Victoria University of Wellington, New Zealand
Te Whare Wananga o te Upoko o te Ika a Maui
Aotearoa

SWEN221: Software Development

16: Testing III

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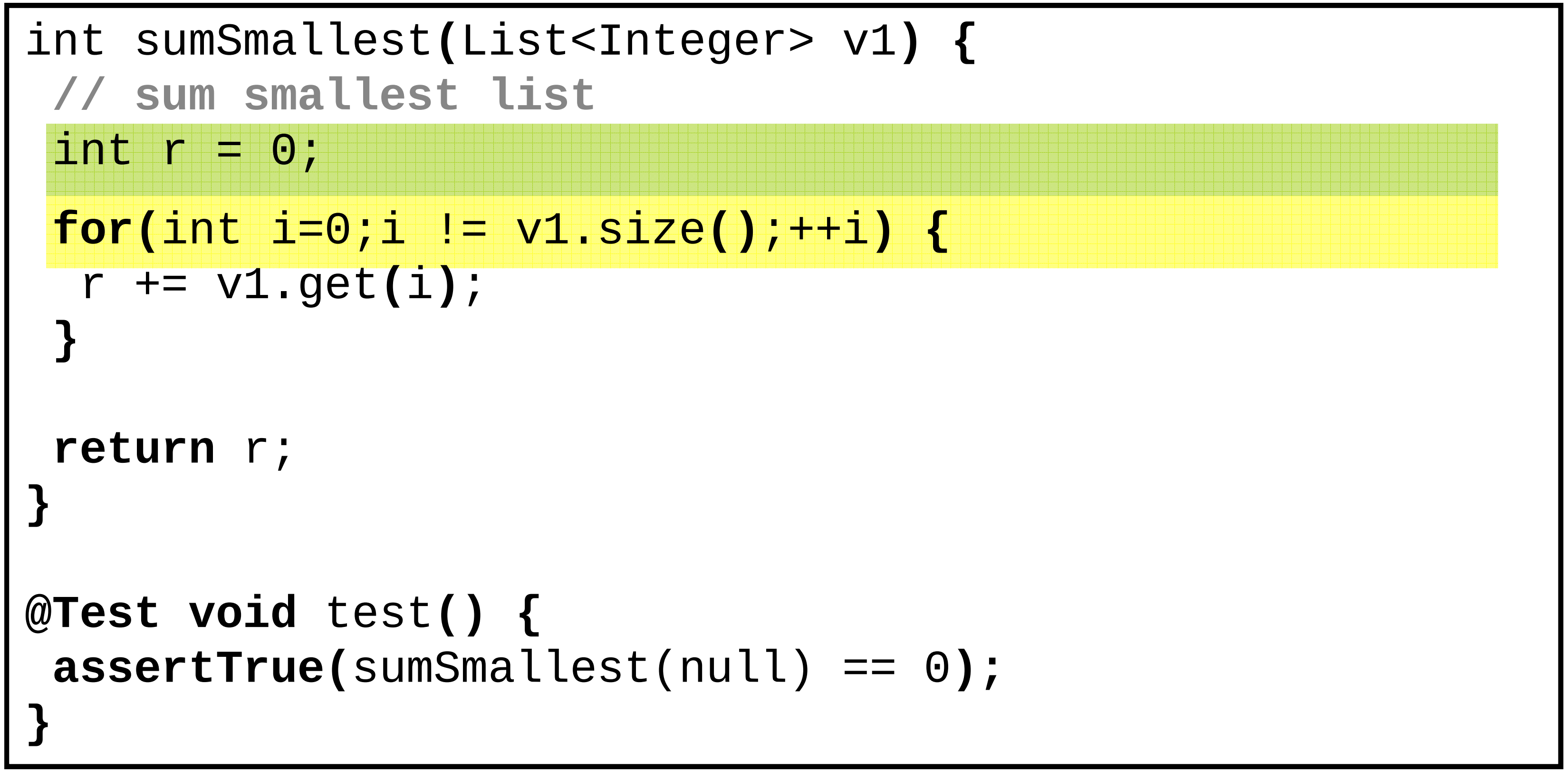
Partial Statement Coverage



```
int sumSmallest(List<Integer> v1) {
 // sum smallest list
 int r = 0;
 for(int i=0;i != v1.size();++i) {
  r += v1.get(i);
 }

 return r;
}

@Test void test() {
 assertTrue(sumSmallest(null) == 0);
}
```

- In EMMA some statements marked yellow
  - Indicates *partial coverage*
  - Statement corresponds to more than one CFG node
  - Some, but not all, of its nodes were executed

