Coupling & Cohesion

and Other Metrics

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Lecture #15 out of 16
90 minutes

- Size and Complexity Metrics
- Coupling and Cohesion
- Productivity and Its Metrics
- Books, Venues, Call-to-Action

Chapter #1:

Size and Complexity Metrics

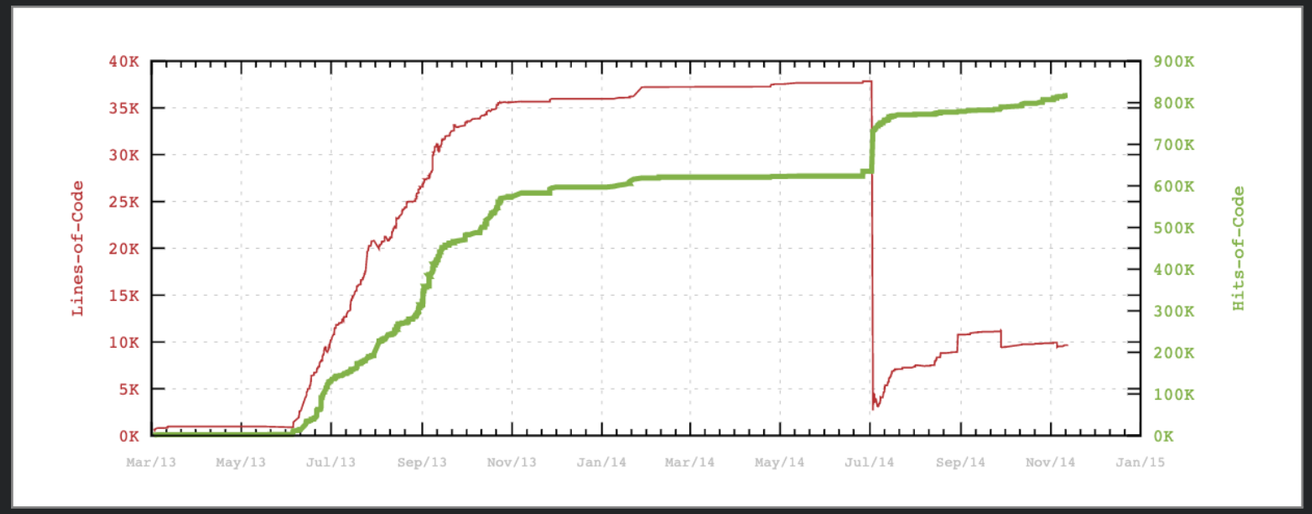
Software Lines of Code (SLOC)

```
/code/takes$ cloc .
     519 text files.
     517 unique files.
      16 files ignored.

github.com/AlDanial/cloc v 1.74  T=2.11 s (238.3 files/s, 25238.0 lines/s)
-------------------------------------------------------------------------------
Language                     files          blank        comment           code
-------------------------------------------------------------------------------
Java                           467           3289          22432          24646
Markdown                         9            236              0           1067
Maven                            2              8             58            678
XSLT                            14             56            266            219
YAML                             5              4              4            155
XML                              3             12             57             74
HTML                             2              8             38             57
Velocity Template Language       2              0              0              5
-------------------------------------------------------------------------------
SUM:                           504           3613          22855          26901
-------------------------------------------------------------------------------
```

https://github.com/AlDanial/cloc

Hits Of Code (HoC) or Code Churn



https://www.yegor256.com/2014/11/14/hits-of-code.html
https://hitsofcode.com/
J.C. Munson et al., *Code churn: a measure for estimating the impact of code change*, International Conference on Software Maintenance (ICSM), 1998

McCabe Cyclomatic Complexity (CC)

Mathematically, the cyclomatic complexity of a structured program[a] is defined with reference to the control-flow graph of the program, a directed graph containing the basic blocks of the program, with an edge between two basic blocks if control may pass from the first to the second. The complexity **M** is then defined as[2]

$$M = E - N + 2P,$$

where

E = the number of edges of the graph.
N = the number of nodes of the graph.
P = the number of connected components.

