Code Coverage

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Lecture #15 out of 24
80 minutes

Example, Part I

Live Code:

```
1  int fibonacci(int n) {
2    if (n <= 0) {
3      return 0;
4    }
5    if (n <= 2) {
6      return 1;
7    }
8    return fibonacci(n-1)
9      + fibonacci(n-2);
10 }
```

Test Code:

```
1 assert fibonacci(1) == 1;
2 assert fibonacci(2) == 1;
```

$$C = 3/10 = 30\%$$

Example, Part I

Live Code:

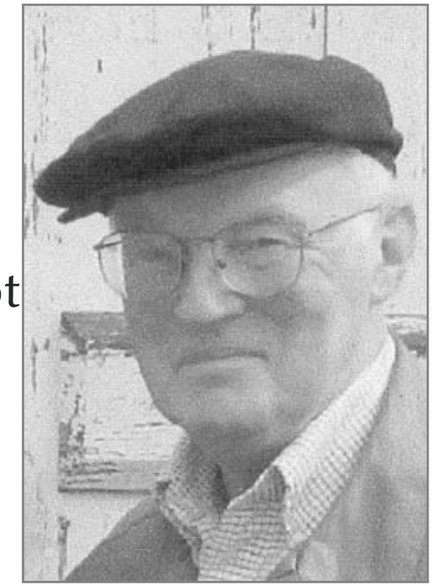
```
1  int fibonacci(int n) {
2    if (n <= 0) {
3      return 0;
4    }
5    if (n <= 2) {
6      return 1;
7    }
8    return fibonacci(n-1)
9      + fibonacci(n-2);
10 }
```

Test Code:

```
1 assert fibonacci(1) == 1;
2 assert fibonacci(2) == 1;
3
4 assert fibonacci(9) == 34;
5 assert fibonacci(10) == 55;
```

$$C = 5/10 = 50\%$$

+2pt



“A disciplined test control process is composed of five steps: 1) establish the intended extent of testing; 2) create a list of functional variations eligible for testing; 3) rank and subset the eligible variations so that test resources can be directed at those with the higher payoff; 4) calculate the test coverage of the test case library; and 5) verify attainment of the planned test coverage.”

— William Robert Elmendorf, *Controlling the Functional Testing of an Operating System*, IEEE Transactions on Systems Science and Cybernetics, 5(4), 1969

+2pt

“Junky software takes more tests to achieve coverage, but it breaks under any systematic test.”

— *Black Box Testing*, Boris Beizer, 1995

+2pt

“Coverage numbers (like many numbers) are dangerous because they’re objective but incomplete. They too often distort sensible action. Using them in isolation is as foolish as hiring based only on GPA.”

— Brian Marick, *How to Misuse Code Coverage*, 1997

+2pt

“I would be suspicious of anything like 100% — it would smell of someone writing tests to make the coverage numbers happy, but not thinking about what they are doing.”

— Martin Fowler, *Test Coverage*, 1997

+2pt

“Our results show that coverage has an insignificant correlation with the number of bugs that are found after the release of the software at the project level, and no such correlation at the file level.”

— *Code Coverage and Postrelease Defects: A Large-Scale Study on Open Source Projects*, Pavneet Singh Kochhar, David Lo, Julia Lawall, Nachiappan Nagappan, IEEE Transactions on Reliability, 66(4), 2017

+2pt

“Google does not enforce any code coverage thresholds across the entire codebase. Projects (or groups of projects) are free to define their own thresholds and goals. Many projects opt-into a centralized voluntary alerting system that defines five levels of code coverage thresholds.”

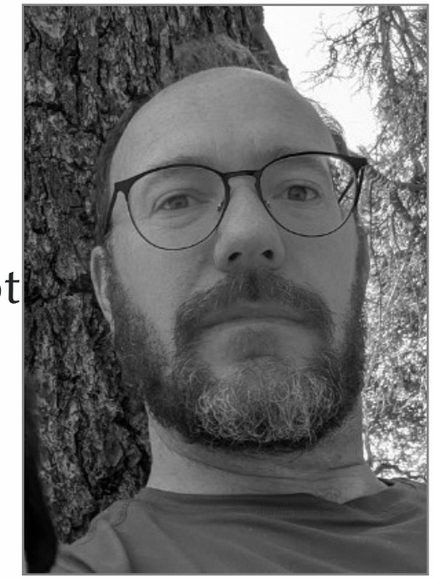
— *Code Coverage at Google*, Goran Petrović, Marko Ivanković, René Just, Gordon Fraser, Proceedings of the 27th Joint Meeting on ESEC/FSE, 2019

Code Coverage Threshold Levels in Google

Table 2: Coverage levels and corresponding thresholds. Many projects voluntarily set these thresholds as their goal.

