

# Coupling and Cohesion

## and Other Metrics

YEGOR BUGAYENKO

Lecture #15 out of 16

80 minutes

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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

[ [SLoC](#) HoC CC CoC ]

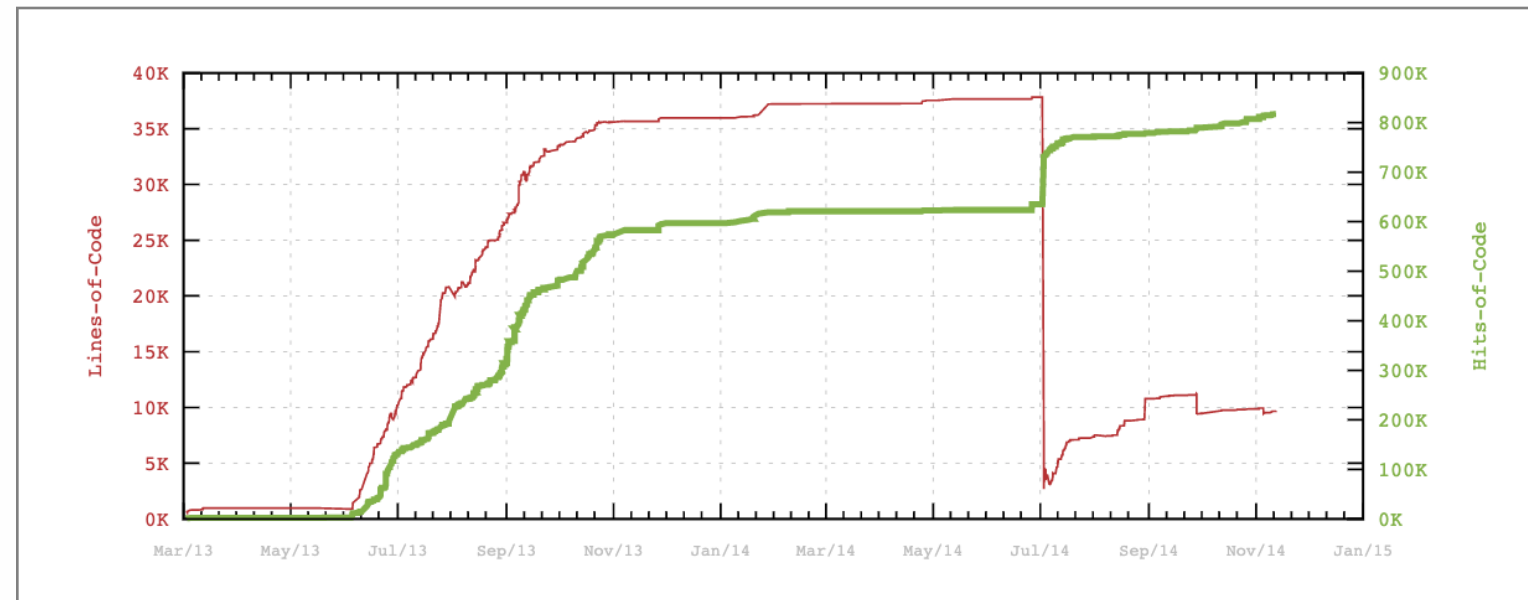
## Software Lines of Code (SLoC)

```
/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](#)<sup>[a]</sup> 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<sup>[2]</sup>

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

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
```

