Why unit test?

UNIT TESTING FOR DATA SCIENCE IN PYTHON

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datacamp

How can we test an implementation?

```
def my_function(argument):
    ...
```

```
my_function(argument_1)
```

```
return_value_1
```

```
my_function(argument_2)
```

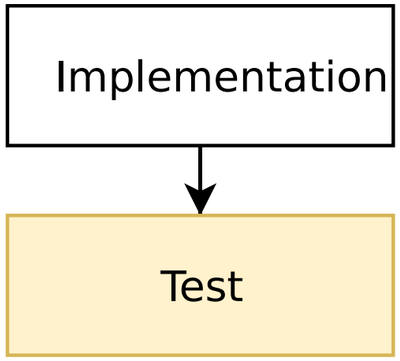
```
return_value_2
```

```
my_function(argument_3)
```

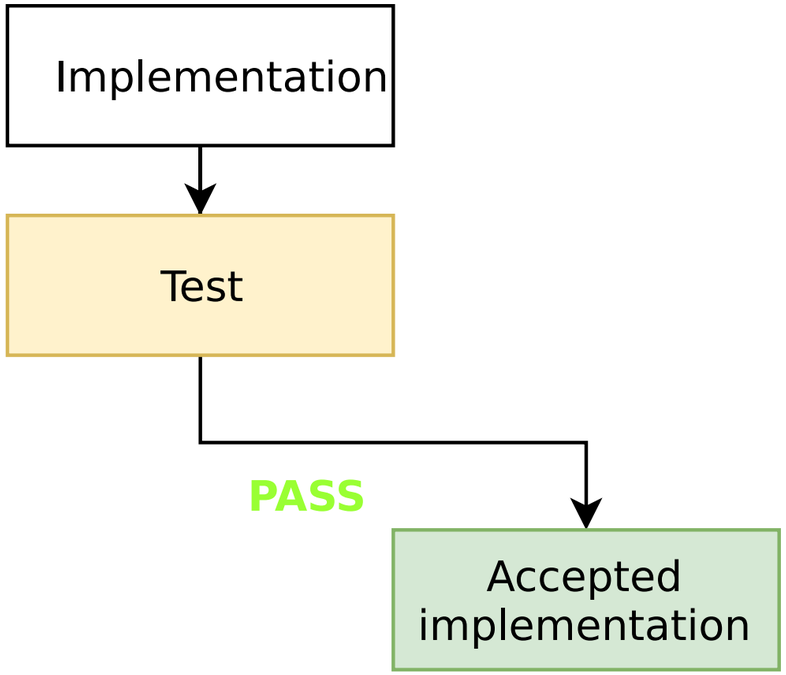
```
return_value_3
```

Life cycle of a function

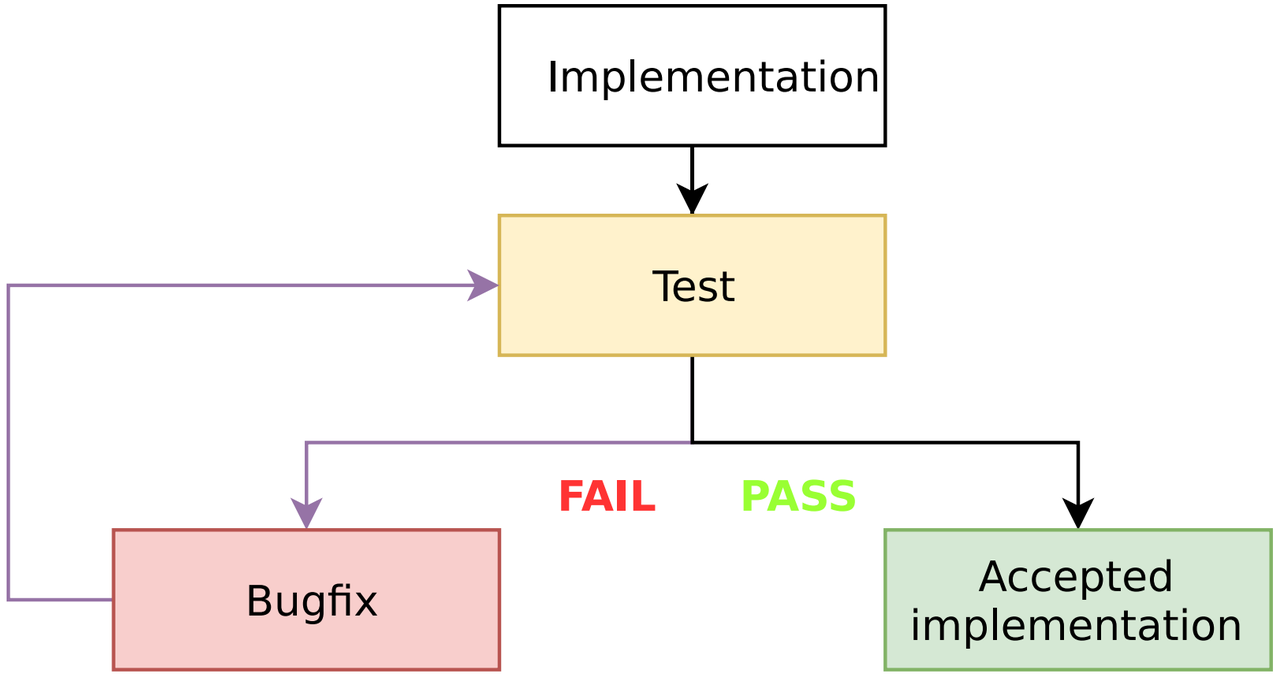
Life cycle of a function



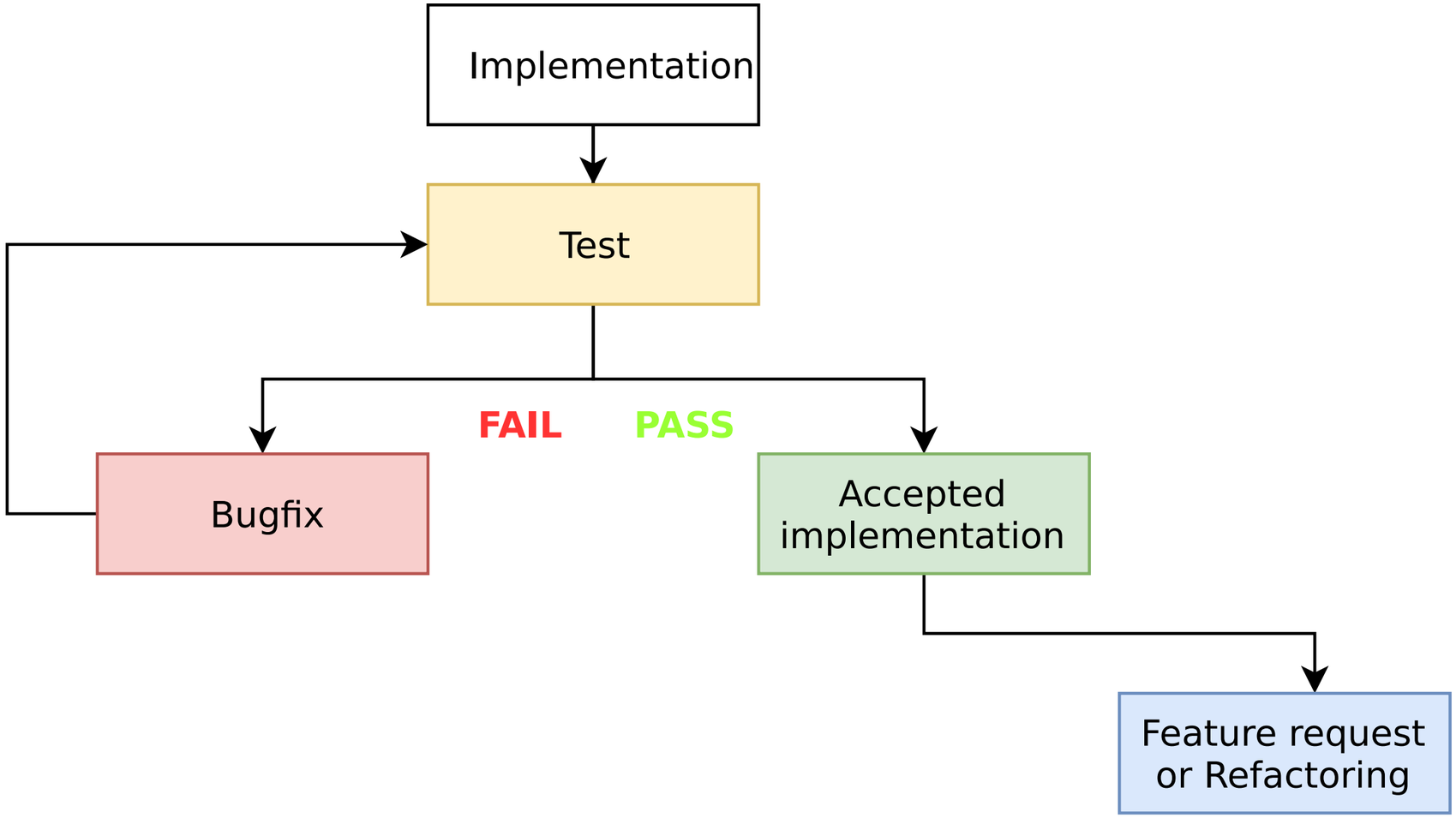
Life cycle of a function



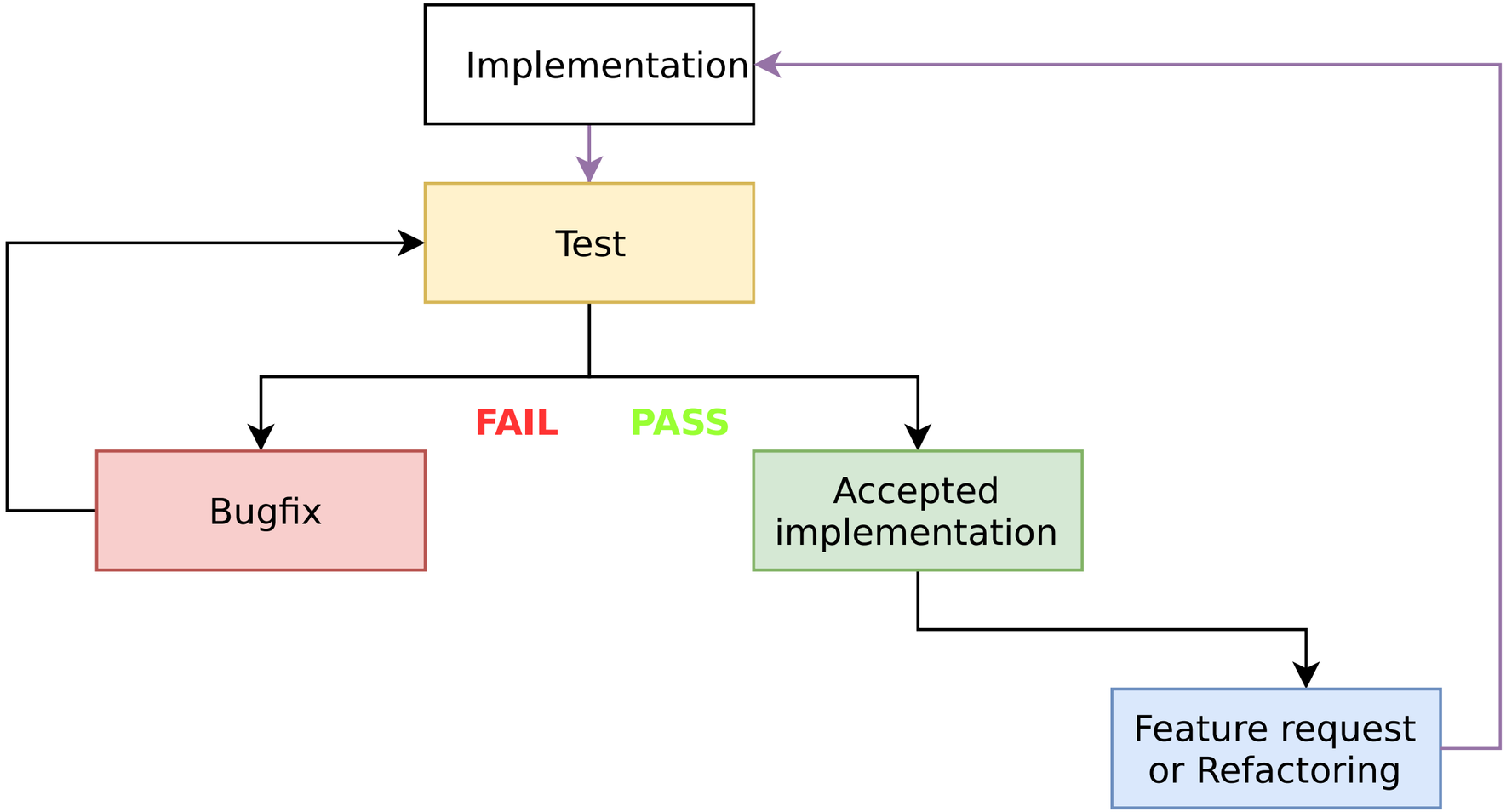
Life cycle of a function



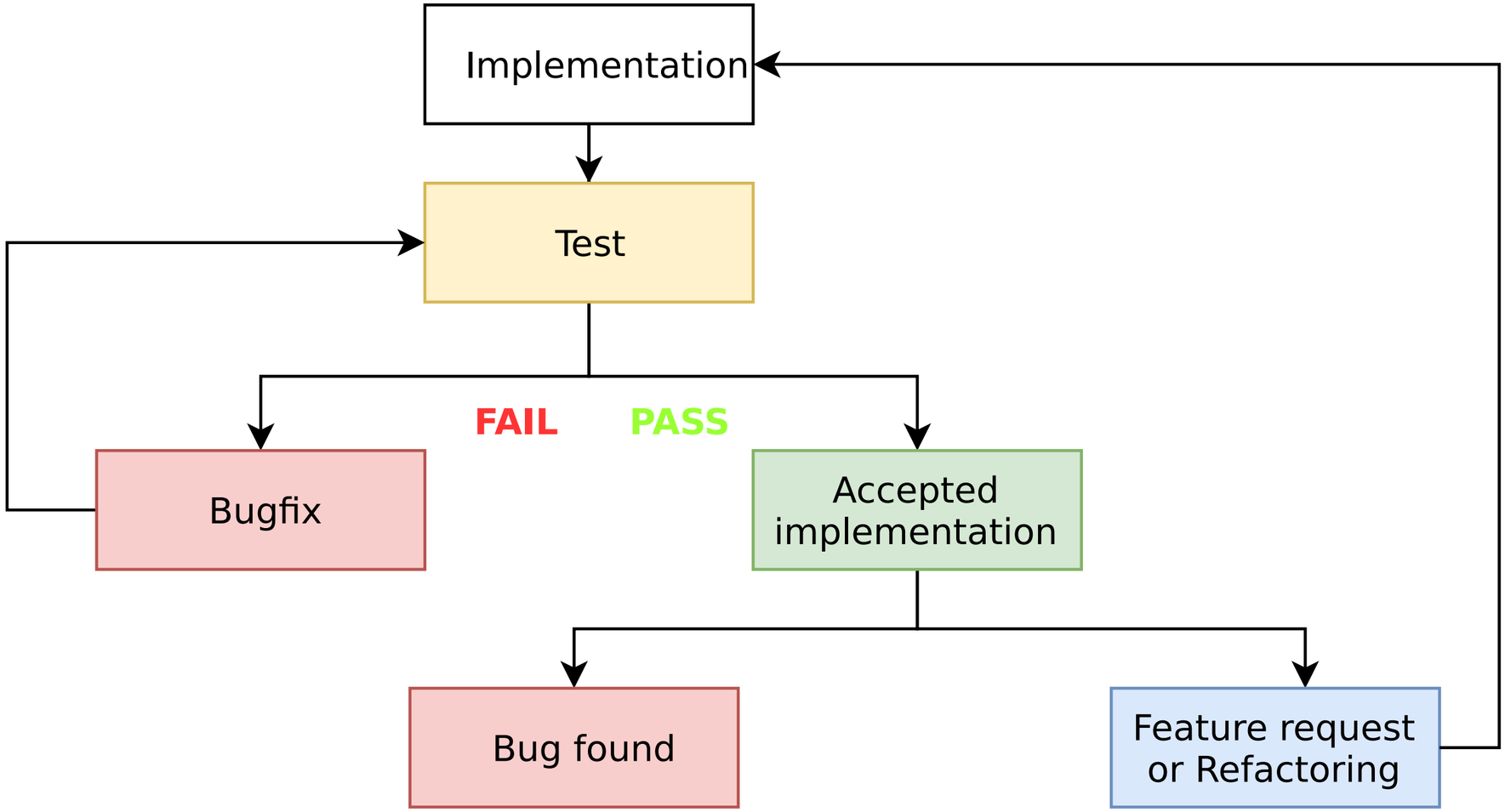
Life cycle of a function



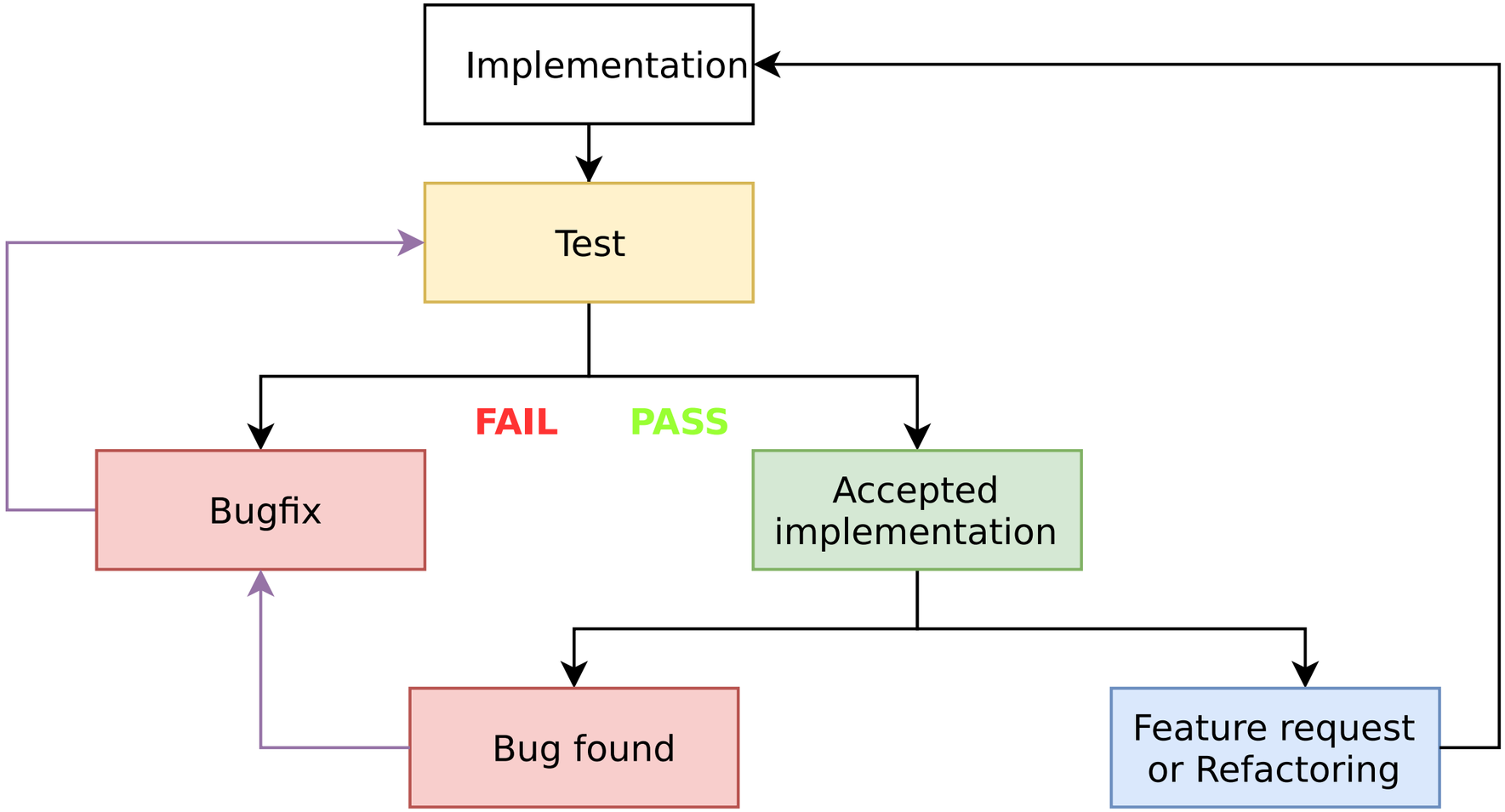
Life cycle of a function



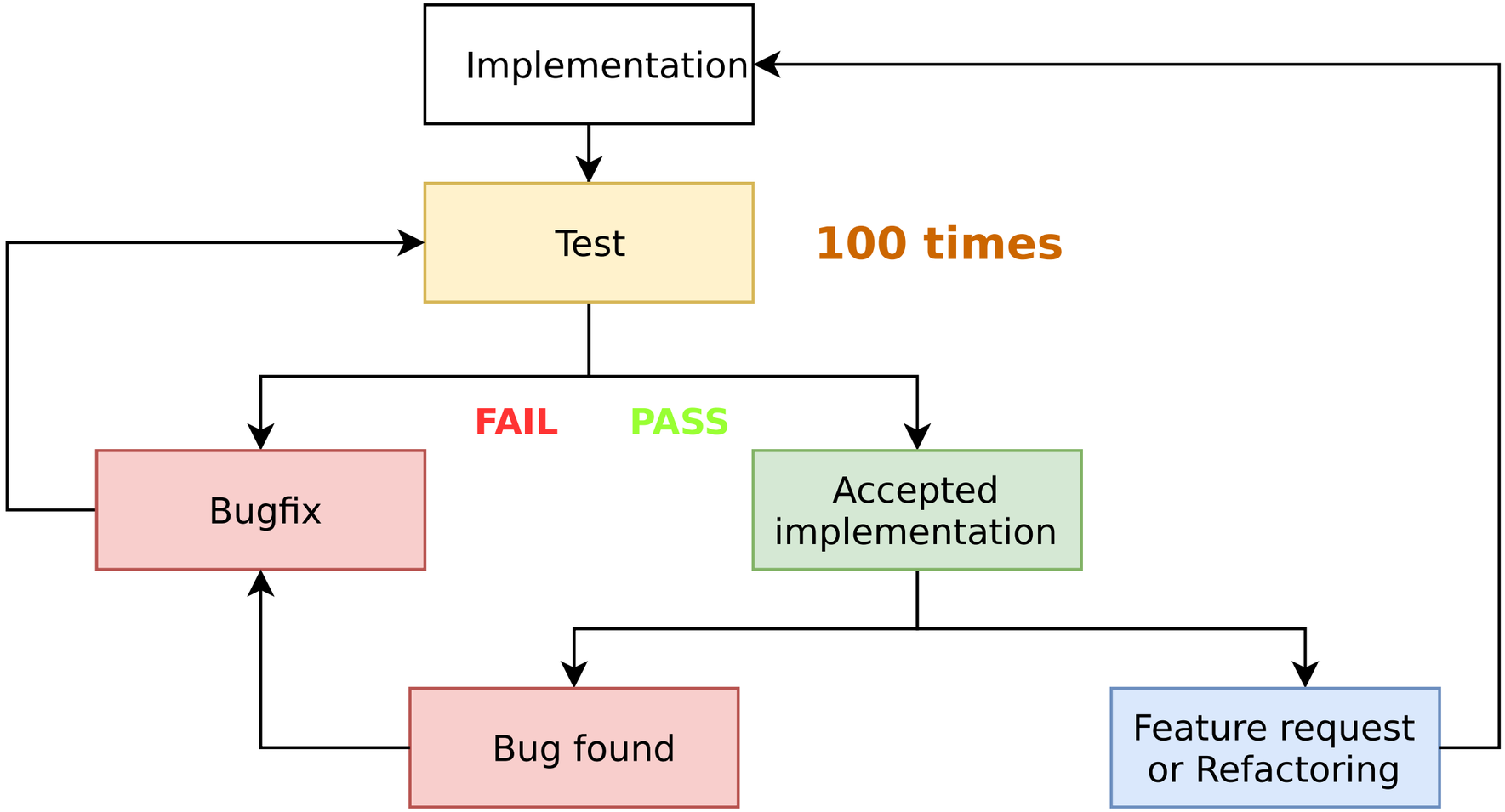
Life cycle of a function



Life cycle of a function



Life cycle of a function



Example

```
def row_to_list(row):
  ...
```

```
area (sq. ft.)  price (dollars)
2,081    314,942
1,059    186,606
    293,410
1,148    206,186
