Lecture 16 — Testing for Android

Jeff Zarnett & Patrick Lam
jzarnett@uwaterloo.ca & p.lam@ece.uwaterloo.ca

Department of Electrical and Computer Engineering
University of Waterloo

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Part I

Code Coverage

Code Coverage

How well are our test cases are testing the program?

Key concept: Code Coverage

What lines of the program are executed during our tests?

Difficult to determine when there is conditional logic.

Conditional Logic

Conditional: a statement evaluated to true or false.

The evaluated value is used to decide what the next step is.

Example: `if (x == 0) { foo(); } else { bar(); }` .

Coverage Definitions

There are some different definitions for coverage:

- **Statement Coverage**
- **Branch Coverage**
- **Multiple Condition Coverage**

“Covered”

A line is “covered” if that line is executed during the course of the test cases.

A branch is covered if that branch is executed during the course of the test cases.

In multiple condition coverage, a class or module is covered if all combinations of the conditionals within it are tested.

“Covered”

We will focus on line coverage, mostly.

Getting 100% statement coverage is generally unrealistic.

Even if we covered all lines, we can still have bugs.

Dividing two numbers may work in the test cases.
result in a divide by zero error if the user puts in 0.

Dead Code

We say code is “dead” if it can never be run.

Sometimes the compiler identifies it for you.

Other times, it’s only revealed by execution.

Dead code does no harm, but effort might be wasted on maintaining it.

Remove it altogether.

Diminishing Returns

As test cases are added we get diminishing returns.

The first test is all “new” lines.

Additional cases might have some overlap.

Case Study: EclEmma

We will examine a plug-in for Eclipse called EclEmma.

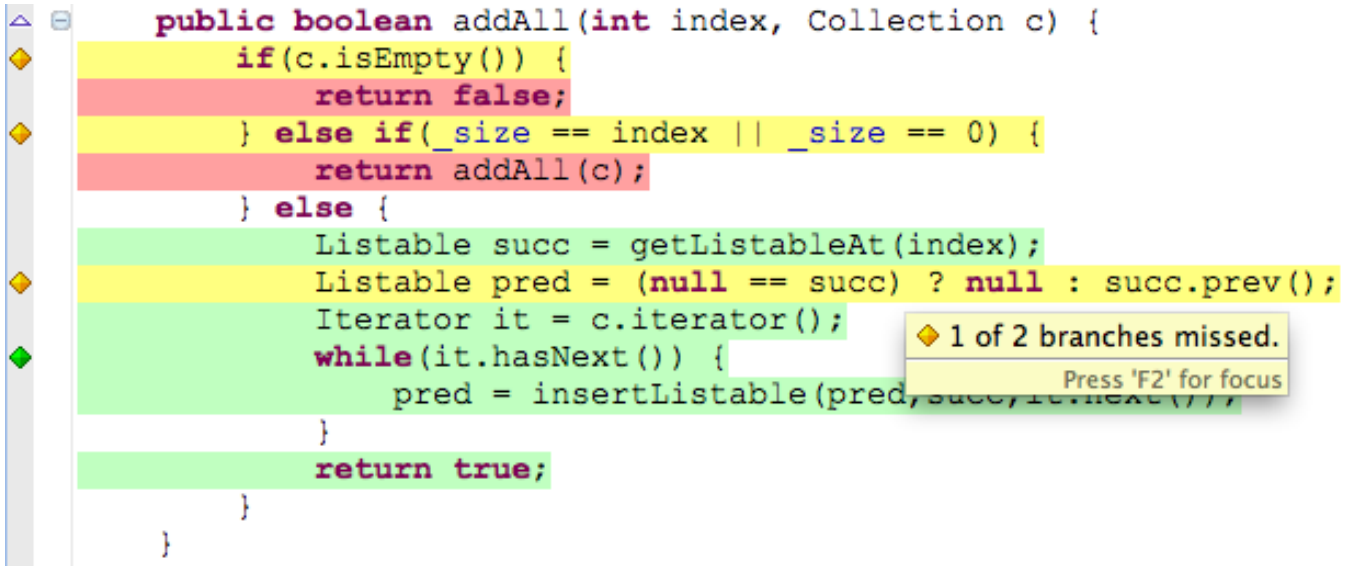
When launched, EclEmma runs the selected unit tests and then analyzes the results.

