SOFTWARE ARCHITECTURE

Escuela de Ingeniería Informática

Universidad de Oviedo

Lab 6

TDD: Test-Driven Development
Code coverage (SonarCloud)
Continuous integration (GitHub Actions)
Static analysis tools (SonarCloud)

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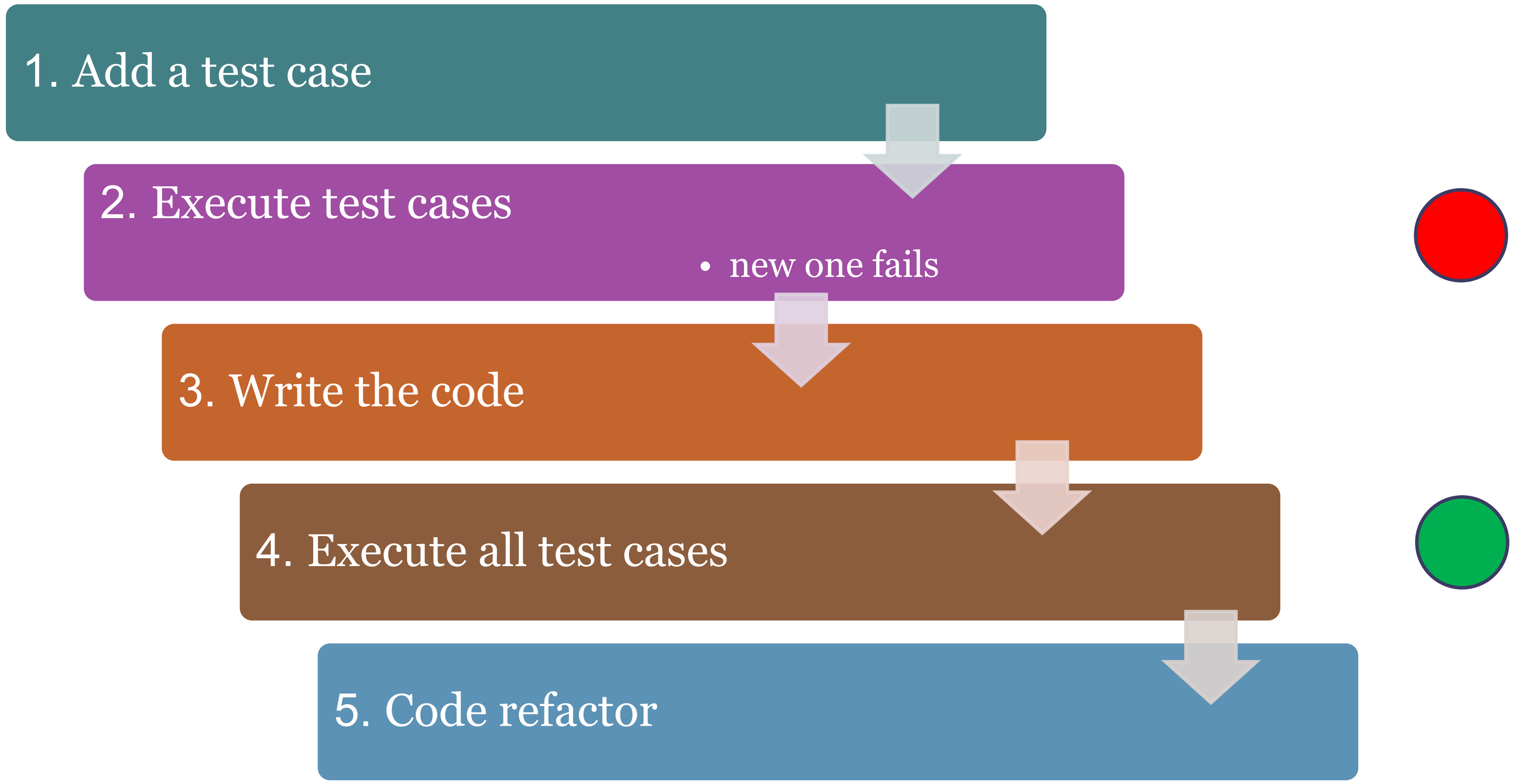
TDD

- Software development process where we start defining test cases and later the code
  - The opposite to software development where tests are defined after code
  - Technique proposed by Kent Beck
- Red/Green development
  - At the start, the tests fail (no code) $\Rightarrow$ Red
  - As we add code, tests start to pass $\Rightarrow$ Green

TDD - Phases


1. Add a test case
2. Execute test cases
• new one fails
3. Write the code
4. Execute all test cases
5. Code refactor

TDD - Features

Simple code created to satisfy the test case
We get clean code as a result + test-suite
Helps focus to know what we want to implement

TDD: "FIRST" Principles for tests

F - Fast
- Execution of (subsets of) tests must be quick

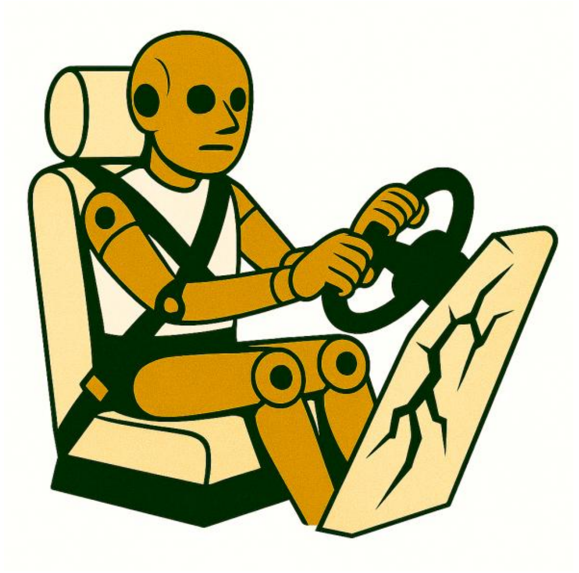
I - Independent:
- No tests depend on others

R - Repeatable:
- If tests are run N times, the result is the same

S - Self-checking
- Test can automatically detect if passed

T - Timely
- Tests are written at the same time (or before) code

Test doubles



- *Dummy* objects:
  - Objects that are passed but not used
- *Fake* objects: Contain a partial implementation.
  - *Stubs:* contain specific answers to some requests
  - *Spies: stubs* that record information for debugging
  - *Mocks:* mimic the behavior of the real object
    - Mocks may contain assertions about the order/number of times methods are called
- Fixtures: Tools that support tests
  - Testing databases, some files, etc.

