

# Dead Code

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Lecture #12 out of 24

80 minutes

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## Motivating Example

Before (**wrong**):

```
1 class Book
2     private int id;
3     public Book(int it)
4         this.id = i;
5     public int getId()
6         return this.id;
7
8     private int setId(int i)
9         this.id = i;
```

After (**better**):

```
1 class Book
2     private final int id;
3     public Book(int it)
4         this.id = i;
5     public int getId()
6         return this.id;
```

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“Dead code is code that has been used in the past, but is currently never executed. Dead code hinders code comprehension and makes the current program structure less obvious.”

— *A Taxonomy and an Initial Empirical Study of Bad Smells in Code*, Mika Mäntylä, Jari Vanhanen, Casper Lassenius, Proceedings of the 19th International Conference on Software Maintenance (ICSM), 2003

## Dead Code Elimination (Compiler Optimization)

Dead code is here:

```
1 void main(int x) {  
2     int a = 42;  
3     if (x > 0) {  
4         a = 256;  
5     }  
6     a = 7;  
7     print(a);  
8 }
```

“Dead code refers to computations whose results are never used. Code that is dead can be eliminated without affecting the behavior of the program.”

Source: *Compiler Techniques for Code Compaction*,  
Saumya K. Debray, William Evans, Robert Muth,  
Bjorn De Sutter, ACM Transactions on Programming  
languages and Systems (TOPLAS), 22(2), 2000

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“Although there is some consensus on the fact that dead code is a common phenomenon, it could be harmful, and it seems to matter to software professionals; surprisingly, dead code has received very little empirical attention from the software engineering research community.”

— *A Multi-Study Investigation Into Dead Code*, Simone Romano, Christopher Vendome, Giuseppe Scanniello, Denys Poshyvanyk, IEEE Transactions on Software Engineering, 2018

## Unreachable/Dead Methods in Java

Table 1: Dataset Information						
Software		LOCs	#Types	#Meth.	#Un. Meth.	%Un. Meth.
ArtOfIllusion	2.4.1	79,383	600	5,426	545	10%
LaTeXDraw	2.0.8	65,334	252	3,130	212	7%
aTunes	1.10.1	42,357	778	4,067	240	6%
MediaPesata	1.0	1,580	31	162	8	5%

Source: *A Graph-based Approach to Detect Unreachable Methods in Java Software*, Simone Romano, Giuseppe Scanniello, Carlo Sartiani, Michele Risi, Proceedings of the 31st Annual ACM Symposium on Applied Computing, 2016

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“We conducted the study on the level of methods in the sense of object oriented programming. The systems contains 25,390 methods. We found that 25% of all methods were never used during the complete period.”

— *How Much Does Unused Code Matter for Maintenance?*, Sebastian Eder, Maximilian Junker, Benedikt Hauptmann, Elmar Juergens, Rudolf Vaas, Karl-Heinz Prommer, Proceedings of the International Conference on Software Engineering (ICSE), 2012

## Volatility Metric



“The variance  $Var(g)$  is the **Volatility** of the source code. The smaller the Volatility the more *cohesive* is the repository and the smaller the amount of the abandoned code inside it.”

Then, the mean  $\mu$  is calculated as:

$$\mu = \frac{1}{Z} \sum_{j=1}^Z g_j \quad (5)$$

Finally, the variance is calculated as:

$$Var(g) = \frac{1}{Z} \sum_{j=1}^Z |g_j - \mu|^2 \quad (6)$$

The variance  $Var(g)$  is the Volatility of the source code.



## Volatility vs. Number of Files in a Repo



## Monolithic Repositories

**Centralization** The codebase is contained in a single repo encompassing multiple projects.

**Visibility** Code is viewable and searchable by all engineers in the organization.

**Synchronization:** The development process is trunk-based; engineers commit to the head of the repo.

**Completeness** Any project in the repo can be built only from dependencies also checked into the repo. Dependencies are unversioned; projects must use whatever version of their dependency is at the repo head.

**Standardization** A shared set of tooling governs how engineers interact with the code, including building, testing, browsing, and reviewing code.

Source: *Advantages and Disadvantages of a Monolithic Repository: A case study at Google*, Ciera Jaspan et al., ICSE, 2018

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“Our survey results show that engineers at Google strongly prefer our monolithic repo, and that visibility of the codebase and simple dependency management were the primary factors for this preference.”

— *Advantages and Disadvantages of a Monolithic Repository: A case study at Google*, Ciera Jaspan, Matthew Jorde, Andrea Knight, Caitlin Sadowski, Edward K. Smith, Collin Winter, Emerson Murphy-Hill, ICSE, 2018

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“The Google codebase includes approximately one billion files and has a history of approximately 35 million commits spanning Google’s entire 18-year existence. The repository contains 86TBa of data, including approximately two billion lines of code in nine million unique source files.”

— *Why Google Stores Billions of Lines of Code in a Single Repository*, Rachel Potvin and Josh Levenberg, Communications of the ACM 59.7, 2016

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“Facebook’s main source repository is enormous—many times larger than even the Linux kernel, which checked in at 17 million lines of code and 44,000 files in 2013.”

— *Scaling Mercurial at Facebook*, Durham Goode et al., 2014

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“Before monorepo, I had to upgrade every package manually, which resulted in dissonance: one package used Symfony\Console 3.2, but other only 2.8 and it got messy for no reason.”

— *How Monolithic Repository in Open Source saved my Laziness*, Tomas Votruba, 2017

## Benefits of “Manyrepo” Approach

**Encapsulation** Each repo encapsulates and hides its details from everybody else.

**Fast Builds** When a repo is small, the time its automated build takes is small.

**Accurate Metrics** Calculating LoC for a large repository doesn't make any sense.

**Homogeneous Tasks** It's easier to make tasks similar in size and complexity.

**Single Coding Standard** Smaller repositories look more beautiful.

**Short Names** Smaller namespaces mean better maintainability.

**Simple Tests** More dependencies are difficult to mock and test.

Source: [Monolithic Repos Are Evil](#) (2018)

## Read this:

*Volatility Metric to Detect Anomalies in Source Code Repositories*, Yegor Bugayenko, Proceedings of the 1st ACM SIGPLAN International Workshop on Beyond Code: No Code, 2021

*Advantages and Disadvantages of a Monolithic Repository: A case study at Google*, Ciera Jaspan, Matthew Jorde, Andrea Knight, Caitlin Sadowski, Edward K. Smith, Collin Winter, Emerson Murphy-Hill, Proceedings of the International Conference on Software Engineering, 2018

Monolithic Repos Are Evil (2018)