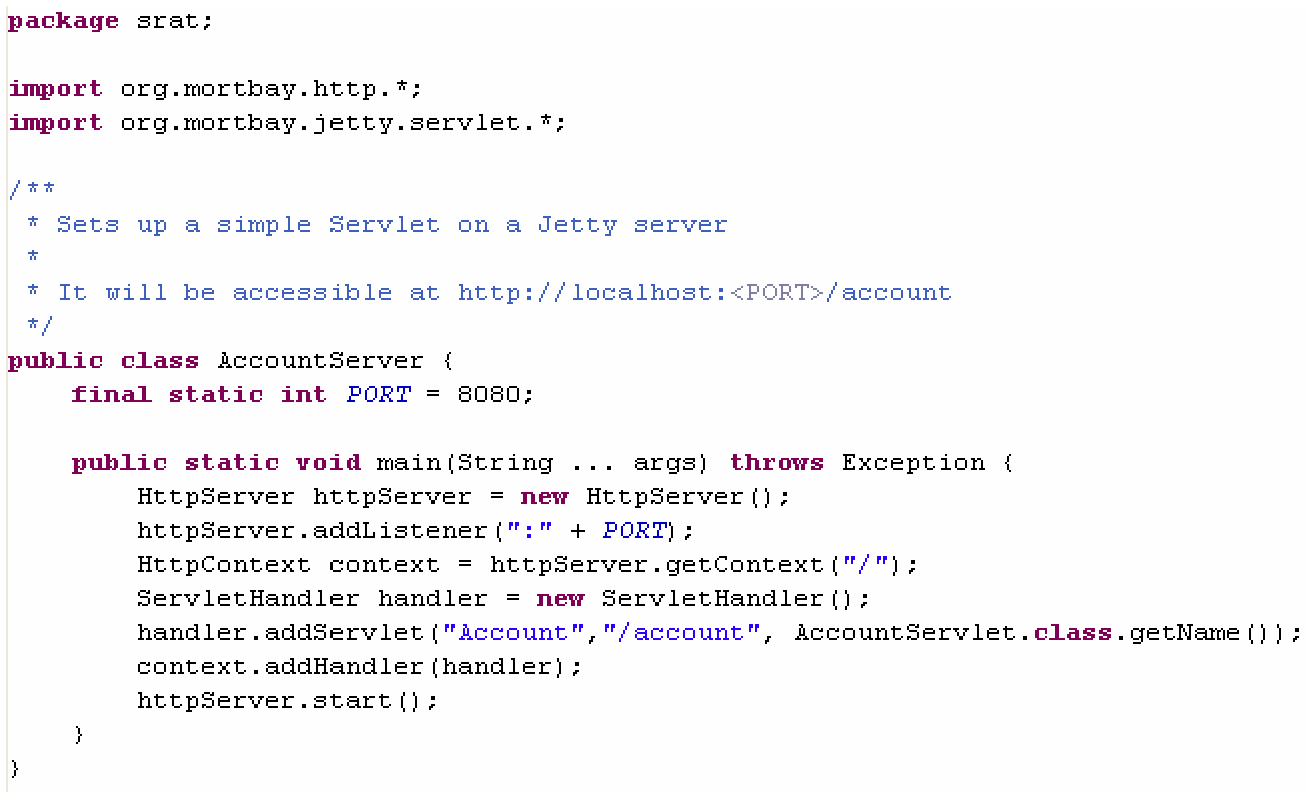
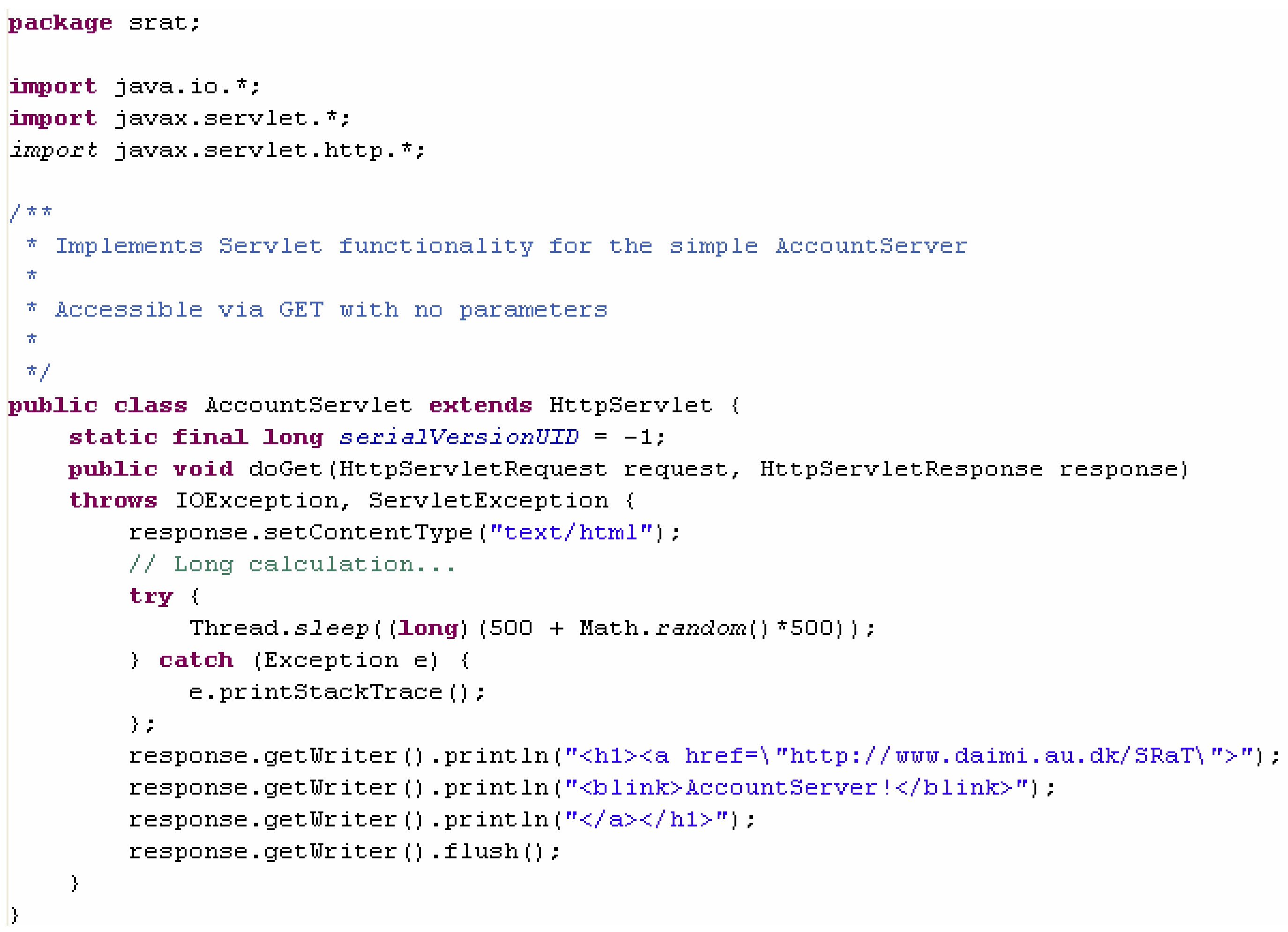
AccountServer



