

# Tutorial - cal (1 e 2)

## Etapa 1 - Configurando ambiente

### 1. Baixar e acessar o repositório

- `git clone https://github.com/stevaoaa/cal_python`
- `cd cal_python`

### 2. Testando aplicação

- `python cal.py`

### 3. Configurar ambiente virtual

#### 1. Instalando `python3-venv`

- Ubuntu: `sudo apt install python3-venv`
- Arch/Manjaro: `sudo pacman -S python3-venv`

#### 2. Criando pasta `venv`

- `python -m venv venv`

### 4. Instalando dependências

#### 1. Acessando ambiente virtual

- `source venv/bin/activate`

#### 2. Instalando `pylint`

- `pip install -U pylint`

#### 3. Instalando dependências do projeto

- `pip install -r requirements.txt`

## Etapa 2 - Executando testes

### 1. Executando testes unitários

- `pytest -vv test_cal.py`

### 2. Verificando e analisando cobertura dos testes

#### 1. Rodando testes de cobertura

- `pytest -vv test_cal.py -cov=cal`

#### 2. Gerando relatório em HTML da cobertura dos testes

- `pytest -vv test_cal.py --cov=cal --cov-branch --cov-report html`

- Com o relatório é possível perceber que os testes não cobrem a função `main`, apenas as funções implementadas.

## Etapa 3 - Executando testes de mutação `mutmut`

### 1. Executando testes de mutação

- `mutmut run paths-to-mutate=cal.py`

### 2. Analisando mutantes que sobreviveram

- Gerando relatório em html
  - `mutmut html`
- Selecionando mutante que sobreviveu, com base no relatório.
  - Mutante 27 selecionado

```
@@ -41,7 +41,7 @@
    k = 0
-    if (is_leap(year) and month > 2):
+    if (is_leap(year) and month >= 2):
        k+= 1
    for i in range(0, month):
```

### 3. Adicionando o caso de teste `test_first_of_month_mutant`

## Tutorial - pdb (3 e 4)

### Etapa 1 - Configurando ambiente

#### 1. Baixar e acessar o repositório

- `git clone https://github.com/inducer/pudb.git`
- `cd pudb`

#### 2. Configurar ambiente virtual

##### 1. Criando pasta `venv`

- `python -m venv venv`

#### 3. Instalando dependências

##### 1. Acessando ambiente virtual

- `source venv/bin/activate`

##### 2. Instalando dependências do projeto

- `pip install -r requirements.dev.txt`

##### 3. Instalando `mutmut`

- `pip install mutmut`

## Etapa 2 - Executando e analisando testes

### 1. Executando os testes unitários

- `pytest -vv`

```
platform linux -- Python 3.12.3, pytest-8.3.2, pluggy-1.5.0 -- /home/luan/dev/pubd/venv/bin/python
cachedir: .pytest_cache
rootdir: /home/luan/dev/pubd
configfile: pyproject.toml
plugins: cov-5.0.0, mock-3.14.0
collected 34 items

pubd/test/test_lowlevel.py::test_detect_encoding_nocookie PASSED [ 29%]
pubd/test/test_lowlevel.py::test_detect_encoding_cookie PASSED [ 53%]
pubd/test/test_lowlevel.py::test_decode_lines PASSED [ 76%]
pubd/test/test_lowlevel.py::test_executable_lines PASSED [ 118%]
pubd/test/test_make_canvas.py::test_simple PASSED [ 142%]
pubd/test/test_make_canvas.py::test_multiple PASSED [ 176%]
pubd/test/test_make_canvas.py::test_boundary PASSED [ 208%]
pubd/test/test_make_canvas.py::test_byte_boundary PASSED [ 232%]
pubd/test/test_make_canvas.py::test_wide_chars PASSED [ 260%]
pubd/test/test_run.py::test_main_version['-v',] PASSED [ 296%]
pubd/test/test_run.py::test_main_version(['--version',]) PASSED [ 328%]
pubd/test/test_run.py::test_main_version(['--version', 'dont_look_at_me.py',]) PASSED [ 356%]
pubd/test/test_run.py::test_main_v_with_args PASSED [ 388%]
pubd/test/test_settings.py::test_load_breakpoints PASSED [ 412%]
pubd/test/test_settings.py::test_save_breakpoints PASSED [ 444%]
pubd/test/test_source_code_providers.py::TestNullSourceCodeProvider::test_get_lines PASSED [ 476%]
pubd/test/test_source_code_providers.py::TestFileSourceCodeProvider::test_string_file_name PASSED [ 508%]
pubd/test/test_source_code_providers.py::TestFileSourceCodeProvider::test_get_lines PASSED [ 540%]
pubd/test/test_source_code_providers.py::TestDirectSourceCodeProvider::test_get_lines PASSED [ 572%]
pubd/test/test_var_view.py::test_get_stringifier PASSED [ 588%]
pubd/test/test_var_view.py::ValueWalkerTest::test_containerlike_classes PASSED [ 612%]
pubd/test/test_var_view.py::ValueWalkerTest::test_dict PASSED [ 644%]
pubd/test/test_var_view.py::ValueWalkerTest::test_empty_dict PASSED [ 676%]
pubd/test/test_var_view.py::ValueWalkerTest::test_empty_frozenset PASSED [ 708%]
pubd/test/test_var_view.py::ValueWalkerTest::test_empty_list PASSED [ 740%]
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pubd/test/test_var_view.py::ValueWalkerTest::test_list PASSED [ 828%]
pubd/test/test_var_view.py::ValueWalkerTest::test_maybe_unreasonable_classes PASSED [ 856%]
pubd/test/test_var_view.py::ValueWalkerTest::test_reasonable_class PASSED [ 888%]
pubd/test/test_var_view.py::ValueWalkerTest::test_set PASSED [ 912%]
pubd/test/test_var_view.py::ValueWalkerTest::test_simple_values PASSED [ 944%]
pubd/test/test_var_view.py::ValueWalkerTest::test_simple_values_expandable PASSED [ 972%]
pubd/test/test_var_view.py::ValueWalkerTest::test_tuple PASSED [ 1000%]

===== 34 passed in 1.61s =====
```

