45426: Teste e Qualidade de Software

Code improvement: refactoring and static code analysis

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Learning objectives

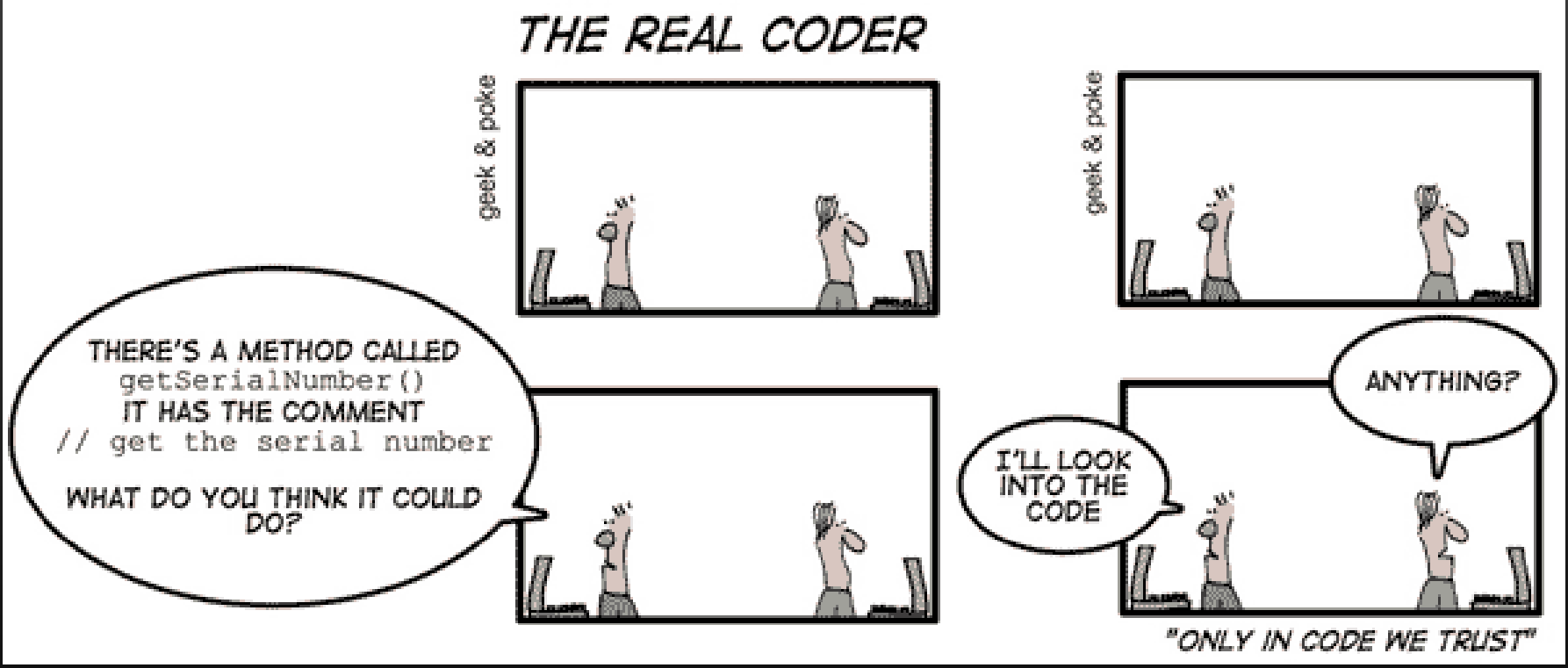
Identify the occurrence of “bad smells” in code

Propose refactoring options for given “bad smells”

Explain the role of Inspectors (static code analysis)