Tests in Rust

- Each file can have unit tests
  - Marked by `#[cfg(test)]` in a module called `tests`
- Integration tests
  - Included in folder `tests`
- Run by:
  - `cargo test`
- You can run a specific test by:
  - `cargo test nombre`

```
#[cfg(test)]
mod tests {
    use super::*;
    use crate::{Movement, PlayerId};


 #[test]
    fn test_random_bot_name() {
        let bot = RandomBot;
        assert_eq!(bot.name(), "random_bot");
    }
. . .
```

Tests in React: vitest

- Test framework for vite
  - vite = development server for React, Vue, Svelte
    - It monitors files while they are edited
- Support for Typescript, JSX, ...
  - Compatible with React, Vue, ...
- Tests descriptions
  - Vocabulary:
    - describe: group tests
    - it: test case
    - expect: declare assertions
    - . . .

TDD - Test example - Web Service

- Basic test for web service

```
import { describe, it, expect, afterEach, vi } from 'vitest'
import request from 'supertest'
import app from '../users-service.js'

describe('POST /createuser', () => {
    it('returns a greeting message for the provided username', async () => {
        const res = await request(app)
            .post('/createuser')
            .send({ username: 'Pablo' })
            .set('Accept', 'application/json')
        expect(res.status).toBe(200)
        expect(res.body).toHaveProperty('message')
        expect(res.body.message).toMatch(/Hello Pablo! Welcome to the course!/i)
    })
})
```

TDD – React test

Check RegisterForm:

Sometimes we have to mock a test
If we don't mock the API, our test depends on the REST API services from UserService
If we want unit tests, we should remove that dependency

```
test('submits username and displays response', async () => {
  const user = userEvent.setup()

  // Mock fetch to resolve automatically
  global.fetch = vi.fn().mockResolvedValueOnce({
    ok: true,
    json: async () => ({ message: 'Hello Pablo! Welcome to the course!' }),
  } as Response)

  render(<RegisterForm />)

  await waitFor(async () => {
    await user.type(screen.getByLabelText(/whats your name\?/i), 'Pablo')
    await user.click(screen.getByRole('button', { name: /lets go!/i }))
    expect(
      screen.getByText(/hello pablo! welcome to the course!/i)
    ).toBeInTheDocument()
  })
})
```

Code Coverage (SonarCloud)

Code coverage: Measure to show what code lines has been executed by a test suite

Tool that includes code coverage as a metric in the code evaluation process

Some terminology about SonarCloud:

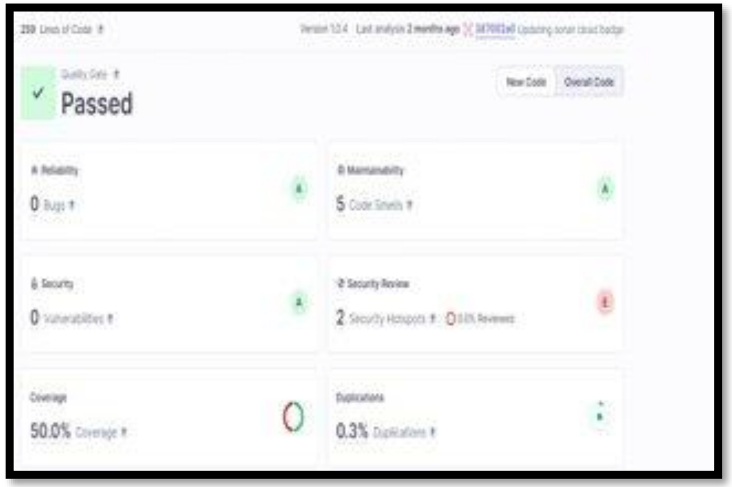
- LC: lines_to_cover – uncovered_lines
- EL: lines_to_cover

Code Coverage in SonarCloud

- Coverage ratio is calculated with the formula:

  LC/EL

- After the tests, it generates a file that allows to do the analysis
  - https://sonarcloud.io/summary/overall?id=Arquisoft_yovi_???



School of Computer Science, University of Oviedo

Continuous Integration (CI)

- Development practice that promotes developers to **integrate** code into a shared repository several times a day
- Every task to build the software is executed when some condition is met
    - For instance, push, pull request, or the creation of a new release

Continuous Integration (CI)

Detect and solve problems continuously
Running code always available
Immediate execution of unit test cases and E2E tests
Running tests in an external environment
Facilitate automatic deployment
Project quality monitorization.