EclEmma Colour-Coding

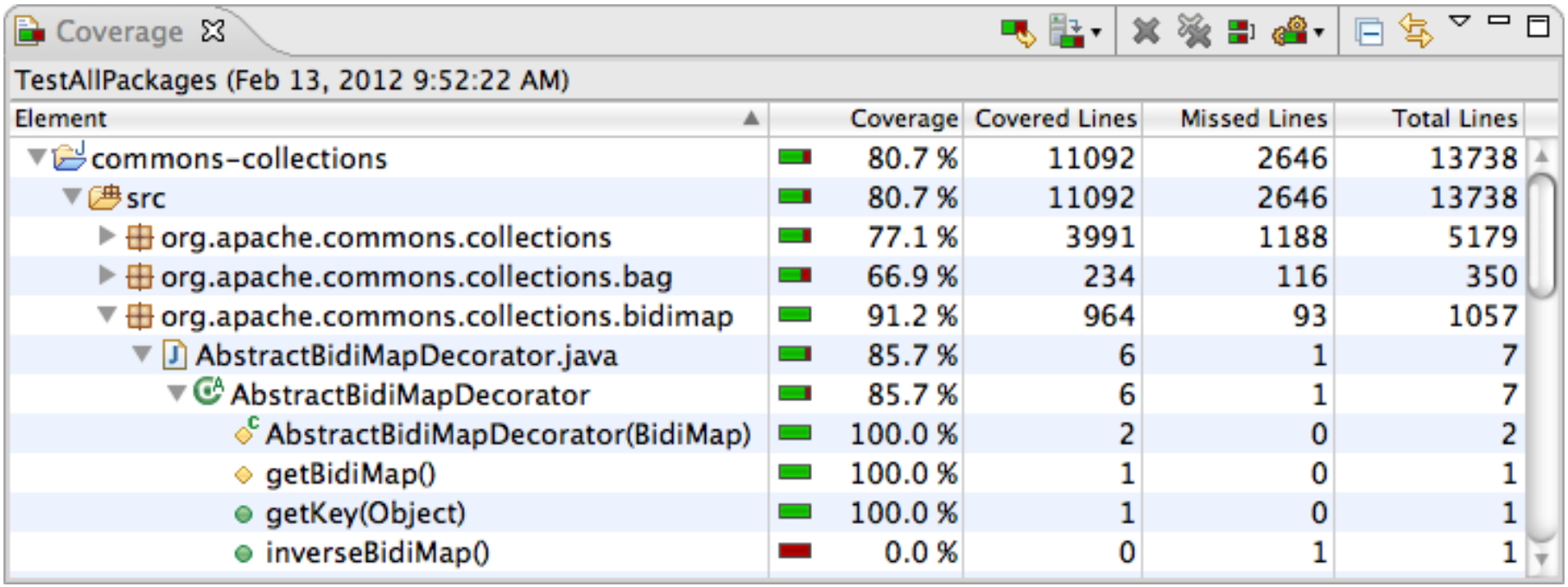
EclEmma will colour-code each line in either:

- **Red** – the line was not executed;
- **Yellow** – a conditional where only one branch was taken (e.g., an if was always evaluated as false); or
- **Green** – the line was executed, or in the case of a conditional, both branches were taken.

EclEmma Colour-Coding



EclEmma Coverage Report



Element	Coverage	Covered Lines	Missed Lines	Total Lines
commons-collections	80.7 %	11092	2646	13738
src	80.7 %	11092	2646	13738
org.apache.commons.collections	77.1 %	3991	1188	5179
org.apache.commons.collections.bag	66.9 %	234	116	350
org.apache.commons.collections.bidimap	91.2 %	964	93	1057
AbstractBidiMapDecorator.java	85.7 %	6	1	7
AbstractBidiMapDecorator	85.7 %	6	1	7
AbstractBidiMapDecorator(BidiMap)	100.0 %	2	0	2
getBidiMap()	100.0 %	1	0	1
getKey(Object)	100.0 %	1	0	1
inverseBidiMap()	0.0 %	0	1	1

Case Study: EclEmma

Using the coverage data, you can decide if your tests are effective in testing the logic of the code.

Too many red lines in the project means more tests (or better tests) are needed.

Exam Question Example

Each line of a method containing logic or a statement is colour-coded:

- Red: if the line was not executed;
- Yellow: if the line is a conditional where only one branch was taken; or
- Green: if the line was executed, or in the case of a conditional, both branches were taken.

Compute Value Function

```
public double computeValue(int input1, int input2) {
  if (input1 < 0) {
    throw new IllegalArgumentException(‘‘Input 1 may not be negative’’);
  }

  if (input2 == -1) {
    return 0;
  } else if (input2 <= 1) {
    return 1;
  }

  int result = (input1 * input2);
  result += (input1 / input2);

  return result;

}
```

Test case 1: `computeValue(7, -1)`
Test case 2: `computeValue(0, 1000)`

Part II

Testing for Android

Avoiding Android-Specific Testing

It's easy if you test classes that don't use Android.

Do that, when possible.

Example:

- put step recognition code in separate class; and
- call that code from your main Activity.

We'd be progressing towards a Model-View-Controller (ECE452) design.

Why Android Testing is Hard

Recall that Android apps are event-driven.