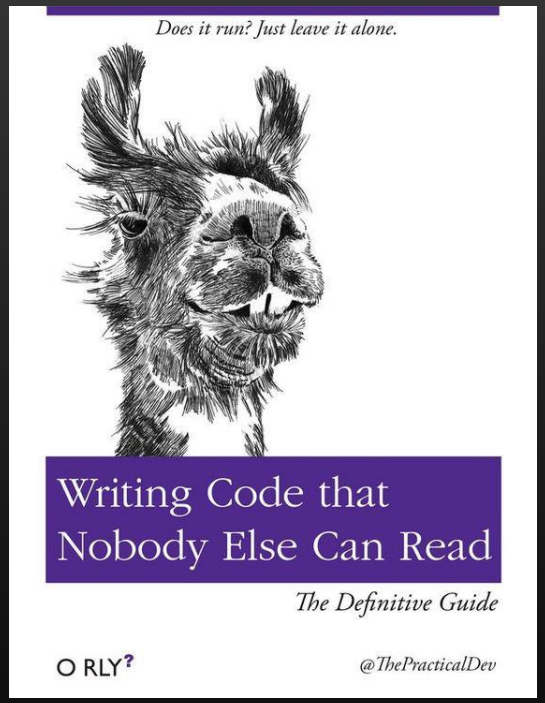
Describe the metrics used in SonarQube

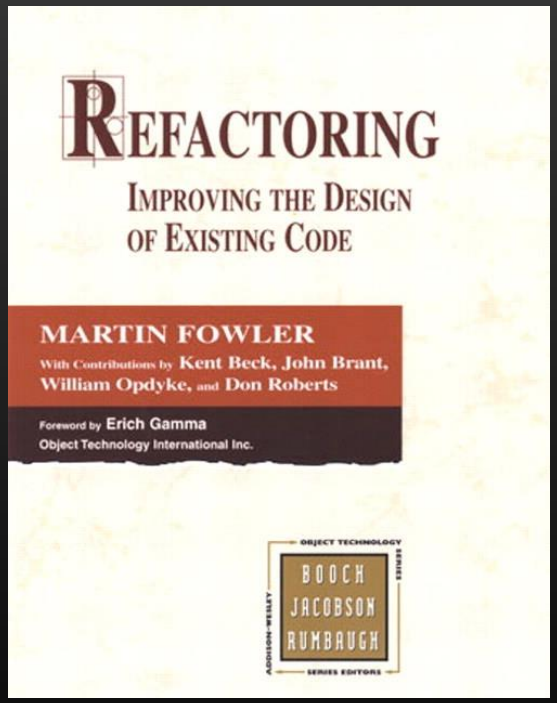
Define the concept of technical debt and explain how it should be managed in a SQEnvironment

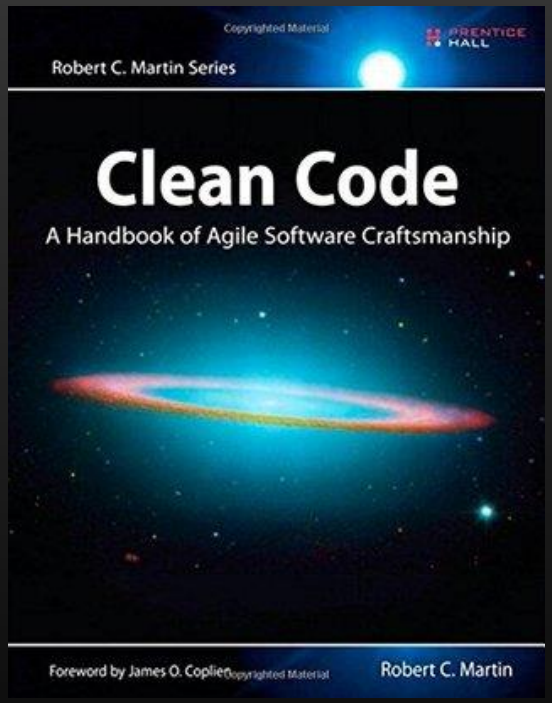


Olivera (2018)

Not all code is equally easy to maintain







Find the intruder…

Oliveira (2018)

Code refactoring

Refactoring is a controlled technique for improving the design of an existing code base

...altering its internal structure without changing its external behavior.