### 2. Verificando cobertura do código

- `pytest -vv --cov=pubd --cov-branch --cov-report html`

```
platform linux -- Python 3.12.3, pytest-8.3.2, pluggy-1.5.0 -- /home/luan/dev/pubd/venv/bin/python
cachedir: .pytest_cache
rootdir: /home/luan/dev/pubd
configfile: pyproject.toml
plugins: cov-5.0.0, mock-3.14.0
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pubd/test/test_run.py::test_main_version['-v',] PASSED [ 296%]
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----- coverage: platform linux, python 3.12.3-final-0 -----
Coverage HTML written to dir coverage_html_report

===== 34 passed in 7.72s =====
```

- Analisando cobertura de código ( `chromium coverage_html_report/index.html` )

Coverage report: 27%

Files Functions Classes

coverage.py v7.6.1, created at 2024-09-03 17:43 -0300

| File                                    | statements | missing | excluded | branches | partial | coverage |
|---|------------|---------|----------|----------|---------|----------|
| pubd/_init_.py                          | 166        | 133     | 2        | 46       | 0       | 18%      |
| pubd/_main_.py                          | 2          | 2       | 3        | 0        | 0       | 0%       |
| pubd/_shab.py                           | 6          | 0       | 0        | 0        | 0       | 100%     |
| pubd/b.py                               | 13         | 13      | 0        | 2        | 0       | 0%       |
| pubd/debugger.py                        | 1463       | 1320    | 17       | 454      | 2       | 8%       |
| pubd/forked.py                          | 18         | 18      | 0        | 8        | 0       | 0%       |
| pubd/python.py                          | 30         | 30      | 0        | 10       | 0       | 0%       |
| pubd/lowlevel.py                        | 149        | 69      | 0        | 60       | 6       | 49%      |
| pubd/remote.py                          | 129        | 129     | 0        | 28       | 0       | 0%       |
| pubd/run.py                             | 49         | 19      | 2        | 10       | 0       | 54%      |
| pubd/settings.py                        | 281        | 154     | 0        | 88       | 13      | 42%      |
| pubd/shell.py                           | 147        | 147     | 0        | 20       | 0       | 0%       |
| pubd/source_view.py                     | 175        | 89      | 0        | 56       | 7       | 45%      |
| pubd/test/_init_.py                     | 0          | 0       | 0        | 0        | 0       | 100%     |
| pubd/test/test_lowlevel.py              | 51         | 3       | 6        | 24       | 6       | 88%      |
| pubd/test/test_make_canvas.py           | 22         | 0       | 7        | 0        | 0       | 100%     |
| pubd/test/test_run.py                   | 22         | 2       | 0        | 6        | 0       | 93%      |
| pubd/test/test_settings.py              | 22         | 0       | 0        | 0        | 0       | 100%     |
| pubd/test/test_source_code_providers.py | 28         | 0       | 0        | 0        | 0       | 100%     |
| pubd/test/test_var_view.py              | 180        | 14      | 0        | 48       | 1       | 93%      |
| pubd/theme.py                           | 59         | 59      | 0        | 14       | 0       | 0%       |
| pubd/themes/_init_.py                   | 12         | 12      | 0        | 0        | 0       | 0%       |
| pubd/themes/agr_256.py                  | 22         | 22      | 0        | 0        | 0       | 0%       |
| pubd/themes/classic.py                  | 4          | 4       | 0        | 0        | 0       | 0%       |
| pubd/themes/dark_vim.py                 | 4          | 4       | 0        | 0        | 0       | 0%       |
| pubd/themes/gray_light_256.py           | 2          | 2       | 0        | 0        | 0       | 0%       |
| pubd/themes/midnight.py                 | 4          | 4       | 0        | 0        | 0       | 0%       |

