Accelerating Information Technology Innovation

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Lecture 4 – Accessing the Web and Unit Tests

Interacting with the Web

How to Access Web Content

1. Give your app permission to access the web
2. Open a connection to a URL
3. Read data from the URL and store it somewhere
4. Display the data from the URL on your app

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Give your app permission to access the web

- Find AndroidManifest.xml file
- Navigate to the Permissions tab
- Select "Add → Uses Permission"
- Select `android.permission.INTERNET` from the drop-down menu

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Open a connection to a URL

- A URL is a type of URI
- Sample code:

```
URL myURL;
myURL = new URL("http://myWebsite.com");
HttpURLConnection conn =
  (HttpURLConnection) url.openConnection();
```

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Read data from the URL and store it somewhere

- Get data from the URL

```
InputStream in = conn.getInputStream();
```

Read data from the URL and store it somewhere

- Get data from the URL

```
InputStream in = conn.getInputStream();
```

- Use a reader to convert the data into the format you want. Useful Java classes.
  - `InputStreamReader`
  - `BufferedReader`
  - `StringBuffer`
  - `CharBuffer`

Read data from the URL and store it somewhere

- Sample code
  (printing data out instead of storing)

```
BufferedReader in =
  new BufferedReader(
    new InputStreamReader(conn.getInputStream()));
String inputLine;

while ((inputLine = in.readLine()) != null) {
    System.out.println(inputLine);
}
```

Read data from the URL and store it somewhere

- May encounter methods that throw exceptions, such as:
  - `MalformedURLException` (`new URL()` throws when the string isn't a URL)
  - `IOException` (`getInputStream()` throws on bad connection)
- Handle them gracefully
  - How should the app work without Internet?

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Display the data from the URL on your app

Access your stored data and display it using whatever combination of layouts and widgets that you choose!

Unit Tests and JUnit

What are unit tests?

- Small pieces of code that test your code
  - Test the smallest testable piece (unit)
  - Tests interact with your main code

Why unit test?

- Guarantee your code does what you say
- Uncover corner cases early on
  - Ensure graceful degradation (GPS unavailable?)
- Debug before you release
- Can help guide development
  - Test-driven development (write tests first)

What goes into a unit test?

- *Assertion* – A test of a single property or value (e.g. assert that "1+1" gives "2")
- *Test Case* – A set of assertions that test a single function or use case
- *Test Suite* – A collection of related *Test Cases* to run together
- *Test Runner* – Code that runs the *Test Suites*
- *Mock Object* – An object substituting for another (when the object itself is not being tested)

Some Types of Assertions

- All can take an extra first argument `String message` to print out when the assertion fails
- `org.junit.Assert.`
  - `assertEquals(expected, actual)`
    - Test that *expected* and *actual* are equal (`.equals()`)
  - `assertTrue(condition)/assertFalse(condition)`
    - Test that *condition* is `true/false`
  - `fail()`
    - Always fail

See also: http://junit.sourceforge.net/javadoc/org/junit/Assert.html

More Types of Assertions

- `android.test.MoreAsserts.`
  - `assertMatchesRegex(expectedRegex, actual)`
    - Test that *actual* matches regular expression *expectedRegex*
  - `assertEmpty(iterable)`
    - Test that *iterable* contains no objects
  - `assertContentsInOrder(iterable, expected...)`
    `assertContentsInAnyOrder(iterable, expected...)`
    - Test that *iterable* contains exactly all of the remaining arguments in exact/any order and nothing else

See also: http://developer.android.com/reference/android/test/MoreAsserts.html

Mock Objects

- Objects that *implement* an *interface* (i.e. they look like the interface)
- But results of functions may be pre-defined (i.e. behavior is deterministic)

Mock Objects: Example

```
public interface ProxySettings {
    public abstract String fetchWithProxy(URL url);
}

public class Weather {
    public static String fetchCurrentWeather(
      String place, ProxySettings proxy) {
        /* ... */
        return proxy.fetchWithProxy(url);
    }
}

ProxySettings proxy = new DeviceProxySettings();
String s = Weather.fetchCurrentWeather("Mumbai", proxy);
Assert.assertEquals(s, "Rain");
```

Mock Objects: Example

Problem: `DeviceProxySettings` *is device-specific!*
Also, if I don't use a proxy, I can't test!

Solution: Make a mock object (class: `MockProxySettings`*)!*

Mock Objects: Example

```
public class MockProxySettings implements ProxySettings {
    public String fetchWithProxy(URL url) {
        /* Fetch without a proxy! */
    }
}

ProxySettings proxy = new MockProxySettings();
String s = Weather.fetchCurrentWeather("Mumbai", proxy);
Assert.assertEquals(s, "Rain");
```

NOTE: What `MockProxySettings` *does isn't important. What we care about is that* `fetchCurrentWeather` *works with a class that behaves like a* `ProxySettings` *interface.*

Unit Testing with JUnit

Making a TestCase

```
public class Email {
    private String mSubject;  // And so on...

    public Email(String from, String subject, String body) {
        mSubject = subject;
        // And so on...
    }

    public String getSubject() {
        return mSubject;
    }
}
```

Making a TestCase

```
public class EmailTestCase extends TestCase {
    public Email myEmail;

    protected void setUp() throws Exception {
        super.setUp();
        /* Set up the objects which will be tested. */
        myEmail = new Email("From", "Subject", "Body");
    }

    protected void tearDown() throws Exception {
        super.tearDown();
        /* Destroy the objects that were  tested. */
    }
}
```

Adding Tests

```
public class EmailTestCase extends TestCase {
    public void testSubject() {
        /* Testing that getSubject() returns what we expect. */
        assertEquals(myEmail.getSubject(), "Subject");
    }
}
```

All tests start with `test`!

