

Coupling and Cohesion

and Other Metrics

YEGOR BUGAYENKO

Lecture #15 out of 16

90 minutes

All videos are in [this YouTube playlist](#).

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Size and Complexity Metrics

Coupling and Cohesion

Productivity and Its Metrics

Books, Venues, Call-to-Action

Chapter #1:

Size and Complexity Metrics

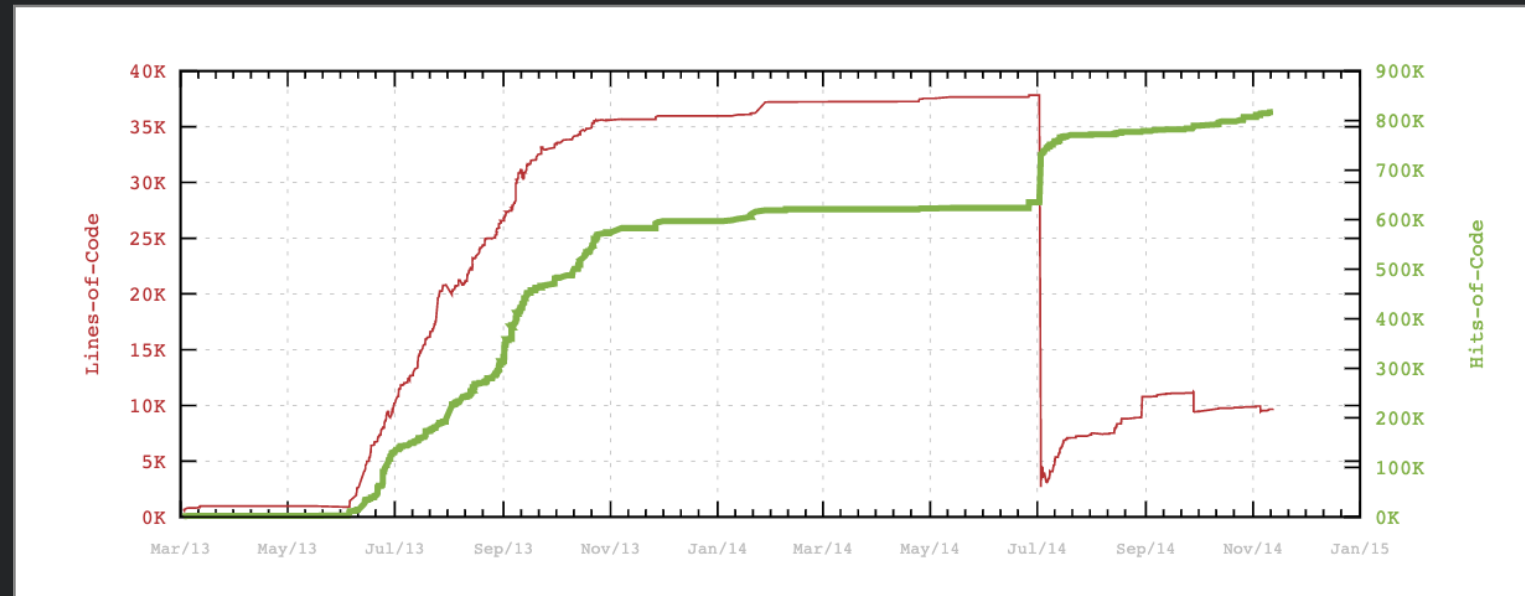
Software Lines of Code (SLoC)

```
/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)

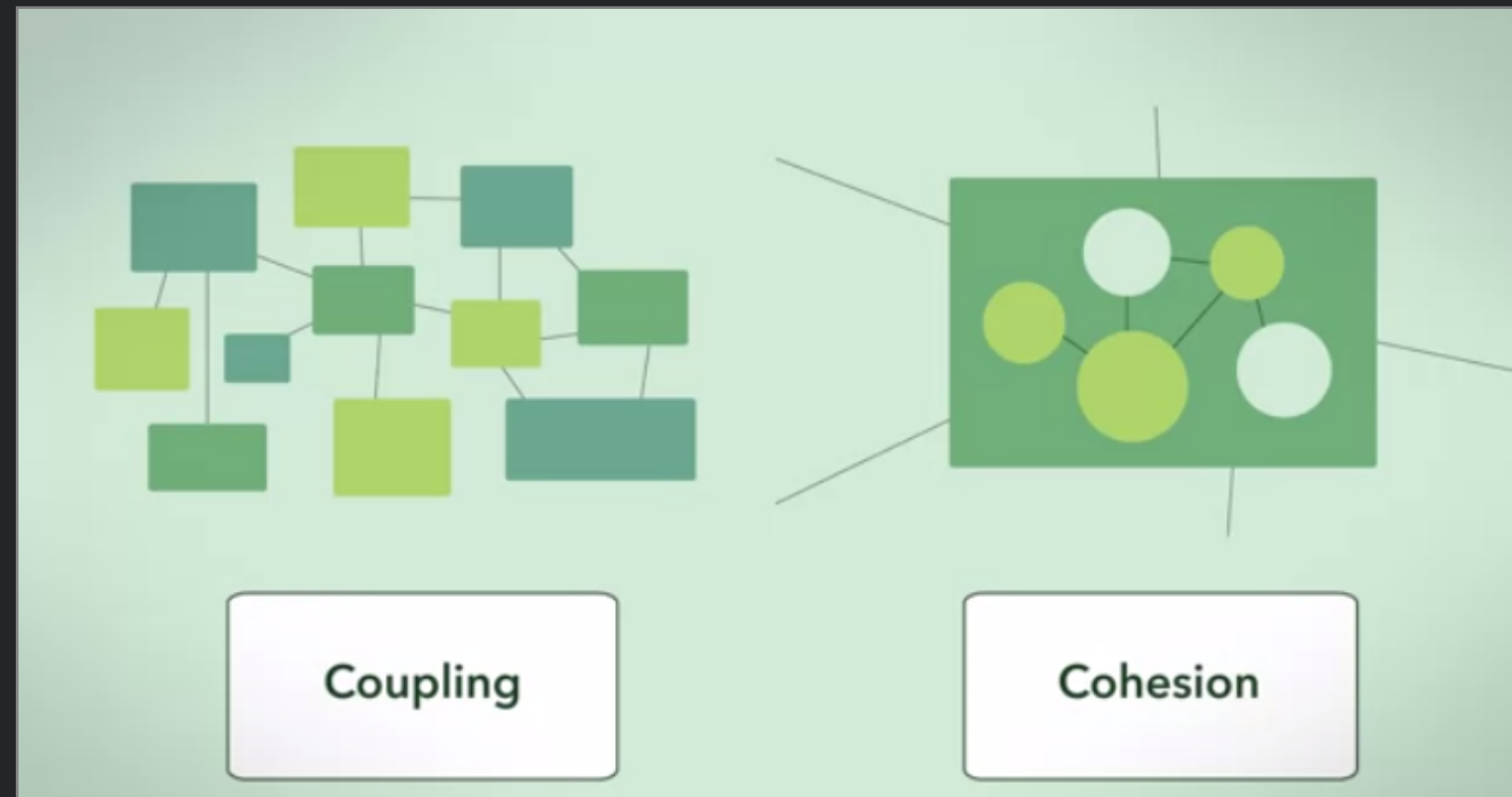
```
void myMethod () {  
    try {  
        if (condition1) {                // +1  
            for (int i = 0; i < 10; i++) { // +2 (nesting=1)  
                while (condition2) { ... } // +3 (nesting=2)  
            }  
        }  
    } catch (Exception1 | Exception2 e) { // +1  
        if (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