Key aspects:

- series of "small" transformations
- preserving functionality & correctness.

Examples

Extract (duplicate code into a) method

Extract interface

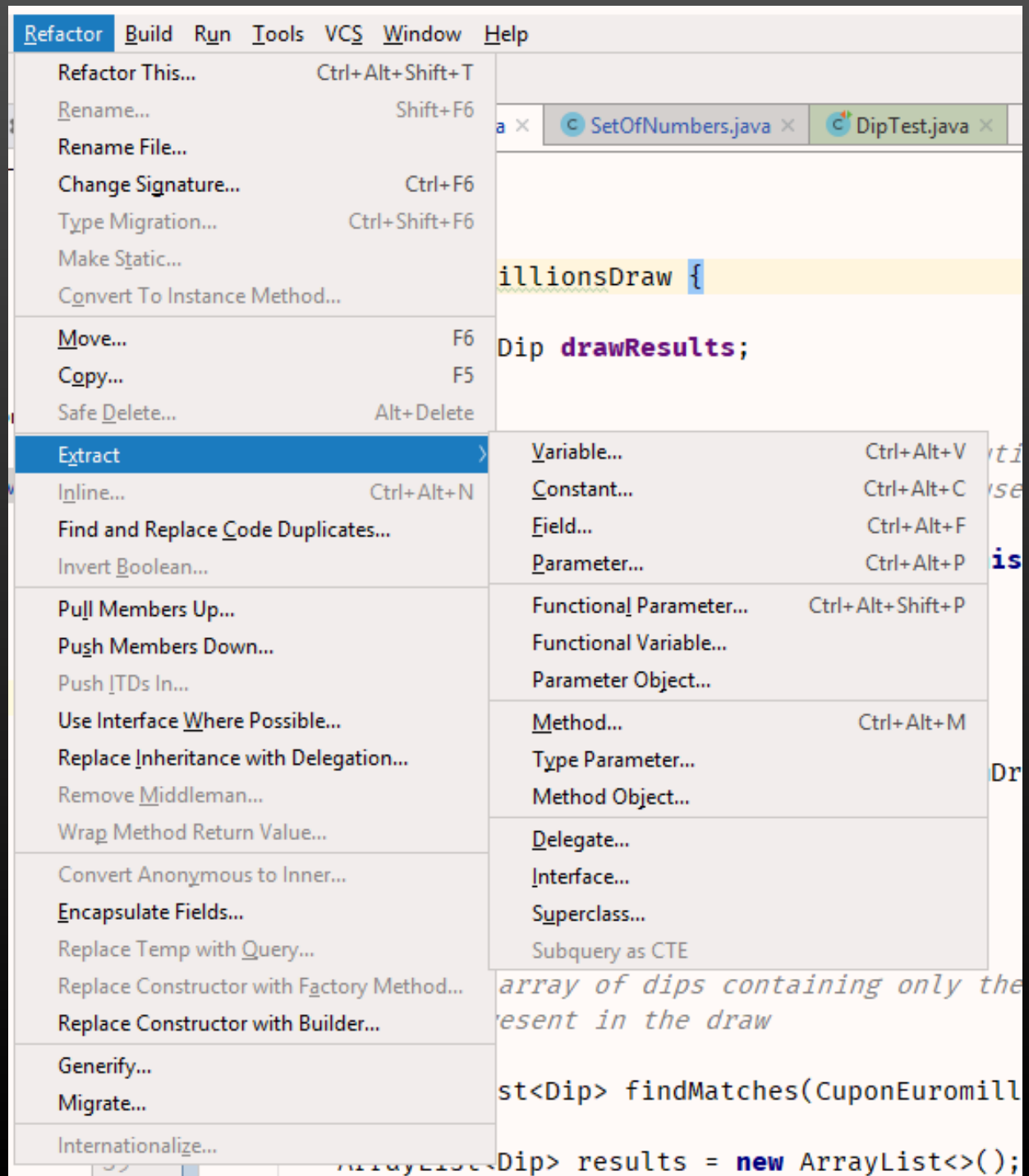
See also:

Source Making: [refactoring techniques]

Fowler: [Catalog of refactoring situations]

Do I need this? Several IDEs will automate refactoring...