NOTE: `TestCase` *extends [is a child class of]* `Assert`*, so* `assertEquals` *may be called without referring to* `Assert`*.*

Collecting Tests in a TestSuite

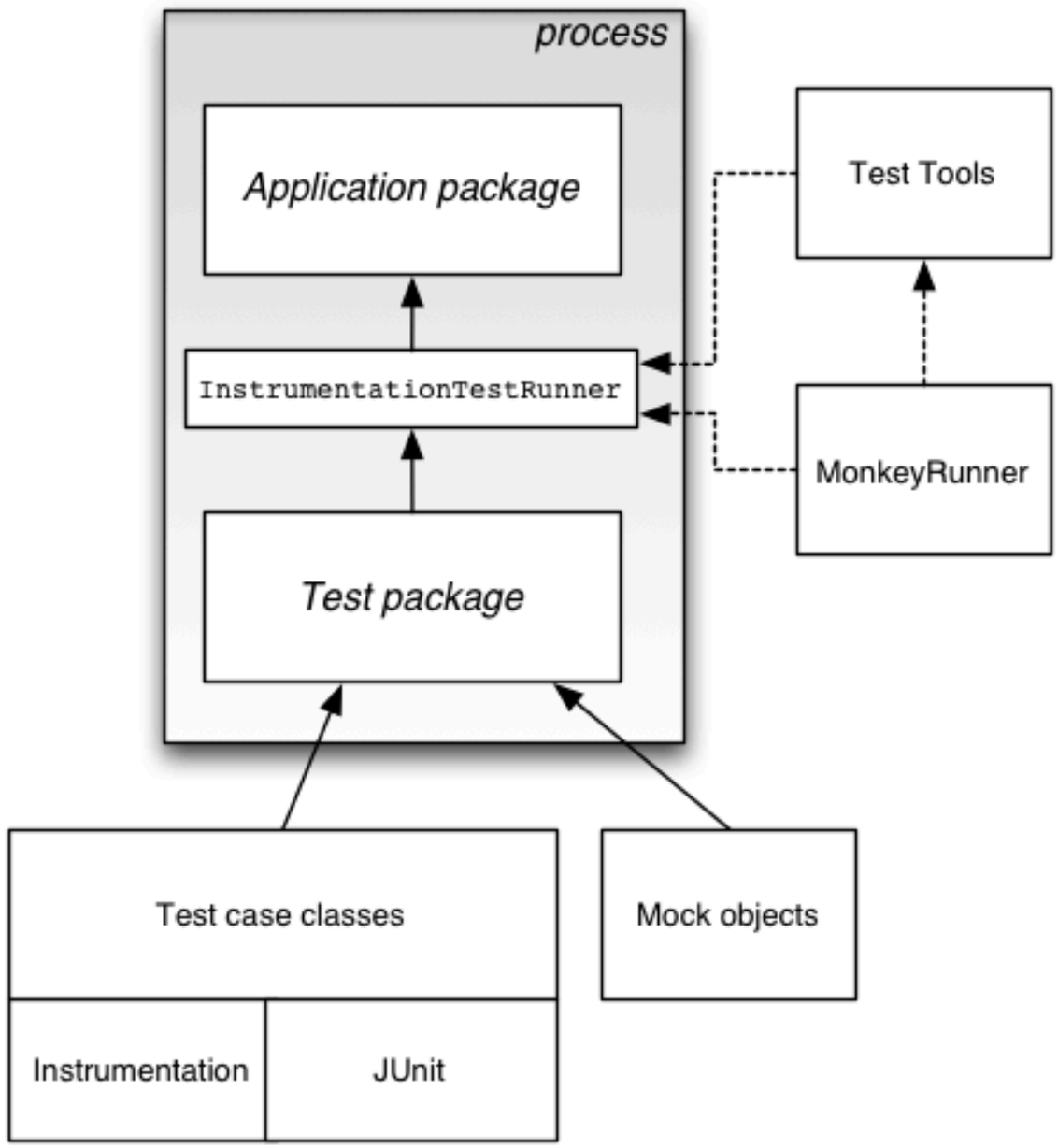
```
public class MyTestSuiteBuilder {
    public static Test suite() {
        /* Create a TestSuite and add each test. */
        TestSuite suite = new TestSuite();
        suite.addTest(new EmailTest("testSubject"));
        return suite;
    }
}
```