Continuous Integration (CI)

- Examples:
  - Jenkins
  - Pipeline
  - Hudson
  - Apache Continuun
  - Travis
  - **GitHub Actions**

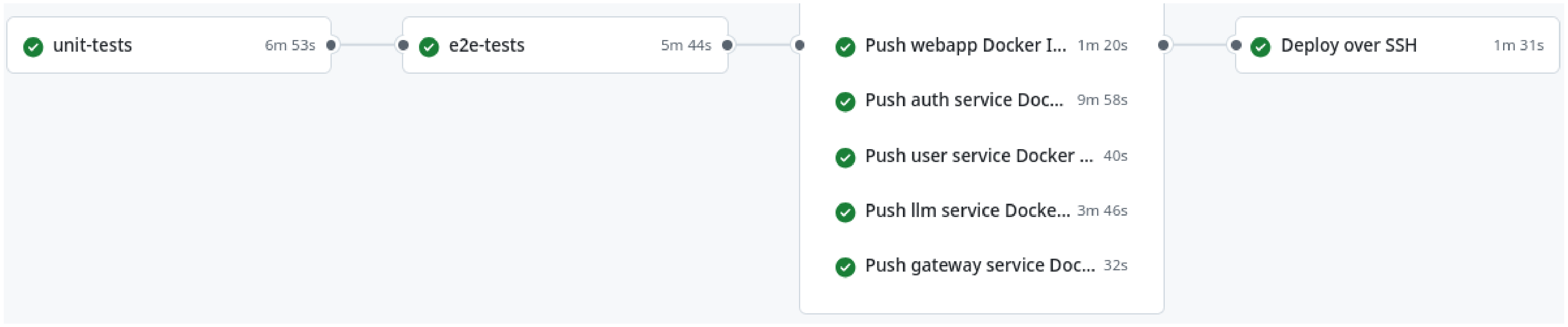
GitHub Actions

- Continuous integration service for projects stored in GitHub
- Free for free software projects
- Configuration is in one or multiple YAML files inside:
  `.github/workflows`

GitHub Actions

- .yml specifies:
  - Conditions for firing the process
  - List of jobs
    - Each executed in a specific environment
  - Steps to carry out the job (checkout, install dependencies, build and test)

```yaml
jobs:
  unit-tests:
    runs-on: ubuntu-latest
    steps:
    - uses: actions/checkout@v4
    - uses: actions/setup-node@v4
      with:
        node-version: 22
    - run: npm --prefix users/authservice ci
    - run: npm --prefix users/userservice ci
    - run: npm --prefix llmservice ci
    - run: npm --prefix gatewayservice ci
    - run: npm --prefix webapp ci
    - run: npm --prefix users/authservice test -- --coverage
    - run: npm --prefix users/userservice test -- --coverage
    - run: npm --prefix llmservice test -- --coverage
    - run: npm --prefix gatewayservice test -- --coverage
    - run: npm --prefix webapp test -- --coverage
    - name: Analyze with SonarQube
      uses: SonarSource/sonarqube-scan-action@master
      env:
        SONAR_TOKEN: ${{ secrets.SONAR_TOKEN }}
```


unit-tests 6m 53s
e2e-tests 5m 44s
Push webapp Docker I... 1m 20s
Push auth service Doc... 9m 58s
Push user service Docker ... 40s
Push llm service Docke... 3m 46s
Push gateway service Doc... 32s
Deploy over SSH 1m 31s

GitHub Actions

- Each job can have a specific purpose
  - Test a part of the app, deploy, etc.
- GitHub actions can be used to automate other parts of the repository.
  - Example: autoreply to new issues created in the repository

GitHub Actions

- We have jobs also to build the docker images and publish them to github
- Check the full documentation for the CI configuration

```yaml
docker-push-webapp:
  name: Push webapp Docker Image to GitHub Packages
  runs-on: ubuntu-latest
  permissions:
    contents: read
    packages: write
  needs: [e2e-tests]
  steps:
  - uses: actions/checkout@v4
  - name: Publish to Registry
    uses: elgohr/Publish-Docker-Github-Action@v5
    env:
      API_URI: http://${{ secrets.DEPLOY_HOST }}:8000
    with:
        name: arquisoft/wichat_0/webapp
        username: ${{ github.actor }}
        password: ${{ secrets.GITHUB_TOKEN }}
        registry: ghcr.io
        workdir: webapp
        buildargs: API_URI
```

Static analysis of the code

Analyze the code without compiling it based in rules
Detects bugs, code smells, system vulnerabilities, etc.
Useful to control the code quality.
If the code does not meet the quality requirements, then the commit can be blocked

Static Analysis - SonarCloud

Static code analysis tool

It needs:

- Git server like GitHub
- Repository access
- An accepted language

Two types of analysis configuration:

- **Automated Analysis** (Default). Code coverage not available. Scanner running in SonarCloud servers
- **CI-based analysis**. Sonar scanner running at the project server and sending reports to SonarCloud.

Sonarlint

SonarLint detects and highlights issues that can lead to bugs, vulnerabilities, and code smells in your IDE (available in the popular ones e.g. IntelliJ, Visual Code, Visal Studio, Eclipse…)

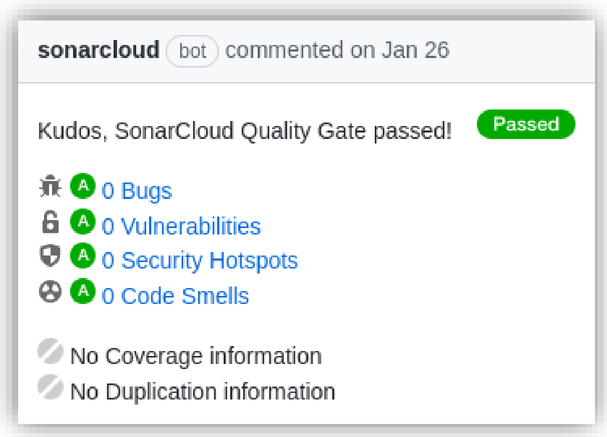
The análisis is performed locally (before the changes are submitted to the repository), can be executed:

- Manually
- Automatically over the changed files before the commit-push.