1,506    248,419
1,210    214,114
1,697    277,794
1,268    194,345
2,318    372,162
1,463238,765
1,468    239,007
```

File: housing_data.txt

Data format

```
def row_to_list(row):
  ...
```

Argument	Type	Return value
`"2,081\t314,942\n"`	Valid	`["2,081", "314,942"]`

```
area (sq. ft.)  price (dollars)
2,081    314,942
1,059    186,606
    293,410
1,148    206,186
1,506    248,419
1,210    214,114
1,697    277,794
1,268    194,345
2,318    372,162
1,463238,765
1,468    239,007
```

File: housing_data.txt

Data isn't clean

```
def row_to_list(row):
  ...
```

Argument	Type	Return value
`"2,081\t314,942\n"`	Valid	`["2,081", "314,942"]`
`"\t293,410\n"`	Invalid	`None`

```
area (sq. ft.)  price (dollars)
2,081    314,942
1,059    186,606
    293,410     <-- row with missing area
1,148    206,186
1,506    248,419
1,210    214,114
1,697    277,794
1,268    194,345
2,318    372,162
1,463238,765
1,468    239,007
```

File: housing_data.txt

Data isn't clean

```
def row_to_list(row):
  ...
```

Argument	Type	Return value
`"2,081\t314,942\n"`	Valid	`["2,081", "314,942"]`
`"\t293,410\n"`	Invalid	`None`
