Eyes on Code Smells: Analyzing Developers' Responses During Code Snippet Analysis

We invite you to voluntarily participate in this research that aims to **analyze how developers comprehend code snippets with or without code smells while using an eye tracker to collect data.**

This survey was divided into three stages: the first to be answered before the analysis of the code snippets, the second during the analysis of the code snippets and the third after the analysis of the code snippets.

The code smells were taken from the dataset created by the researchers of the following article:

- [Lech Madeyski and Tomasz Lewowski. 2020. MLCQ: Industry-Relevant Code Smell Data Set. In Proceedings of the Evaluation and Assessment in Software Engineering (EASE '20). Association for Computing Machinery, New York, NY, USA, 342–347. https://doi.org/10.1145/3383219.3383264

The **target audience** of this survey is Java or similar language developers.

13 Java code snippets will be presented where the developer should analyze and explain how this code snippet works, if it was difficult to comprehend, if there is a code smell and what its type is. If it has a code smell, the developer should classify it according to severity (minor, major or critical) and classify how he/she felt during the analysis on a scale of 1 for very uncomfortable to 5 for very comfortable.

During the analysis, the developer will use a Tobii TX300 eye tracker will be positioned underneath the monitor to collect biometric data. A camera will also be used to record the developer during the research.

Participation is voluntary, anonymous, and you can withdraw at any time. The results of this study will be published by the researchers in the form of a scientific article. This questionnaire takes around **60 minutes** to be answered.

Throughout the process, respect for privacy and ethical standards will be ensured, as advocated by the General Data Protection Law (Law No. 13.709/2018), guaranteeing that participants' information is treated confidentially. Initially, data collected through the unidentified online questionnaire will be anonymized, removing any information that could directly identify participants, following the guidelines of the mentioned legislation. The data will then be organized and coded to facilitate analysis. The results will be presented in an aggregated and individually non-identifiable form, thus preserving the privacy of the participants in accordance with applicable legal provisions.

The study is part of the Post-Graduate Program of the Department of Informatics at PUC-Rio and is being developed by the master's student: Vinicius Souza Martins. And it is led by Professor Juliana Alves Pereira and Professor Alessandro Garcia.

If you need to contact the researchers, please use the following e-mails: vmartins@inf.puc-rio.br; jualvespereira@gmail.com

* Indicates required question

Consent

1. I am aware that my participation in the research is voluntary and that there are no penalties if I withdraw from participating at any time. *

   Furthermore, I authorize the use of the answers and data anonymously for research and the production of a scientific article.

   I undertake to answer the form honestly in order to contribute to the veracity of the information.

   In the event of a negative response, the form will be closed, thus ensuring respect for the autonomy and privacy of the participants.

   Mark only one oval.

   - ◯ I have read and accept the terms.
   - ◯ I do not accept the terms.

Definition of code smells

In this section, you will be introduced to the concept of code smells.

2. Read this definition of code smells: Code smells are poor design and implementation choices in code development that affect understanding and maintenance of the software. *

   Now answer the question: Are you familiar with the concept of code smells?

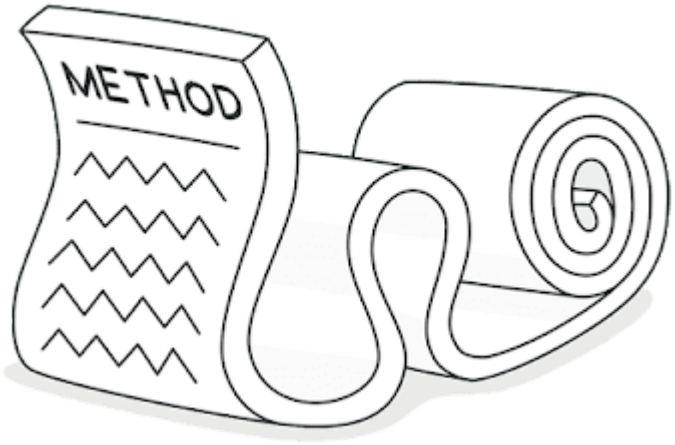
   Mark only one oval.