For further details regarding supported IDEs, languages and installation instructions, please visit the oficial webpage

SonarCloud - yovi_x configuration

After changes are pushed to the repository (example, a new pull request)
We have information about the code quality of the pull request that we are merging to our project


sonarcloud bot commented on Jan 26

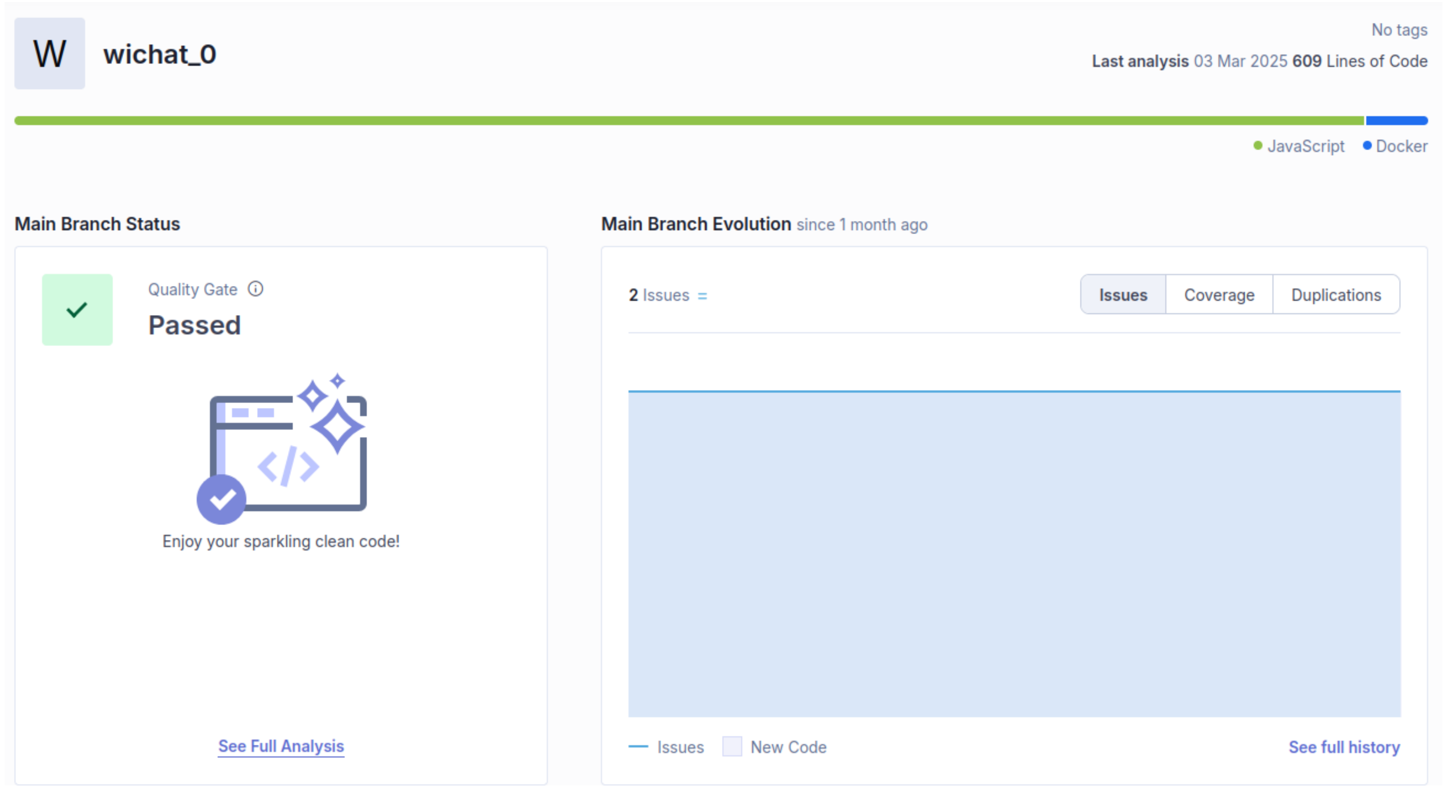
Kudos, SonarCloud Quality Gate passed! Passed

A 0 Bugs
A 0 Vulnerabilities
A 0 Security Hotspots
A 0 Code Smells

No Coverage information
No Duplication information

SonarCloud

In the Project Dashboard we can check project last analysis in the main branch, pull request and specific branches


W wichat_0

No tags

Last analysis 03 Mar 2025 609 Lines of Code

● JavaScript ● Docker

Main Branch Status

Quality Gate

Passed

Enjoy your sparkling clean code!