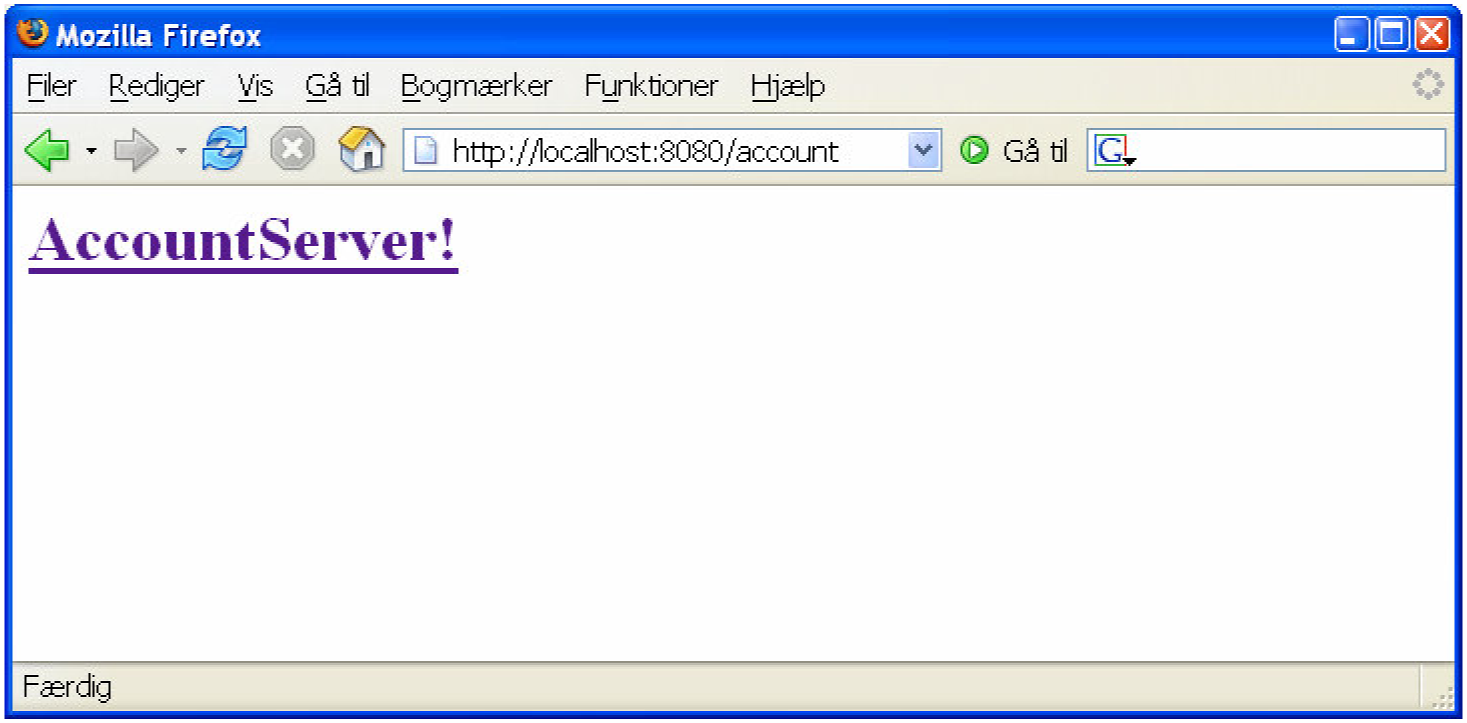
```java
package srat;

import org.mortbay.http.*;
import org.mortbay.jetty.servlet.*;

/**
 * Sets up a simple Servlet on a Jetty server
 *
 * It will be accessible at http://localhost:<PORT>/account
 */
public class AccountServer {
    final static int PORT = 8080;

    public static void main(String ... args) throws Exception {
        HttpServer httpServer = new HttpServer();
        httpServer.addListener(":" + PORT);
        HttpContext context = httpServer.getContext("/");
        ServletHandler handler = new ServletHandler();
        handler.addServlet("Account","/account", AccountServlet.class.getName());
        context.addHandler(handler);
        httpServer.start();
    }
}
```