   - ◯ Yes, I know what they are and maybe used some tools
   - ◯ Somewhat - I heard about them in the past but never dug deeper
   - ◯ Not really - I heard about them for the first time in this experiment

Types of Code Smells

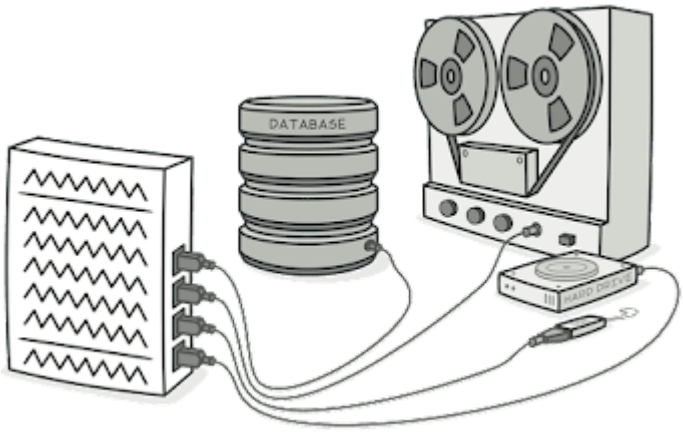
In this section, you will be presented with the definition of some types of code smells.

Long Method



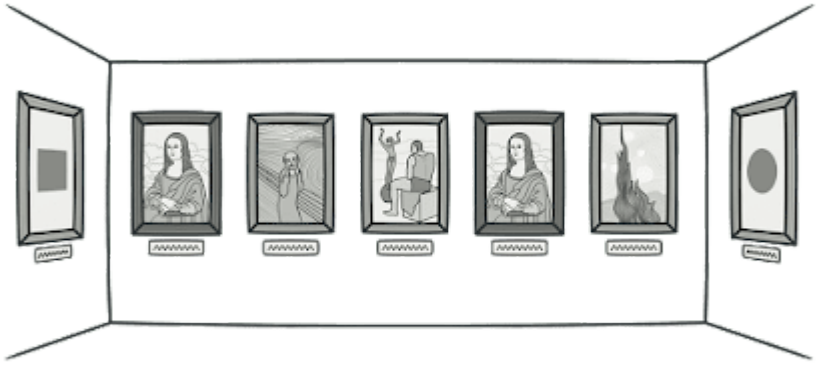
A method contains too many lines of code. Generally, any method longer should make you start asking questions.

Data Class



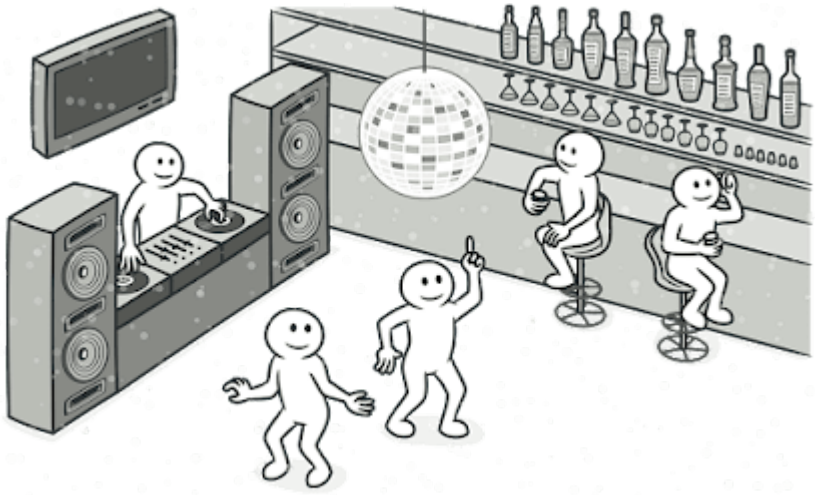
A data class refers to a class that contains only fields and crude methods for accessing them (getters and setters). These are simply containers for data used by other classes. These classes don’t contain any additional functionality and can’t independently operate on the data that they own.