Statement & Branch Coverage

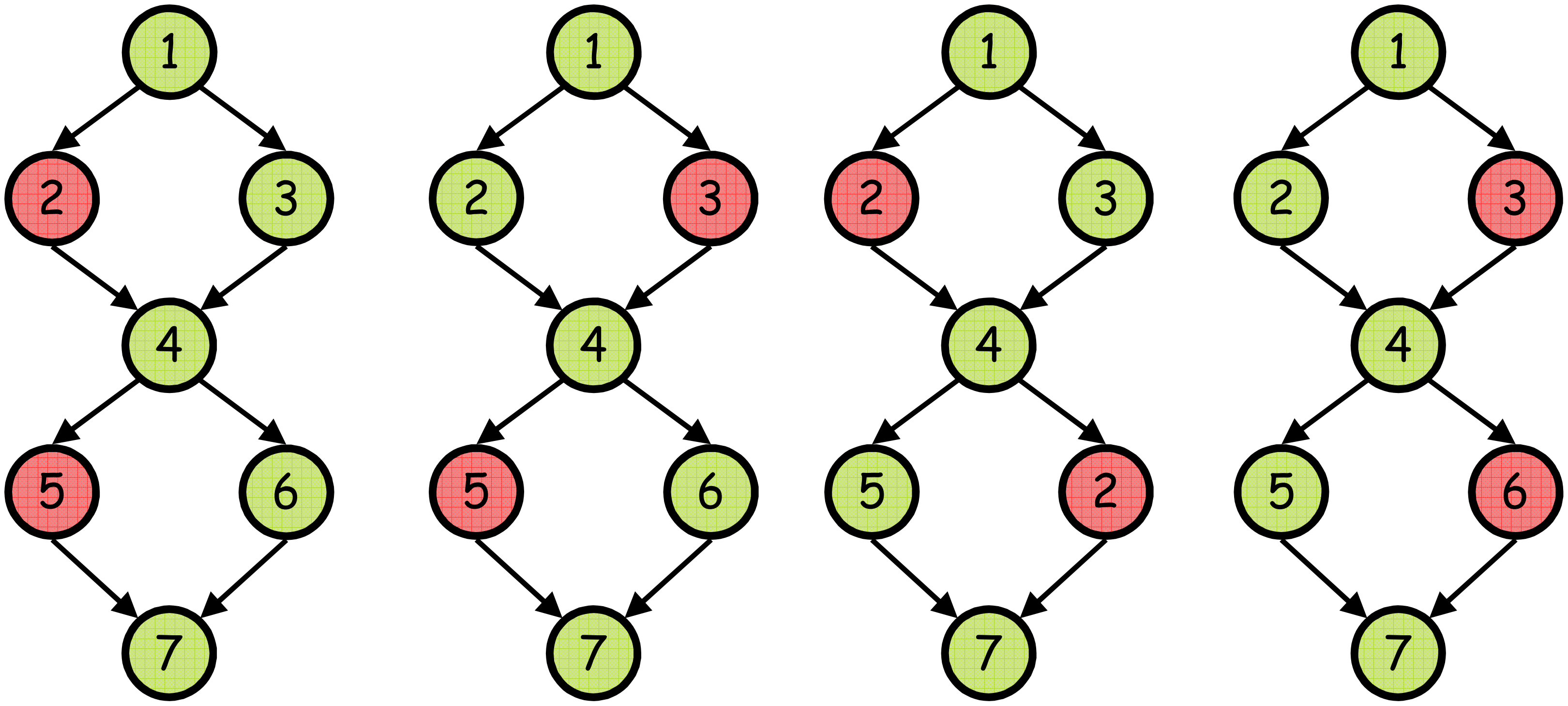
```
class Test {
 static int f(int x, int y) {
  if(x < y && y >= 0) { x = y; y = 0; }
  if(x <= y) { x = x / y; }
  return x;
}}

@Test void tester() {
 assertTrue(Test.f(0,5) == 5);
 assertTrue(Test.f(-4,-2) == 2);
}
```

- Compute (as %):
  - Statement Coverage
  - Branch Coverage

- Q) What's the problem ?

Execution Paths

Definition: An **execution path** a path through a method’s CFG which corresponds to an execution of that method.



- Here, four distinct paths through CFG
- **100% Path Coverage**: tested all paths through CFG

Infeasible Paths

- Consider this method:

```
class Test {
 static int f(int x, int y) {
  if(x < y) { x = -y;}
  if(x >= y) { x = y; }
  return x;
}}

@Test void tester() {
 assertTrue(Test.f(0,5) == -5);
 assertTrue(Test.f(5,0) == 0);
}
```

- How many execution paths are there here?
- What path coverage is obtained here?