Introduced by by Thomas J. McCabe, Sr. in 1976

Cognitive Complexity (CoC)

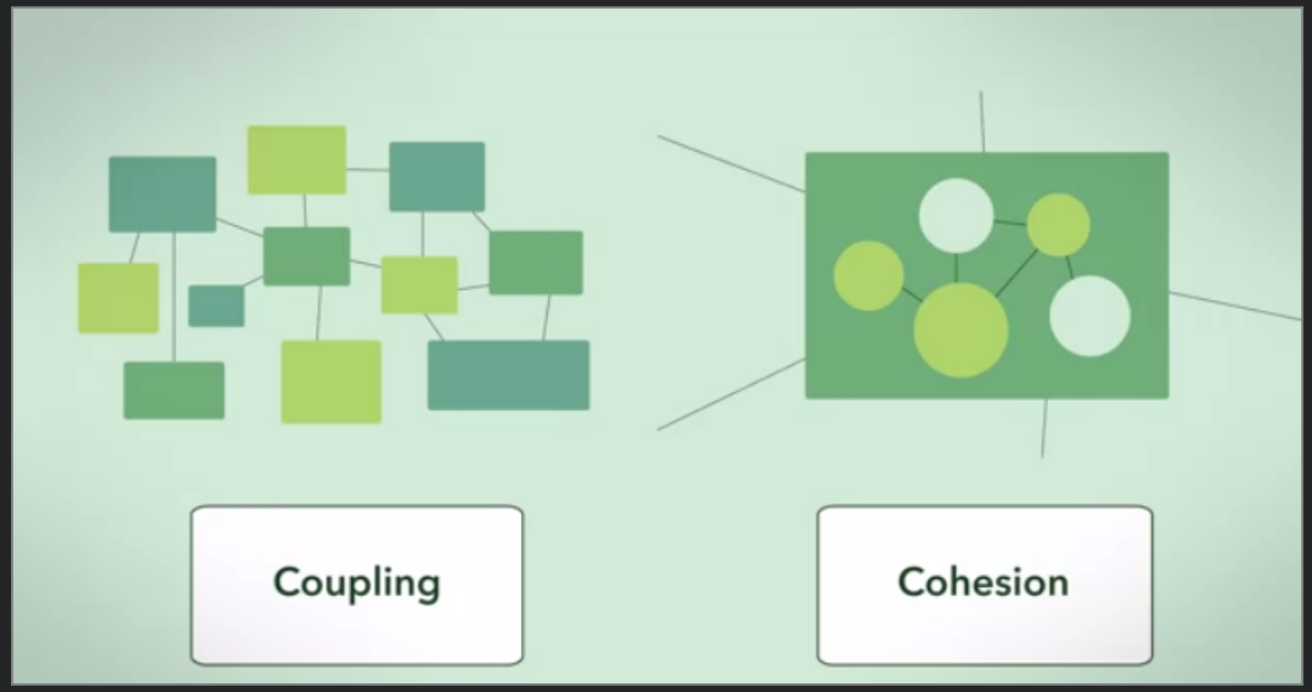
```
void myMethod () {
  try {
    if (condition1) {                    // +1
      for (int i = 0; i < 10; i++) {     // +2 (nesting=1)
        while (condition2) { … }         // +3 (nesting=2)
      }
    }
  } catch (ExcepType1 | ExcepType2 e) { // +1
    if (condition2) { … }                // +2 (nesting=1)
  }
}                                        // Cognitive Complexity 9
```

by G. Ann Campbell, SonarSource, 2011

Chapter #2:

Coupling and Cohesion

Low Coupling and High Cohesion



Invented by Larry Constantine in the late 1960s as part of a structured design.