- Podemos perceber que há uma baixa cobertura de código no projeto.

## Etapa 3 - Executando testes de mutação

### 1. Acessando pasta pubd

- `cd pubd`

### 2. Executando teste de mutação

- `mutmut run --paths-to-mutate=.`

```

~/dev/pubd/pubd main mutmut run --paths-to-mutate=.

- Mutation testing starting -

These are the steps:
1. A full test suite run will be made to make sure we
   can run the tests successfully and we know how long
   it takes (to detect infinite loops for example)
2. Mutants will be generated and checked

Results are stored in .mutmut-cache.
Print found mutants with `mutmut results`.

Legend for output:
🔪 Killed mutants. The goal is for everything to end up in this bucket.
🕒 Timeout. Test suite took 10 times as long as the baseline so were killed.
😟 Suspicious. Tests took a long time, but not long enough to be fatal.
😞 Survived. This means your tests need to be expanded.
🚫 Skipped. Skipped.

1. Using cached time for baseline tests, to run baseline again delete the cache file

2. Checking mutants
🔪 5651/5651 🕒 573 🕒 6 😟 1 😞 5071 🚫 0

```

- Observação:

- Como o projeto não tem uma ampla cobertura de testes, boa parte dos módulos mutados nem serão executados. Por isso a quantidade de mutantes que sobreviveram é elevada.

### 3. Analisando e gerando relatório de mutação

#### 1. Gerando relatório

- `mutmut html`

## 2. Analisando o relatório

# Mutation testing report

Killed 571 out of 5651 mutants

| File   | Total | Skipped | Killed | % killed | Survived |
|--|-------|---------|--------|----------|----------|
| <a href="#">./_init_.py</a>                          | 146   | 0       | 2      | 1.37     | 144      |
| <a href="#">./_main_.py</a>                          | 2     | 0       | 0      | 0.00     | 2        |
| <a href="#">./shtab.py</a>                           | 3     | 0       | 0      | 0.00     | 3        |
| <a href="#">./b.py</a>                               | 7     | 0       | 0      | 0.00     | 7        |
| <a href="#">./debugger.py</a>                        | 1840  | 0       | 17     | 0.92     | 1823     |
| <a href="#">./forked.py</a>                          | 20    | 0       | 0      | 0.00     | 20       |
| <a href="#">./ipython.py</a>                         | 18    | 0       | 0      | 0.00     | 18       |
| <a href="#">./lowlevel.py</a>                        | 102   | 0       | 26     | 25.49    | 76       |
| <a href="#">./remote.py</a>                          | 117   | 0       | 0      | 0.00     | 117      |
| <a href="#">./run.py</a>                             | 68    | 0       | 25     | 36.76    | 43       |
| <a href="#">./settings.py</a>                        | 418   | 0       | 45     | 10.77    | 373      |
| <a href="#">./shell.py</a>                           | 74    | 0       | 0      | 0.00     | 74       |
| <a href="#">./source_view.py</a>                     | 237   | 0       | 24     | 10.13    | 208      |
| <a href="#">./test/test_lowlevel.py</a>              | 98    | 0       | 67     | 68.37    | 30       |
| <a href="#">./test/test_make_canvas.py</a>           | 66    | 0       | 62     | 93.94    | 4        |
| <a href="#">./test/test_run.py</a>                   | 28    | 0       | 19     | 67.86    | 9        |
| <a href="#">./test/test_settings.py</a>              | 33    | 0       | 28     | 84.85    | 5        |
| <a href="#">./test/test_source_code_providers.py</a> | 26    | 0       | 21     | 80.77    | 5        |
| <a href="#">./test/test_var_view.py</a>              | 236   | 0       | 130    | 55.08    | 106      |
| <a href="#">./theme.py</a>                           | 269   | 0       | 0      | 0.00     | 269      |
| <a href="#">./themes/_init_.py</a>                   | 12    | 0       | 0      | 0.00     | 12       |
| <a href="#">./themes/agr_256.py</a>                  | 94    | 0       | 0      | 0.00     | 94       |
| <a href="#">./themes/classic.py</a>                  | 110   | 0       | 0      | 0.00     | 110      |
| <a href="#">./themes/dark_vim.py</a>                 | 101   | 0       | 0      | 0.00     | 101      |
| <a href="#">./themes/gray_light_256.py</a>           | 73    | 0       | 0      | 0.00     | 73       |
| <a href="#">./themes/midnight.py</a>                 | 204   | 0       | 0      | 0.00     | 204      |
| <a href="#">./themes/mono.py</a>                     | 10    | 0       | 0      | 0.00     | 10       |
| <a href="#">./themes/monokai.py</a>                  | 146   | 0       | 0      | 0.00     | 146      |
| <a href="#">./themes/monokai_256.py</a>              | 97    | 0       | 0      | 0.00     | 97       |
| <a href="#">./themes/nord_dark_256.py</a>            | 93    | 0       | 0      | 0.00     | 93       |
| <a href="#">./themes/solarized.py</a>                | 109   | 0       | 0      | 0.00     | 109      |
| <a href="#">./themes/utils.py</a>                    | 6     | 0       | 0      | 0.00     | 6        |
| <a href="#">./themes/vim.py</a>                      | 127   | 0       | 0      | 0.00     | 127      |
| <a href="#">./ui_tools.py</a>                        | 226   | 0       | 25     | 11.06    | 201      |
| <a href="#">./var_view.py</a>                        | 435   | 0       | 80     | 18.39    | 354      |