IntelliJ support



When to refactor

Resolve “code smells” (anti-patterns)

See: catalog of bad code smells

Examples:

Duplicate code → Extract method

Long method → Extract method

Data class → Encapsulate field

Feature Envy → Move method

Why refactoring? MAINTAIN & EVOLVE!

Cleaner code

→ easier to understand and maintain

Better design for the current understanding of the architecture

Reduce complexity

→ easier to understand and evolve

Make the code more reusable

→ component-like thinking (generalize for other needs)

Improve performance

Improve security (by removing vulnerabilities)

Oliveira (2018)

Code inspection

Analysis of code patterns, without running the code

Examples of issues found in SA:

Referencing a variable with an undefined value

Variables that are never used

Unreachable (dead) code

Programming standards violations

Security vulnerabilities

Internationalization (i18n) issues

Catalogs of code weaknesses (setting the vocabulary)

CWE - Common Weakne | Refactoring

cwe.mitre.org/index.html

Common Weakness Enumeration

A Community-Developed List of Software Weakness Types

CWE and SANS Institute TOP 25 MOST DANGEROUS SOFTWARE ERRORS

ID Lookup: Go

Home | About | CWE List | Scoring | Community | News | Search

CWE™ is a community-developed list of common software security weaknesses. It serves as a common language, a measuring stick for software security tools, and as a baseline for weakness identification, mitigation, and prevention efforts.

View the CWE List

View by Research Concepts | View by Development Concepts | View by Architectural Concepts

Search CWE

Easily find a specific software weakness by performing a search of the CWE List by keywords(s) or by CWE-ID Number. To search by multiple keywords, separate each by a space.

NPE due to a badly handled exception

```
// Execute
Process process = null;
try{
  if(cmd.length == 1) {
     process = Runtime.getRuntime().exec( cmd[0] );
  } else {
     process = Runtime.getRuntime().exec( cmd );
  }
}
catch(Exception e){
    e.printStackTrace();
}

  try {
      if(inputToStdIn) {
         sendInput(process, stream);
      } else {
         process.getOutputStream().close();
```

'process' is by definition null here.

If an exception is thrown when executing the command line, 'process' remains null.

So a NullPointerException will be thrown later.

NullPointerException might be thrown as 'process' is nullable here ... 2 months ago ▾ L193

Blocker Open Not assigned Not planned 10min debt bug, cert, cwe, owasp-a1, owasp-a2, owasp-a6, security

```
      }
```

https://blog.sonarsource.com/sonaranalyzer-for-java-tricky-bugs-are-running-scared/

Useless condition

```
// Handle web socket routes
if (webSocketServletContextHandler == null) {
    server.setHandler(handler);
} else {
    List<Handler> handlersInList = new ArrayList<>();
    handlersInList.add(handler);

    // WebSocket handler must be the last one
    if (webSocketServletContextHandler != null) {
```

If 'webSocketServercontextHandler' is null in this branch, it can't be nullable in the 'else' branch

Change this condition so that it does not always evaluate to "true" ... 2 months ago L115

Blocker Open Not assigned Not planned 15min debt bug, cwe, misra

```
        handlersInList.add(webSocketServletContextHandler);
    }

    HandlerList handlers = new HandlerList();
    handlers.setHandlers(handlersInList.toArray(new Handler[handlersInList.size()]));
    server.setHandler(handlers);
}
```

https://blog.sonarsource.com/sonaranalyzer-for-java-tricky-bugs-are-running-scared/