Duplicate Code



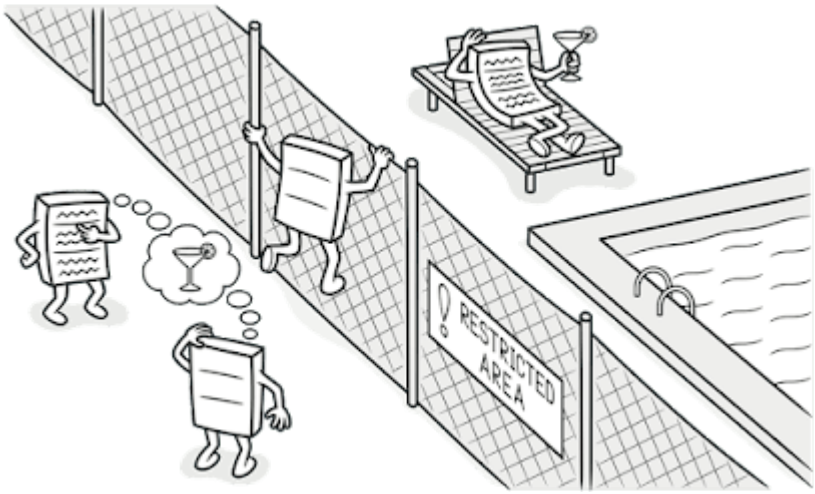
Two code fragments look almost identical.

Data Clumps



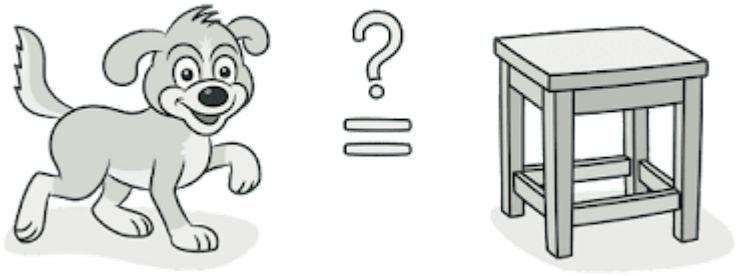
Sometimes different parts of the code contain identical groups of variables (such as parameters for connecting to a database). These clumps should be turned into their own classes.

Feature Envy



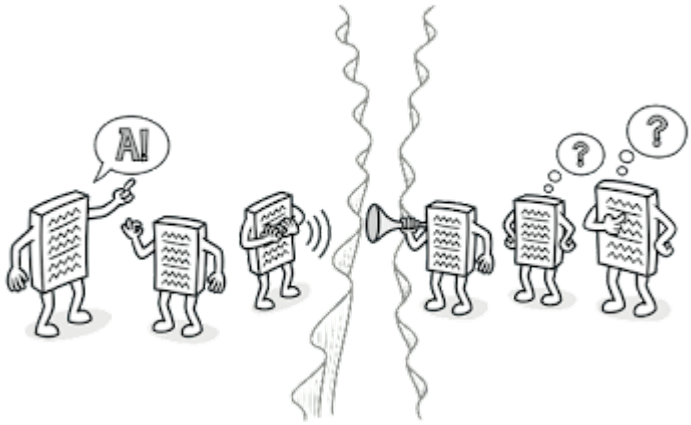
A method accesses the data of another object more than its own data.

Refused Bequest



If a subclass uses only some of the methods and properties inherited from its parents, the hierarchy is off-kilter. The unneeded methods may simply go unused or be redefined and give off exceptions.

Message Chains



When a client requests another object, that object requests yet another one, and so on.

Code snippets analysis

In this section, you will answer questions and analyze the 13 code snippets presented.

The first one you can clarify your doubts with the researcher and the next ones you will analyze without anyone's interference.

Answer the questions while reviewing each code snippet. After reviewing the presented code snippet and having answered all the questions in the presented snippet, move on to the next code snippet and repeat the process. As long as you stay on the code snippet, feel free to go back and change your answers. **Do not return** after moving to the next code snippet.

Code snippet 1

3. 1.1. Please, describe how the code snippets works. *

4. 1.2. Is the analyzed code snippets hard to comprehend? *

Mark only one oval.

- ◯ Yes
- ◯ No

5. 1.3. Based on the previous answer, explain why. *

6. 1.4. Is there a code smell in the analyzed code snippet? *

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 10*

Code snippet 1 with code smell

7. 1.5. What code smell(s)? *

Check all that apply.