- Com isso, podemos perceber que boa parte dos mutantes que foram mortos fazem parte do código de teste ou possuem uma quantidade de testes maior comparada aos outros módulos.

## Etapa 4 - Melhorando testes

- Nesta etapa iremos adicionar alguns testes para aumentar a cobertura de código e matar possíveis mutantes.

### 1. Escolhendo módulo

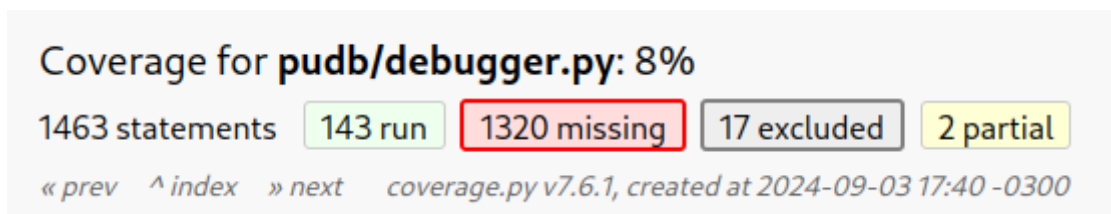
- O `pubd/debugger.py` foi escolhido por ter uma baixa cobertura de código (8%) e alta quantidade de mutantes vivos (1823).
- O foco principal será na classe `Debugger`.

### 2. Melhorando testes

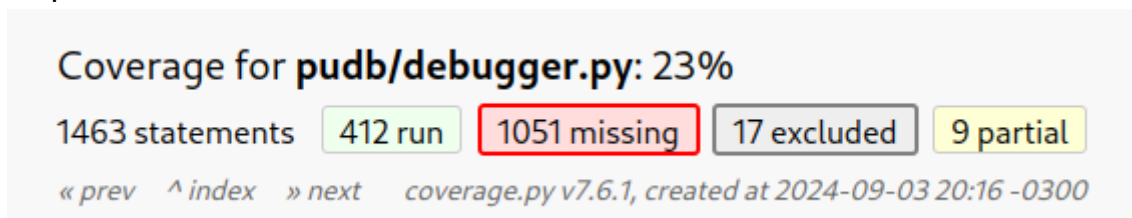
- Para melhorar a cobertura e qualidade dos testes referentes ao `debugger.py`, foi utilizado o relatório do `mutmut` como base para criação dos casos de teste.
- Com isso, os seguintes testes:
  - `test_singleton_constructor`
  - `test_continue_at_start`
  - `test_ui_should_not_be_none`
  - `test_steal_output`

### 3. Analisando melhoria

- Os testes implementados aumentaram a cobertura de código do módulo `debugger.py` de 8% para 23%.
  - Antes



- Depois



- Os testes implementados mataram os mutantes 1066, 1067, 1068, 1069, 1070, 1071 e 1072.