or

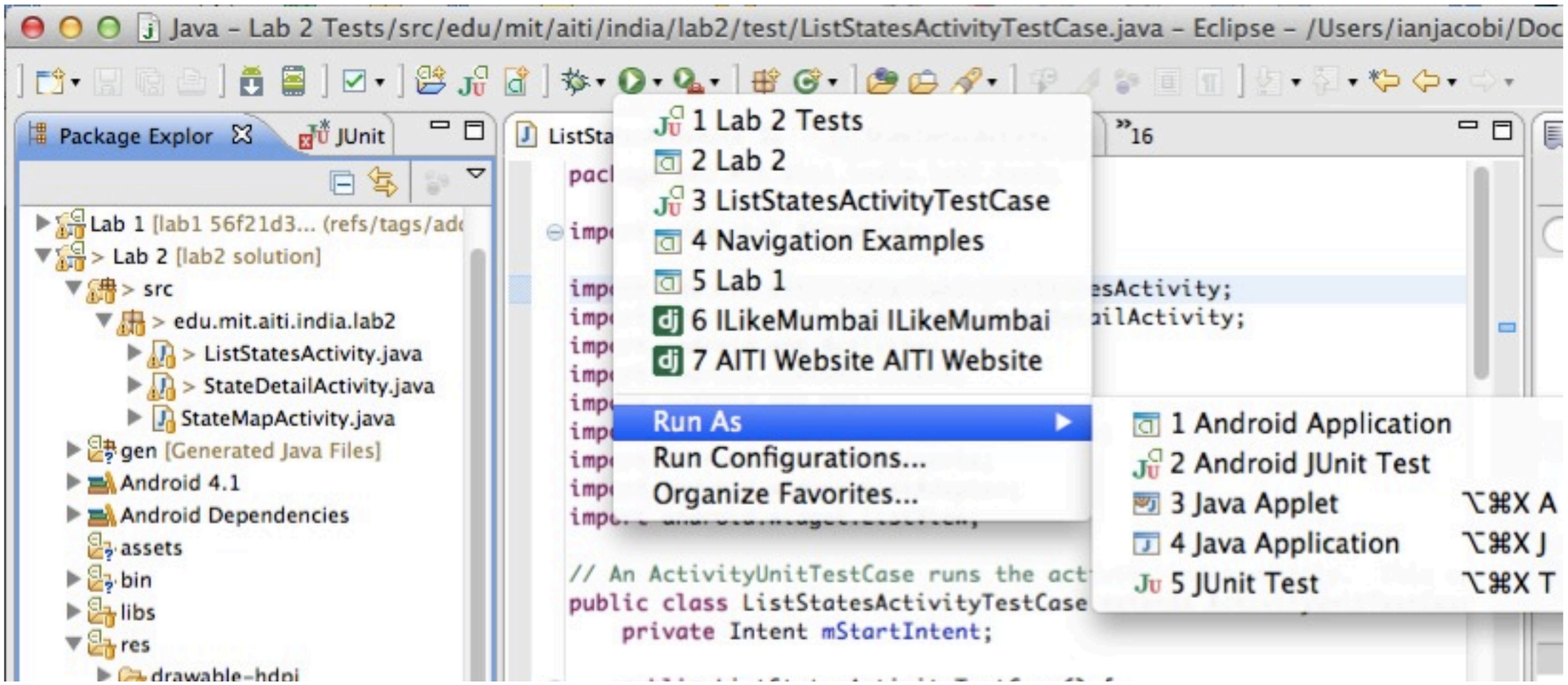
```
    public static Test suite() {
        /* Create a TestSuite and add each test. */
        TestSuite suite = new TestSuite(EmailTest.class);
        return suite;
    }
```

