Code Style

Yegor Bugayenko

Lecture #22 out of 24
80 minutes

Which One Looks Better for You?

C:

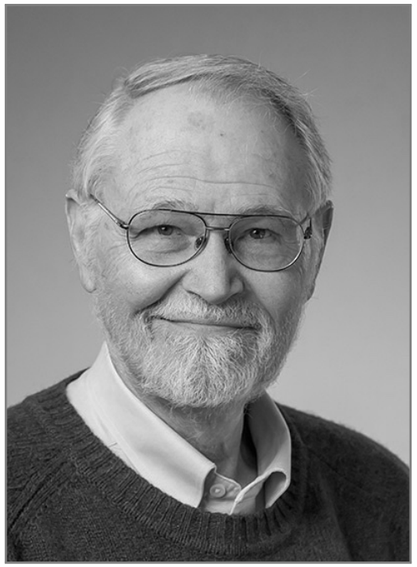
```c
int f(int n)
{
  if (n == 1 || n < 2)
    return 1;
  int r = f (n-1);
  int r2 = f(n - 2);
  return r +r2;
  }
```

Java:

```java
int fibonacci(int n) {
  if (n <= 2) {
    return 1;
  }
  return fibonacci(n - 1)
    + fibonacci(n - 2);
}
```

Ruby:

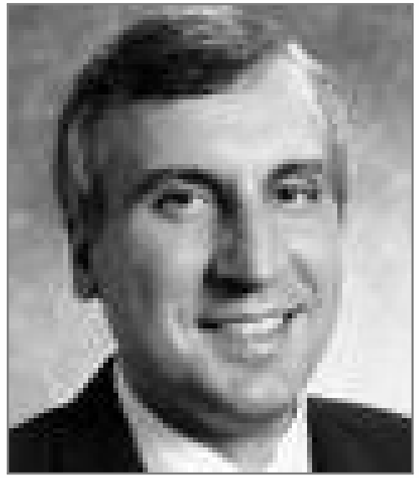
```ruby
def fibonacci(int n)
  return 1 if n <= 2
  fibonacci(n - 1)
    + fibonacci(n - 2)
end
```



Brian Kernighan

"The harder it is for people to grasp the intent of any given section, the longer it will be before the program becomes operational. Trying to outsmart a compiler defeats much of the purpose of using one. Write clearly — don't sacrifice clarity for 'efficiency.'"

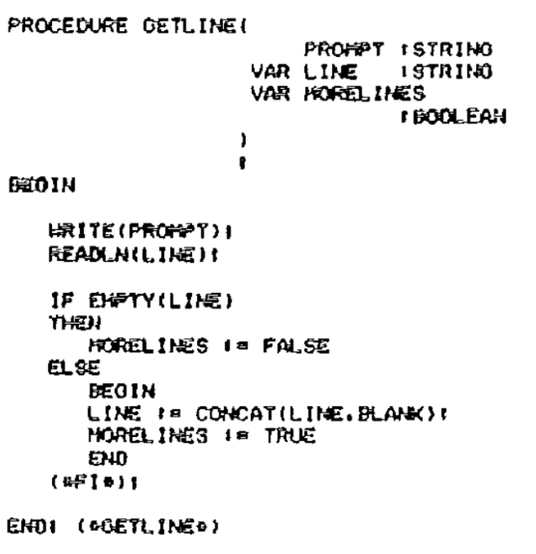
— Brian W. Kernighan and Phillip James Plauger. *The Elements of Programming Style.* McGraw-Hill, Inc., 1974



David Marca

“The effective utilization of extra spaces, blank lines, or special characters can illuminate the logical structure of a program. So we should not be afraid to: indent, indent consistently (3 is a readable minimum), start each statement on a new line, put only one word on a line, use extra pages to visually collect code, put blank lines between code, align keywords, separate code from comments with white space.”

— David Marca. Some Pascal Style Guidelines. *ACM SIGPLAN Notices*, 16(4): 70–80, 1981



```
PROCEDURE GETLINE(
                      PROMPT :STRING
                  VAR LINE   :STRING
                  VAR MORELINES
                             :BOOLEAN
                  );
                  {
BEGIN

   WRITE(PROMPT);
   READLN(LINE);

   IF EMPTY(LINE)
   THEN
      MORELINES := FALSE
   ELSE
      BEGIN
      LINE := CONCAT(LINE,BLANK);
      MORELINES := TRUE
      END
   (*FI*);

END; (*GETLINE*)
```

"The best style enforcer is the computer … but only if we can easily cope with its ever-present restrictions."