AccountServlet



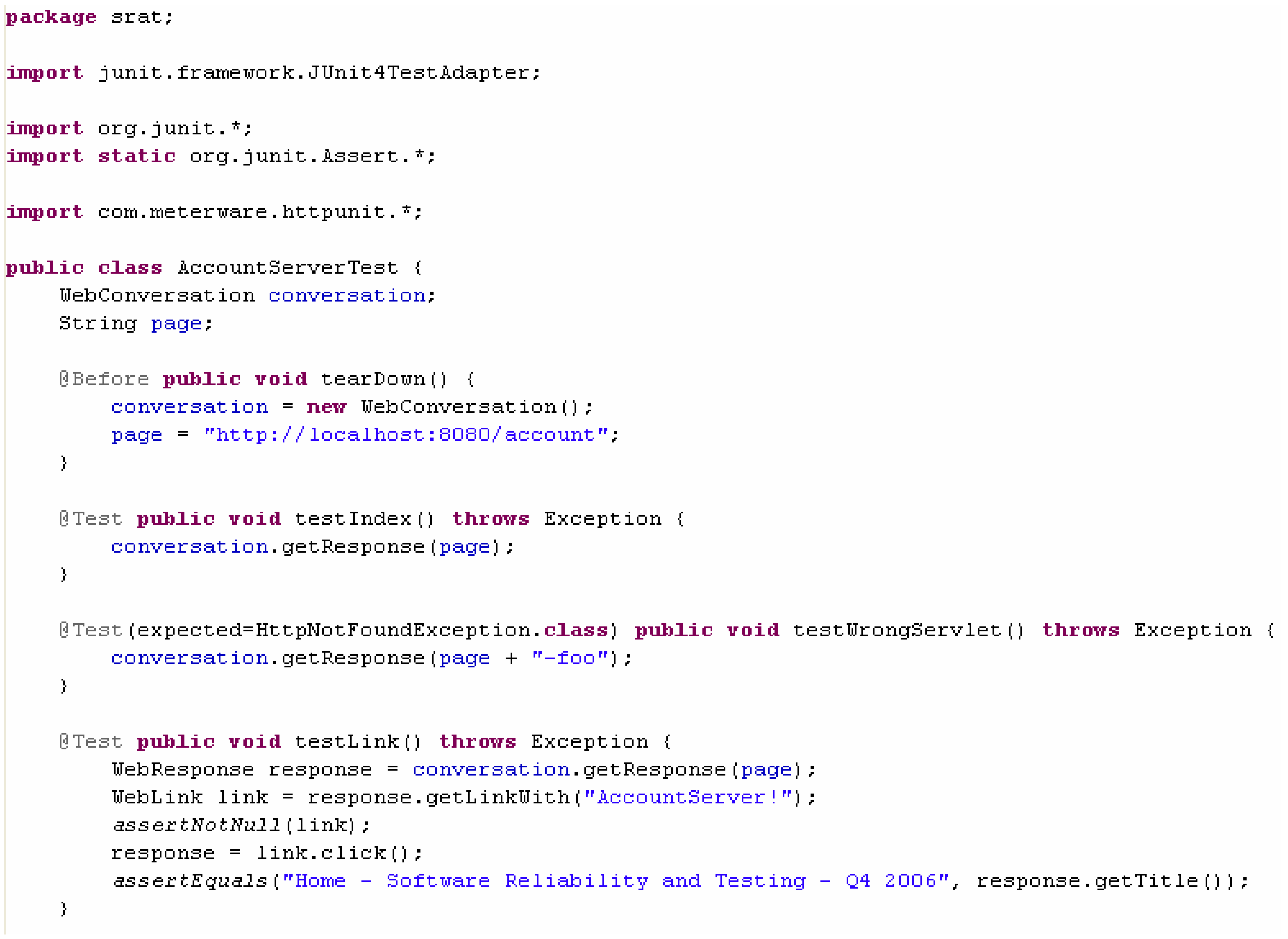
```java
package srat;

import java.io.*;
import javax.servlet.*;
import javax.servlet.http.*;

/**
 * Implements Servlet functionality for the simple AccountServer
 *
 * Accessible via GET with no parameters
 *
 */
public class AccountServlet extends HttpServlet {
    static final long serialVersionUID = -1;
    public void doGet(HttpServletRequest request, HttpServletResponse response)
    throws IOException, ServletException {
        response.setContentType("text/html");
        // Long calculation...
        try {
            Thread.sleep((long)(500 + Math.random()*500));
        } catch (Exception e) {
            e.printStackTrace();
        };
        response.getWriter().println("<h1><a href=\"http://www.daimi.au.dk/SRaT\">");
        response.getWriter().println("<blink>AccountServer!</blink>");
        response.getWriter().println("</a></h1>");
        response.getWriter().flush();
    }
}
```