- ☐ Data Class
- ☐ Long Method
- ☐ Feature Envy
- ☐ Other: _____

8. 1.6. What is the code smell severity? *

Mark only one oval.

- ◯ Minor
- ◯ Major
- ◯ Critical

9. What was your reason for choosing this severity? *

Code snippet 1 feeling

10. 1.7. How did you feel during the analysis of this code snippet? (1 for very uncomfortable to 5 for very comfortable). *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

Code snippet 2

11. 2.1. Please, describe how the code snippets works. *

12. 2.2. Is the analyzed code snippets hard to comprehend? *

Mark only one oval.

- ◯ Yes
- ◯ No

13. 2.3. Based on the previous answer, explain why. *

14. 2.4. Is there a code smell in the analyzed code snippet? *

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 18*

Code snippet 2 with code smell

15. 2.5. What code smell(s)? *

Check all that apply.

- ☐ Long Method
- ☐ Data Class
- ☐ Feature Envy
- ☐ Other: _____

16. 2.6. What is the code smell severity? *

Mark only one oval.

- ◯ Minor
- ◯ Major
- ◯ Critical

17. What was your reason for choosing this severity? *

Code snippet 2 feeling

18. 2.7. How did you feel during the analysis of this code snippet? (1 for very uncomfortable to 5 for very comfortable). *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

Code snippet 3

19. 3.1. Please, describe how the code snippets works. *

20. 3.2. Is the analyzed code snippets hard to comprehend? *

Mark only one oval.

- ◯ Yes
- ◯ No

21. 3.3. Based on the previous answer, explain why. *

22. 3.4. Is there a code smell in the analyzed code snippet? *

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 26*

Code snippet 3 with code smell

23. 3.5. What code smell(s)? *

Check all that apply.

- ☐ Long Method
- ☐ Data Class
- ☐ Feature Envy
- ☐ Other: _____

24. 3.6. What is the code smell severity? *

Mark only one oval.

- ◯ Minor
- ◯ Major
- ◯ Critical

25. What was your reason for choosing this severity? *

Code snippet 3 feeling

26. 3.7. How did you feel during the analysis of this code snippet? (1 for very uncomfortable to 5 for very comfortable). *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

Code snippet 4

27. 4.1. Please, describe how the code snippets works. *

28. 4.2. Is the analyzed code snippets hard to comprehend? *

Mark only one oval.

- ◯ Yes
- ◯ No

29. 4.3. Based on the previous answer, explain why. *

30. 4.4. Is there a code smell in the analyzed code snippet? *

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 34*

Code snippet 4 with code smell

31. 4.5. What code smell(s)? *

Check all that apply.

- ☐ Long Method
- ☐ Data Class
- ☐ Feature Envy
- ☐ Other: _____

32. 4.6. What is the code smell severity? *

Mark only one oval.

- ◯ Minor
- ◯ Major
- ◯ Critical

33. What was your reason for choosing this severity? *

Code snippet 4 feeling

34. 4.7. How did you feel during the analysis of this code snippet? (1 for very uncomfortable to 5 for very comfortable). *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

Code snippet 5

35. 5.1. Please, describe how the code snippets works. *

36. 5.2. Is the analyzed code snippets hard to comprehend? *

Mark only one oval.

- ◯ Yes
- ◯ No

37. Please select the second option below to show you are reading the instructions. *

Mark only one oval.

- ◯ I am not paying attention.
- ◯ I am paying attention.
- ◯ I am not sure what to choose.
- ◯ None of the above.

38. 5.3. Based on the answer 5.2, explain why. *

_____

_____

_____

_____

_____

39. 5.4. Is there a code smell in the analyzed code snippet? *

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 43*

Code snippet 5 with code smell

40. 5.5. What code smell(s)? *

Check all that apply.

- ☐ Long Method
- ☐ Data Class
- ☐ Feature Envy
- ☐ Other: _____

41. 5.6. What is the code smell severity? *

Mark only one oval.

- Minor
- Major
- Critical

42. What was your reason for choosing this severity? *

Code snippet 5 feeling

43. 5.7. How did you feel during the analysis of this code snippet? (1 for very uncomfortable to 5 for very comfortable). *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

Code snippet 6

44. 6.1. Please, describe how the code snippets works. *

45. 6.2. Is the analyzed code snippets hard to comprehend? *

Mark only one oval.