Need something to produce events for you.

This is not really unit testing, more like integration tests.

What To Test[1]

Orientation change:

- is screen redrawn correctly?
- did you lose any state?

Configuration change (e.g. adding a keyboard):

- again as for orientation change;
- do you handle the new device properly?

Battery life:

- don't hog the battery (out of scope for us).

External resources:

- how does your app behave when it doesn't have necessary resources, e.g. GPS?

[1] `http://developer.android.com/tools/testing/what_to_test.html`, accessed 7Feb13.

Android Activity Unit Tests

This is allegedly possible using `ActivityUnitTestCase`.

More like unit tests than what we'll see next.

There is no useful documentation on the Internet, apart from Javadoc.

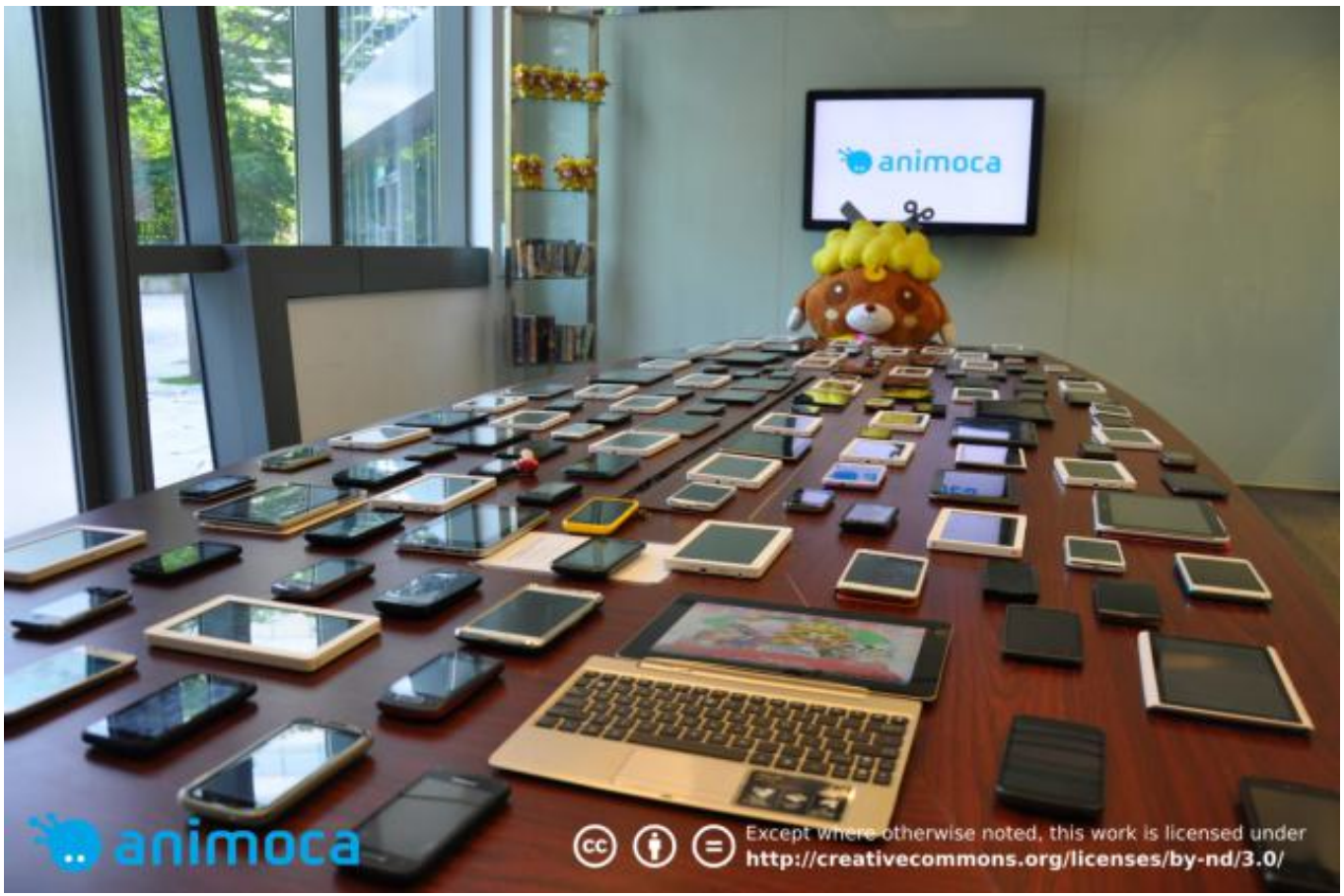
Beyond the scope of this course.