http://localhost:8080/account


Mozilla Firefox
Filer Rediger Vis Gå til Bogmærker Funktioner Hjælp
http://localhost:8080/account
Gå til
Færdig

AccountServer!

Using HttpUnit



```
package srat;

import junit.framework.JUnit4TestAdapter;

import org.junit.*;
import static org.junit.Assert.*;

import com.meterware.httpunit.*;

public class AccountServerTest {
    WebConversation conversation;
    String page;

    @Before public void tearDown() {
        conversation = new WebConversation();
        page = "http://localhost:8080/account";
    }

    @Test public void testIndex() throws Exception {
        conversation.getResponse(page);
    }

    @Test(expected=HttpNotFoundException.class) public void testWrongServlet() throws Exception {
        conversation.getResponse(page + "-foo");
    }

    @Test public void testLink() throws Exception {
        WebResponse response = conversation.getResponse(page);
        WebLink link = response.getLinkWith("AccountServer!");
        assertNotNull(link);
        response = link.click();
        assertEquals("Home - Software Reliability and Testing - Q4 2006", response.getTitle());
    }
```

Using HttpUnit

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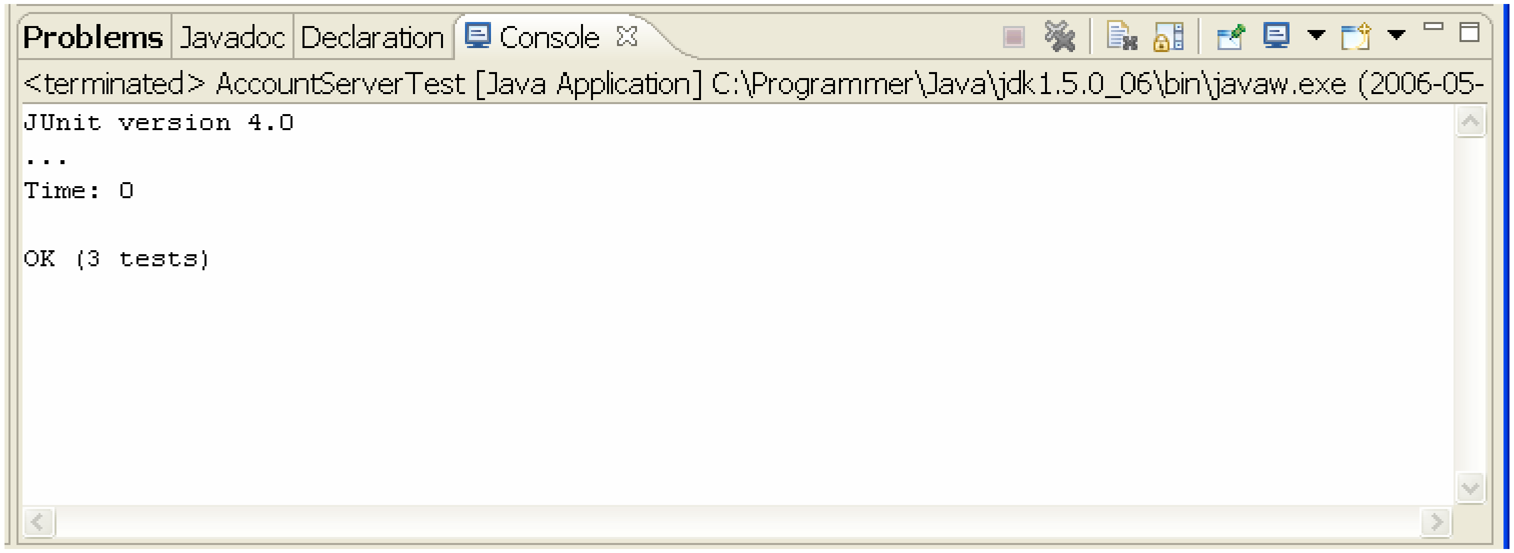

```
<terminated> AccountServerTest [Java Application] C:\Programmer\Java\jdk1.5.0_06\bin\javaw.exe (2006-05-
JUnit version 4.0
...
Time: 0

OK (3 tests)
```