`"1,463238,765\n"`	Invalid	`None`

```
area (sq. ft.)  price (dollars)
2,081    314,942
1,059    186,606
    293,410     <-- row with missing area
1,148    206,186
1,506    248,419
1,210    214,114
1,697    277,794
1,268    194,345
2,318    372,162
1,463238,765    <-- row with missing tab
1,468    239,007
```

File: housing_data.txt

Time spent in testing this function

```
def row_to_list(row):
  ...
```

Argument	Type	Return value
`"2,081\t314,942\n"`	Valid	`["2,081", "314,942"]`
`"\t293,410\n"`	Invalid	`None`
`"1,463238,765\n"`	Invalid	`None`

```
row_to_list("2,081\t314,942\n")
```

```
["2,081", "314,942"]
```

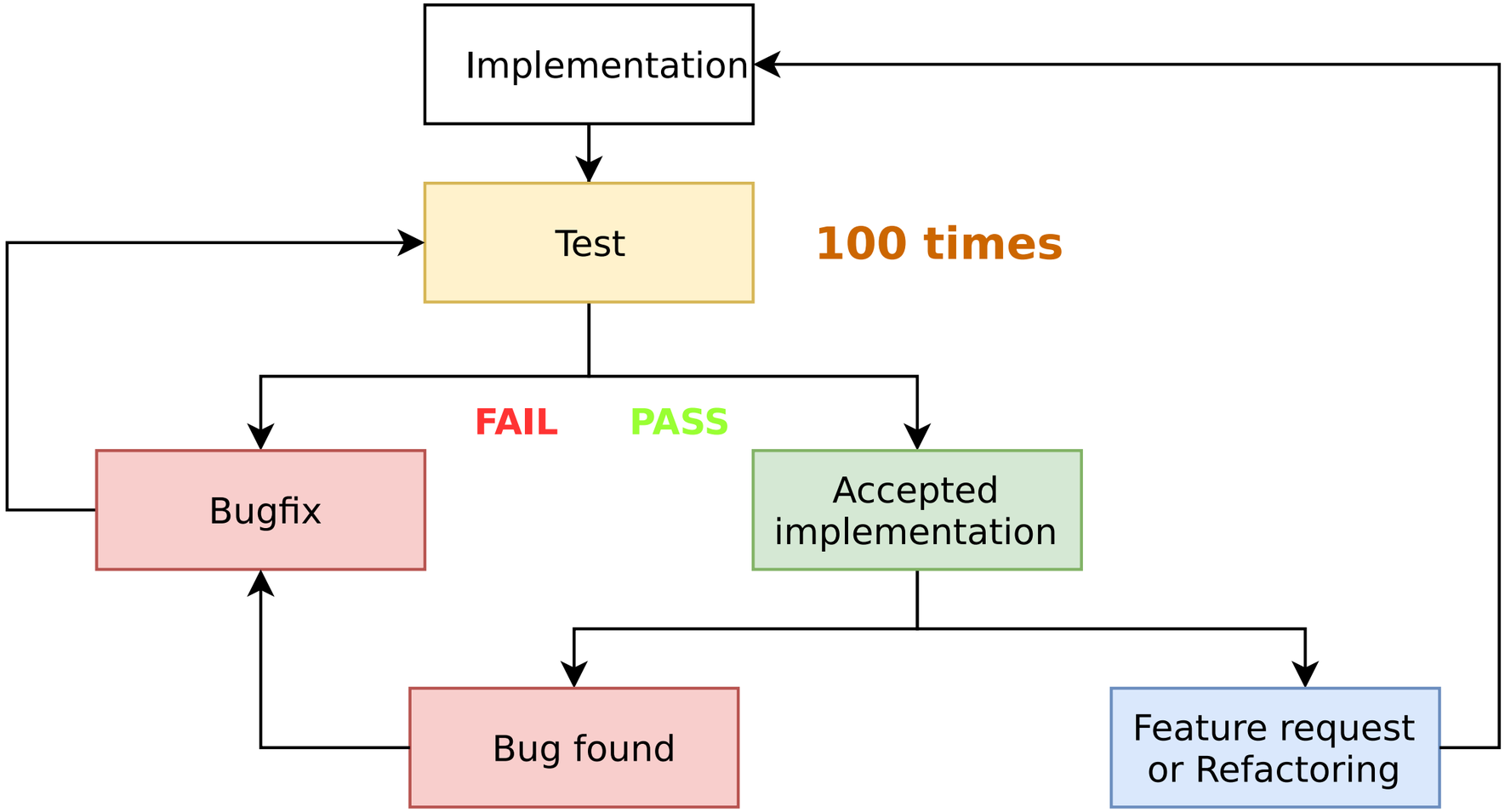
```
row_to_list("\t293,410\n")
```

```
None
```

```
row_to_list("1,463238,765\n")
```

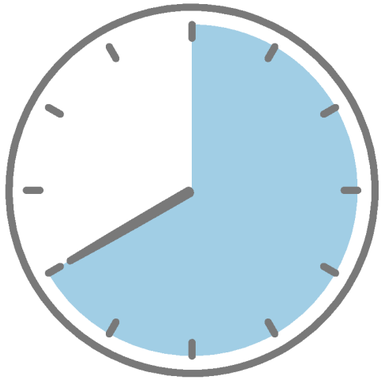
```
None
```

Time spent in testing this function



Time spent in testing this function

5 mins x 100 ~

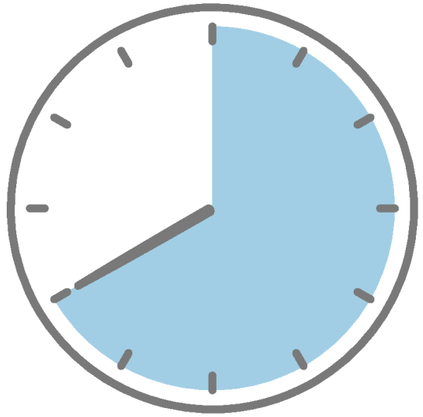


8 hours

Manual testing vs. unit tests

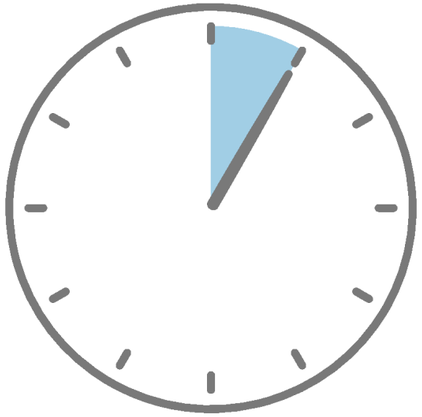
- Unit tests automate the repetitive testing process and saves time.