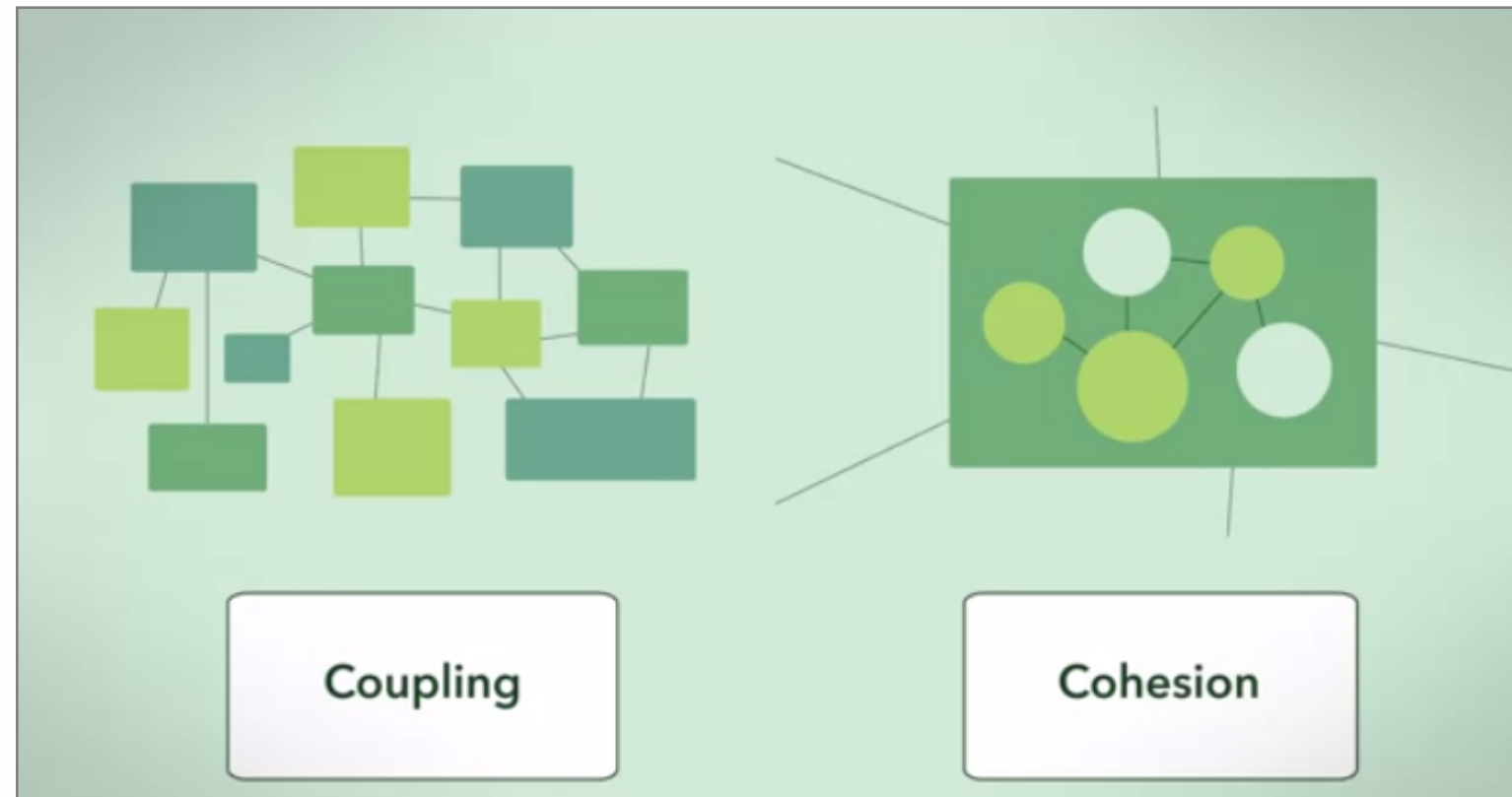
by G. Ann Campbell, SonarSource, 2011

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  $\mu_j$  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> ➞



[ [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.

18/26

[ NoBlame NoQuality NoQuality NoMeetings NoBoss ]

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.

19/26

[ 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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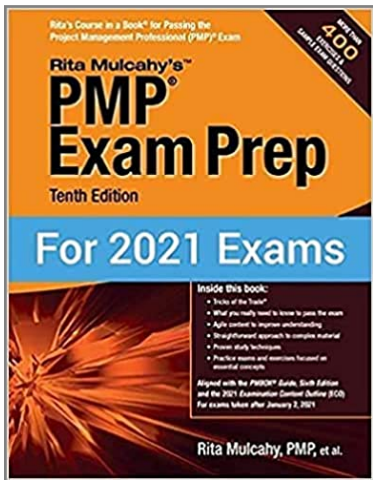
Work for Product, Not for Boss

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

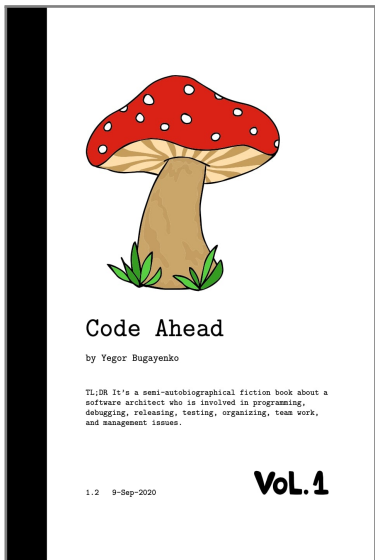
<https://www.yegor256.com/2015/02/23/haircut.html>

Chapter #4:

## Books, Venues, Call-to-Action



Rita Mulcahy. PMP Exam Prep, 2009



Yegor Bugayenko. *Code Ahead*. Amazon, 2018

## 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?

# Bibliography

Rita Mulcahy. PMP Exam Prep, 2009.

Yegor Bugayenko. *Code Ahead*. Amazon, 2018.