Unit Testing on Android

Unit Testing on Android

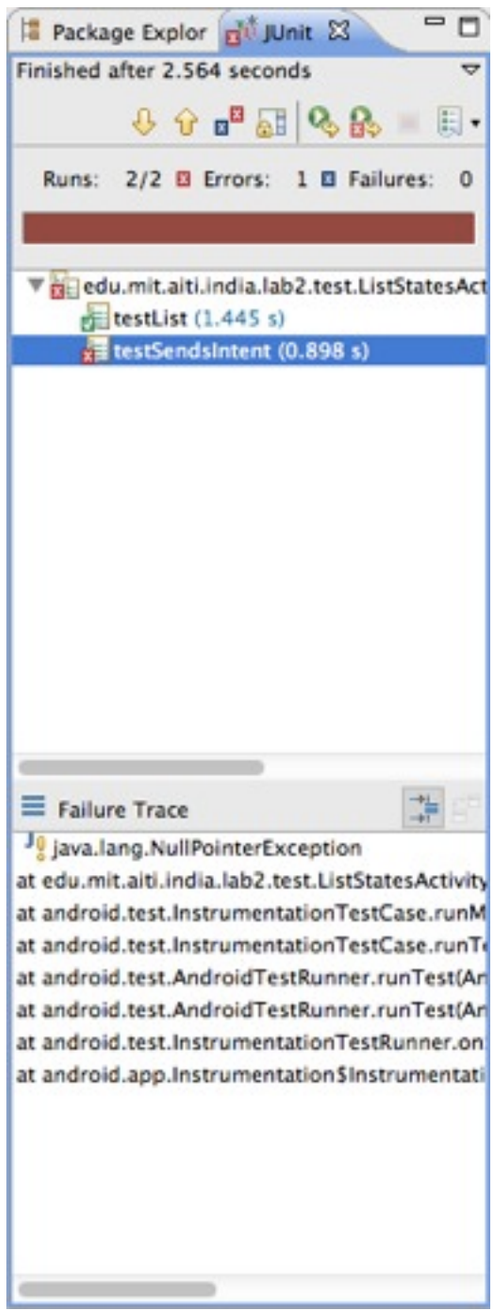


Unit Testing in Eclipse



Run like any other app

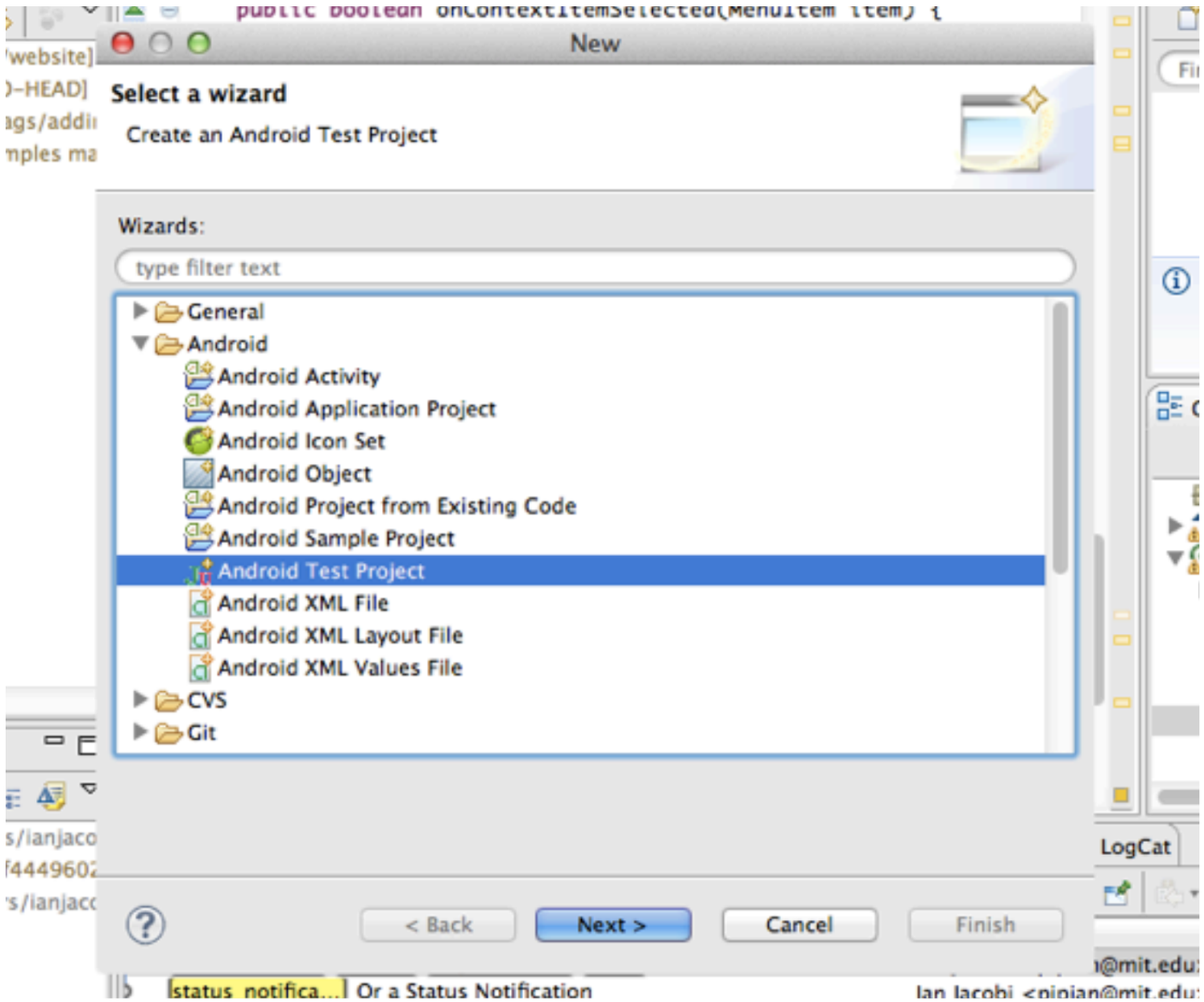