Manually testing on the interpreter



8 hours

Unit tests



1 hour

Learn unit testing - with a data science spin

```
area (sq. ft.)   price (dollars)
2,081    314,942
1,059    186,606
    293,410
1,148    206,186
1,506    248,419
1,210    214,114
1,697    277,794
1,268    194,345
2,318    372,162
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1,468    239,007
```

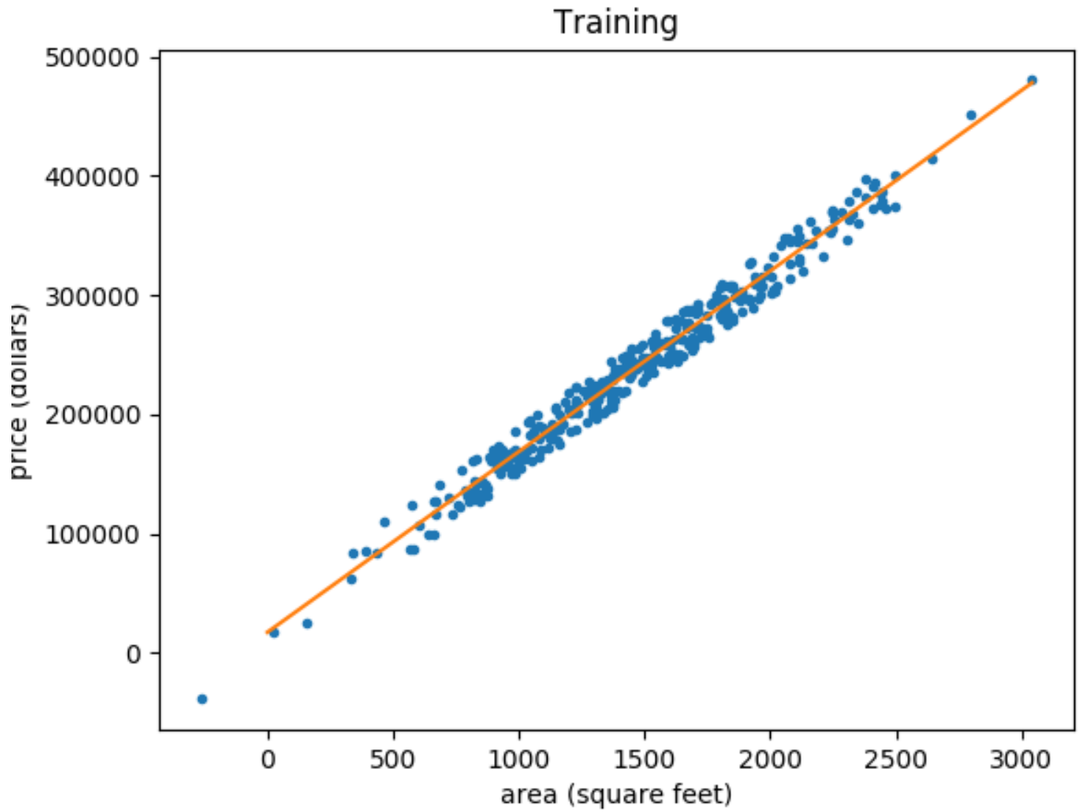

Linear regression of housing price against area

GitHub repository of the course

- Implementation of functions like `row_to_list()`.

Develop a complete unit test suite

```
data/
src/
|-- data/
|-- features/
|-- models/
|-- visualization/
```

Develop a complete unit test suite

```
data/
src/
|-- data/
|-- features/
|-- models/
|-- visualization/
tests/                                  # Test suite
|-- data/
|-- features/
|-- models/
|-- visualization/
```

- Write unit tests for your own projects.

Let's practice these concepts!

UNIT TESTING FOR DATA SCIENCE IN PYTHON

Write a simple unit test using pytest

UNIT TESTING FOR DATA SCIENCE IN PYTHON

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Test Automation Engineer

datacamp

Testing on the console

```
row_to_list("2,081\t314,942\n")
```

```
["2,081", "314,942"]
```

```
row_to_list("\t293,410\n")
```

```
None
```

```
row_to_list("1,463238,765\n")
```

```
None
```

- Unit tests improve this process.

Python unit testing libraries

- pytest
- unittest
- nosetests
- doctest

We will use pytest!

- Has all essential features.
- Easiest to use.
- **Most popular.**

Step 1: Create a file

- Create `test_row_to_list.py` .
- `test_` indicate unit tests inside (naming convention).
- Also called **test modules**.

Step 2: Imports

Test module: `test_row_to_list.py`

```
import pytest
import row_to_list
```

Step 3: Unit tests are Python functions

Test module: `test_row_to_list.py`

```
import pytest
import row_to_list


def test_for_clean_row():
```

Step 3: Unit tests are Python functions

Test module: `test_row_to_list.py`

```
import pytest
import row_to_list

def test_for_clean_row():
```

Argument	Type	Return value
`"2,081\t314,942\n"`	Valid	`["2,081", "314,942"]`

Step 4: Assertion

Test module: `test_row_to_list.py`

```
import pytest
import row_to_list

def test_for_clean_row():
  assert ...
```

Argument	Type	Return value
`"2,081\t314,942\n"`	Valid	`["2,081", "314,942"]`

Theoretical structure of an assertion

```
assert boolean_expression
```

```
assert True
```

```

```

```
assert False
```

```
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
AssertionError
```

Step 4: Assertion

Test module: `test_row_to_list.py`

```
import pytest
import row_to_list

def test_for_clean_row():
  assert row_to_list("2,081\t314,942\n") == \
         ["2,081", "314,942"]
```

Argument	Type	Return value
`"2,081\t314,942\n"`	Valid	`["2,081", "314,942"]`

A second unit test

Test module: `test_row_to_list.py`

```
import pytest
import row_to_list

def test_for_clean_row():
  assert row_to_list("2,081\t314,942\n") == \
         ["2,081", "314,942"]

def test_for_missing_area():
  assert row_to_list("\t293,410\n") is None
```

Argument	Type	Return value
`"2,081\t314,942\n"`	Valid	`["2,081", "314,942"]`
`"\t293,410\n"`	Invalid	`None`

Checking for None values

Do this for checking if `var` is `None`.

```
assert var is None
```

Do *not* do this.

```
assert var == None
```

A third unit test

Test module: `test_row_to_list.py`

```
import pytest
import row_to_list

def test_for_clean_row():
  assert row_to_list("2,081\t314,942\n") == \
         ["2,081", "314,942"]

def test_for_missing_area():
  assert row_to_list("\t293,410\n") is None

def test_for_missing_tab():
  assert row_to_list("1,463238,765\n") is None
```

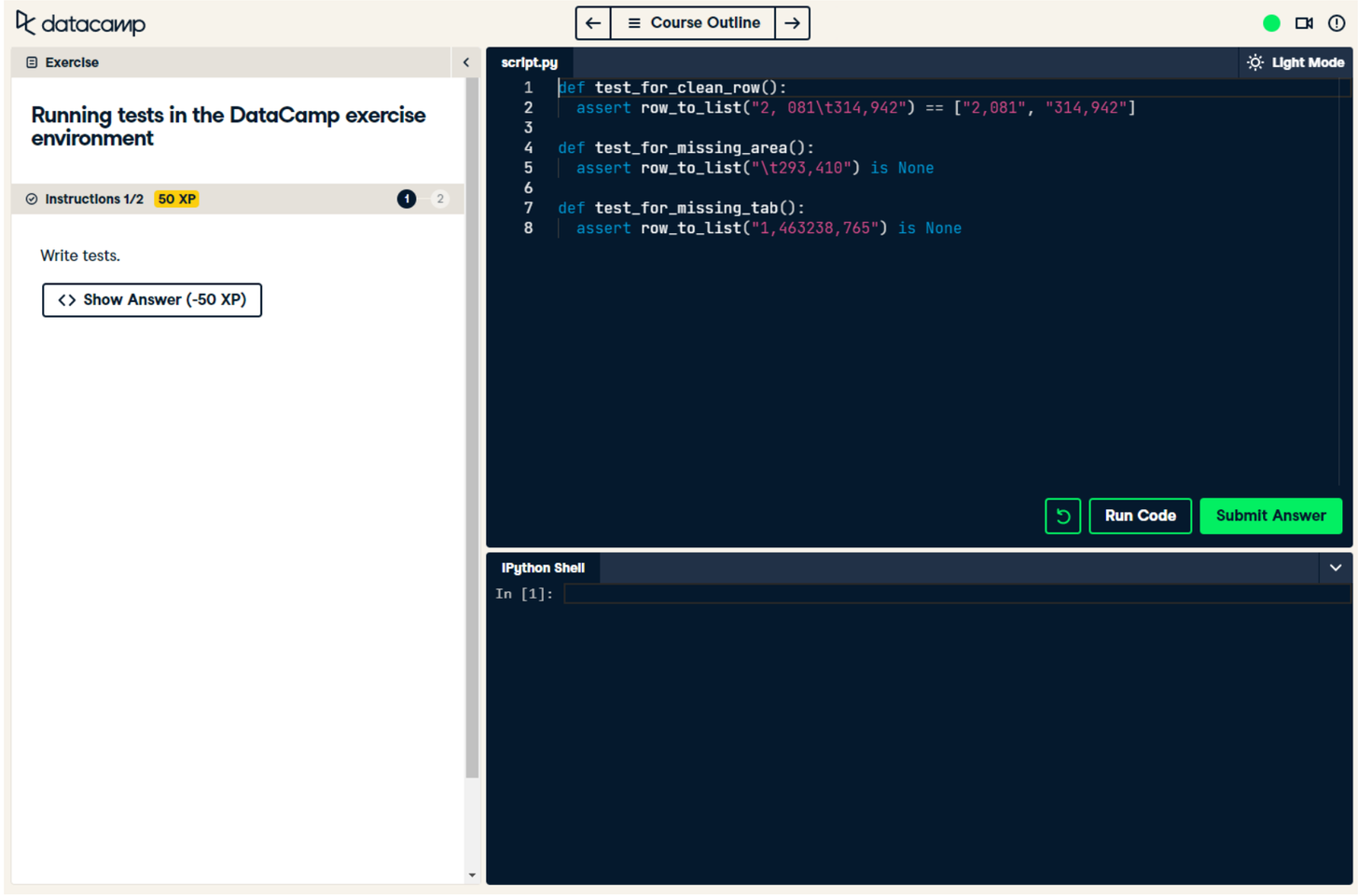
Argument	Type	Return value
`"2,081\t314,942\n"`	Valid	`["2,081", "314,942"]`
`"\t293,410\n"`	Invalid	`None`
`"1,463238,765\n"`	Invalid	`None`

