Cognitive Complexity

Yegor Bugayenko

Lecture #3 out of 24
80 minutes

The slidedeck was presented by the author in this YouTube Video

1. Cyclomatic complexity is highly inaccurate if being compared with code readability evaluated by a human.

Ann Campbell

"A guiding principle in the formulation of Cognitive Complexity has been that it should incent good coding practices. That is, it should either ignore or discount features that make code more readable."

— G. Ann Campbell. Cognitive Complexity: An Overview and Evaluation. In *Proceedings of the International Conference on Technical Debt*, pages 57–58, 2018. doi:10.1145/3194164.3194186

```
int sumOfPrimes(int max) {                    // +1          String getWords(int number) { // +1
  int total = 0;                                               switch (number) {
  OUT: for (int i = 1; i <= max; ++i) { // +1                    case 1:                    // +1
    for (int j = 2; j < i; ++j) {        // +1                     return "one";
      if (i % j == 0) {                  // +1                   case 2:                    // +1
        continue OUT;                                             return "a couple";
      }                                                         case 3:                    // +1
    }                                                             return "a few";
    total += i;                                               default:
  }                                                             return "lots";
  return total;                                              }
}                    // Cyclomatic Complexity 4            }      // Cyclomatic Complexity 4
```

"The mathematical model underlying Cyclomatic Complexity gives these two methods equal weight, yet it is intuitively obvious that the control flow of `sumOfPrimes` is more difficult to understand than that of `getWords`"

Source: G. Ann Campbell. {Cognitive Complexity} — A New Way of Measuring Understandability, 2017

```
int sumOfPrimes(int max) {                           String getWords(int number) {
  int total = 0;                                        switch (number) {              // +1
  OUT: for (int i = 1; i <= max; ++i) { // +1             case 1:
    for (int j = 2; j < i; ++j) {        // +2              return "one";
      if (i % j == 0) {                  // +3           case 2:
        continue OUT;                    // +1             return "a couple";
      }                                                  case 3:
    }                                                      return "a few";
    total += i;                                          default:
  }                                                        return "lots";
  return total;                                        }
}                      // Cognitive Complexity 7       }      // Cognitive Complexity 1
```

"The Cognitive Complexity algorithm gives these two methods markedly different scores, ones that are far more reflective of their relative understandability."

Source: G. Ann Campbell. {Cognitive Complexity} — A New Way of Measuring Understandability, 2017

Luigi Lavazza

"Being able to find statistical correlations between code understandability and source code measures would be greatly beneficial for the software development process, which involves a great deal of activities involving program comprehension."

— Luigi Lavazza, Abedallah Zaid Abualkishik, Geng Liu, and Sandro Morasca. An Empirical Evaluation of the "Cognitive Complexity" Measure as a Predictor of Code Understandability. *Journal of Systems and Software*, 197:111561, 2023. doi:10.1016/j.jss.2022.111561

CoCo is supported in a few static analyzers:

- in PMD since 6.22.0

- in Rubocop since 0.25 (called "perceived complexity")

- in ESLint via SonarSource plugin

- in Flake8 via this plugin

- in Clippy since 1.35.0

- in PHPCS via this plugin

2. "Perceived complexity" is human's impression and conceptualization of a system as being complex.

Social Code Analysis

"Social code analysis enriches our understanding of the code quality by overlaying a developer's behavior with the structural analysis of the code" — Technology Radar of ThoughtWorks, March 2017

"BrainMaster Technologies (USA) sells this "Freedom 20R" EEG head set for $31,025. A similar device you can get from Neiry (Russia), for 3% of this price."

References

G. Ann Campbell. {Cognitive Complexity} — A New Way of Measuring Understandability, 2017.

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