

Lines of Code (LoC)


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Lecture #1 out of 24

80 minutes

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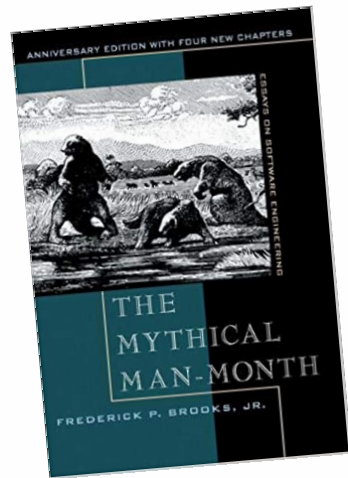


1. Quality of code means maintainability:
how quickly other programmers can
understand your code.



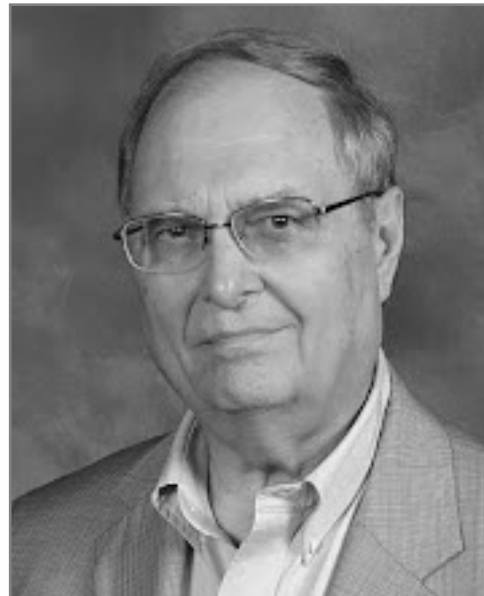
“It has been suggested that there is some law of nature telling us that the amount of intellectual effort needed grows with the square of program length. But, thank goodness, no one has been able to prove this law. And this is because it need not be true.”

— Edsger W. Dijkstra. The Humble Programmer. *Communications of the ACM*, 15(10):859–866, 1972. doi:[10.1145/355604.361591](https://doi.org/10.1145/355604.361591)



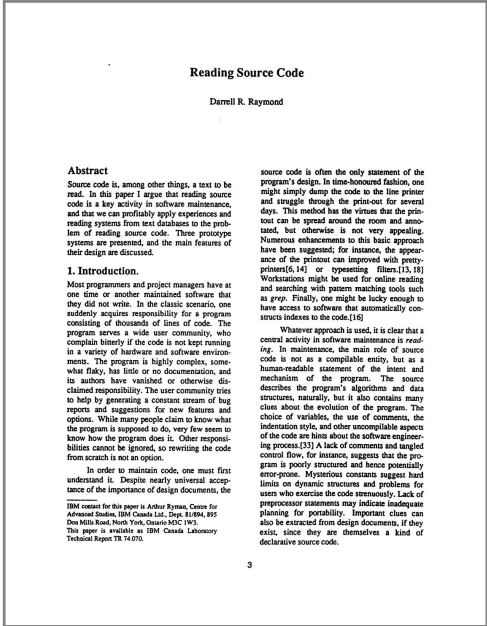
“A programmer depends upon other people’s programs. These are often maldesigned, poorly implemented, incompletely delivered (no source code or test cases), and poorly documented. So he must spend hours studying and fixing things that in an ideal world would be complete, available, and usable.”

— Frederick P. Brooks. *The Mythical Man-Month: Essays on Software Engineering*. Addison-Wesley, 1978. doi:[10.5555/540031](https://doi.org/10.5555/540031)



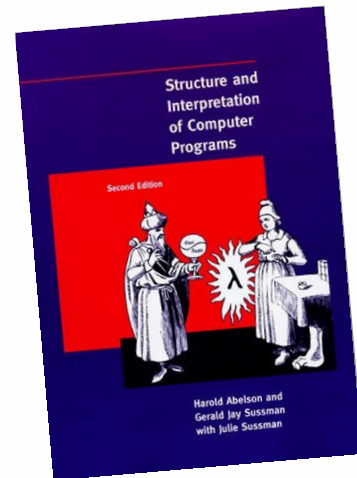
“One of the most overlooked programming skills is the ability to read a program, an activity the programmer is called upon to do with surprising frequency.”