- ◯ Yes
- ◯ No

46. 6.3. Based on the previous answer, explain why. *

_____

_____

_____

_____

_____

47. 6.4. Is there a code smell in the analyzed code snippet? *

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 51*

Code snippet 6 with code smell

48. 6.5. What code smell(s)? *

Check all that apply.

- ☐ Long Method
- ☐ Data Class
- ☐ Feature Envy
- ☐ Other: _____

49. 6.6. What is the code smell severity? *

Mark only one oval.

- ◯ Minor
- ◯ Major
- ◯ Critical

50. What was your reason for choosing this severity? *

Code snippet 6 feeling

51. 6.7. How did you feel during the analysis of this code snippet? (1 for very uncomfortable to 5 for very comfortable). *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

Code snippet 7

52. 7.1. Please, describe how the code snippets works. *

53. 7.2. Is the analyzed code snippets hard to comprehend? *

Mark only one oval.

- ◯ Yes
- ◯ No

54. 7.3. Based on the previous answer, explain why. *

55. 7.4. Is there a code smell in the analyzed code snippet? *

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 59*

Code snippet 7 with code smell

56. 7.5. What code smell(s)? *

Check all that apply.

- ☐ Long Method
- ☐ Data Class
- ☐ Feature Envy
- ☐ Other: _____

57. 7.6. What is the code smell severity? *

Mark only one oval.

- ◯ Minor
- ◯ Major
- ◯ Critical

58. What was your reason for choosing this severity? *

Code snippet 7 feeling

59. 7.7. How did you feel during the analysis of this code snippet? (1 for very uncomfortable to 5 for very comfortable). *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

Code snippet 8

60. 8.1. Please, describe how the code snippets works. *

61. 8.2. Is the analyzed code snippets hard to comprehend? *

Mark only one oval.

- ◯ Yes
- ◯ No

62. 8.3. Based on the previous answer, explain why. *

63. 8.4. Is there a code smell in the analyzed code snippet? *

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 67*

Code snippet 8 with code smell

64. 8.5. What code smell(s)? *

Check all that apply.

- ☐ Long Method
- ☐ Data Class
- ☐ Feature Envy
- ☐ Other: _____

65. 8.6. What is the code smell severity? *

Mark only one oval.

- ◯ Minor
- ◯ Major
- ◯ Critical

66. What was your reason for choosing this severity? *

Code snippet 8 feeling

67. 8.7. How did you feel during the analysis of this code snippet? (1 for very uncomfortable to 5 for very comfortable). *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

Code snippet 9

68. 9.1. Please, describe how the code snippets works. *

69. 9.2. Is the analyzed code snippets hard to comprehend? *

Mark only one oval.

- ◯ Yes
- ◯ No

70. 9.3. Based on the previous answer, explain why. *

71. 9.4. Is there a code smell in the analyzed code snippet? *

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 75*

Code snippet 9 with code smell

72. 9.5. What code smell(s)? *

Check all that apply.

- ☐ Long Method
- ☐ Data Class
- ☐ Feature Envy
- ☐ Other: _____

73. 9.6. What is the code smell severity? *

Mark only one oval.

- ◯ Minor
- ◯ Major
- ◯ Critical

74. What was your reason for choosing this severity? *

Code snippet 9 feeling

75. 9.7. How did you feel during the analysis of this code snippet? (1 for very uncomfortable to 5 for very comfortable). *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

Code snippet 10

76. 10.1. Please, describe how the code snippets works. *

77. 10.2. Is the analyzed code snippets hard to comprehend? *

Mark only one oval.

- ◯ Yes
- ◯ No

78. 10.3. Based on the previous answer, explain why. *

79. Choose the option labeled 'Blue' *

Mark only one oval.

- ◯ Green
- ◯ Yellow
- ◯ Blue
- ◯ Red

80. 10.4. Is there a code smell in the analyzed code snippet? *

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 84*

Code snippet 10 with code smell

81. 10.5. What code smell(s)? *

Check all that apply.