Part III

Case Study: QA for Android Games

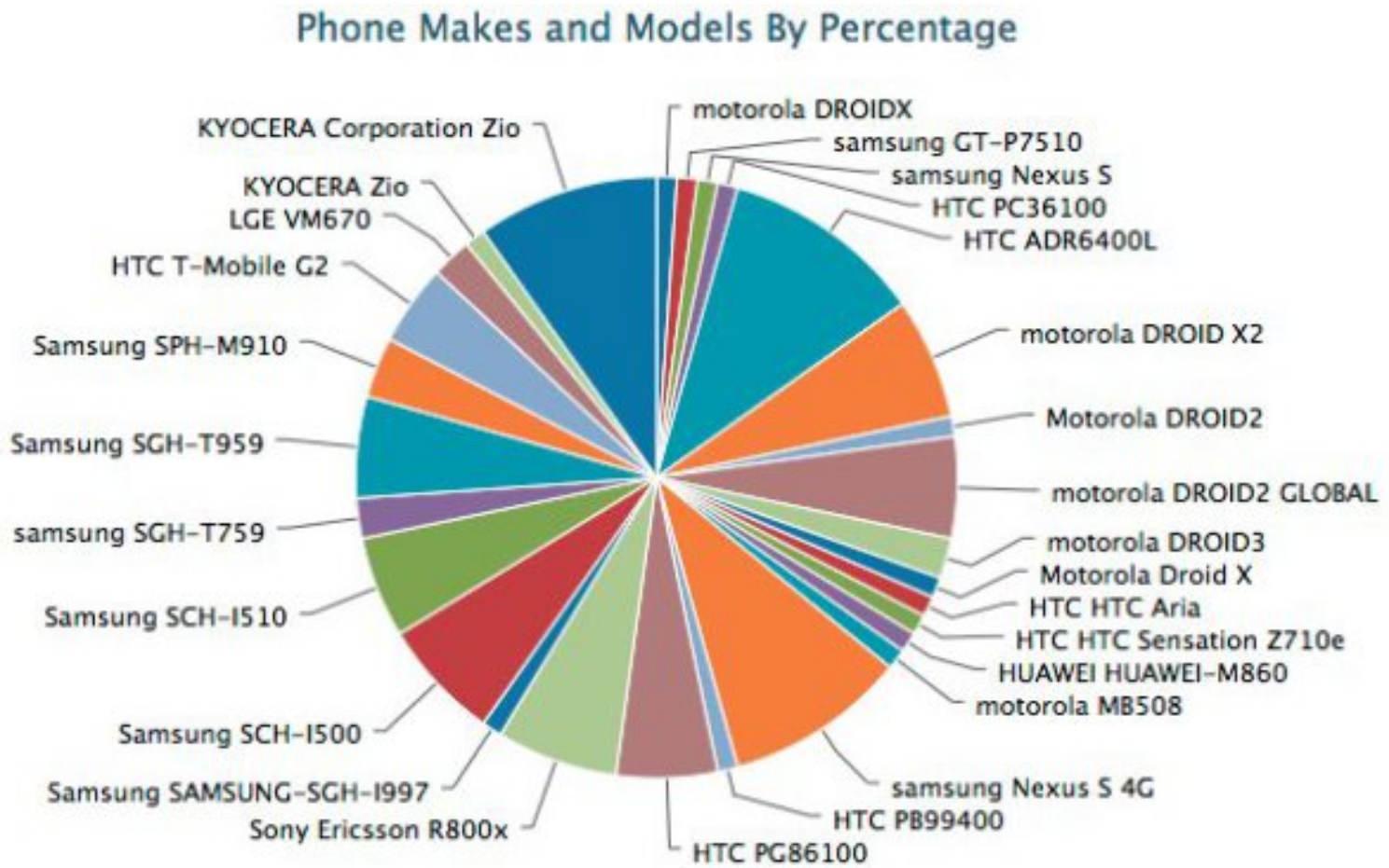
Android Game Testing

Now we will examine a real situation: Android Game Testing



Android Games: Challenge

The biggest challenge is: fragmentation.



Android Game Testing

Tip 1: **Test on Real Devices**.

Emulators are good, but not perfect.

Sensors and touch interface hard to emulate.

Tip 2: **Choose your Devices**.

How many is enough?

Some use a small number (5-12); others $>$ 40.

Criteria: phone vs tablet, highres vs lowres screen, GPU.

Individual devices (e.g., Galaxy S3).

Tip 3: **Know what NOT to test**.

Decide what devices you will not support.

Choose to say no to small, slow, or outdated devices.

Tip 4: **Test Continuously**.

Pocket Gems creates test, but offshore the rest of the testing.

The offshore team files bugs.

Tests created concurrently with development.

Android Game Testing: Lessons

It's not enough to just check the software.
    Battery life, memory use, and performance must be tested.

Testing is tightly integrated - no "big bang" testing.

Run a final, extra thorough test phase before release.