— Lionel E. Deimel Jr. The Uses of Program Reading. *ACM SIGCSE Bulletin*, 17 (2):5–14, 1985. doi:[10.1145/382204.382524](https://doi.org/10.1145/382204.382524)



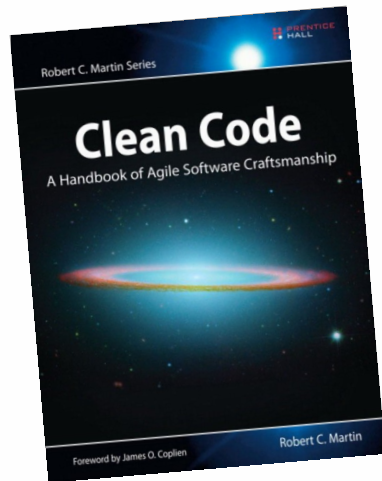
“Whatever approach is used, it is clear that a central activity in software maintenance is reading. In maintenance, the main role of source code is not as a compilable entity, but as a human-readable statement of the intent and mechanism of the program.”

— Darrell R. Raymond. Reading Source Code. In *Proceedings of the Conference of the Centre for Advanced Studies on Collaborative Research*, pages 3–16, 1991. doi:[10.5555/962111.962113](https://doi.org/10.5555/962111.962113)



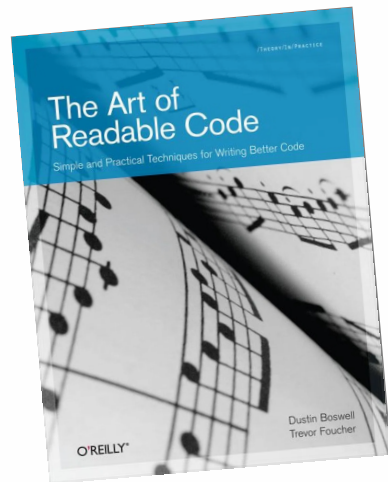
“We want to establish the idea that a computer language is not just a way of getting a computer to perform operations but rather that it is a novel formal medium for expressing ideas about methodology. Thus, programs must be written for people to read, and only incidentally for machines to execute.”

— Harold Abelson and Gerald Jay Sussman. *Structure and Interpretation of Computer Programs*. The MIT Press, 1996. doi:[10.5555/26777](https://doi.org/10.5555/26777)



“Indeed, the ratio of time spent reading vs. writing is well over 10:1. We are constantly reading old code as part of the effort to write new code. Because this ratio is so high, we want the reading of code to be easy, even if it makes the writing harder.”


— Robert C. Martin. *Clean Code: A Handbook of Agile Software Craftsmanship*. Pearson Education, 2008. doi:[10.5555/1388398](https://doi.org/10.5555/1388398)



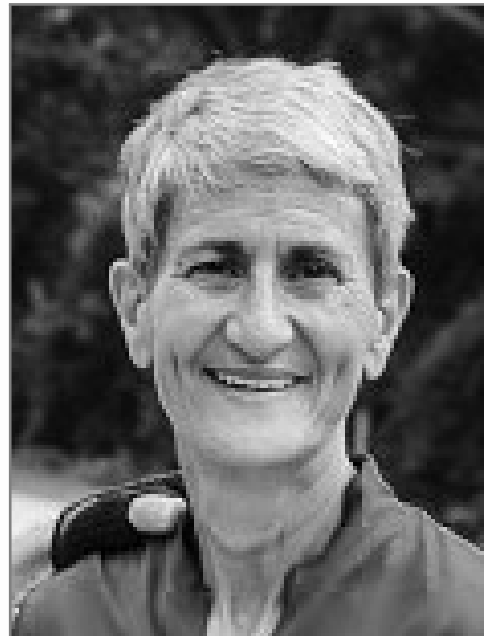
DUSTIN BOSWELL

“Code should be written to minimize the time it would take for someone else to understand it. It’s so important that we call it The Fundamental Theorem of Readability.”

— Dustin Boswell and Trevor Foucher. *The Art of Readable Code*, 2011



2. Everybody wants higher quality of code, but nobody knows how to measure it.



“It’s not enough to make claims about your software; you must support your claims with measurable evidence.”

— Shari Lawrence Pfleeger. Software Metrics: Progress After 25 Years? *IEEE Software*, 25(6):32–34, 2008. doi:[10.1109/MS.2008.160](https://doi.org/10.1109/MS.2008.160)



MARIZA A. S. BIGONHA

“The application of thresholds could lower the cost of software quality evaluation since they can reduce the amount of software code that should be inspected. Therefore, the thresholds provide a way for quantitative and qualitative evaluations to complement each other, leading to a more efficient quality assessment of object-oriented software systems.”