Suspect unreachable branch

```
TemporaryResources tmp = new TemporaryResources();
File output = null;
try {
  TikaInputStream tikaStream = TikaInputStream.get(stream, tmp);
  File input = tikaStream.getFile();
  String cmdOutput = computePoT(input);
  FileInputStream ofStream = new FileInputStream(new File(
      input.getAbsoluteFile() + ".of.txt"));
  FileInputStream ogStream = new FileInputStream(new File(
      input.getAbsoluteFile() + ".hog.txt"));
  extractHeaderOutput(ofStream, metadata, "of");
  extractHeaderOutput(ogStream, metadata, "og");
  xhtml.startDocument();
  doExtract(ofStream, xhtml, "Histogram of Optical Flows (HOF)",
      metadata.get("of_frames"), metadata.get("of_vecSize"));
  doExtract(ogStream, xhtml, "Histogram of Oriented Gradients (HOG)",
      metadata.get("og_frames"), metadata.get("og_vecSize"));
  xhtml.endDocument();

} finally {
  tmp.dispose();
  if (output != null) {
```

'output' is in fact never initialised so indeed always null so the content of the branch is unreachable.

Change this condition so that it does not always evaluate to "false" ... 4 months ago L145

Blocker Open Not assigned Not planned 15min debt bug, cwe, misra

```
    output.delete();
  }
}
}
```


Rivera (2018)

Code inspection in IntelliJ

tqs-euromillions-unit › src › main › java › sets › SetOfNumbers

Add Configuration... Git:

Project

- tqs-euromillions-unit [euromillions-play]
  - .idea
  - .settings
  - src
    - main
      - java
        - euromillions
          - CuponEuromillions
          - Dip
          - EuromillionsDraw
        - sets
        - ui
        - rsa-uml-classes.dnx
        - rsa-uml-classes.png
    - test
  - target
  - .classpath
  - .gitignore
  - .project
  - euromillions-play.iml
  - Jenkinsfile
  - nbactions.xml
  - pom.xml

Dip.java | EuromillionsDraw.java | SetOfNumbers.java | DipTest.java

```
11  public class SetOfNumbers  implements Iterable<Integer> {
12
13      private ArrayList<Integer> collection = null;
14
15
16      public static SetOfNumbers fromArray( int[] values) {
17          SetOfNumbers newSet = new SetOfNumbers();
18          for( int n : values) {
19              newSet.add( n);
20          }
21          return newSet
22      }
23
24      public SetOfNumbe
25          super();
26          collection =
27      }
28
29          public int si
32
33          /**
```

SetOfNumbers › collection

Specify Inspection Scope

Inspection scope

- Whole project
- File '...\src\main\java\sets\SetOfNumbers.java [euromillions-play]'
- Custom scope All Places
- Include test sources

Inspection profile

Project Default Project

OK Cancel

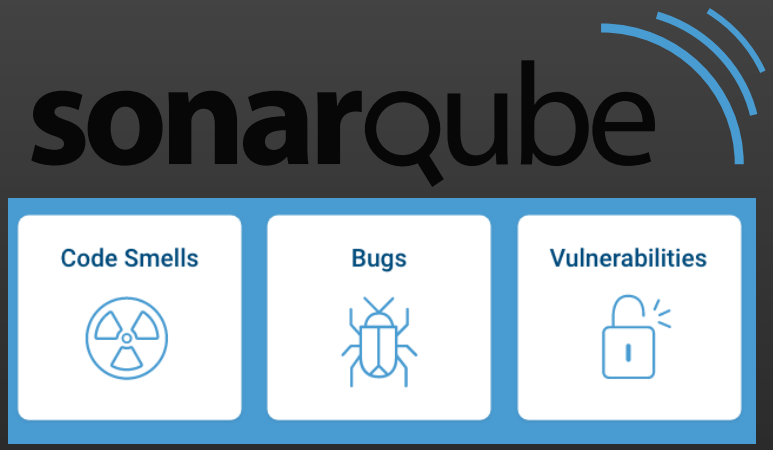
Inspection Results: 'Project Default' Profile on Project 'euromillions... | 'Project Default' Profile on Project 'euromillions-play'