Level	Threshold
Level 1	Coverage automation disabled
Level 2	Coverage automation enabled
Level 3	Project coverage at least 60%; Changelist coverage at least 70%
Level 4	Project coverage at least 75%; Changelist coverage at least 80%
Level 5	Project coverage at least 90%; Changelist coverage at least 90%

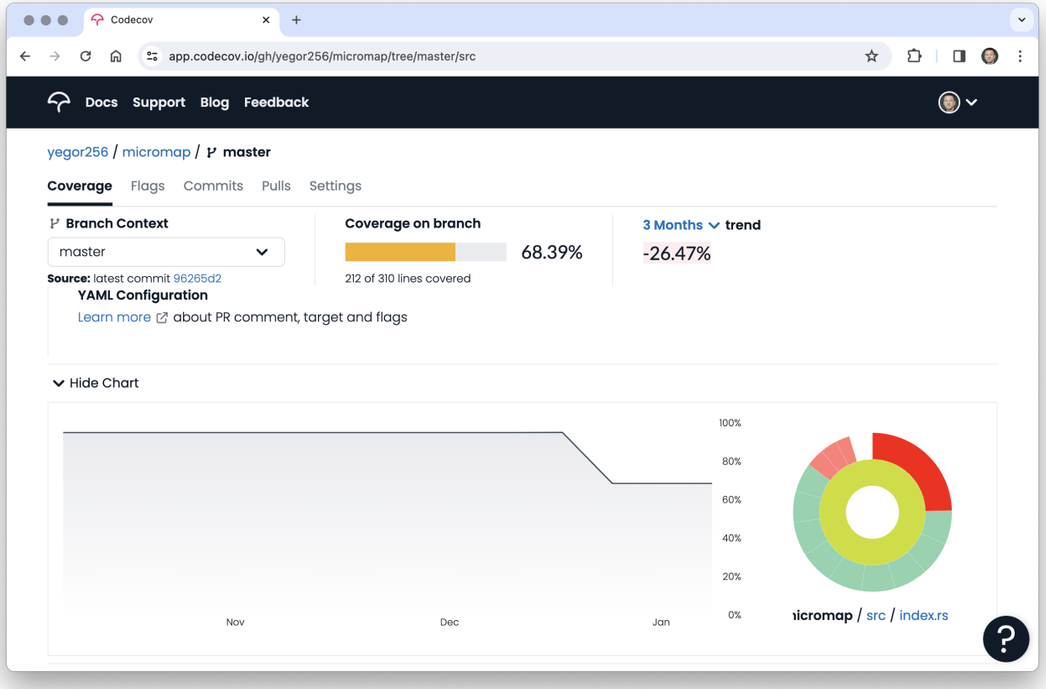
+2pt



“Code coverage does not guarantee that the covered lines or branches have been tested correctly, it just guarantees that they have been executed by a test. But a low code coverage number does guarantee that large areas of the product are going completely untested by automation on every single deployment.”

— *Code Coverage Best Practices*, Carlos Arguelles, Marko Ivanković, Adam Bender, Google Blog, 2020

Codecov.io


Codecov
app.codecov.io/gh/yegor256/micromap/tree/master/src
Docs Support Blog Feedback
yegor256 / micromap / master
Coverage Flags Commits Pulls Settings
Branch Context
master
Source: latest commit 96265d2
Coverage on branch
68.39%
212 of 310 lines covered
3 Months trend
-26.47%
YAML Configuration
Learn more about PR comment, target and flags
Hide Chart
100%
80%
60%
40%
20%
0%
Nov
Dec
Jan
micromap / src / index.rs

Line Coverage

yegor256 / micromap / master

Coverage Flags Commits Pulls Settings

micromap / src / iterators.rs — Uncovered | Partial | Covered

```
110     #[inline]
111     #[must_use]
112     fn into_iter(self) -> Self::IntoIter {
113         IntoIter {
114             pos: 0,
115             map: ManuallyDrop::new(self),
116         }
117     }
118 }
119
120 impl<K: PartialEq, V, const N: usize> Drop for IntoIter<K, V, N> {
121     fn drop(&mut self) {
122         for i in self.pos..self.map.len {
123             self.map.item_drop(i);
124         }
125     }
126 }
127
128 impl<'a, K, V> DoubleEndedIterator for Iter<'a, K, V> {
129     fn next_back(&mut self) -> Option<Self::Item> {
130         self.iter.next_back().map(|p| {
131             let p = unsafe { p.assume_init_ref() };
132             (&p.0, &p.1)
133         })
134     }
135 }
```

Tarpaulin for Rust

Code | Blame | 23 lines (23 loc) · 551 Bytes | Raw

```yaml
---
name: tarpaulin
on:
  push:
    branches:
      - master
jobs:
  tarpaulin:
    runs-on: ubuntu-22.04
    steps:
      - uses: actions/checkout@v4
      - uses: actions-rs/toolchain@v1
        with:
          toolchain: stable
          override: true
      - uses: actions-rs/tarpaulin@v0.1
        with:
          version: '0.22.0'
          args: '--all-features --exclude-files src/lib.rs -- --test-threads 1'
      - uses: codecov/codecov-action@v3
        with:
          token: ${{ secrets.CODECOV_TOKEN }}
          fail_ci_if_error: true
```

Code Coverage can be calculated by a few tools:

- JaCoCo for Java
- Istanbul for Javascript
- Gcov for C/C++
- Coverage.py for Python
- Simplecov for Ruby
- Tarpaulin for Rust

Read this:

Code Coverage Best Practices, Carlos Arguelles, Marko Ivanković, Adam Bender, Google Blog, 2020

Black Box Testing, Boris Beizer, John Wiley & Sons, 1995