- ☐ Long Method
- ☐ Data Class
- ☐ Feature Envy
- ☐ Other: _____

82. 10.6. What is the code smell severity? *

Mark only one oval.

- Minor
- Major
- Critical

83. What was your reason for choosing this severity? *

Code snippet 10 feeling

84. 10.7. How did you feel during the analysis of this code snippet? (1 for very uncomfortable to 5 for very comfortable). *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

Code snippet 11

85. 11.1. Please, describe how the code snippets works. *

86. 11.2. Is the analyzed code snippets hard to comprehend? *

Mark only one oval.

- ◯ Yes
- ◯ No

87. 11.3. Based on the previous answer, explain why. *

_____

_____

_____

_____

_____

88. 11.4. Is there a code smell in the analyzed code snippet? *

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 92*

Code snippet 11 with code smell

89. 11.5. What code smell(s)? *

Check all that apply.

- ☐ Long Method
- ☐ Data Class
- ☐ Feature Envy
- ☐ Other: _____

90. 11.6. What is the code smell severity? *

Mark only one oval.

- ◯ Minor
- ◯ Major
- ◯ Critical

91. What was your reason for choosing this severity? *

Code snippet 11 feeling

92. 11.7. How did you feel during the analysis of this code snippet? (1 for very uncomfortable to 5 for very comfortable). *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

Code snippet 12

93. 12.1. Please, describe how the code snippets works. *

94. 12.2. Is the analyzed code snippets hard to comprehend? *

Mark only one oval.

- ◯ Yes
- ◯ No

95. 12.3. Based on the previous answer, explain why. *

96. 12.4. Is there a code smell in the analyzed code snippet? *

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 100*

Code snippet 12 with code smell

97. 11.5. What code smell(s)? *

Check all that apply.

- ☐ Long Method
- ☐ Data Class
- ☐ Feature Envy
- ☐ Other: _____

98. 11.6. What is the code smell severity? *

Mark only one oval.

- ◯ Minor
- ◯ Major
- ◯ Critical

99. What was your reason for choosing this severity? *

Code snippet 12 feeling

100. 11.7. How did you feel during the analysis of this code snippet? (1 for very uncomfortable to 5 for very comfortable). *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

Code snippet 13

101. 13.1. Please, describe how the code snippets works. *

102. 13.2. Is the analyzed code snippets hard to comprehend? *

Mark only one oval.

- ◯ Yes
- ◯ No

103. 13.3. Based on the previous answer, explain why. *

104. 13.4. Is there a code smell in the analyzed code snippet? *

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 108*

Code snippet 13 with code smell

105. 13.5. What code smell(s)? *

Check all that apply.

- ☐ Long Method
- ☐ Data Class
- ☐ Feature Envy
- ☐ Other: _____

106. 13.6. What is the code smell severity? *

Mark only one oval.

- ◯ Minor
- ◯ Major
- ◯ Critical

107. What was your reason for choosing this severity? *

Code snippet 13 feeling

108. 13.7. How did you feel during the analysis of this code snippet? (1 for very uncomfortable to 5 for very comfortable). *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

Developer background

In this section, questions related to the developer's background will be asked.

109. Which is the highest level of formal education that you graduated? *

Mark only one oval.

- ◯ Secondary school (or lower)
- ◯ Bachelor of Science (BSc) / Bachelor of Engineering (BEng)
- ◯ Other Bachelor-level
- ◯ Master of Science (MSc) / Master of Engineering (MEng)
- ◯ Other Master-level
- ◯ Doctoral (Ph.D.) or higher

110. How long professional experience in programming do you have? (Answer in years and months. Ex.: 1Y3M or 0Y2M) *

111. How long professional experience in software development do you have? (Please include programming, testing, administration, management, projects, etc.) *

_____

112. How long professional experience in programming in Java do you have? *

_____

113. Which programming languages did you use throughout your career? *

Check all that apply.

