

CSE 503

Software Engineering

Winter 2021

Software Testing

January 27, 2021

Automated Test Generation

Challenges for Automated Testing



```
1 Packet filter(Server s) {  
2     Packet p = s.readUDP();  
3  
4  
5     p = ... // filter packet  
6  
7     return p;  
8 }
```

How to write tests for filter?

Challenges for Automated Testing



```
1 Random r = new Random();  
2  
3 int rnd(int a, int b) {  
4     int n = r.nextInt(a, b);  
5     return n;  
6  
7  
8 }
```

How to write tests for rnd?

Challenges for Automated Testing



```

1 public List sort(List l) {
2     List s = shuf(l);
3     ... // sort the list
4     return s;
5 }
6
7 private List shuf(List l) {
8     List shuf = ...;
9     ... // shuffle the list
10    return shuf;
11 }
    
```

How to thoroughly test shuf?

Effectiveness guarantees

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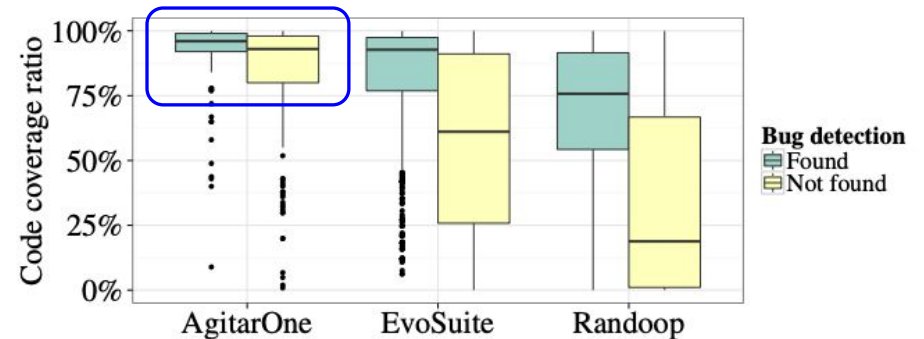


Fig. 3: Code coverage ratios for generated test suites that found a bug and generated test suites that did not. The differences are significant for all tools (Mann-Whitney U test, $p < 0.001$).

Challenges for Automated Test Generation

- Effectiveness (generated tests' ability to detect faults)
- Readability (generated tests' clarity)
- Maintainability (co-evolution of code and tests)

Other challenges

“If you ask Randoop to test code that modifies your file system (such as `File.delete()`), then Randoop will generate tests that modify your file system! Be careful when choosing classes and methods to test.”

Live demo

Instructions



1. `git clone https://github.com/rjust/defects4j defects4j`
2. `cd defects4j`
3. `./init.sh`
4. `./framework/bin/defects4j checkout -p Lang -v 12f -w ./Lang-12`
5. `./framework/bin/gen_tests.pl -g evosuite -pLang -v12f -n1 -o ./gen-tests -b30`
6. `./framework/bin/gen_tests.pl -g randoop -pLang -v12f -n1 -o ./gen-tests -b30`
7. `./framework/bin/defects4j coverage -w ./Lang-12 -s./gen-tests/Lang/evosuite/1/Lang-12f-evosuite.1.tar.bz2`
8. `./framework/bin/defects4j coverage -w ./Lang-12 -s./gen-tests/Lang/randoop/1/Lang-12f-randoop.1.tar.bz2`
9. (View:
 - a. `./Lang-12/src/main/java/org/apache/commons/lang3/RandomStringUtils.java`
 - b. `./gen-tests/Lang/randoop/1/Lang-12f-randoop.1.tar.bz2`
 - c. `./gen-tests/Lang/evosuite/1/Lang-12f-evosuite.1.tar.bz2`