See Full Analysis

Main Branch Evolution since 1 month ago

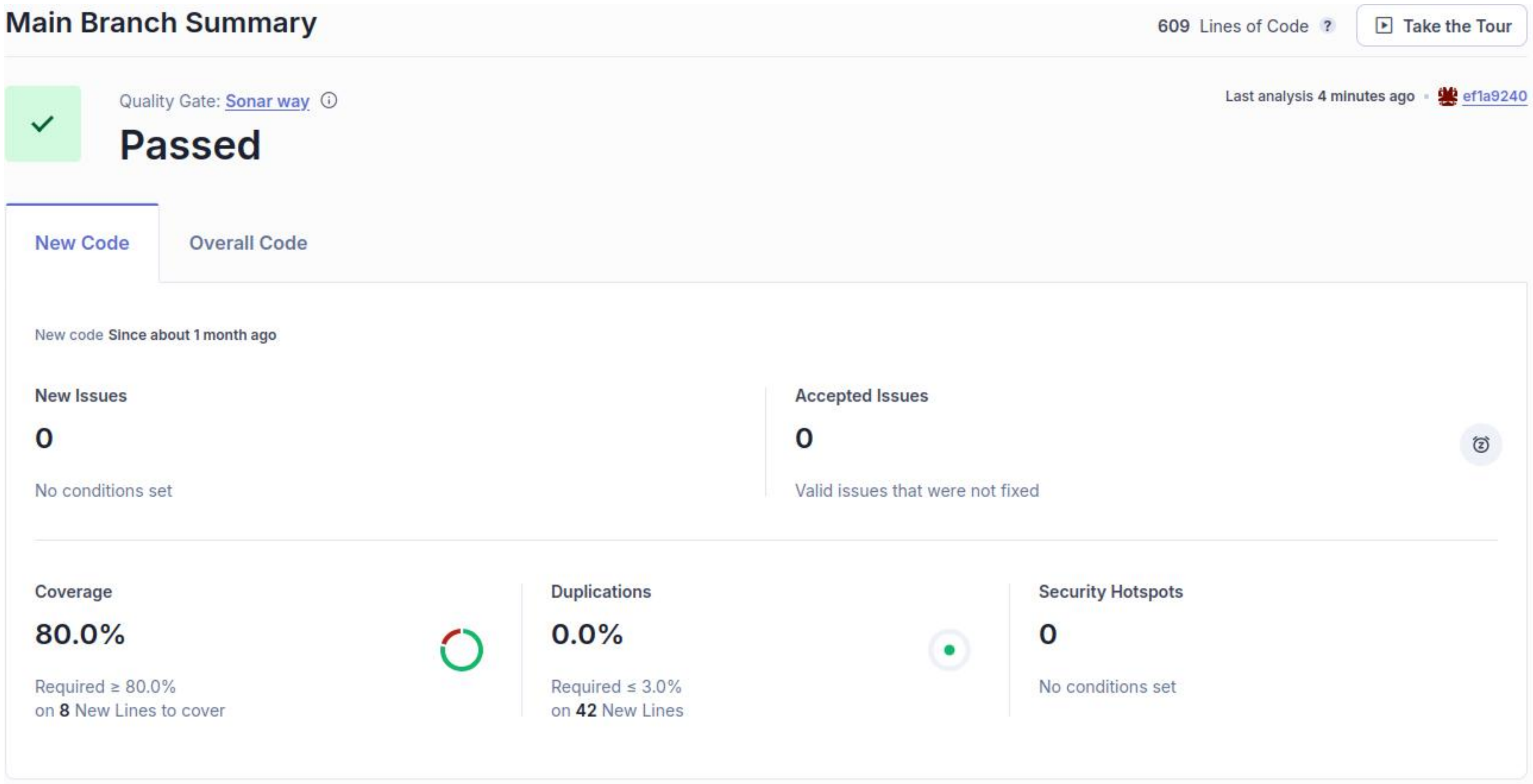
2 Issues =

Issues Coverage Duplications

— Issues ▢ New Code

See full history

SonarCloud: Project certification and Quality evolution



Main Branch Summary

609 Lines of Code

Take the Tour

Quality Gate: Sonar way

Passed

Last analysis 4 minutes ago · ef1a9240

New Code | Overall Code

New code Since about 1 month ago

New Issues
0
No conditions set

Accepted Issues
0
Valid issues that were not fixed

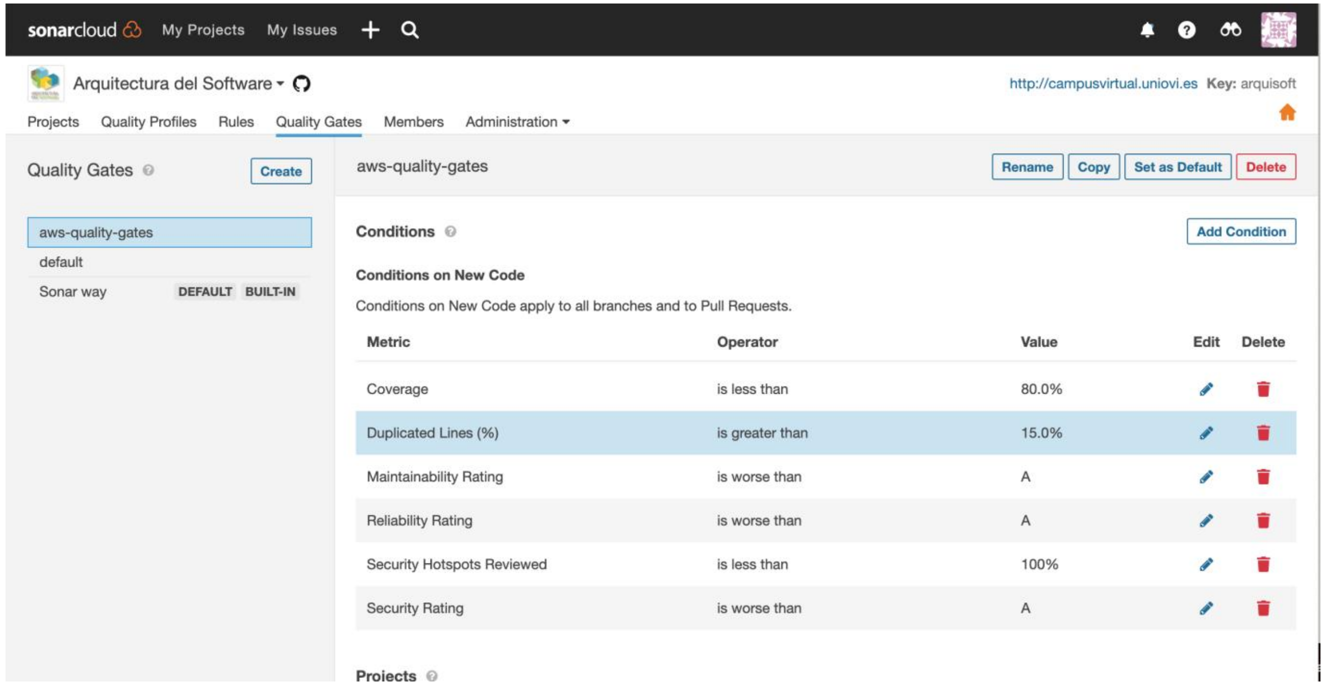
Coverage
80.0%
Required ≥ 80.0%
on 8 New Lines to cover