- [ ] Assembly
- [ ] C
- [ ] C++
- [ ] C#
- [ ] Clojure
- [ ] COBOL
- [ ] Delphi
- [ ] Elixir
- [ ] Erlang
- [ ] Go
- [ ] Groovy
- [ ] Haskell
- [ ] Java
- [ ] JavaScript
- [ ] Kotlin
- [ ] Matlab
- [ ] Objective-C
- [ ] Perl
- [ ] PHP
- [ ] Python
- [ ] R
- [ ] Ruby
- [ ] Scala
- [ ] Smalltalk
- [ ] SQL
- [ ] Swift
- [ ] TypeScript
- [ ] Rust
- [ ] Visual Basic
- [ ] Visual Basic .NET
- [ ] Other: _____

114. Which of those tools did you ever use? *

Check all that apply.

- [ ] A compiler
- [ ] A linter
- [ ] Model checker
- [ ] Proof assistant
- [ ] A static analysis tool (e.g., FindBugs)
- [ ] A defect prediction tool
- [ ] Fuzzer
- [ ] Mutation tester
- [ ] Code review tools
- [ ] I don't use any
- [ ] Other: _____

115. Which of those roles have you held throughout your professional career? *

Check all that apply.

- [ ] Junior Software Developer/Engineer
- [ ] Software Developer/Engineer
- [ ] Senior/Lead Software Developer/Engineer
- [ ] Data Scientist
- [ ] Project Manager
- [ ] Other management role
- [ ] Designer
- [ ] Business Analyst / Requirements Engineer
- [ ] Software Tester
- [ ] Hardware Tester
- [ ] Operations Engineer / System Administrator
- [ ] Architect
- [ ] Other: _____

116. Which of those are your current roles? *

Check all that apply.

- [ ] Student - Bachelor level
- [ ] Student - Master level
- [ ] Student - PhD level
- [ ] Junior Software Developer/Engineer
- [ ] Software Developer/Engineer
- [ ] Senior/Lead Software Developer/Engineer
- [ ] Data Scientist
- [ ] Project Manager
- [ ] Other management role
- [ ] Designer
- [ ] Business Analyst / Requirements Engineer
- [ ] Software Tester
- [ ] Hardware Tester
- [ ] Operations Engineer / System Administrator
- [ ] Architect
- [ ] Lecturer
- [ ] Other: _____

117. Read this definition of code review: A code review is a process where someone, other than the author(s) of a piece of code, examines that code. *

Now answer the question: Are you familiar with the concept of code reviews?

Mark only one oval.

- ◯ Yes, I know what they are and maybe used some tools
- ◯ Somewhat - I heard about them in the past but never dug deeper
- ◯ Not really - I heard about them for the first time in this experiment

118. Have you ever used any code review analysis tools? *

Check all that apply.

- [ ] SonarQube
- [ ] Codacy
- [ ] DeepScan
- [ ] ReSharper
- [ ] Code Climate
- [ ] ESLint
- [ ] PyLint
- [ ] PMD
- [ ] Organic
- [ ] I don't use any
- [ ] Other: _____

119. Please describe your earlier experience with code review analysis tools.

_____

_____

_____

_____

_____

120. How long have you been conducting regular code reviews for your peers? *

Mark only one oval.

- ◯ I don't conduct code reviews
- ◯ Less than half a year
- ◯ Between half a year and two years
- ◯ More than two years

121. Code in which of those languages would you feel comfortable reviewing? *

Check all that apply.

- [ ] Assembly
- [ ] C
- [ ] C++
- [ ] C#
- [ ] Clojure
- [ ] COBOL
- [ ] Delphi
- [ ] Elixir
- [ ] Erlang
- [ ] Go
- [ ] Groovy
- [ ] Haskell
- [ ] Java
- [ ] JavaScript
- [ ] Kotlin
- [ ] Matlab
- [ ] Objective-C
- [ ] Perl
- [ ] PHP
- [ ] Python
- [ ] R
- [ ] Ruby
- [ ] Scala
- [ ] Smalltalk
- [ ] SQL
- [ ] Swift
- [ ] TypeScript
- [ ] Rust
- [ ] Visual Basic
- [ ] Visual Basic .NET
- [ ] None

- [ ] Other: _____

122. Which of the following code smells do you believe you can recognize? *

Check all that apply.