Step 5: Running unit tests

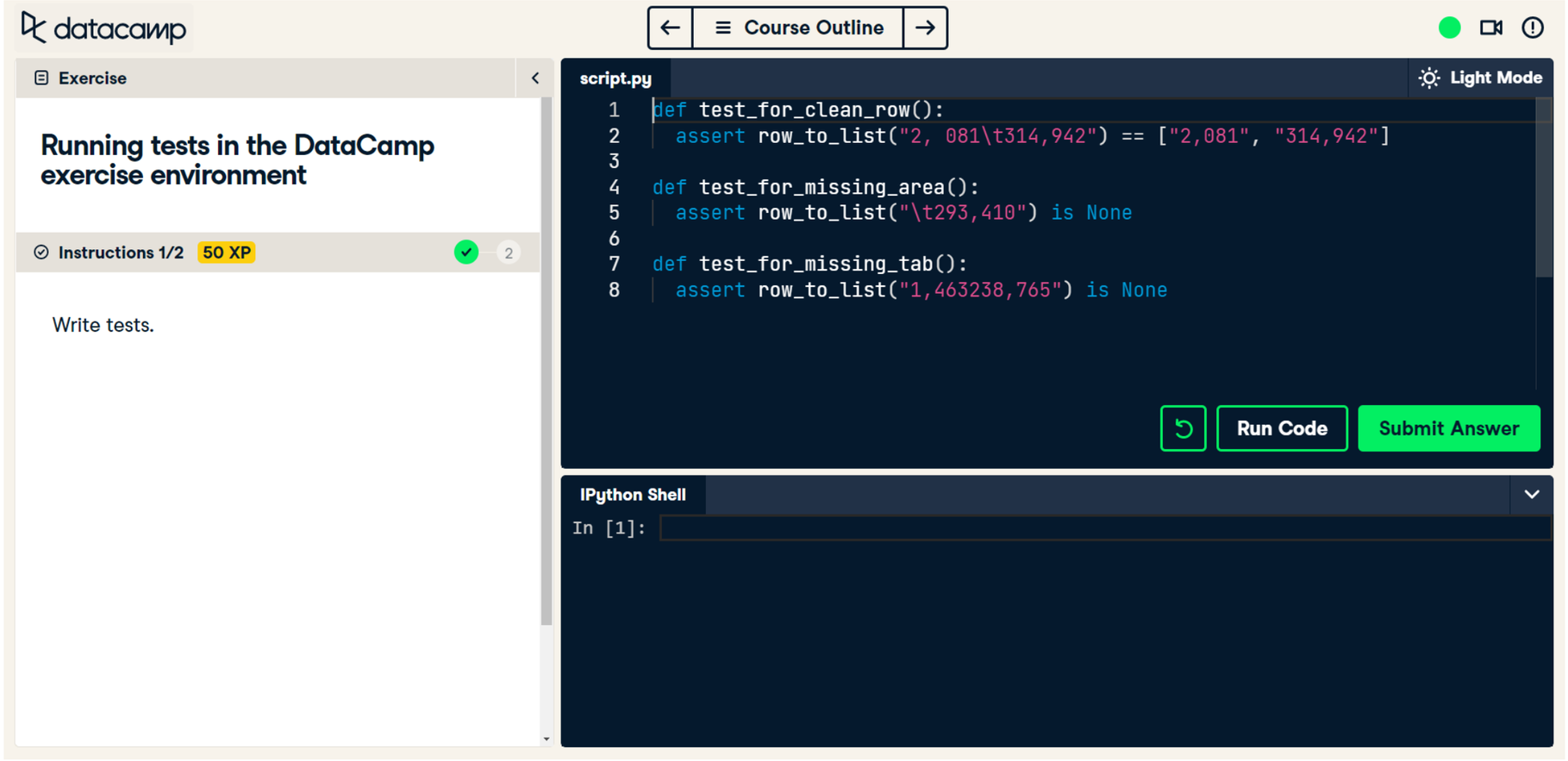
- Do this in the command line.

```
pytest test_row_to_list.py
```

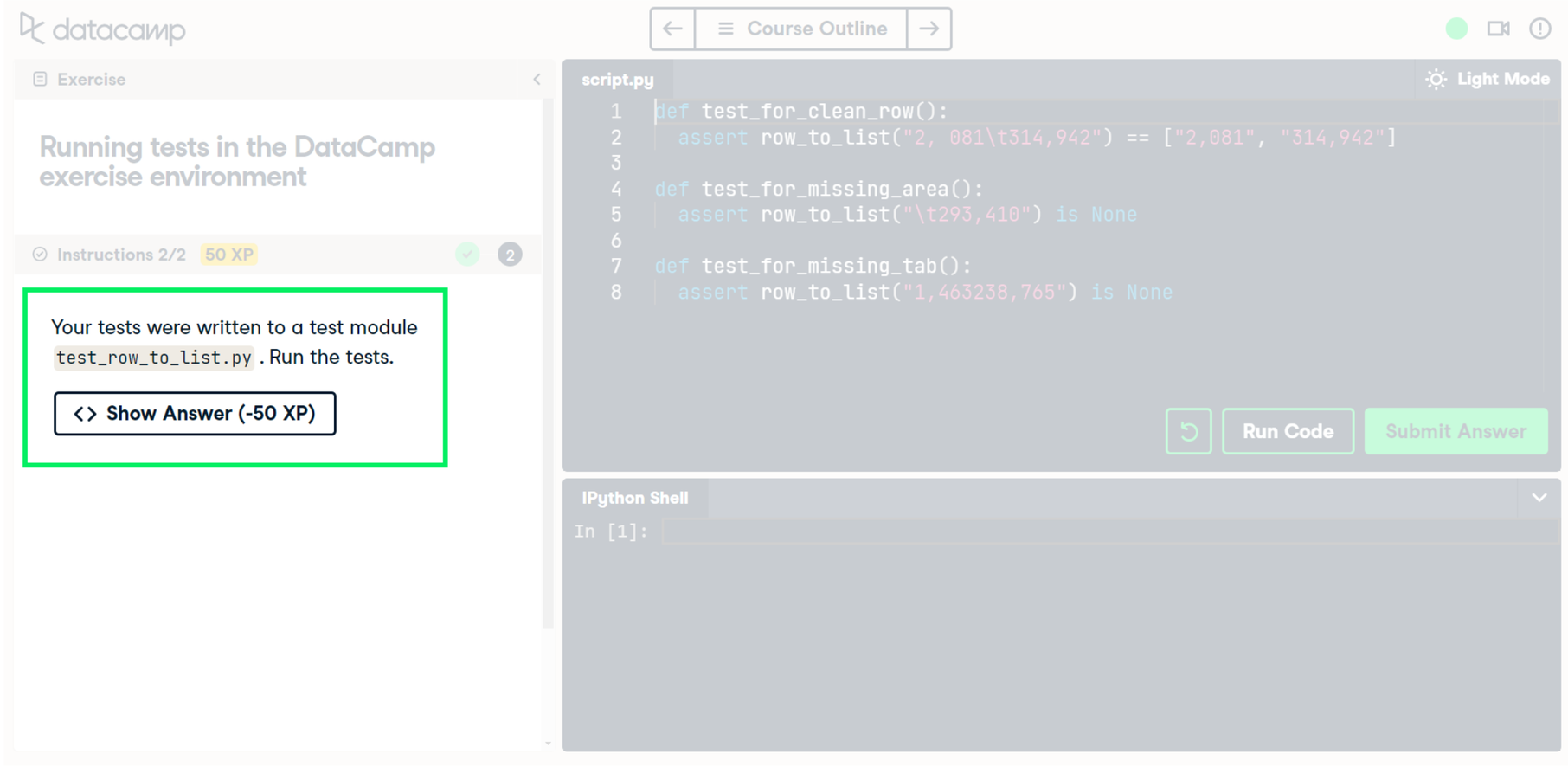
Running unit tests in DataCamp exercises



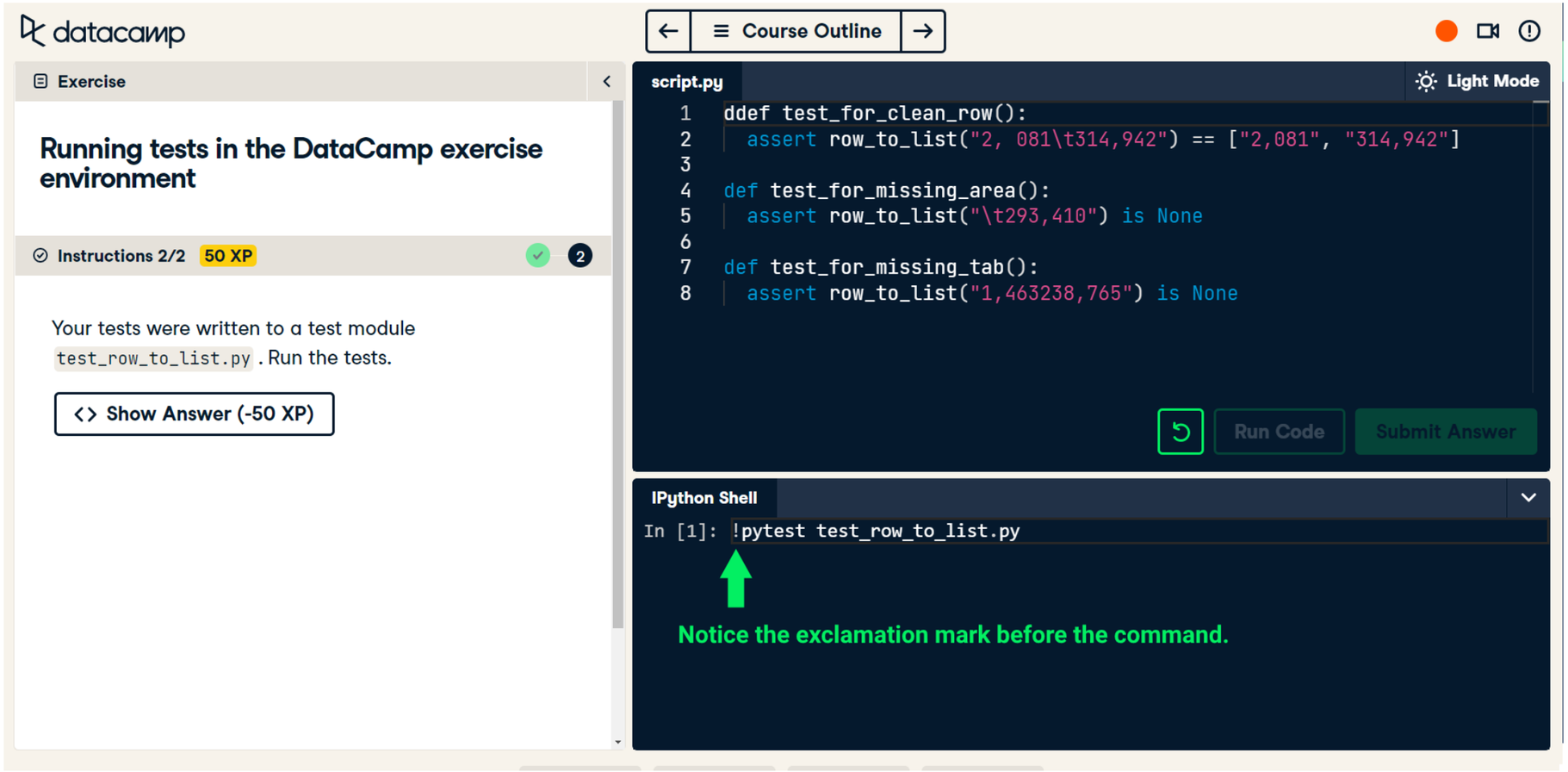
Running unit tests in DataCamp exercises