— Tarcísio G. S. Filó, Mariza A. S. Bigonha, and Kécia A. M. Ferreira. Evaluating Thresholds for Object-Oriented Software Metrics. *Journal of the Brazilian Computer Society*, 30(1):313–346, 2024. doi:[10.5753/jbcs.2024.3373](https://doi.org/10.5753/jbcs.2024.3373)

Table 3. Catalog of Thresholds (extracted from Filó et al. [2015])

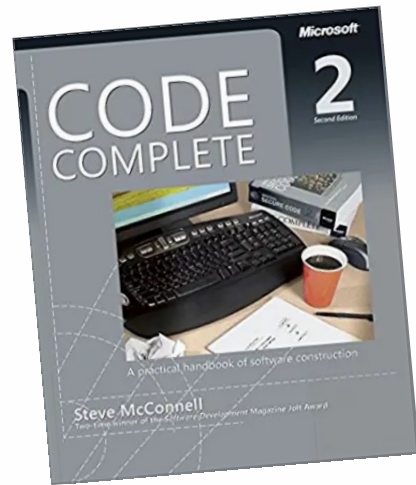
| Metrics | Good/Common | Regular/Casual | Bad/Uncommon |
|---------|----------------|------------------------|--------------|
| AC | $m \leq 7$ | $7 < m \leq 39$ | $m > 39$ |
| EC | $m \leq 6$ | $6 < m \leq 16$ | $m > 16$ |
| DIT | $m \leq 2$ | $2 < m \leq 4$ | $m > 4$ |
| LCOM | $m \leq 0.167$ | $0.167 < m \leq 0.725$ | $m > 0.725$ |
| MLOC | $m \leq 10$ | $10 < m \leq 30$ | $m > 30$ |
| NBD | $m \leq 1$ | $1 < m \leq 3$ | $m > 3$ |
| NOC | $m \leq 11$ | $11 < m \leq 28$ | $m > 28$ |
| NOF | $m \leq 3$ | $3 < m \leq 8$ | $m > 8$ |
| NOM | $m \leq 6$ | $6 < m \leq 14$ | $m > 14$ |
| NORM | $m \leq 2$ | $2 < m \leq 4$ | $m > 4$ |
| NSC | $m \leq 1$ | $1 < m \leq 3$ | $m > 3$ |
| NSF | $m \leq 1$ | $1 < m \leq 5$ | $m > 5$ |
| NSM | $m \leq 1$ | $1 < m \leq 3$ | $m > 3$ |
| PAR | $m \leq 2$ | $2 < m \leq 4$ | $m > 4$ |
| RMD | $m \leq 0.467$ | $0.467 < m \leq 0.750$ | $m > 0.750$ |
| SIX | $m \leq 0.019$ | $0.019 < m \leq 1.333$ | $m > 1.333$ |
| VG | $m \leq 2$ | $2 < m \leq 4$ | $m > 4$ |
| WMC | $m \leq 11$ | $11 < m \leq 34$ | $m > 34$ |

To evaluate our catalog, in that work, we handled a case study to assess proprietary software from a public organization with a bad internal quality to verify the proposed thresholds’ ability to indicate it.

Source: Tarcísio G. S. Filó, Mariza A. S. Bigonha, and Kecia A. M. Ferreira. Evaluating Thresholds for Object-Oriented Software Metrics. *Journal of the Brazilian Computer Society*, 30(1):313–346, 2024. doi:[10.5753/jbcs.2024.3373](https://doi.org/10.5753/jbcs.2024.3373)

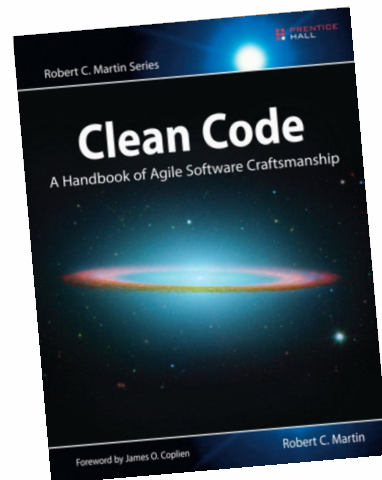
Source: Tarcísio G. S. Filó, Mariza Bigonha, and Kecia Ferreira. A Catalogue of Thresholds for Object-Oriented Software Metrics, 2015

3. Size of code is the key contributor to its quality, while Lines of Code (LoC) is the basic measurement of size.



“Studies have found that larger routines are more error-prone than smaller ones. Keeping routines short helps reduce errors and makes the code easier to maintain.”

— Steve McConnell. *Code Complete*. Pearson Education, 2004.
[doi:10.5555/1096143](https://doi.org/10.5555/1096143)



“The first rule of functions is that they should be small. The second rule of functions is that they should be even smaller than that.”

