CSE 503

Software Engineering

Winter 2021

Software Testing

January 27, 2021

Automated Test Generation

Challenges for Automated Testing

```
1 Packet filter(Server s) {
2
3   Packet p = s.readUDP();
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
5   int n = r.nextInt(a, b);
6
7   return n;
8 }
```

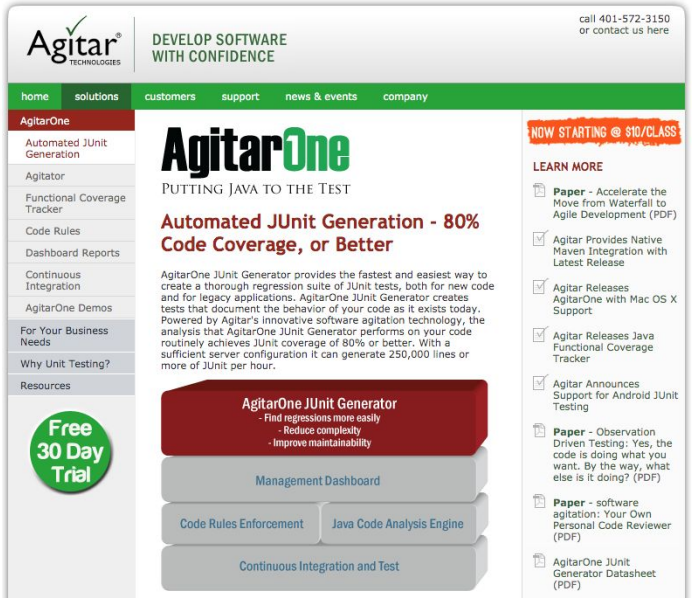
How to write tests for `rnd`?

Challenges for Automated Testing

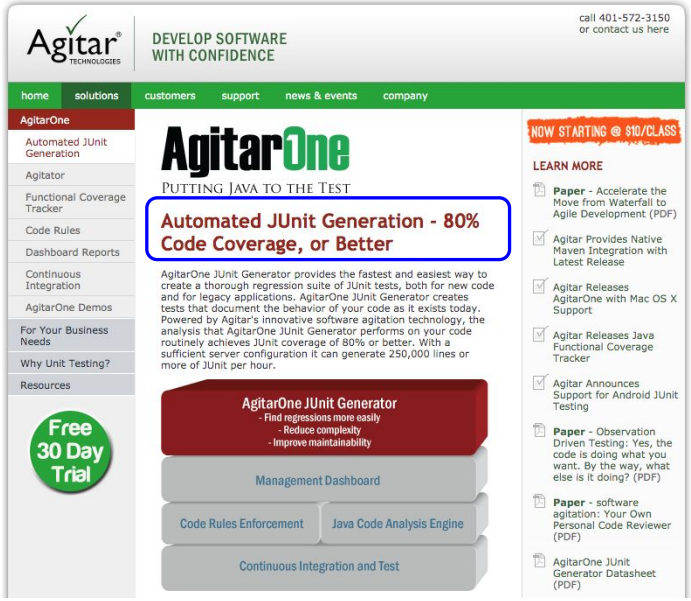
```
1  public List sort(List l) {
2    List s = shuf(l);
3    … // sort the list
4    return s;
5  }
6
7  private List shuf(List l) {
8    List shuf = …;
9    … // shuffle the list
10   return shuf;
11 }
```

How to thoroughly test `shuf`?

Effectiveness guarantees



Effectiveness guarantees



Effectiveness guarantees

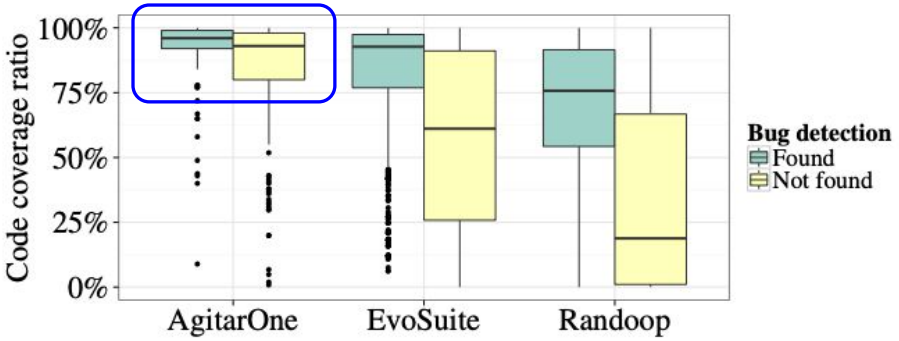


Fig. 3: Code coverage ratios for generated test suites that found a bug and generated test suites that did not. The differences are significant for all tools (Mann-Whitney U test, $p < 0.001$).

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)