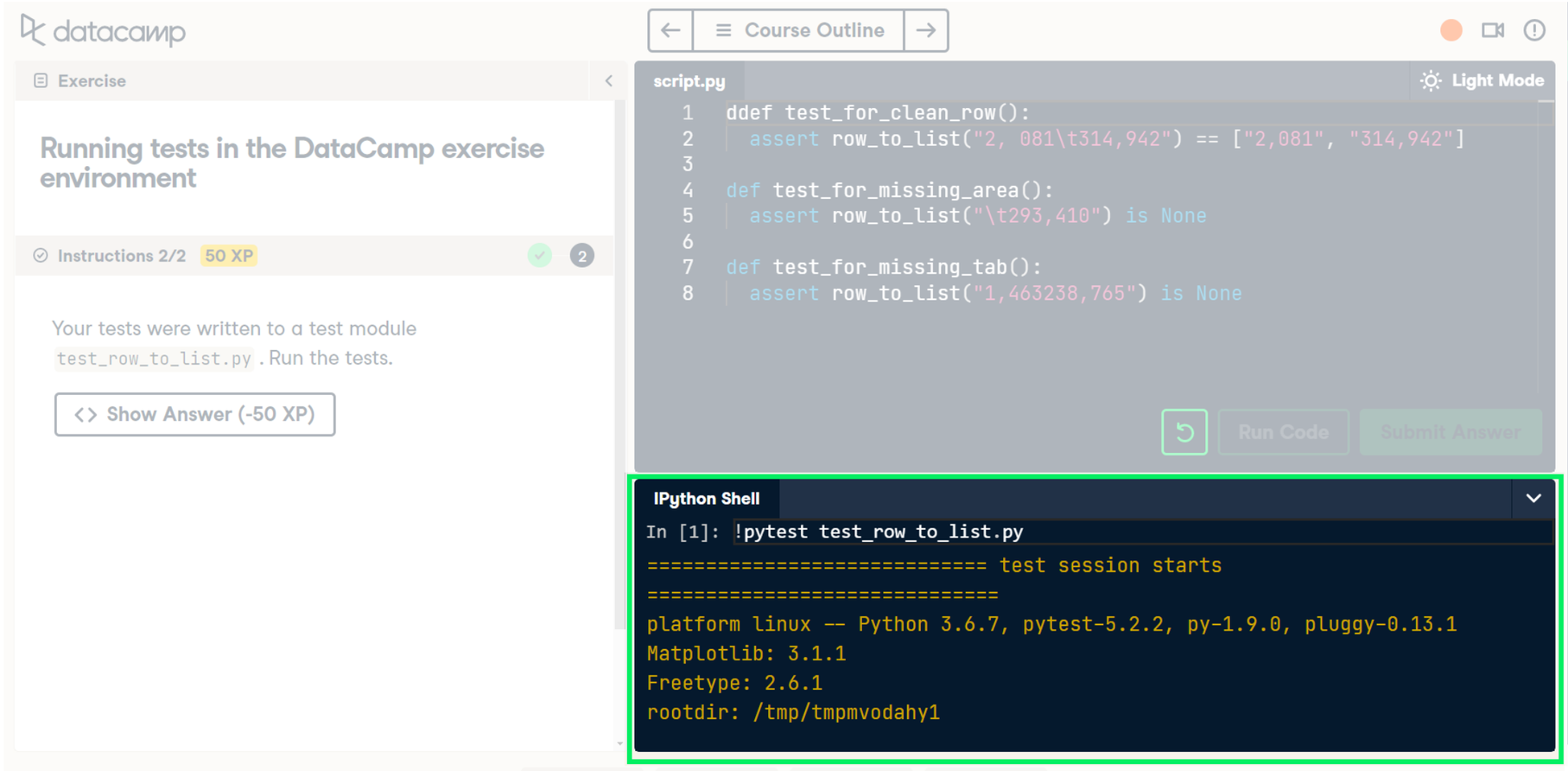
Running unit tests in DataCamp exercises



Running unit tests in DataCamp exercises



Next lesson: test result report



Let's write some unit tests!

UNIT TESTING FOR DATA SCIENCE IN PYTHON

Understanding test result report

UNIT TESTING FOR DATA SCIENCE IN PYTHON

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datacamp

Unit tests for row_to_list()

Test module: `test_row_to_list.py`

```
import pytest
import row_to_list

def test_for_clean_row():
  assert row_to_list("2,081\t314,942\n") == \
         ["2,081", "314,942"]

def test_for_missing_area():
  assert row_to_list("\t293,410\n") is None

def test_for_missing_tab():
  assert row_to_list("1,463238,765\n") is None
```

Argument	Type	Return value
`"2,081\t314,942\n"`	Valid	`["2,081", "314,942"]`
`"\t293,410\n"`	Invalid	`None`
`"1,463238,765\n"`	Invalid	`None`

Test result report

```
!pytest test_row_to_list.py
```

```
============================= test session starts ==============================
platform linux -- Python 3.6.7, pytest-4.0.1, py-1.8.0, pluggy-0.9.0
rootdir: /tmp/tmpvdblq9g7, inifile:
plugins: mock-1.10.0
collecting ...
collected 3 items

test_row_to_list.py .F.                                                  [100%]

=================================== FAILURES ===================================
_____________________________ test_for_missing_area ____________________________

    def test_for_missing_area():
>     assert row_to_list("\t293,410\n") is None
```

Section 1: general information

```
============================= test session starts ==============================
platform linux -- Python 3.6.7, pytest-4.0.1, py-1.8.0, pluggy-0.9.0
rootdir: /tmp/tmpvdblq9g7, inifile:
plugins: mock-1.10.0
```

Section 2: Test result

```
collecting ...
collected 3 items


test_row_to_list.py .F.                                              [100%]
```

Section 2: Test result

```
collecting ...
collected 3 items


test_row_to_list.py .F.                                  [100%]
```

Character	Meaning	When	Action
F	Failure	An exception is raised when running unit test.	Fix the function or unit test.

Section 2: Test result

```
collecting ...
collected 3 items

test_row_to_list.py .F.                                  [100%]
```

Character	Meaning	When	Action
F	Failure	An exception is raised when running unit test.	Fix the function or unit test.

- assertion raises `AssertionError`

```
def test_for_missing_area():
  assert row_to_list("\t293,410") is None    # AssertionError from this line
```

Section 2: Test result

```
collecting ...
collected 3 items


test_row_to_list.py .F.                                              [100%]
```

Character	Meaning	When	Action
F	Failure	An exception is raised when running unit test.	Fix the function or unit test.

- another exception

```
def test_for_missing_area():
  assert row_to_list("\t293,410") is none    # NameError from this line
```

Section 2: Test result

```
collecting ...
collected 3 items


test_row_to_list.py .F.                                  [100%]
```

Character	Meaning	When	Action
F	Failure	An exception is raised when running unit test.	Fix the function or unit test.
.	Passed	No exception raised when running unit test	Everything is fine. Be happy!

Section 3: Information on failed tests

```
================================== FAILURES ===================================
_____________________________ test_for_missing_area ______________________________

    def test_for_missing_area():
>     assert row_to_list("\t293,410\n") is None
E     AssertionError: assert ['', '293,410'] is None
E      +  where ['', '293,410'] = row_to_list('\t293,410\n')

test_row_to_list.py:7: AssertionError
```

- The line raising the exception is marked by `>` .

```
>     assert row_to_list("\t293,410\n") is None
```

Section 3: Information on failed tests

```
================================== FAILURES ===================================
_____________________________ test_for_missing_area ______________________________

    def test_for_missing_area():
>     assert row_to_list("\t293,410\n") is None
E     AssertionError: assert ['', '293,410'] is None
E      +  where ['', '293,410'] = row_to_list('\t293,410\n')

test_row_to_list.py:7: AssertionError
```

- the exception is an `AssertionError` .

```
E     AssertionError: assert ['', '293,410'] is None
```

Section 3: Information about failed tests

```
================================== FAILURES ===================================
_____________________________ test_for_missing_area ______________________________

    def test_for_missing_area():
>     assert row_to_list("\t293,410\n") is None
E     AssertionError: assert ['', '293,410'] is None
E      +  where ['', '293,410'] = row_to_list('\t293,410\n')

test_row_to_list.py:7: AssertionError
```

- the line containing `where` displays return values.

```
E      +  where ['', '293,410'] = row_to_list('\t293,410\n')
```

Section 4: Test result summary

```
====================== 1 failed, 2 passed in 0.03 seconds ======================
```

- Result summary from all unit tests that ran: **1 failed, 2 passed tests.**
- Total time for running tests: **0.03 seconds.**
  - Much faster than testing on the interpreter!

Let's practice reading test result reports

UNIT TESTING FOR DATA SCIENCE IN PYTHON

More benefits and test types

UNIT TESTING FOR DATA SCIENCE IN PYTHON

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Test Automation Engineer

datacamp

Unit tests serve as documentation

Test module: `test_row_to_list.py`

```
import pytest
import row_to_list

def test_for_clean_row():
  assert row_to_list("2,081\t314,942\n") == \
         ["2,081", "314,942"]

def test_for_missing_area():
  assert row_to_list("\t293,410\n") is None

def test_for_missing_tab():
  assert row_to_list("1,463238,765\n") is None
```

Unit tests serve as documentation

Test module: `test_row_to_list.py`

```
import pytest
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def test_for_clean_row():
  assert row_to_list("2,081\t314,942\n") == \
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def test_for_missing_area():
  assert row_to_list("\t293,410\n") is None

def test_for_missing_tab():
  assert row_to_list("1,463238,765\n") is None
```
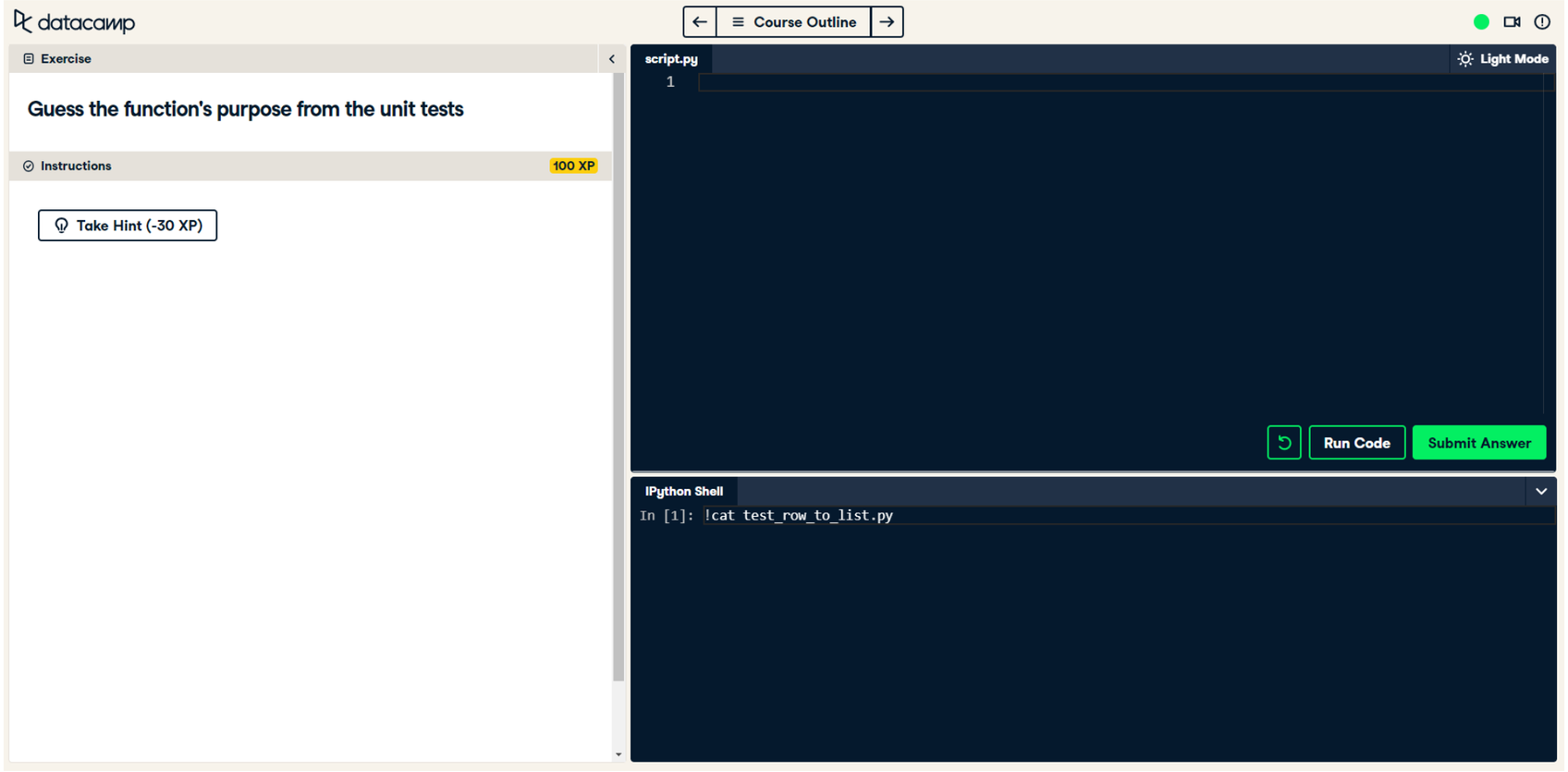