Source: David Marca. Some Pascal Style Guidelines. *ACM SIGPLAN Notices*, 16(4):70–80, 1981

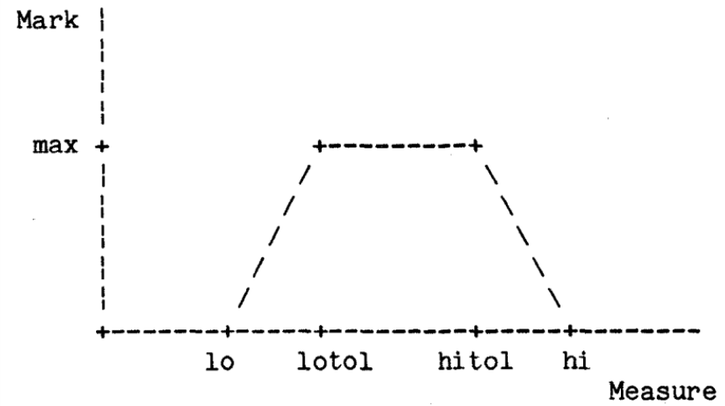
Michael J. Rees

"STYLE was designed to input the source of a syntactically correct Pascal program, make simple measurements on a one-pass line-by-line basis, and yield a style mark out of 100%."

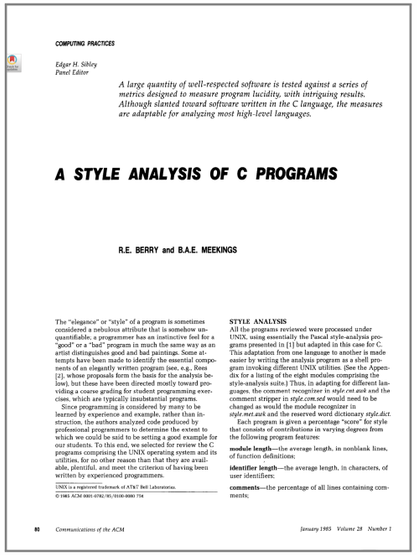
— Michael J. Rees. Automatic Assessment Aids for Pascal Programs. *ACM SIGPLAN Notices*, 17(10):33–42, 1982

Rees Score, for Pascal

Measure	max	lo	hi	lotol	hitol
chars/line	15	12	30	15	25
% comments	10	15	35	20	25
% indent	12	60	90	70	80
% blank lines	5	8	20	10	15
% spaces	8	8	20	12	18
proc/fn length	20	10	50	20	35
# res. words	10	22	41	26	40
id. length	20	7	16	9	15
# ids	0	0	0	0	0
---					
labels & gotos	20	1	200	3	199



Source: Michael J. Rees. Automatic Assessment Aids for Pascal Programs. *ACM SIGPLAN Notices*, 17(10): 33–42, 1982



COMPUTING PRACTICES

Edgar H. Sibley
Panel Editor

A large quantity of well-respected software is tested against a series of metrics designed to measure program lucidity, with intriguing results. Although slanted toward software written in the C language, the measures are adaptable for analyzing most high-level languages.

A STYLE ANALYSIS OF C PROGRAMS

R.E. BERRY and B.A.E. MEEKINGS

The "elegance" or "style" of a program is sometimes considered a nebulous attribute that is somehow unquantifiable; a programmer has an instinctive feel for a "good" or a "bad" program in much the same way as an artist distinguishes good and bad paintings. Some attempts have been made to identify the essential components of an elegantly written program (see, e.g., Rees [2], whose proposals form the basis for the analysis below), but these have been directed mostly toward providing a coarse grading for student programming exercises, which are typically insubstantial programs.

Since programming is considered by many to be learned by experience and example, rather than instruction, the authors analyzed code produced by professional programmers to determine the extent to which we could be said to be setting a good example for our students. To this end, we selected for review the C programs comprising the UNIX operating system and its utilities, for no other reason than that they are available, plentiful, and meet the criterion of having been written by experienced programmers.