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]Soft Skills

Drawing

Writing

Reporting

Branching

Asking

Charging

Relaxing



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

Size C-and-C Productivity B.V.C.

17/25

[NoBlame NoQuality NoQuality NoMeetings NoBoss]

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>

Size C-and-C Productivity B.V.C.
[NoBlame NoQuality NoQuality NoMeetings NoBoss]

18/25

Aim for Speed, Not for Quality

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

Size C-and-C Productivity B.V.C.

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[NoBlame NoQuality NoQuality NoMeetings NoBoss]

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>

Size C-and-C Productivity B.V.C.

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[NoBlame NoQuality NoQuality NoMeetings NoBoss]

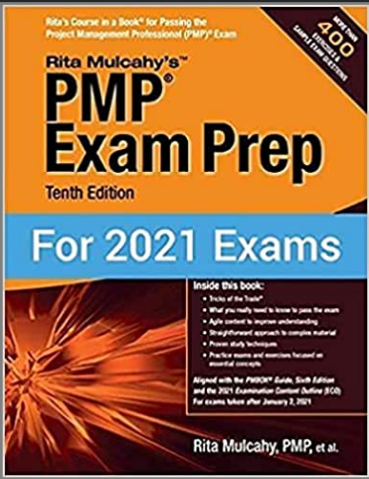
Work for Product, Not for Boss

<https://www.yegor256.com/2015/01/26/happy-boss-false-objective.html>

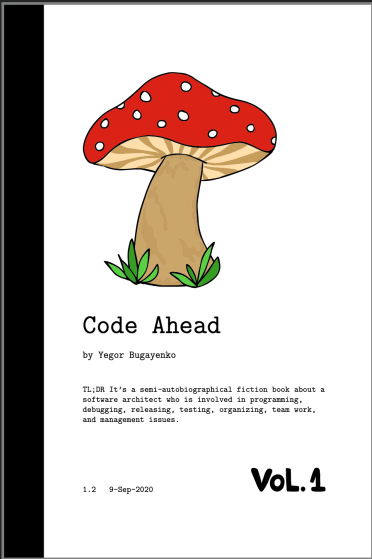
<https://www.yegor256.com/2015/02/23/haircut.html>

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?