- Created from the test module

Argument	Return value
`"2,081\t314,942\n"`	`["2,081", "314,942"]`
`"\t293,410\n"`	`None`
`"1,463238,765\n"`	`None`

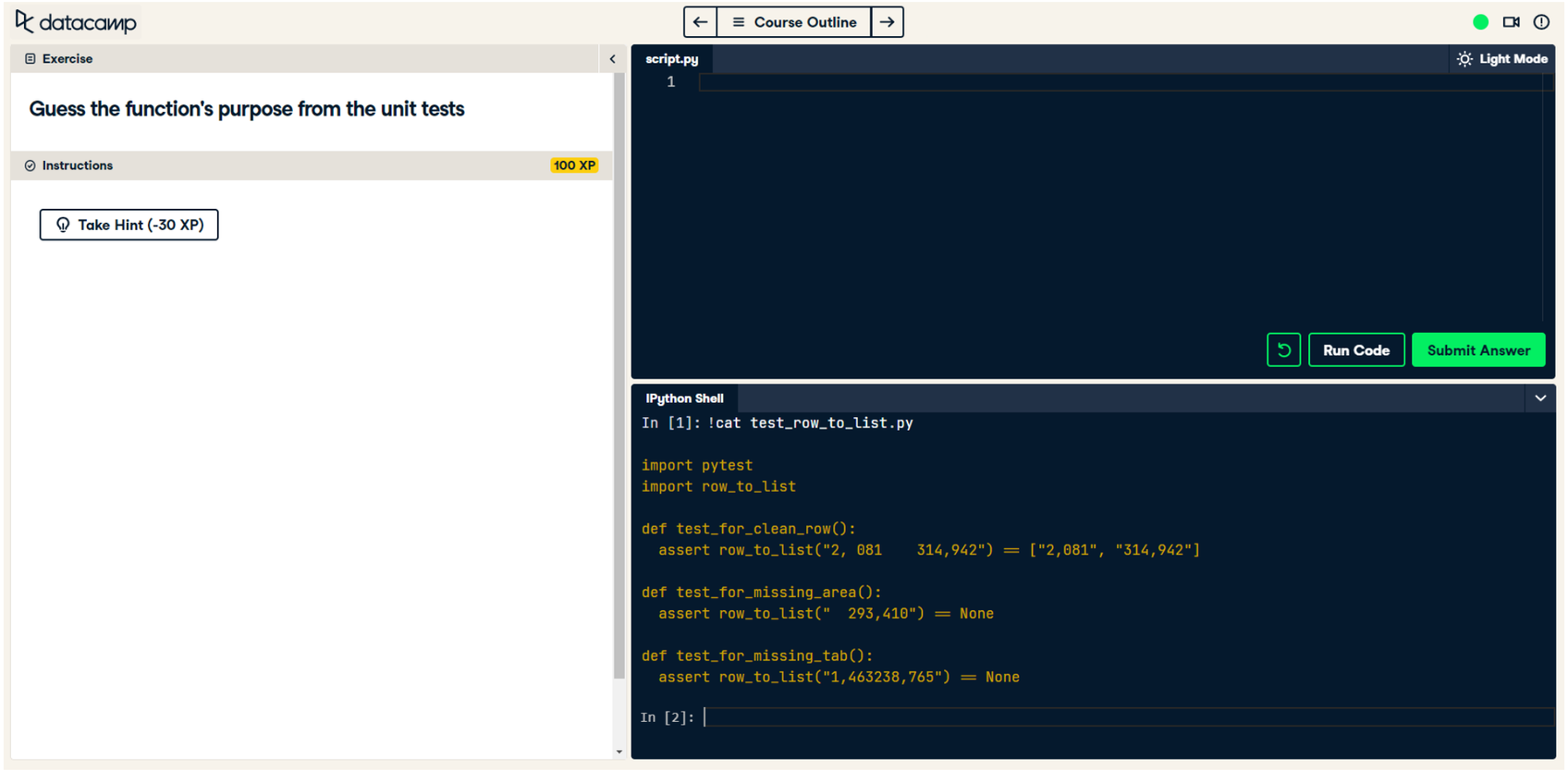
Guess function's purpose by reading unit tests

```
!cat test_row_to_list.py
```



Guess function's purpose by reading unit tests

```
!cat test_row_to_list.py
```



More trust

- Users can run tests and verify that the package works.

Travis CI passing | AppVeyor passing | Azure Pipelines succeeded | codecov 85%

NumPy is the fundamental package needed for scientific computing with Python.

- **Website (including documentation):** https://www.numpy.org
- **Mailing list:** https://mail.python.org/mailman/listinfo/numpy-discussion

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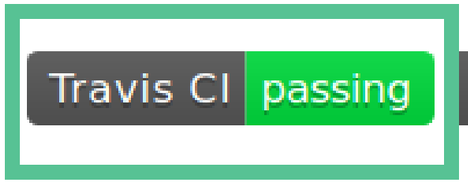
NumPy



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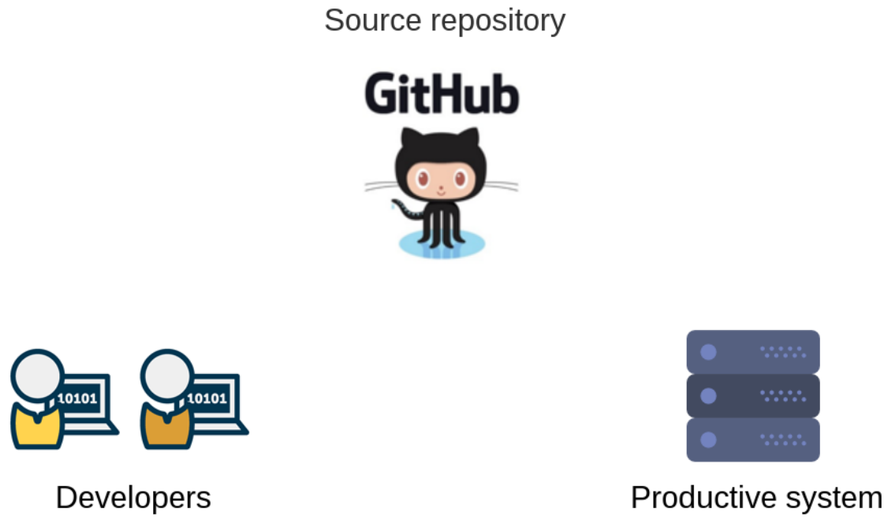
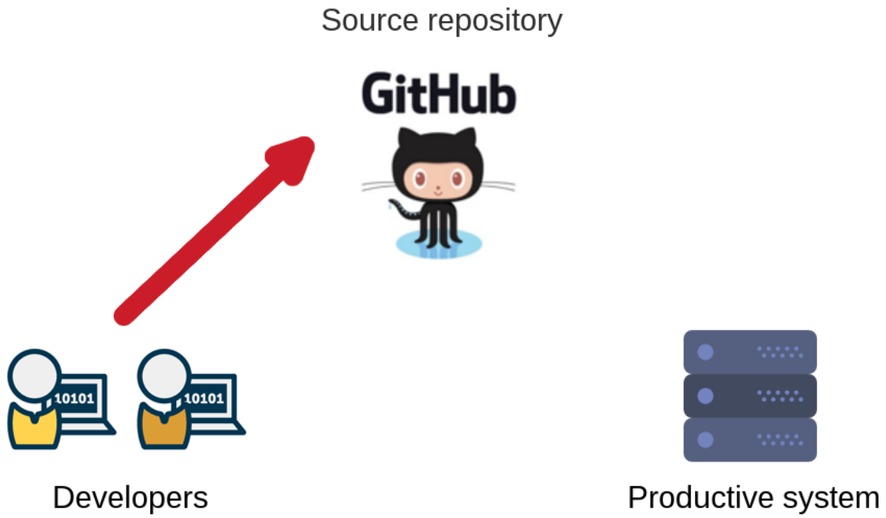
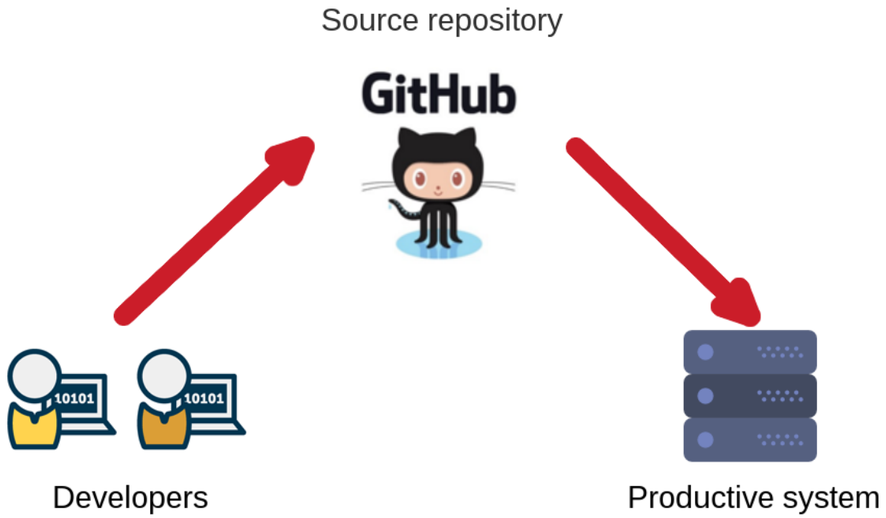
Reduced downtime