- [ ] Blob / God Class
- [ ] Long Method
- [ ] Data Class
- [ ] Feature Envy
- [ ] Blue Box
- [ ] Inappropriate Intimacy
- [ ] Shotgun Surgery
- [ ] Swiss Army Knife
- [ ] Duplicate Code
- [ ] Data Clumps
- [ ] Refused Bequest
- [ ] Message Chains
- [ ] None
- [ ] Other: _____

123. Do you feel that code smells in traditional sense make the code less maintainable? *

Mark only one oval.

- ◯ Definitely, that's why the concept was invented
- ◯ I'd assume so, but in my experience I hardly ever find this a problem
- ◯ Not really, there are many worse problems in the code

124. Do you feel that concept of code smell can be transferred between programming languages? *

Mark only one oval.

- ◯ Not at all
- ◯ Only between very similar languages
- ◯ In a family of languages, with minor adjustments
- ◯ Yes, but it may no longer be meaningful

125. What is the biggest problem you encounter **in comprehending** code written by you or other people? *

Mark only one oval.

- ◯ It's complexity
- ◯ Readability (code snippets that is difficult to read or poorly formatted)
- ◯ Lack of comments or documentation
- ◯ Language conventions (poor variable or function naming)
- ◯ Code not adhering to common style
- ◯ It's size
- ◯ It's age
- ◯ Lack of modularity
- ◯ The presence of code smells
- ◯ How well it is tested
- ◯ It's dependencies
- ◯ Other: _____

126. Which quality assurance techniques do you use in your daily work?

Mark only one oval.

- ◯ Unit testing
- ◯ Integration/system testing
- ◯ Mutation testing
- ◯ Performance testing
- ◯ Linting
- ◯ Static analysis (e.g. model checking, symbolic execution)
- ◯ Program proving
- ◯ Fuzzing
- ◯ Code review
- ◯ None
- ◯ Other: _____

127. Do you believe that reviews contribute to code quality?

Mark only one oval.

- ◯ Yes, positively
- ◯ Yes, negatively
- ◯ No

128. Have you ever participated in any research with biosensors? If yes, please describe. *

Survey after analysis of code snippets

129. How did you feel during the analysis of **all** code snippets? (1 for very uncomfortable to 5 for very comfortable). *

Mark only one oval.

1	2	3	4	5
◯	◯	◯	◯	◯

130. Do you think the use of biosensors (such as smartwatch and eye tracker) affected your ability to analyze code snippets in search of code smells? *

Mark only one oval.

- ◯ Yes
- ◯ May be
- ◯ No
- ◯ I don't know how to comment

131. Do you think the use of biosensors by developers can provide valuable data to understand the code smell analysis process? *

Mark only one oval.

- Yes
- May be
- No
- I don't know how to comment

132. Would you be open to using biosensors in your daily coding activities to better understand your performance and potentially improve your code quality? *

Mark only one oval.

- Yes
- May be
- No
- I don't know how to comment

133. Do you have any suggestions to improve the use of biosensors in the context of code smell analysis? *

134. What features do you think are most relevant when using eye tracking to assess code comprehensibility? *

Check all that apply.

- [ ] Fixation duration: The length of time a developer spends fixating on a particular word or line of code can indicate how difficult it is for them to comprehend. Longer fixation durations may indicate that the code is difficult to understand or requires additional mental effort to comprehend.
- [ ] Saccade length: Saccades are the rapid eye movements that occur as a person shifts their focus from one object to another. The length of these movements can indicate the level of cognitive effort required to process the information. Longer saccade lengths may indicate that the code is more complex or requires more effort to comprehend.
- [ ] Gaze location: Eye tracking can also provide information about where the developer is looking on the screen. If the developer is fixating on irrelevant parts of the screen or is not able to locate important parts of the code, this may indicate that the code is difficult to navigate or comprehend.
- [ ] Pupil dilation: Pupil dilation is a physiological response that can indicate changes in cognitive load. If the developer is experiencing increased cognitive load while reading a particular fragment of code, this may be reflected in changes in pupil dilation.
- [ ] Reading speed: Eye tracking can also provide information about reading speed. If the developer is reading slowly or is frequently pausing to re-read sections of code, this may indicate that the code is difficult to comprehend.
- [ ] I don't know how to comment
- [ ] Other: _____

Thank you for participating in our research!