UNIX is a registered trademark of AT&T Bell Laboratories.
© 1985 ACM 0001-0782/85/0100-0080 75¢

STYLE ANALYSIS

All the programs reviewed were processed under UNIX, using essentially the Pascal style-analysis programs presented in [1] but adapted in this case for C. This adaptation from one language to another is made easier by writing the analysis program as a shell program invoking different UNIX utilities. (See the Appendix for a listing of the eight modules comprising the style-analysis suite.) Thus, in adapting for different languages, the comment recognizer in *style.ret.awk* and the comment stripper in *style.com.sed* would need to be changed as would the module recognizer in *style.met.awk* and the reserved word dictionary *style.dict*.

Each program is given a percentage "score" for style that consists of contributions in varying degrees from the following program features:

module length—the average length, in nonblank lines, of function definitions;

identifier length—the average length, in characters, of user identifiers;

comments—the percentage of all lines containing comments;

80 Communications of the ACM January 1985 Volume 28 Number 1

"The 'elegance' or 'style' of a program is sometimes considered a nebulous attribute that is somehow unquantifiable; a programmer has an instinctive feel for a 'good' or a 'bad' program in much the same way as an artist distinguishes good and bad paintings."

— R. E. Berry and B. A. E. Meekings. A Style Analysis of C Programs. *Communications of the ACM*, 28(1):80–88, 1985

Berry-Meekings Score, for C Programs

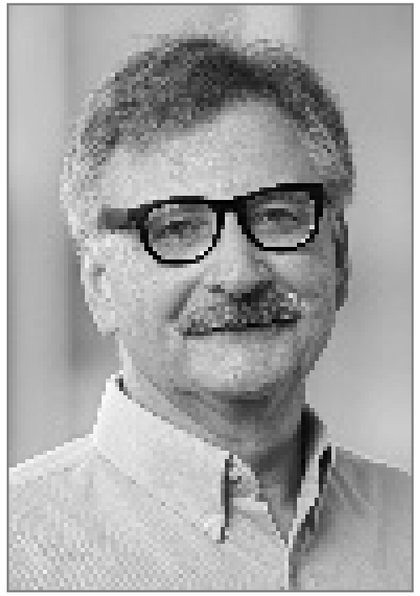
TABLE I. Metric Boundary Values

Metric	%	L	S	F	H
Module length	15	4	10	25	35
Identifier length	14	4	5	10	14
Comment lines (%)	12	8	15	25	35
Indentation (%)	12	8	24	48	60
Blank lines (%)	11	8	15	30	35
Characters per line	9	8	12	25	30
Spaces per line	8	1	4	10	12
Defines (%)	8	10	15	25	30
Reserved words	6	4	16	30	36
Include files	5	0	3	3	4
Gotos	−20	1	3	99	99

Source: R. E. Berry and B. A. E. Meekings. A Style Analysis of C Programs. *Communications of the ACM*, 28(1):80–88, 1985

"An individual score for each metric is determined by reference to the value in this table for

1. the point L, below which no score is obtained;
2. the point S, the start of the "ideal" range for the metric;
3. the point F, the end of the ideal range;
4. the point H, above which no score is obtained."



Warren Harrison

"To determine the relationship (if any) between the style metric and error proneness of each module, we performed a simple correlation analysis. The results were discouraging in the sense that a correlation of only -0.052 existed between the observed error frequency and the style metric, suggesting that the style metric bore little relationship to the error frequency encountered in our data."

— Warren Harrison and Curtis R. Cook. A Note on the Berry-Meekings Style Metric. *Communications of the ACM*, 29(2):123–125, 1986

My Favorite Style Checkers

- ESLint (2013) for JavaScript
- Clang-Tidy (2007?) for C++
- Pylint (2006) for Python
- Rubocop (2012) for Ruby
- PHP_CodeSniffer (2011) for PHP
- rustfmt (2015) for Rust
- Qulice by Bugayenko [2014] for Java: Checkstyle (2001) + PMD (2022)

How Many Rules in Style Checkers?

- 690+ in Clang-Tidy (C++)
- 550+ in Rubocop (Ruby)
- 400+ in PMD (Java)
- 130+ in Checkstyle (Java)
- 120+ in Pylint (Python)

Some/most of the rules no only check style, but also find bugs.