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JMeter

http://jakarta.apache.org/jmeter/

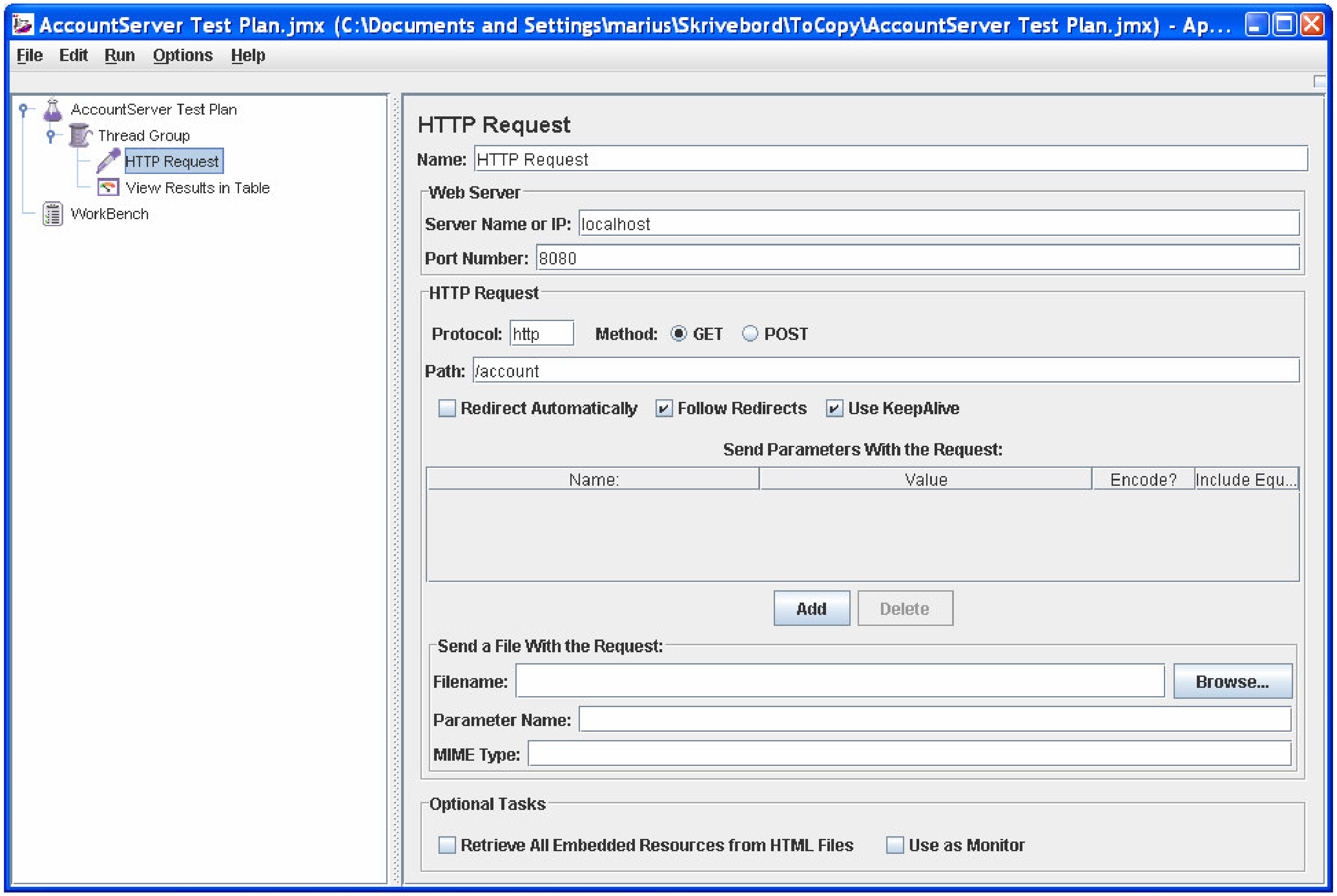
- Performance measurements on use of static and dynamic resources
- Files, Servlets, scripts, Java objects, data bases, ...

GUI for defining and visualizing *test plans*

- *Thread groups* emulate concurrent users
  - *Samplers* define input from thread groups (e.g., HTTP requests)
  - *Listeners* used to capture, analyze, and visualize test runs

Example...

Using JMeter


AccountServer Test Plan.jmx (C:\Documents and Settings\marius\Skrivebord\ToCopy\AccountServer Test Plan.jmx) - Ap...

HTTP Request

Name: HTTP Request

Web Server

Server Name or IP: localhost

Port Number: 8080

HTTP Request

Protocol: http Method: [✓ GET] POST

Path: /account

☐ Redirect Automatically ☑ Follow Redirects ☑ Use KeepAlive

Send Parameters With the Request:

Name:	Value	Encode?	Include Equ...

Send a File With the Request:

Filename:

Parameter Name:

MIME Type:

Optional Tasks

☐ Retrieve All Embedded Resources from HTML Files ☐ Use as Monitor

Using JMeter

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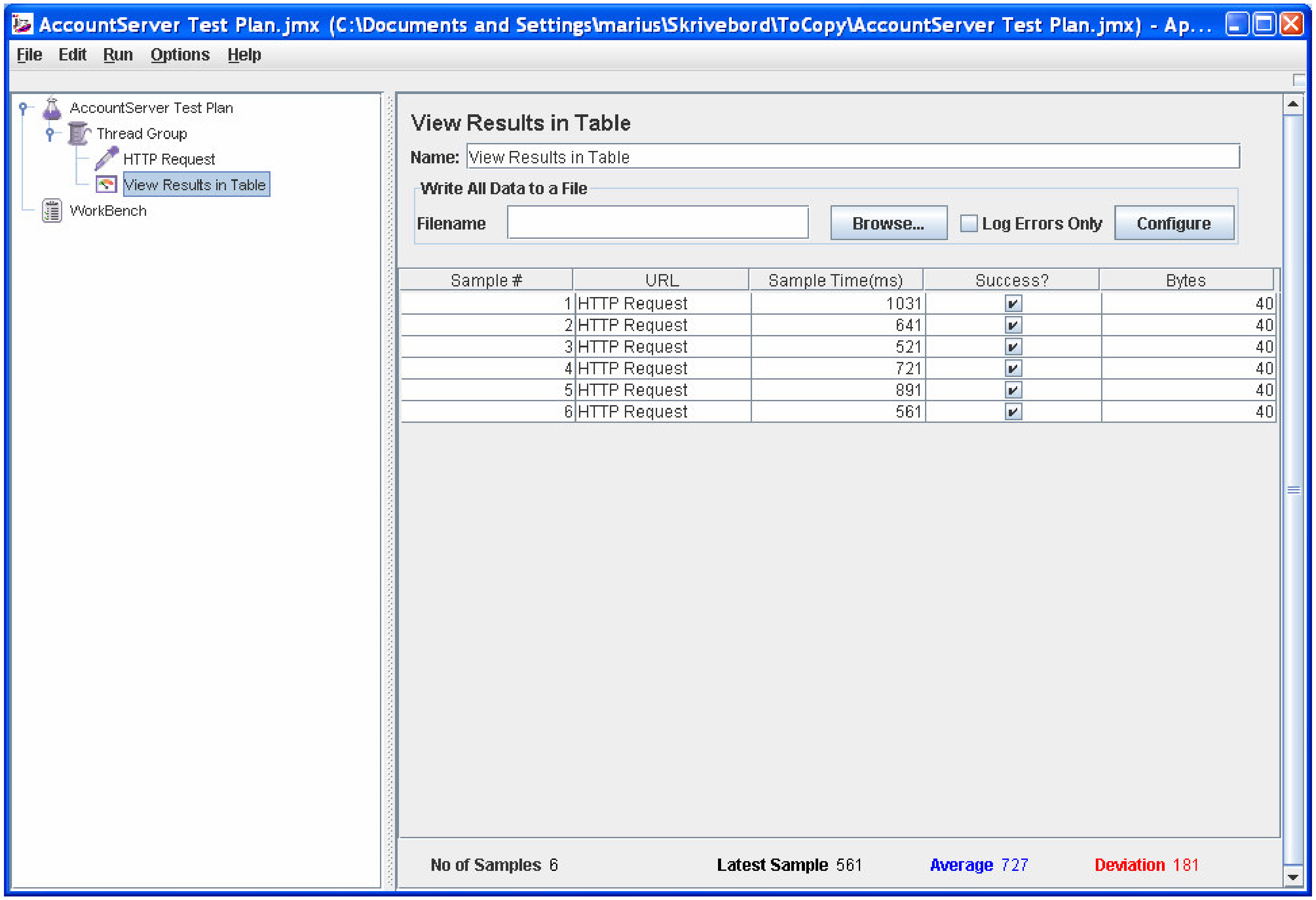

AccountServer Test Plan.jmx (C:\Documents and Settings\marius\Skrivebord\ToCopy\AccountServer Test Plan.jmx) - Ap...
File Edit Run Options Help
AccountServer Test Plan
Thread Group
HTTP Request
View Results in Table
WorkBench
Browse...
Configure

View Results in Table

Name: View Results in Table

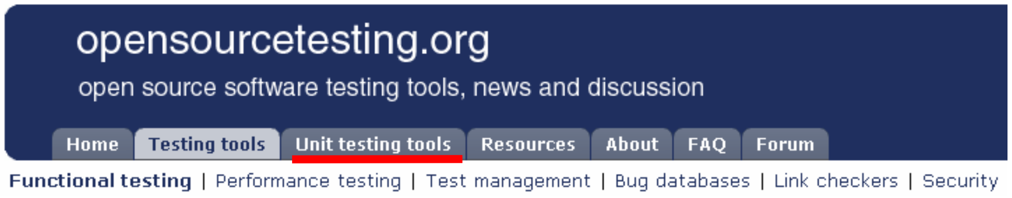
Write All Data to a File

Filename

☐ Log Errors Only

Sample #	URL	Sample Time(ms)	Success?	Bytes
1	HTTP Request	1031	✓	40
2	HTTP Request	641	✓	40
3	HTTP Request	521	✓	40
4	HTTP Request	721	✓	40
5	HTTP Request	891	✓	40
6	HTTP Request	561	✓	40