Loops

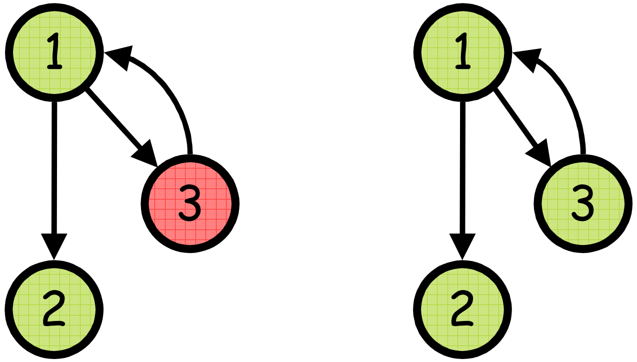
- Consider this method:

```
class Test {
 static int sum(int x, int y) {
  int s = 0;
  for(int i=x;i<y;++i) {
   s = s + i;
  }
  return s;
}}
```

- Q) How many execution paths are there here?

Simple Path Coverage

Definition: A **simple execution path** is a path through the method which iterates each loop at most once.



- Simple Path Coverage Criteria:
  - Aim to test all simple paths through a method
  - Helps keep the number of tests manageable
  - Two paths in above loop example

```
int sumSmallest(List<Integer> v1, List<Integer> v2) {
 // sum smallest list
 int r = 0;
 if(v1.size() <= v2.size()) {
  for(int i=0;i != v1.size();++i) { r += v1.get(i); }
 } else { for(int i=0;i != v2.size();++i) { r += v2.get(i); }}
 return r;
}

@Test void tester() {
 List<Integer> EMPTY = new ArrayList<Integer>();
 List<Integer> NONEMPTY = new ArrayList<Integer>();
 NONEMPTY.add(1);
 assertTrue(sumSmallest(EMPTY, EMPTY) == 0);
 assertTrue(sumSmallest(NONEMPTY, EMPTY) == 0);
 assertTrue(sumSmallest(NONEMPTY, NONEMPTY) == 0);
}
```

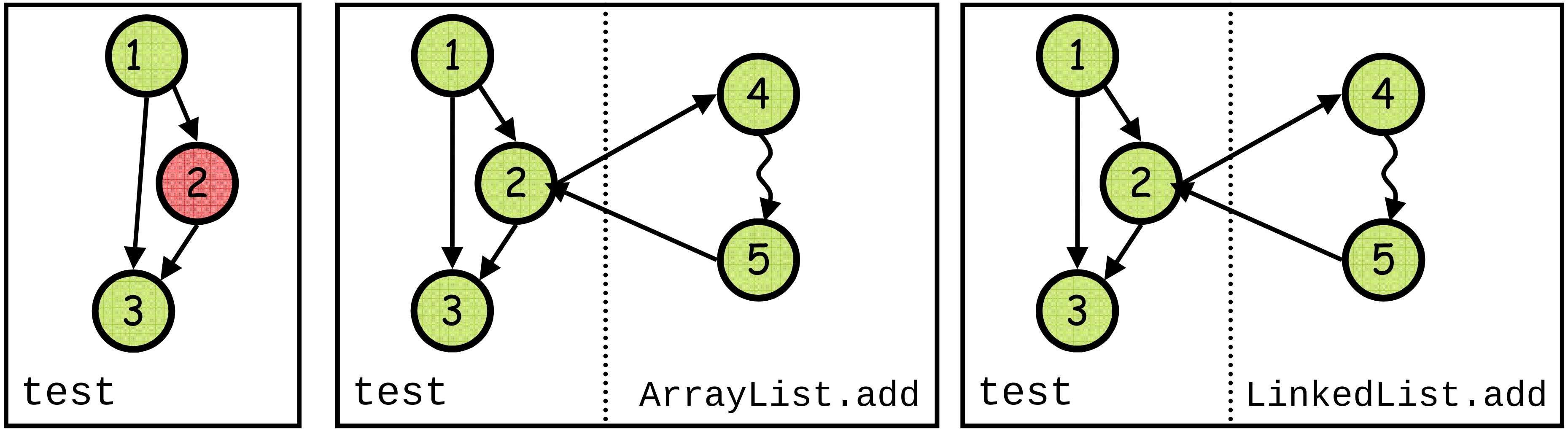
- Calculate (as %):
  - Simple Path Coverage

Coverage & Object Orientation

- Consider this method:

```
public void test(int x, List<String> ls) {
 if(x == 0) { ls.add(“Hello”); }
}
```

- Now, consider some execution paths:



- So, how many execution paths are possible?

Coverage & Object Orientation

Definition: A **polymorphic execution path** is a path through one or more dynamically dispatched method calls

- Recall Dynamic Dispatch:
  - Method executed depends on dynamic type of receiver
  - So, providing different instances can have different behaviour
  - i.e. different execution paths
- Polymorphic Code Coverage:
  - Given a fixed set of classes
  - Can determine maximum number of polymorhic paths
  - Hence, can determine polymorphic code coverage