Duplications
0.0%
Required ≤ 3.0%
on 42 New Lines

Security Hotspots
0
No conditions set

SonarCloud: Quality Gates

At organization level, we can define the Quality Gates that our project must pass.



aws-quality-gates

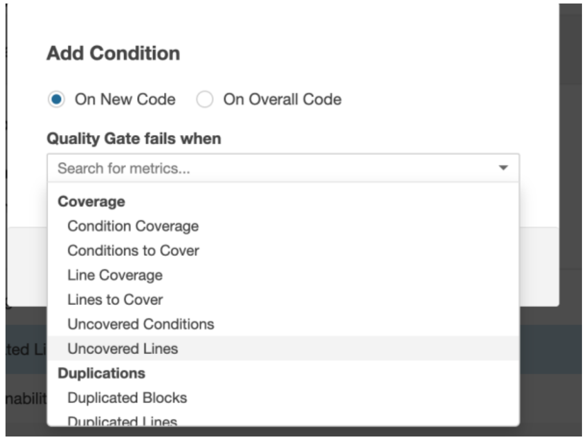
Conditions

Conditions on New Code

Conditions on New Code apply to all branches and to Pull Requests.

Metric	Operator	Value	Edit	Delete
Coverage	is less than	80.0%		
Duplicated Lines (%)	is greater than	15.0%		
Maintainability Rating	is worse than	A		
Reliability Rating	is worse than	A		
Security Hotspots Reviewed	is less than	100%		
Security Rating	is worse than	A		

Projects



Add Condition

[✓ On New Code] On Overall Code

Quality Gate fails when

Example AWS-Quality-Gates , we increase the procentage of duplicate lines that can be found before launch exception

SonarCloud: Quality gates

A **Quality Gate** is a set of conditions that our project should meet.

- That conditions include different aspect: code coverage, static code analyse based in rules, code duplicated, ..

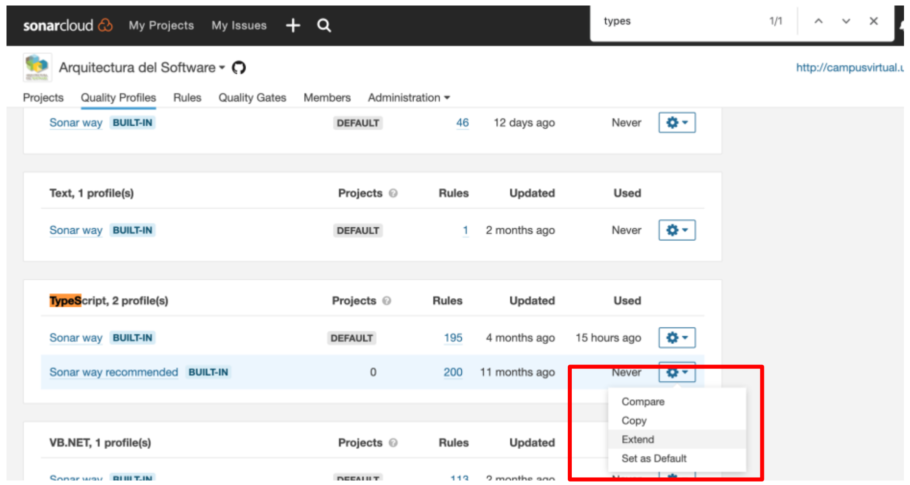
yovi_0 default project uses code coverage with SonarCloud

SonarCloud: Profiles and Rules

Rules are defined at profile level

We can add, desactivate, update rules creating a new profile :

Copy a parent profile - change it - associate it to the project



sonarcloud   My Projects   My Issues

types 1/1

Arquitectura del Software   http://campusvirtual.u

Projects   Quality Profiles   Rules   Quality Gates   Members   Administration

		Projects	Rules	Updated	Used
Sonar way	BUILT-IN	DEFAULT	46	12 days ago	Never

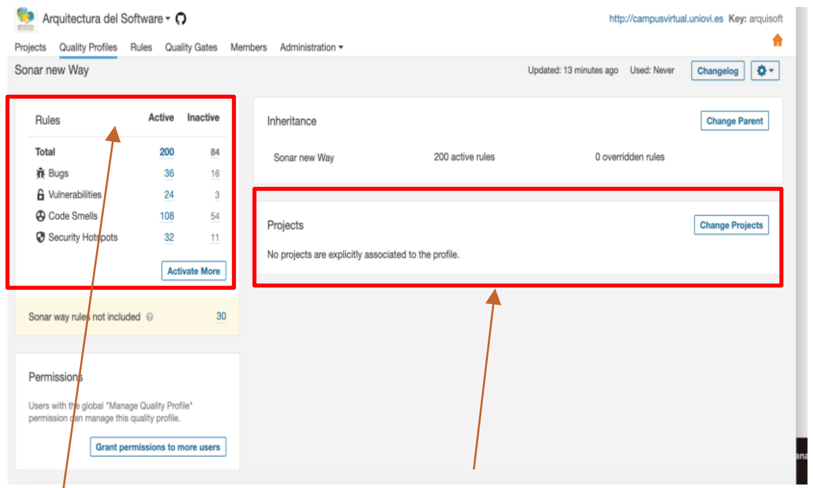
Text, 1 profile(s)		Projects	Rules	Updated	Used
Sonar way	BUILT-IN	DEFAULT	1	2 months ago	Never