No of Samples 6   Latest Sample 561   Average 727   Deviation 181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Mock Objects

http://www.mockobjects.com/ / http://www.jmock.org/

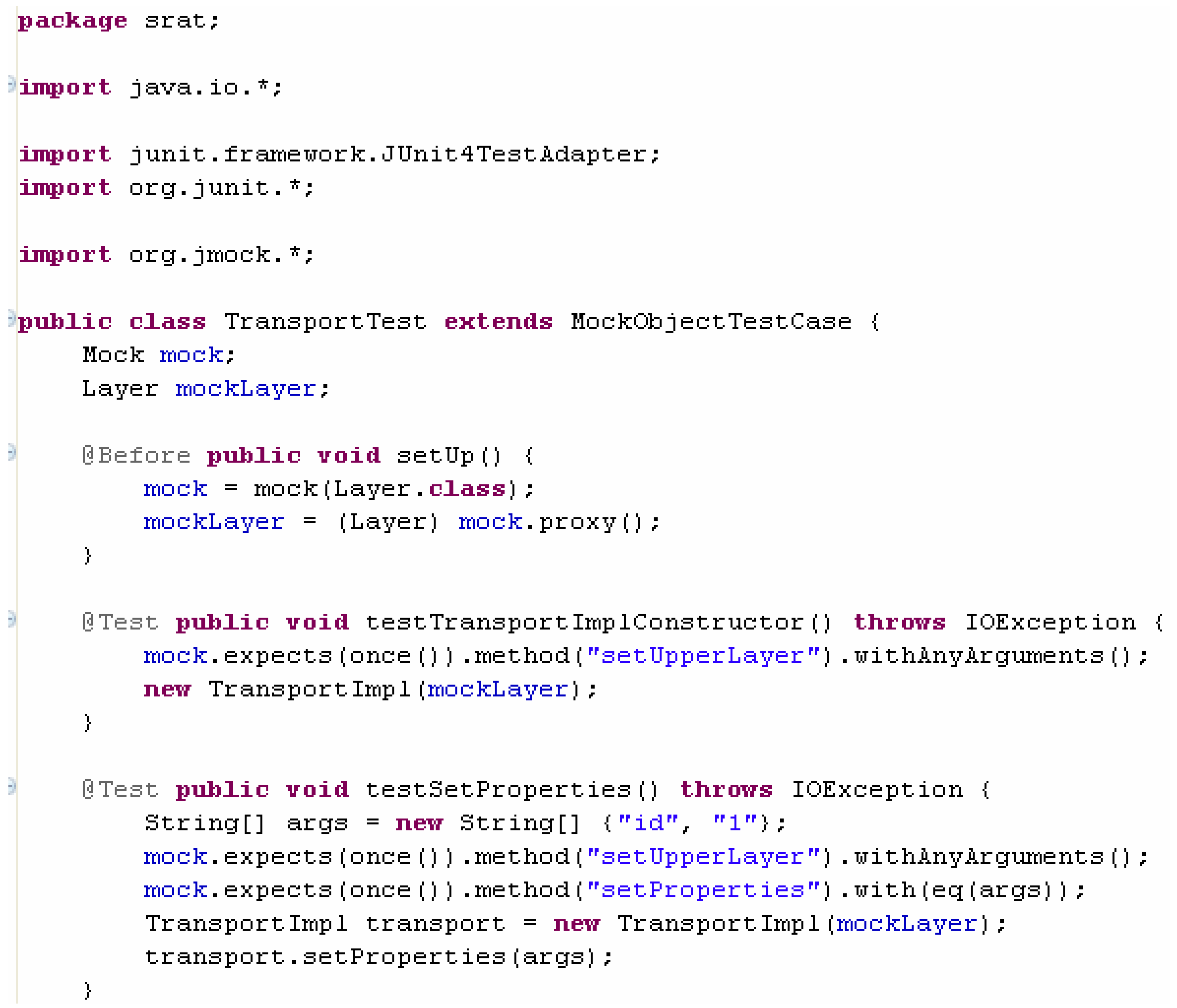
– Library for testing Java code using *mock objects*

Mock objects

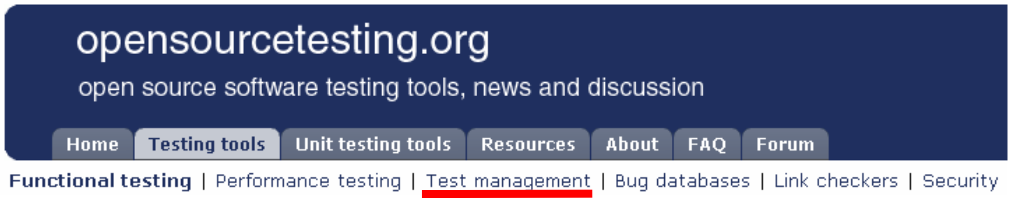
– Given an interface create an advanced stub at runtime using reflection
– May define expected values on mock objects using constraints

Example...

Using jMock



```
package srat;

import java.io.*;

import junit.framework.JUnit4TestAdapter;
import org.junit.*;

import org.jmock.*;

public class TransportTest extends MockObjectTestCase {
    Mock mock;
    Layer mockLayer;

    @Before public void setUp() {
        mock = mock(Layer.class);
        mockLayer = (Layer) mock.proxy();
    }

    @Test public void testTransportImplConstructor() throws IOException {
        mock.expects(once()).method("setUpperLayer").withAnyArguments();
        new TransportImpl(mockLayer);
    }

    @Test public void testSetProperties() throws IOException {
        String[] args = new String[] {"id", "1"};
        mock.expects(once()).method("setUpperLayer").withAnyArguments();
        mock.expects(once()).method("setProperties").with(eq(args));
        TransportImpl transport = new TransportImpl(mockLayer);
        transport.setProperties(args);
    }
```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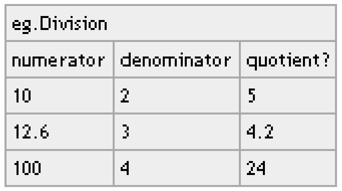
FitNesse

http://fitnesse.org/

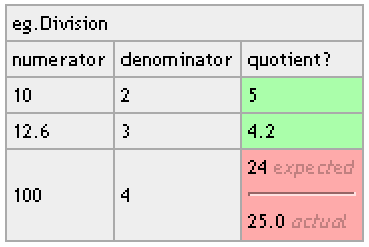
– Wiki-based collaborative tool for defining acceptance tests