Unit Testing in Eclipse



View tests which fail

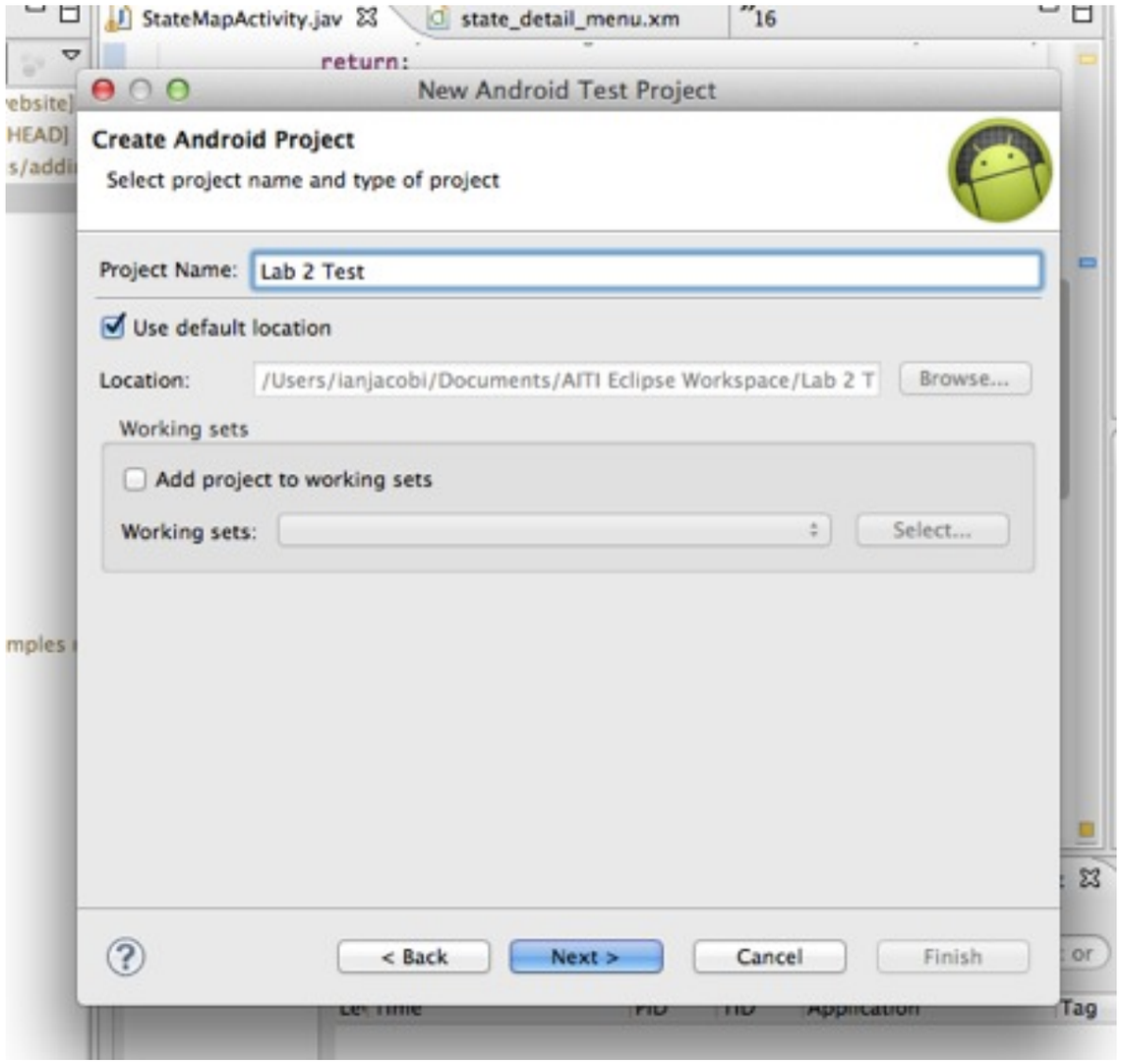
And why

Creating Unit Tests in Eclipse



Make an Android Test Project

