# symflower

AUTOMATING QUALITY ASSURANCE

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# Fantastic Bugs

symflower
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… and Where to Find Them

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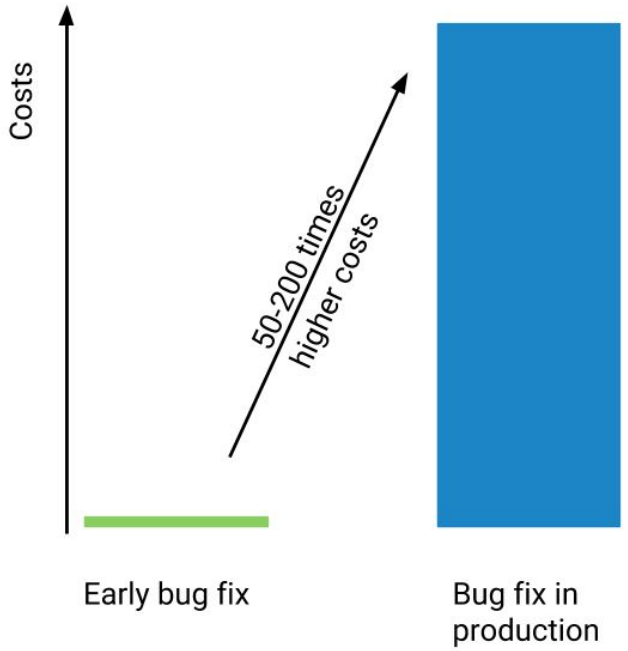
# Some Fantastic Bugs(/Problems)

- Ariane 5 Flight 501 ($370.0M)
  - Reuse of code led to overflow 64bit->16bit
- Mars Climate Orbiter ($327.6M)
  - Expected different unit for metrics in one component
- Heartbleed Bug (>$500.0M)
  - Wrong bound-checking in kind of unused feature
- Year 2000 problem (>$300.0B <- B as in billion!)
  - Huge part: software testing

# The Problem

- Software has errors
- Testing is time-consuming
- Humans are inaccurate




**Over 30% of software development time is consumed by quality assurance.**

# Even More Problems

- Worst-case: customer finds problems first
- Customers are usually **really bad** reporters
- Reproducing **external** problems is very hard
- Reproducing **system** problems is hard
- Fixing production problems is “tricky”
- Fixing problems often creates more problems

# Solutions

- 1) Early detection
  - Find problems before they go into production
  - Find problems **before they even go into staging**
- 2) Automate the complete testing process
  - Machines scale, humans do not
- 3) (Very very) thorough testing
  - Only feasible on the unit level (?)

# Implementation of Solution 1&2

- CI/CD (Continuous Integration/Deployment)
  - Build, static analysis, automated tests, … per change
  - Automated deployments do not make mistakes
- “Testing” deployments
  - Find component/system problems on live environment
  - Copy “real” data to find outliers
  - Migrate deployment first to get ~real scenario
- CODE REVIEWS!

# Problems with 2&3

- Am I testing the “right” things?
  - Specification-based testing?

(Java Code)

```java
static int compare(int a, int b) {
    int c = a - b;

    if (c < 0) {
        return -1;
    } else if (c > 0) {
        return 1;
    } else {
        return 0;
    }
}
```

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**Overflow, e.g. with a=0, b=-2147483648 -> c=-2147483648**

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  - MC/DC coverage?

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**y=0 leads to “division by zero”**

**… and there is an overflow:**

**x=-2147483648, y=-1 -> -2147483648**

(Java Code)

```java
public static boolean isSorted(int[] a) {
    int i = 0;
    while (i < a.length - 1 && a[i] <= a[i + 1]) {
        i = i + 1;
    }

    return i == a.length - 1;
}
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  - When do I know that I have tested enough?
- How to automate not just the test execution?

# Suggestions to Approximate 2&3

- “Mutation Testing” for existing tests
  - Check if the whole implementation is **really** covered
  - E.g. https://github.com/zimmski/go-mutesting
- Mold implementation into test cases
  - One test case for every “interesting” path
  - Specification can then be checked with all cases
- Find test cases
  - E.g. Fuzzing+MBT or better: Symflower

# We Are Hiring!

- We offer
  - challenging algorithmic tasks to work on
  - state of the art development processes and tools
  - a work environment that you can shape with us

- Talk to me, or Evelyn after the lecture
- Drop us an email with your CV at you@symflower.com

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