TypeScript, 2 profile(s)		Projects	Rules	Updated	Used
Sonar way	BUILT-IN	DEFAULT	195	4 months ago	15 hours ago
Sonar way recommended	BUILT-IN	0	200	11 months ago	Never

Compare
Copy
Extend
Set as Default

VB.NET, 1 profile(s)		Projects	Rules	Updated
Sonar way	BUILT-IN	DEFAULT	113	2 months ago

Create a new profile



Arquitectura del Software   http://campusvirtual.uniovi.es Key: arquisoft

Projects   Quality Profiles   Rules   Quality Gates   Members   Administration

Sonar new Way   Updated: 13 minutes ago   Used: Never   Changelog

Rules	Active	Inactive
Total	200	84
Bugs	36	16
Vulnerabilities	24	3
Code Smells	108	54
Security Hotspots	32	11

Activate More

Sonar way rules not included 30

Permissions

Users with the global "Manage Quality Profile" permission can manage this quality profile.

Grant permissions to more users

Inheritance   Change Parent

Sonar new Way   200 active rules   0 overridden rules

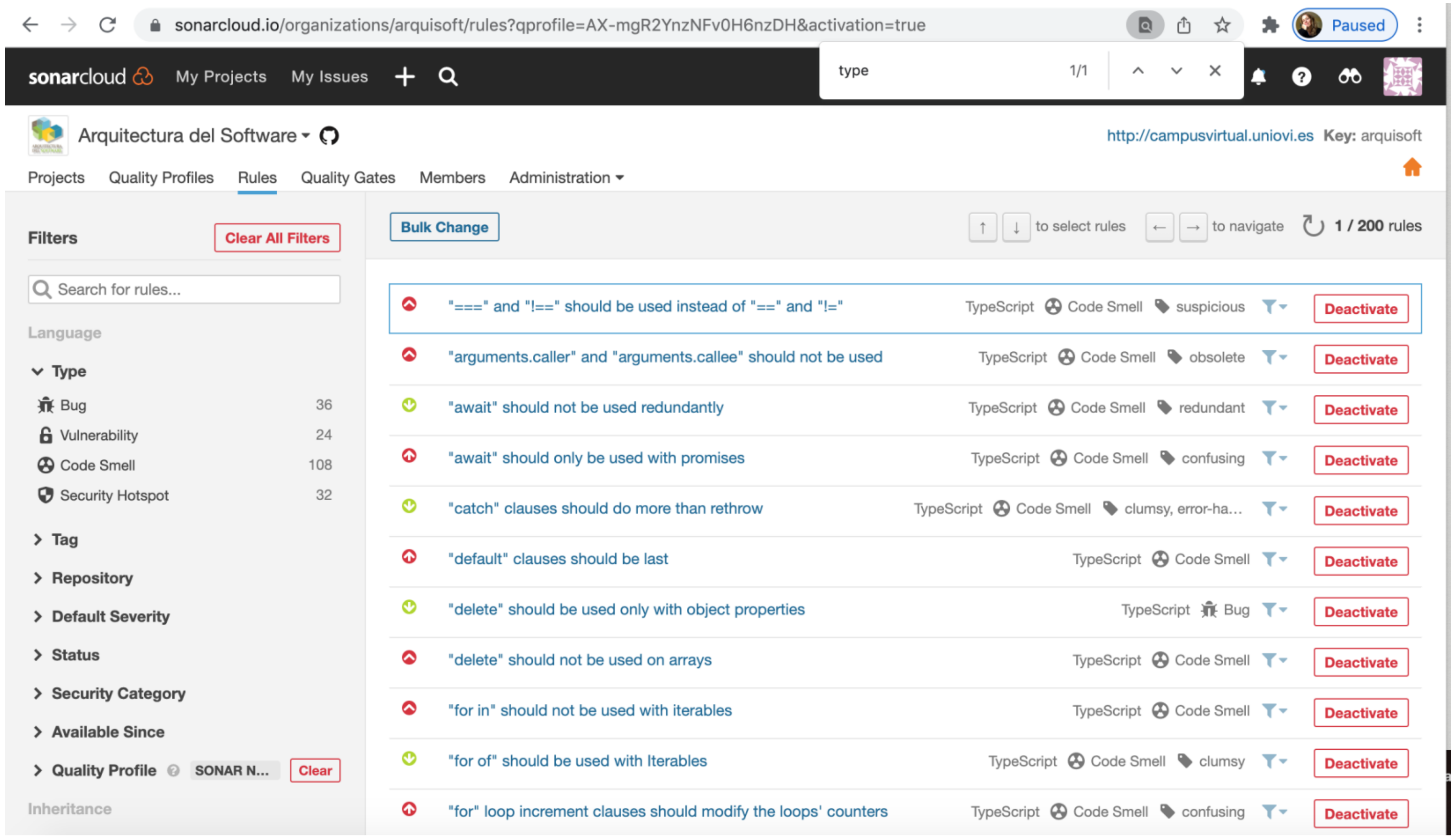
Projects   Change Projects

No projects are explicitly associated to the profile.