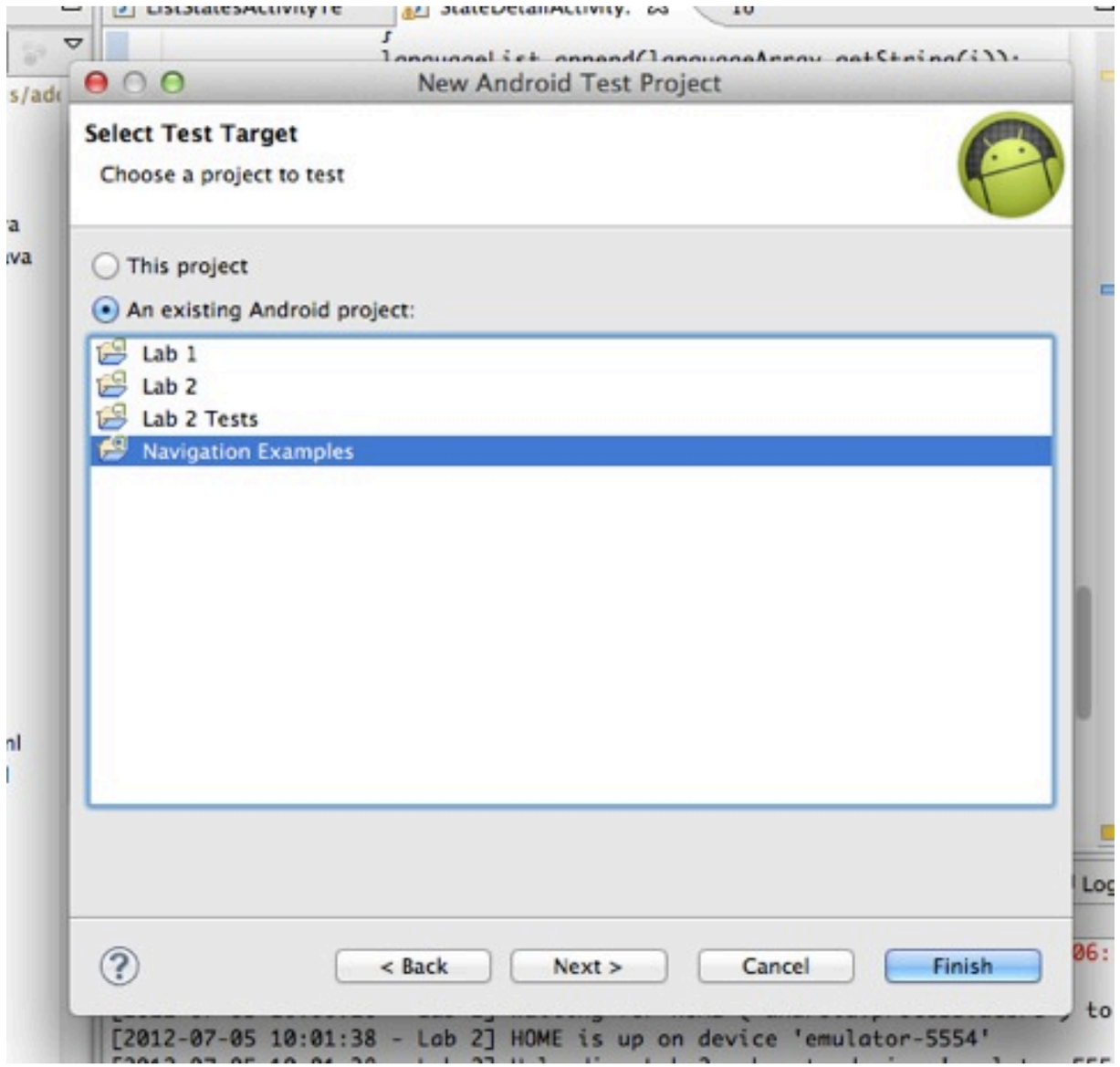
Creating Unit Tests in Eclipse



Name it after your project

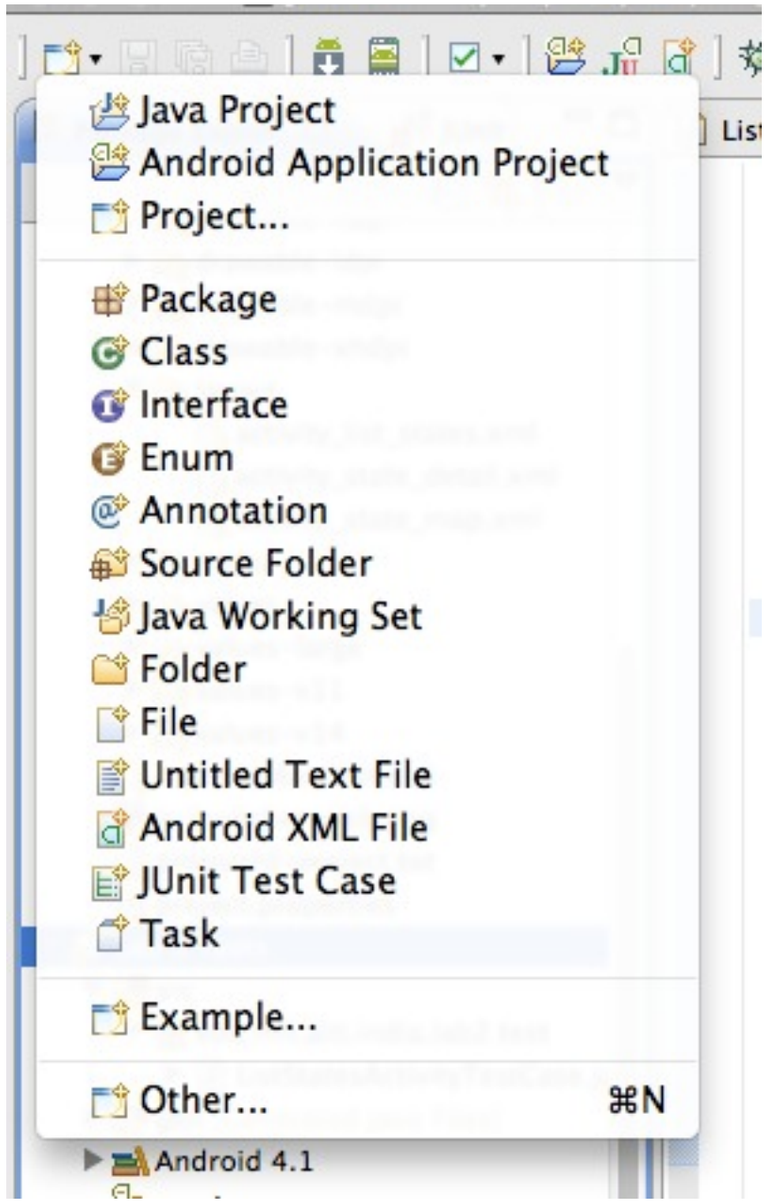
(Yes, this means you need 2 git repositories)