Some Exotic Style Checkers

- Shellcheck for Bash
- markdownlint for Markdown
- Checkmake for Makefile
- xcop for XML

Christian Collberg

"Code obfuscation means one user runs an application through an obfuscator, a program that transforms the application into one that is functionally identical to the original but which is much more difficult for another user to understand."

— Christian Collberg, Clark Thomborson, and Douglas Low. A Taxonomy of Obfuscating Transformations. Technical report, Department of Computer Science, The University of Auckland, New Zealand, 1997

Cathal Boogerd

"First, there are 9 out of 72 rules for which violations were observed that perform significantly better than a random predictor at locating fault-related lines. Second, we observed a negative correlation between MISRA rule violations and observed faults. In addition, 29 out of 72 rules had a zero true positive rate. This makes it possible that adherence to the MISRA standard as a whole would have made the software less reliable."

— Cathal Boogerd and Leon Moonen. Assessing the Value of Coding Standards: An Empirical Study. In *Proceedings of the International Conference on Software Maintenance*, pages 277–286. IEEE, 2008

Henry Ledgard

"An individual's body language helps clarify the spoken word. In a similar sense, the programmer relies on white space—what is not said directly—in the code to communicate logic, intent, and understanding."

— Robert Green and Henry Ledgard. Coding Guidelines: Finding the Art in the Science. *Communications of the ACM*, 54(12):57–63, 2011

Figure 9. Examples of K&R, ANSI, and Whitesmiths coding styles.

```
if (expression) {
    statements
}
```

```
if (expression)
{
    statements
}
```

```
if (expression)
    {
    statements
    }
```

Source: Robert Green and Henry Ledgard. Coding Guidelines: Finding the Art in the Science. *Communications of the ACM*, 54(12):57–63, 2011

Peter C. Rigby

"We list the reasons why our interviewees rejected a patch or required further modification before accepting it: Poor quality, Violation of style, Gratuitous changes mixed with 'true' changes, Code does not do or fix what it claims to or introduces new bugs, Fix conflicts with existing code, Use of incorrect API or library."

— Peter C. Rigby and Margaret-Anne Storey. Understanding Broadcast Based Peer Review on Open Source Software Projects. In *Proceedings of the 33rd International Conference on Software Engineering*, pages 541–550, 2011

Moritz Beller

> “Most Automated Static Analysis Tools configurations deviate slightly from the default, but hardly any introduce new custom analyses. ”

— Moritz Beller, Radjino Bholanath, Shane McIntosh, and Andy Zaidman. Analyzing the State of Static Analysis: A Large-Scale Evaluation in Open Source Software. In *Proceedings of the 23rd International Conference on Software Analysis, Evolution, and Reengineering (SANER)*, volume 1, pages 470–481. IEEE, 2016

TABLE V
SUMMARY OF RULE CHANGES FROM DEFAULT CONFIGURATIONS.

Tool	Changed	Reconfigured	No Deviations	Total
ESLINT	80.5%	5.7%	13.8%	4,274
FINDBUGS	93.0%	—	7.0%	2,057
JSHINT	89.6%	0.7%	9.7%	104,914
JSL	94.6%	—	5.4%	848
PYLINT	53.3%	—	46.7%	3,951
RUBOCOP	79.1%	3.2%	17.7%	9,579

Source: Moritz Beller, Radjino Bholanath, Shane McIntosh, and Andy Zaidman. Analyzing the State of Static Analysis: A Large-Scale Evaluation in Open Source Software. In *Proceedings of the 23rd International Conference on Software Analysis, Evolution, and Reengineering (SANER)*, volume 1, pages 470–481. IEEE, 2016

TABLE VI
AVERAGE MEAN OF CUSTOM RULES IN ASAT CONFIGURATIONS.

Tool	Percentage of Custom Rules
CHECKSTYLE	0.2%
ESLINT	4.1%
FINDBUGS	1.3%
JSCS	4.7%
JSHINT	0.1%
PMD	2.9%
PYLINT	1.1%
RUBOCOP	0.9%

Source: Moritz Beller, Radjino Bholanath, Shane McIntosh, and Andy Zaidman. Analyzing the State of Static Analysis: A Large-Scale Evaluation in Open Source Software. In *Proceedings of the 23rd International Conference on Software Analysis, Evolution, and Reengineering (SANER)*, volume 1, pages 470–481. IEEE, 2016

Fiorella Zampetti

"Results indicate that build breakages due to static analysis tools are mainly related to adherence to coding standards, and there is also some attention to missing licenses. Build failures related to tools identifying potential bugs or vulnerabilities occur less frequently, and in some cases such tools are activated in a 'softer' mode, without making the build fail."