Set the profile rules

Associate the profile to the project

Rules configuration



sonarcloud.io/organizations/arquisoft/rules?qprofile=AX-mgR2YnzNFv0H6nzDH&activation=true

sonarcloud · My Projects · My Issues

type 1/1

Arquitectura del Software · http://campusvirtual.uniovi.es **Key:** arquisoft

Projects · Quality Profiles · Rules · Quality Gates · Members · Administration

Filters · Clear All Filters

Search for rules...

Language

Type

Bug	36
Vulnerability	24
Code Smell	108
Security Hotspot	32

- Tag
- Repository
- Default Severity
- Status
- Security Category
- Available Since
- Quality Profile · SONAR N... · Clear

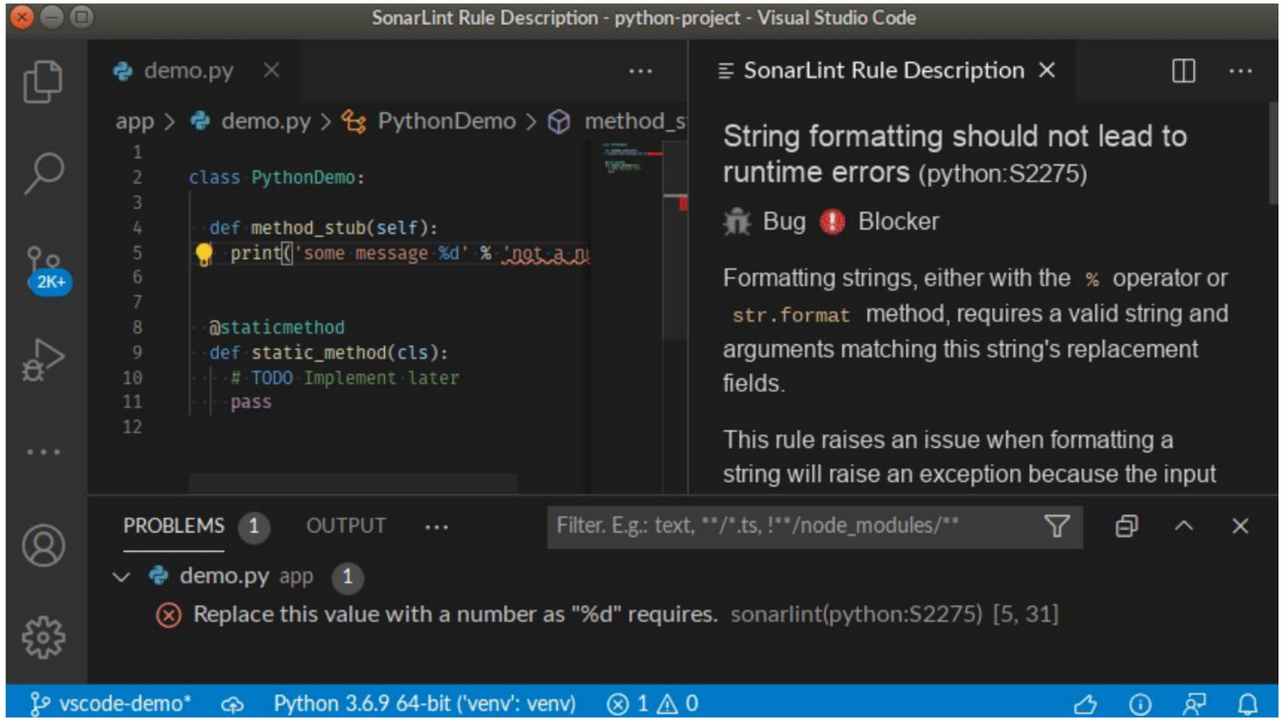
Inheritance

Bulk Change · ↑ ↓ to select rules · ← → to navigate · 1 / 200 rules

"===" and "!==" should be used instead of "==" and "!="	TypeScript	Code Smell	suspicious	Deactivate
"arguments.caller" and "arguments.callee" should not be used	TypeScript	Code Smell	obsolete	Deactivate
"await" should not be used redundantly	TypeScript	Code Smell	redundant	Deactivate
"await" should only be used with promises	TypeScript	Code Smell	confusing	Deactivate
"catch" clauses should do more than rethrow	TypeScript	Code Smell	clumsy, error-ha...	Deactivate
"default" clauses should be last	TypeScript	Code Smell		Deactivate
"delete" should be used only with object properties	TypeScript	Bug		Deactivate
"delete" should not be used on arrays	TypeScript	Code Smell		Deactivate
"for in" should not be used with iterables	TypeScript	Code Smell		Deactivate
"for of" should be used with Iterables	TypeScript	Code Smell	clumsy	Deactivate
"for" loop increment clauses should modify the loops' counters	TypeScript	Code Smell	confusing	Deactivate

View alerts when coding

- https://marketplace.visualstudio.com/items?itemName=SonarSource.sonarlint-vscode


SonarLint Rule Description - python-project - Visual Studio Code
demo.py
app > demo.py > PythonDemo > method_s
SonarLint Rule Description
PROBLEMS 1
OUTPUT
Filter. E.g.: text, **/*.ts, !**/node_modules/**
vscode-demo*
Python 3.6.9 64-bit ('venv': venv)
1 0

```python

class PythonDemo:

    def method_stub(self):
        print('some message %d' % 'not a nu

    @staticmethod
    def static_method(cls):
        # TODO Implement later
        pass
```

String formatting should not lead to runtime errors (python:S2275)

Bug Blocker

Formatting strings, either with the `%` operator or `str.format` method, requires a valid string and arguments matching this string's replacement fields.

This rule raises an issue when formatting a string will raise an exception because the input

```
demo.py app 1
Replace this value with a number as "%d" requires. sonarlint(python:S2275) [5, 31]
```