Creating Unit Tests in Eclipse



Choose the project to test

Creating Unit Tests in Eclipse

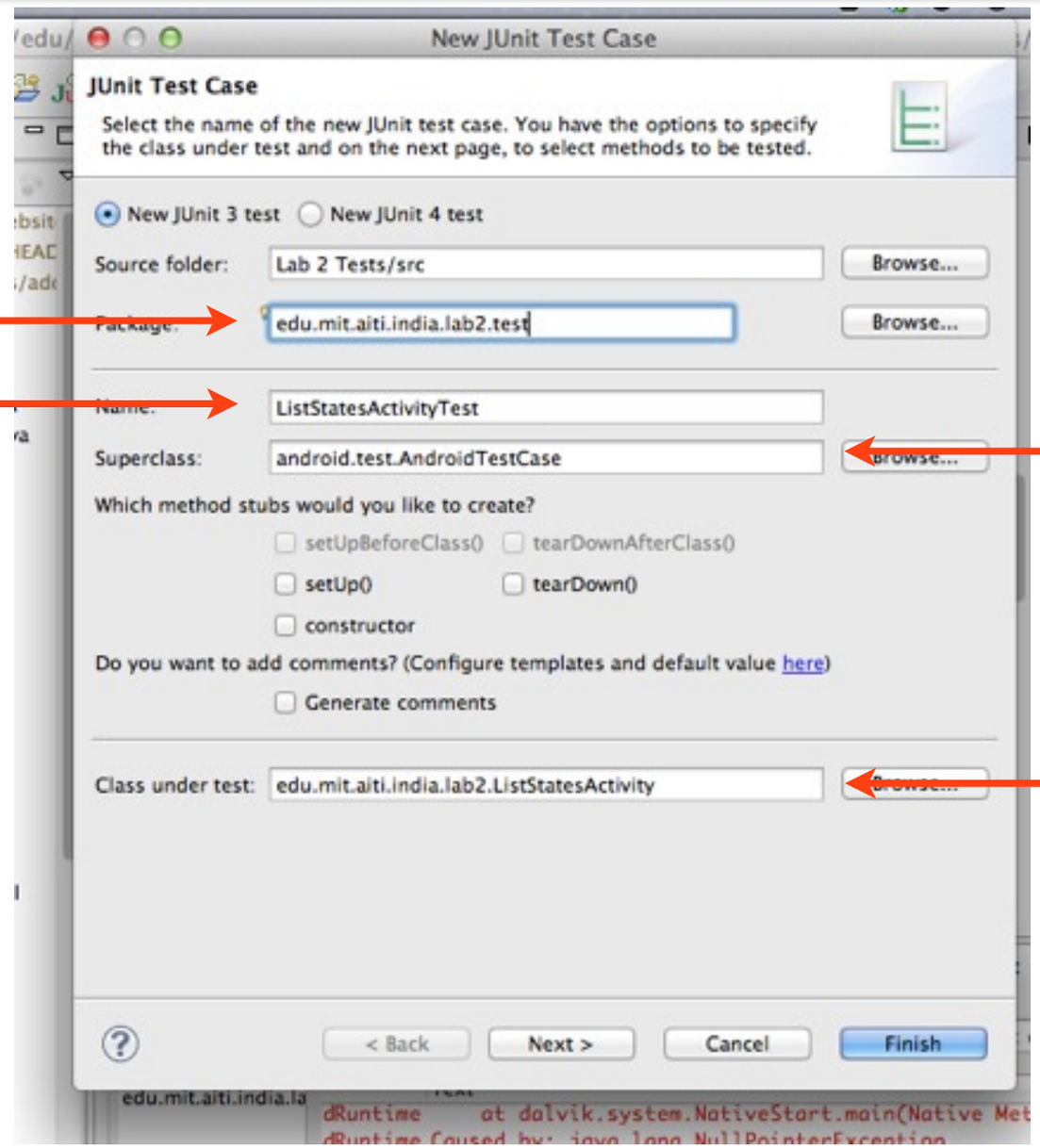


Add a new JUnit Test Case

Creating Unit Tests in Eclipse

Test Package

Test Class Name



Test Superclass

Class being tested

Set the properties of the Test Case

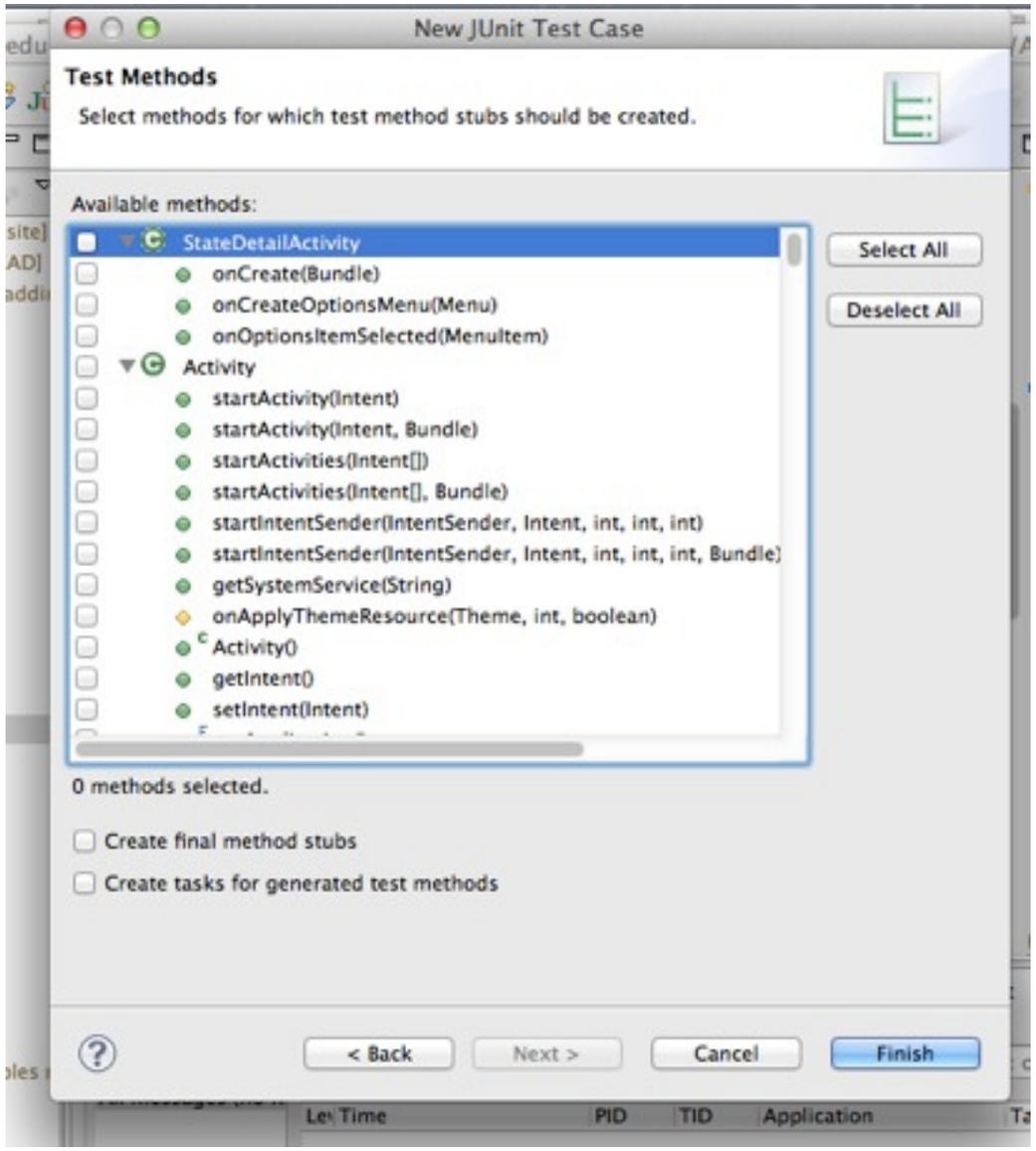
Aside: Test Case Superclasses

- `TestCase` – JUnit default (not for Android classes)
- `AndroidTestCase` – Android default
- `ActivityInstrumentationTestCase2<T>` – Test Activities in Android environment
- `ActivityUnitTestCase<T>` – Test Activities in standalone environment (e.g. to test Intents)
- `ServiceTestCase` – Test Services
- `ProviderTestCase2` – Test Content Providers

What's with the <T>?