— Fiorella Zampetti, Simone Scalabrino, Rocco Oliveto, Gerardo Canfora, and Massimiliano Di Penta. How Open Source Projects use Static Code Analysis Tools in Continuous Integration Pipelines. In *Proceedings of the 14th International Conference on Mining Software Repositories (MSR)*, pages 334–344. IEEE, 2017

Jennifer Bauer

"While the perceptual processing of code is required to understand it, higher level processing, such as understanding its semantics and reasoning about its functionality, affect program comprehensibility more strongly. The influence of indentation could have been masked by these side effects, so it might well be that the effect of indentation comes more into play when the code is longer and more complex."

— Jennifer Bauer, Janet Siegmund, Norman Peitek, Johannes C. Hofmeister, and Sven Apel. Indentation: Simply a Matter of Style or Support for Program Comprehension? In *Proceedings of the 27th International Conference on Program Comprehension (ICPC)*, pages 154–164. IEEE, 2019

Weiqin Zou

"A pull request that is consistent with the current code style tends to be merged into the codebase more easily (faster)."

— Jennifer Bauer, Janet Siegmund, Norman Peitek, Johannes C. Hofmeister, and Sven Apel. Indentation: Simply a Matter of Style or Support for Program Comprehension? In *Proceedings of the 27th International Conference on Program Comprehension (ICPC)*, pages 154–164. IEEE, 2019

References

Jennifer Bauer, Janet Siegmund, Norman Peitek, Johannes C. Hofmeister, and Sven Apel. Indentation: Simply a Matter of Style or Support for Program Comprehension? In *Proceedings of the 27th International Conference on Program Comprehension (ICPC)*, pages 154–164. IEEE, 2019.

Moritz Beller, Radjino Bholanath, Shane McIntosh, and Andy Zaidman. Analyzing the State of Static Analysis: A Large-Scale Evaluation in Open Source Software. In *Proceedings of the 23rd International Conference on Software Analysis, Evolution, and Reengineering (SANER)*, volume 1, pages 470–481. IEEE, 2016.

R. E. Berry and B. A. E. Meekings. A Style Analysis of C Programs. *Communications of the ACM*, 28(1): 80–88, 1985.

Cathal Boogerd and Leon Moonen. Assessing the Value of Coding Standards: An Empirical Study. In *Proceedings of the International Conference on Software Maintenance*, pages 277–286. IEEE, 2008.

Yegor Bugayenko. Strict Control of Java Code Quality. `https://www.yegor256.com/140813.html`, August 2014. [Online; accessed 26-02-2024].

Christian Collberg, Clark Thomborson, and Douglas Low. A Taxonomy of Obfuscating Transformations. Technical report, Department of Computer Science, The University of Auckland, New Zealand, 1997.

Robert Green and Henry Ledgard. Coding Guidelines: Finding the Art in the Science. *Communications of the ACM*, 54(12):57–63, 2011.

Warren Harrison and Curtis R. Cook. A Note on the Berry-Meekings Style Metric. *Communications of the ACM*, 29(2):123–125, 1986.

Brian W. Kernighan and Phillip James Plauger. *The Elements of Programming Style*. McGraw-Hill, Inc., 1974.

David Marca. Some Pascal Style Guidelines. *ACM SIGPLAN Notices*, 16(4):70–80, 1981.

Michael J. Rees. Automatic Assessment Aids for

Pascal Programs. *ACM SIGPLAN Notices*, 17(10): 33–42, 1982.

Peter C. Rigby and Margaret-Anne Storey. Understanding Broadcast Based Peer Review on Open Source Software Projects. In *Proceedings of the 33rd International Conference on Software Engineering*, pages 541–550, 2011.

Fiorella Zampetti, Simone Scalabrino, Rocco Oliveto, Gerardo Canfora, and Massimiliano Di Penta. How Open Source Projects use Static Code Analysis Tools in Continuous Integration Pipelines. In *Proceedings of the 14th International Conference on Mining Software Repositories (MSR)*, pages 334–344. IEEE, 2017.