E.g., testing a calculator thrugh a ColumnFixture

```
|eg.Division|
|numerator|denominator|quotient?|
|10       |2          |5        |
|12.6     |3          |4.2      |
|100      |4          |33       |
```



eg.Division		
numerator	denominator	quotient?
10	2	5
12.6	3	4.2
100	4	24



eg.Division		
numerator	denominator	quotient?
10	2	5
12.6	3	4.2
100	4	24 *expected* / 25.0 *actual*

`eg.Division` denotes a fixture class that is run by the FitNesse server

```
public class Division extends ColumnFixture {
  public double numerator, denominator;
  public double quotient() {
    return numerator/denominator;
  }
}
```

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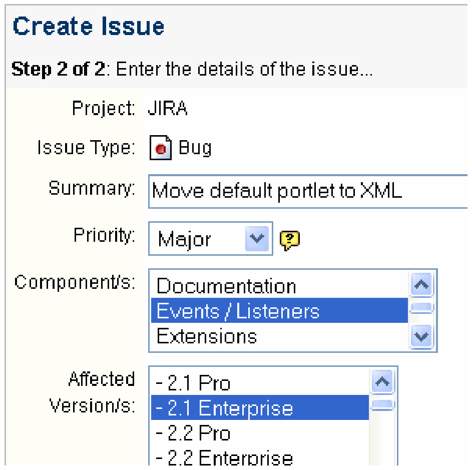
JIRA

http://www.atlassian.com/software/jira/

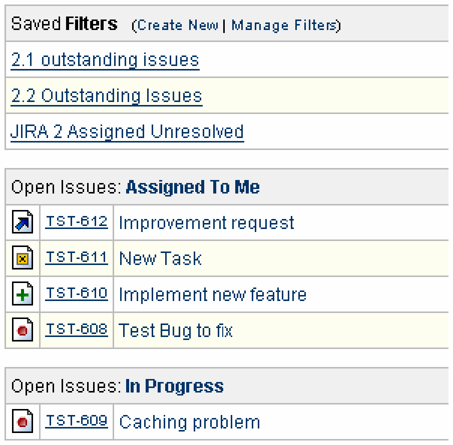
– Issue and defect tracking and management



Create Issue

Step 2 of 2: Enter the details of the issue...

Project:	JIRA
Issue Type:	Bug
Summary:	Move default portlet to XML
Priority:	Major
Component/s:	Documentation Events / Listeners Extensions
Affected Version/s:	- 2.1 Pro - 2.1 Enterprise - 2.2 Pro - 2.2 Enterprise



Saved **Filters** (Create New | Manage Filters)

2.1 outstanding issues

2.2 Outstanding Issues

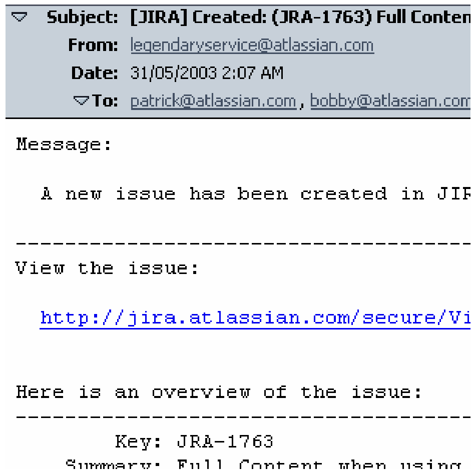
JIRA 2 Assigned Unresolved

Open Issues: **Assigned To Me**

TST-612	Improvement request
TST-611	New Task
TST-610	Implement new feature
TST-608	Test Bug to fix

Open Issues: **In Progress**

TST-609	Caching problem



Subject: [JIRA] Created: (JRA-1763) Full Conten

From: legendaryservice@atlassian.com

Date: 31/05/2003 2:07 AM

To: patrick@atlassian.com, bobby@atlassian.com

```
Message:

  A new issue has been created in JIR

-------------------------------------
View the issue:

  http://jira.atlassian.com/secure/Vi


Here is an overview of the issue:
-------------------------------------
        Key: JRA-1763
    Summary: Full Content when using
```

A JIRA installation

– Is web-based

– Covers a number of projects

- Projects have issues, versions, components

Summary

The is a huge variety of testing tools for all parts of the testing process

- Many open source tools exist – also of relatively high quality
- Complements commercial testing tools
- Many are domain-dependent

We saw/have seen some examples

- JUnit, AETG, JTest, HttpUnit, JMeter, FitNesse, JIRA

No substitute for common sense and hard work though...