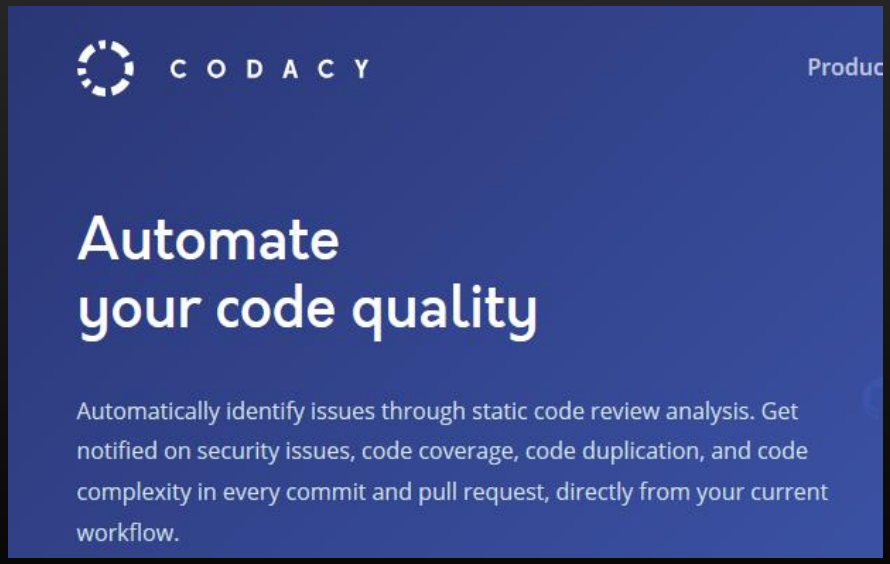
- Warning 12 warnings
  - Java 12 warnings
    - Control flow issues 2 warnings
      - Redundant 'if' statement 2 warnings
        - Dip 1 warning
          - 'if' statement can be simplifie
        - SetOfNumbers 1 warning
    - Declaration redundancy 6 warnings
    - Java language level migration aids 2 wa
    - Javadoc 1 warning
    - Probable bugs 1 warning
  - Typo 40 typos

Simplify Suppress

```
        }
        if (!Objects.equals(this.starts, other.starts)) {
            return false;
```

Advanced inspection frameworks





Rivera (2018)

Sonar Qube concepts

Code Smell

A maintainability-related issue in the code. Leaving it as-is means that at best maintainers will have a harder time than they should making changes to the code. At worst, they'll be so confused by the state of the code that they'll introduce additional errors as they make changes.

Bug

An issue that represents something wrong in the code. If this has not broken yet, it will, and probably at the worst possible moment. This needs to be fixed. Yesterday.

Vulnerability

A security-related issue which represents a potential backdoor for attackers.

https://docs.sonarqube.org/display/SONAR/Concepts

Quality gates

Ready for delivery? Yes, if the defined Quality Gate is met.

Recommended Quality Gate

Metric	Over Leak Period	Operator	Warning	Error
Coverage on New Code	Always	is less than		80
Duplicated Lines on New Code (%)	Always	is greater than		3
Maintainability Rating on New Code	Always	is worse than		A
Reliability Rating on New Code	Always	is worse than		A
Security Rating on New Code	Always	is worse than		A

https://docs.sonarqube.org/display/SONAR/Metric+Definitions

Metric Definitions

Created by Anonymous on Jan 30, 2018

Table of Contents

This is not an exhaustive list of metrics. For the full list, consult the *api/metrics* WebAPI on your SonarQube instance.

Complexity

Name	Key	Description
Complexity	complexity	It is the complexity calculated based on the number of paths through the code. Whenev the control flow of a function splits, the complexity counter gets incremented by on Each **function** has a minimum complexity c 1. This calculation varies slightly by languag because keywords and functionalities do. More details
Cognitive Complexity	cognitive_complexity	How hard it is to understand the code's con flow. See https://www.sonarsource.com/resources/wh

Technical debt