— Robert C. Martin. *Clean Code: A Handbook of Agile Software Craftsmanship*. Pearson Education, 2008. doi:[10.5555/1388398](https://doi.org/10.5555/1388398)

4. It may be wrong to measure productivity of a programmer by counting lines of code, but for the quality of code the LoC metric is a perfect indicator.


cloc.pl

```
/code/o/eo$ cloc .
1131 text files.
951 unique files.
241 files ignored.
```

github.com/AlDanial/cloc v 2.02 T=0.69 s (1377.8 files/s, 130550.4 lines/s)

| Language | files | blank | comment | code |
|----------------------------|-------|-------|---------|-------|
| Java | 457 | 3791 | 21555 | 31527 |
| YAML | 296 | 276 | 6852 | 7892 |
| XSLT | 105 | 441 | 2489 | 5255 |
| XML | 26 | 65 | 304 | 4058 |
| Maven | 10 | 40 | 277 | 1786 |
| Markdown | 12 | 184 | 1 | 671 |
| ANTLR Grammar | 2 | 134 | 187 | 566 |
| Groovy | 15 | 43 | 395 | 262 |
| Rust | 2 | 11 | 46 | 158 |
| JSON | 3 | 0 | 0 | 150 |
| XSD | 2 | 8 | 38 | 133 |
| Properties | 12 | 20 | 252 | 50 |
| Text | 4 | 4 | 0 | 45 |
| Bourne Shell | 1 | 1 | 31 | 44 |
| Velocity Template Language | 1 | 4 | 0 | 37 |
| TOML | 3 | 3 | 1 | 24 |
| SUM: | 951 | 5025 | 32428 | 52658 |

<https://github.com/AlDanial/cloc>



5. In 2011, Uncle Bob suggested that 200 lines per Java class is a good guideline to stay below.

Table 7
Product size and testing effort

| Product | Size | Testing effort (person quarters) |
|---------|---------|-------------------------------------|
| P(C1) | 8787 | 10 |
| P(F1) | 154,985 | 13 |
| P(I1) | 87,779 | 32 |
| P(E1) | 181,434 | 20 |
| P(C2) | 121,138 | 21 |
| P(F3) | 237,621 | 26 |
| P(I3) | 43,859 | 8 |
| P(E10) | 161,053 | 28 |

Pearson correlation $r = 0.53$, $r_2 = 0.28$, $p = 0.08$.

“We conclude that code size is not a good predictor of testing effort (measured by allocated test engineers) at either product or product line levels. Other metrics, like code coupling and cohesion are more appropriate for such estimation.”

Source: Samuel A. Ajila and Razvan T. Dumitrescu. Experimental Use of Code Delta, Code Churn, and Rate of Change to Understand Software Product Line Evolution. *Journal of Systems and Software*, 80(1): 74–91, 2007. doi:[10.1016/j.jss.2006.05.034](https://doi.org/10.1016/j.jss.2006.05.034)

6. Instead of counting lines, it may be more reasonable to count NCSS (Non Commenting Source Statements), but not always.

LoC vs NCSS

```
1 #!/bin/bash
2 set -e
3
4 # Simple intro:
5 printf "Hello, %s!
6     Your balance is %d." \
7     "${name}" \
8     "$(psql 'SELECT balance
9         FROM user WHERE id = 42')"
```

Lines of Code = ?

NCSS = ?



7. There are 27.8M lines of C code in Linux kernel. What does it tell us?

Largest Open Source Projects

- KDE 57.9M LOC, 19402 years of effort
- NetBSD 50M LOC, 16822 years of effort
- Linux kernel 36.6M LOC, 12,369 years of effort
- Google Chrome 25M LOC, 8131 years of effort
- Mozilla Firefox 20.5M LOC, 6564 years of effort
- FreeBSD 17.2 LOC, 5538 years of effort
- GNOME 15.7 LOC, 4946 years of effort
- LibreOffice 9.5M LOC, 2907 years of effort
- QT 5, 8.2M LOC, 2525 years of effort
- OpenJDK 8.4M LOC, 2583 years of effort
- IntelliJ IDEA community 6.1 LOC, 1850 years of effort
- GNU compiler collections 7.5M LOC, 2,327 years of effort
- Blender 3D 2.1M LOC, 612 years of effort
- PostgreSQL 2.0M LOC, 596 years of effort
- TensorFlow 2.5M LOC, 724 years of effort

Found it on [Quora](#).

How many lines of code are in your repositories? How many lines of code you write every week? How many lines of code you delete every week? How about annually?

8. Java is two times more verbose than Ruby. Does it mean the quality of an average Ruby code is higher?

References

Harold Abelson and Gerald Jay Sussman. *Structure and Interpretation of Computer Programs*. The MIT Press, 1996. doi:[10.5555/26777](https://doi.org/10.5555/26777).

Samuel A. Ajila and Razvan T. Dumitrescu. Experimental Use of Code Delta, Code Churn, and Rate of Change to Understand Software Product Line Evolution. *Journal of Systems and Software*, 80(1):74–91, 2007. doi:[10.1016/j.jss.2006.05.034](https://doi.org/10.1016/j.jss.2006.05.034).

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