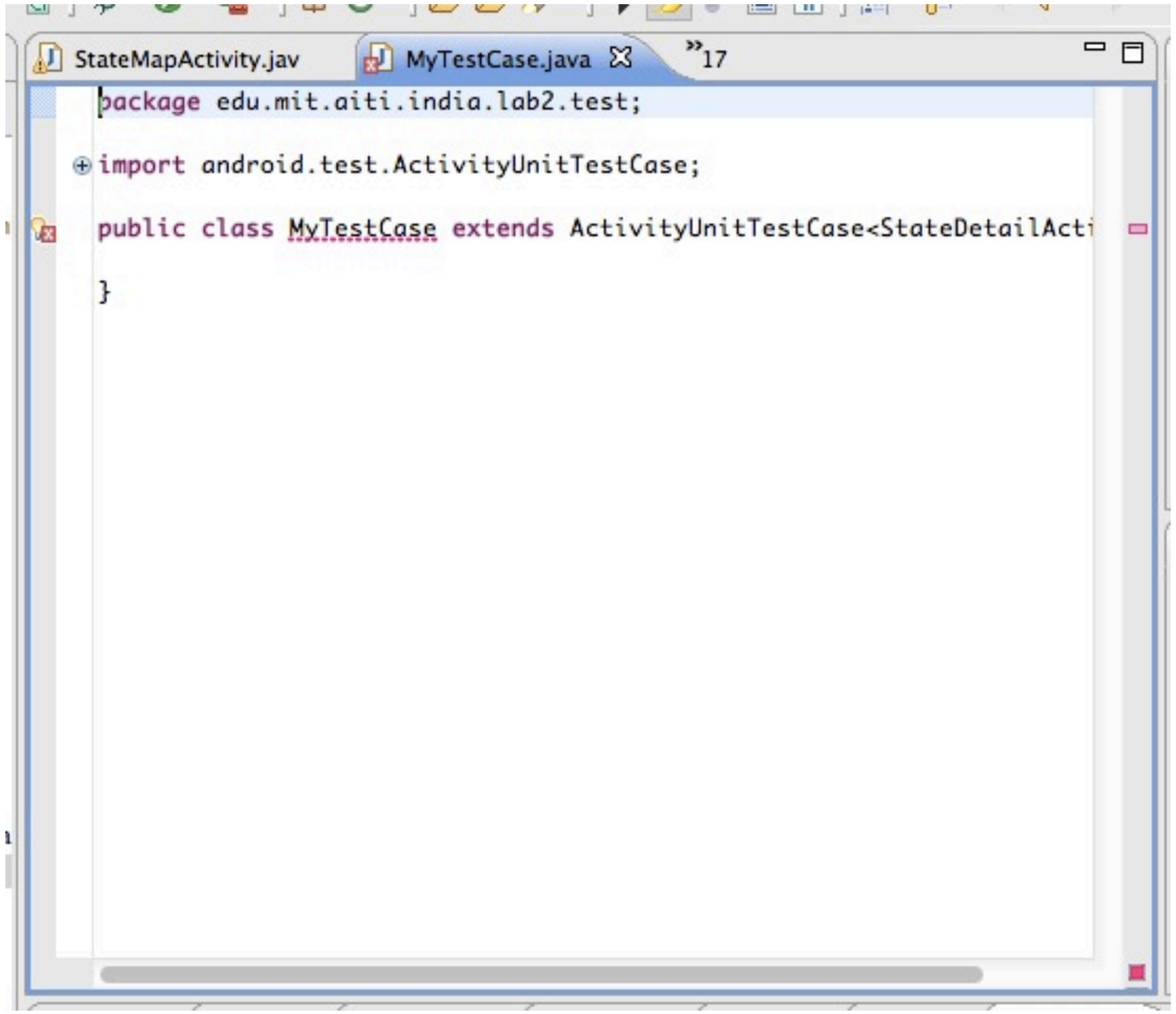
- <T> is used in "generic templates"
- T substituted with a class (e.g. `<MyActivity>`)
- Used with classes to specify the type of class being operated on
  - (e.g. `ArrayList<String>` is an `ArrayList` of `String` objects)

Creating Unit Tests in Eclipse



Select what functions you want to test (if any)

Creating Unit Tests in Eclipse



Basic Unit Test created!

A Live Activity Unit Test!

References

- HttpURLConnection (Android APIs)
  <http://developer.android.com/reference/java/net/HttpURLConnection.html>

- Simple HttpURLConnection example
  <http://digiassn.blogspot.in/2008/10/java-simple-httpurlconnection-example.html>

- How do you GET/POST? See Tim Bray's "HttpURLConnection's Dark Secrets"
  <http://www.tbray.org/ongoing/When/201x/2012/01/17/HttpURLConnection>

- JUnit Cookbook
  <http://junit.sourceforge.net/doc/cookbook/cookbook.htm>

- Android Testing
  <http://developer.android.com/tools/testing/index.html>

- Unit Testing Best Practices
  <http://www.bobmccune.com/2006/12/09/unit-testing-best-practices/>