Lack of Cohesion of Methods (LCOM)

The Lack of Cohesion of Methods (**LCOM**) is a correlation between the methods and the local instance variables of a class (we use the version suggested by Henderson-Sellers et al. [19], also known as LCOM5). Let m be the number of methods, a be the number of attributes and μ_j be the amount of methods, which use attribute j, then,

$$LCOM = \frac{1}{1-m}\left(\frac{1}{a}\sum_{j=1}^{a}\mu_j\right) - m.$$

Method-Method through Attributes Cohesion (MMAC)

The Method-Method through Attributes Cohesion (**MMAC**) metric, introduced by Dallal and Briand [13], is the average cohesion of all pairs of methods. Let k be the number of methods, l be the number of distinct parameter types, and x_i be the number of methods that use type i, then,

$$MMAC = \frac{1}{lk(k-1)} \sum_{i=1}^{l} x_i(x_i - 1).$$

Normalized Hamming Distance (NHD)

The Normalized Hamming Distance (**NHD**) class cohesion metric, introduced by Counsell et al. [11], measures the similarity in all methods of a class in terms of the types of their arguments. Let l be the number of distinct parameter types, k be the number of methods, and c_j be the number of methods that have a parameter of type j, then,

$$NHD = 1 - \frac{2}{lk(k-1)} \sum_{j=1}^{l} c_j(k - c_j).$$

Sensitive Class Cohesion Metric (SCOM)

The Sensitive Class Cohesion Metric (**SCOM**), introduced by Fernández and Peña [14], is a ratio of the summation of connection intensities $C_{i,j}$ of all pairs (i, j) of m methods to the total number of pairs of methods. Connection intensity must be given more weight $\alpha_{i,j}$ when such a pair involves more attributes:

$$SCOM = \frac{2}{m(m-1)} \sum_{i=1}^{m-1} \sum_{j=i+1}^{m} C_{i,j} \times \alpha_{i,j}$$

Chapter #3:

Productivity and Its Metrics

Some Productivity Metrics

- Features Delivered
- Pull Requests Merged
- Bugs Fixed
- Bugs Reported
- Releases Published
- Uptime
- Cost of Pull Request
- Mentee Results

https://www.yegor256.com/shift-m/2020/44.html →

Soft Skills

Drawing

Writing

Reporting

Branching

Asking

Charging

Relaxing

https://www.yegor256.com/2018/08/29/soft-skills.html →

Blame the Code, Not Yourself

https://www.yegor256.com/2018/04/17/how-to-be-lazy.html
https://www.yegor256.com/2015/02/16/it-is-not-a-school.html

Aim for Speed, Not for Quality

https://www.yegor256.com/2018/03/06/speed-vs-quality.html

Avoid Meetings

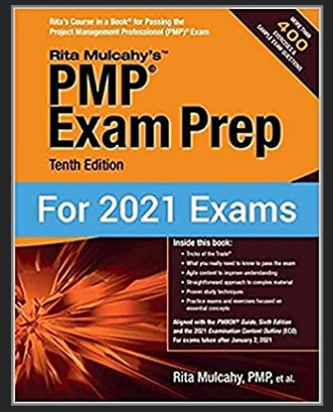
https://www.yegor256.com/2015/07/13/meetings-are-legalized-robbery.html
https://www.yegor256.com/2015/01/08/morning-standup-meetings.html

Work for Product, Not for Boss

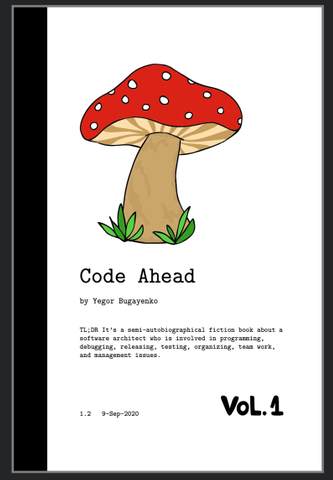
https://www.yegor256.com/2015/01/26/happy-boss-false-objective.html
https://www.yegor256.com/2015/02/23/haircut.html

Chapter #4:

Books, Venues, Call-to-Action



“PMP Exam Prep: Tenth Edition” by Rita Mulcahy



“Code Ahead” by Yegor Bugayenko

Where to go:

International Conference on Software Metrics in Software Engineering (ICSMSE)

Call to Action:

Configure automated collection of cohesion and other metrics in your project, and publish the numbers on each build.

Still unresolved issues:

- How to measure code readability?
- How to connect management and software metrics?
- How to balance different metrics?
- How to predict the future using metrics?