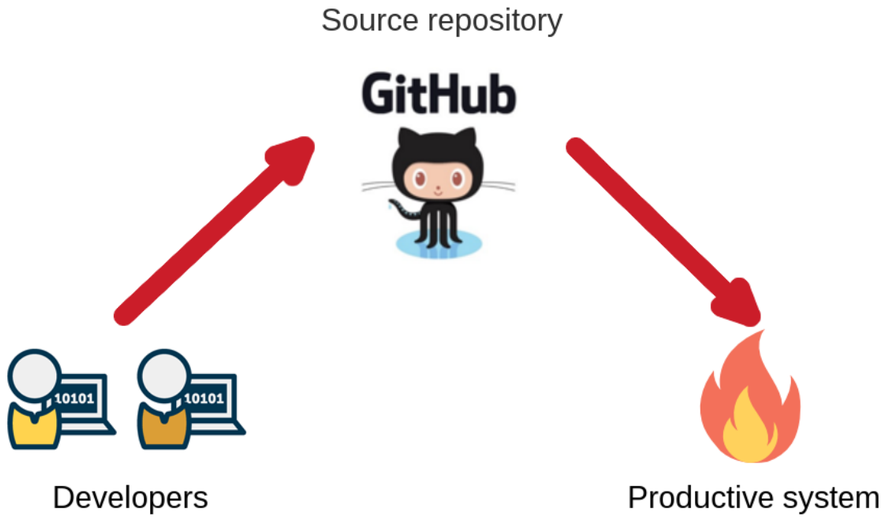
Reduced downtime



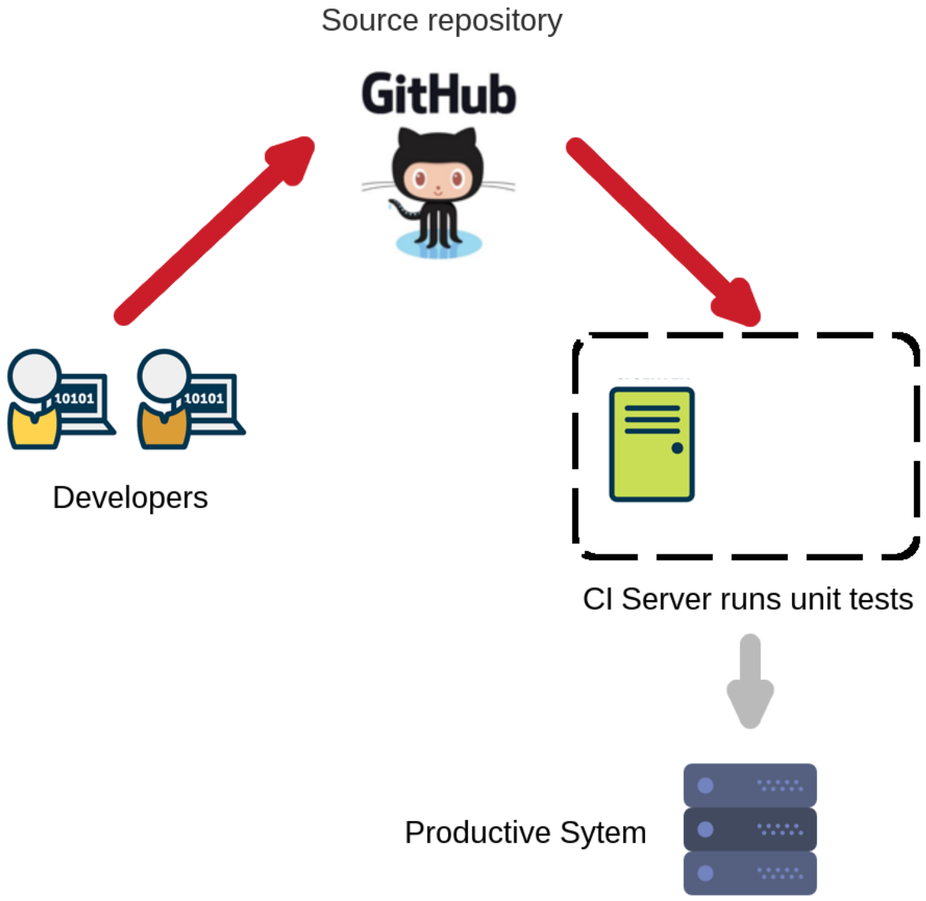
Reduced downtime



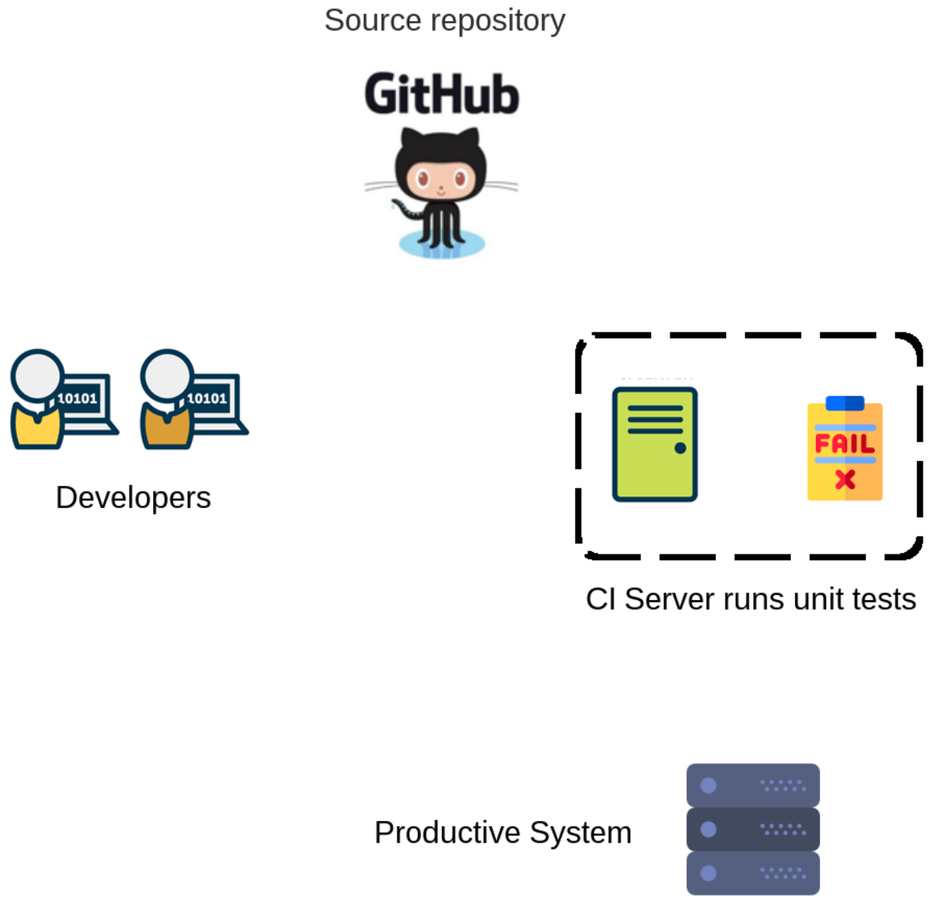
Reduced downtime



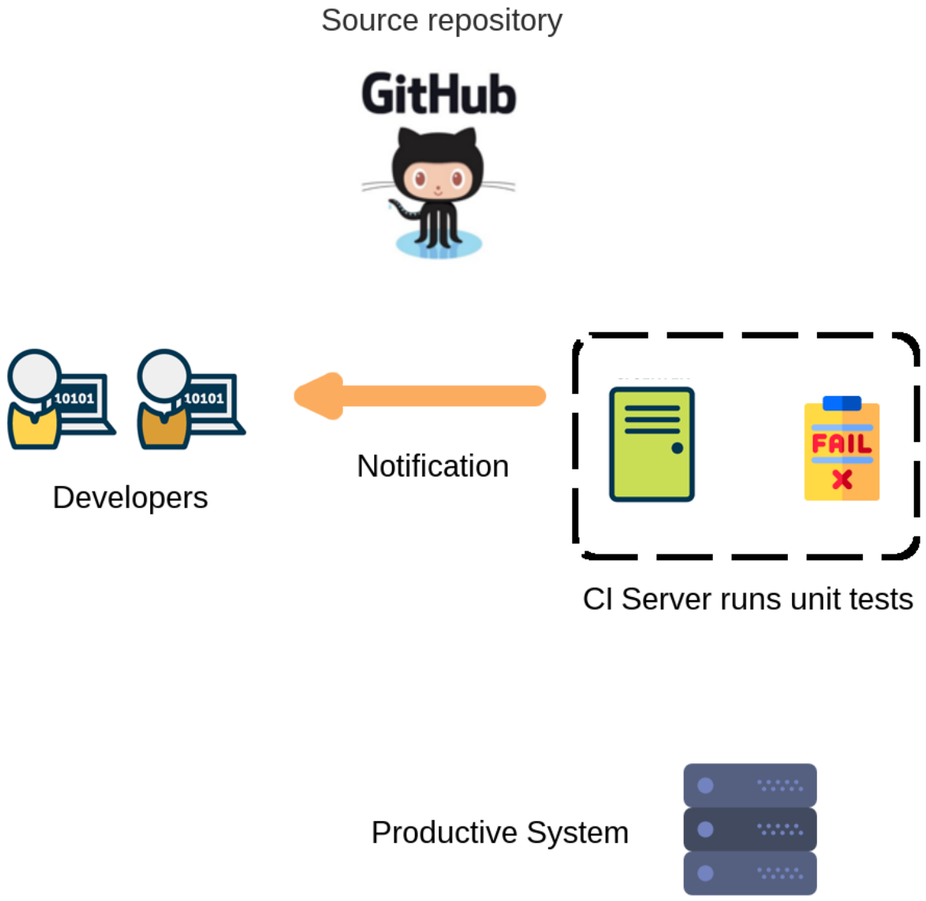
Reduced downtime



Reduced downtime



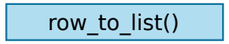
Reduced downtime



All benefits

- Time savings.
- Improved documentation.
- More trust.
- Reduced downtime.

Tests we already wrote

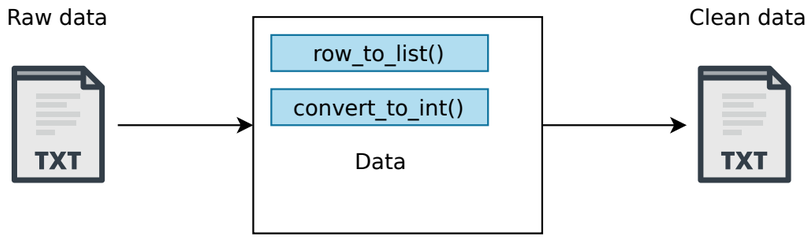


Tests we already wrote

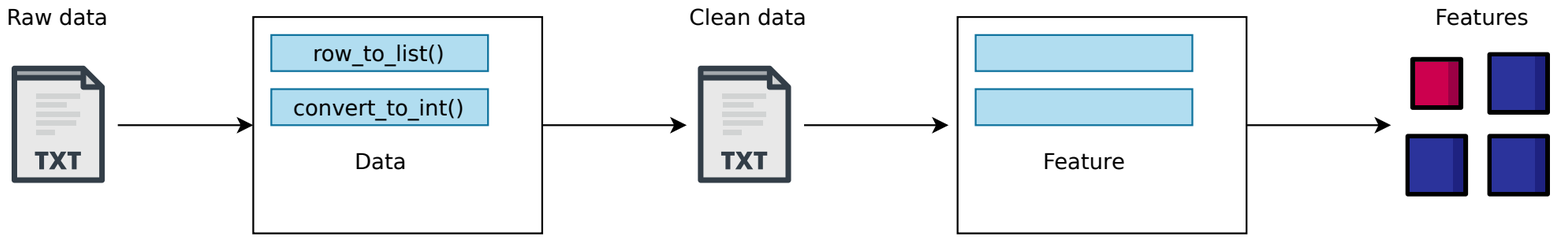
row_to_list()

convert_to_int()

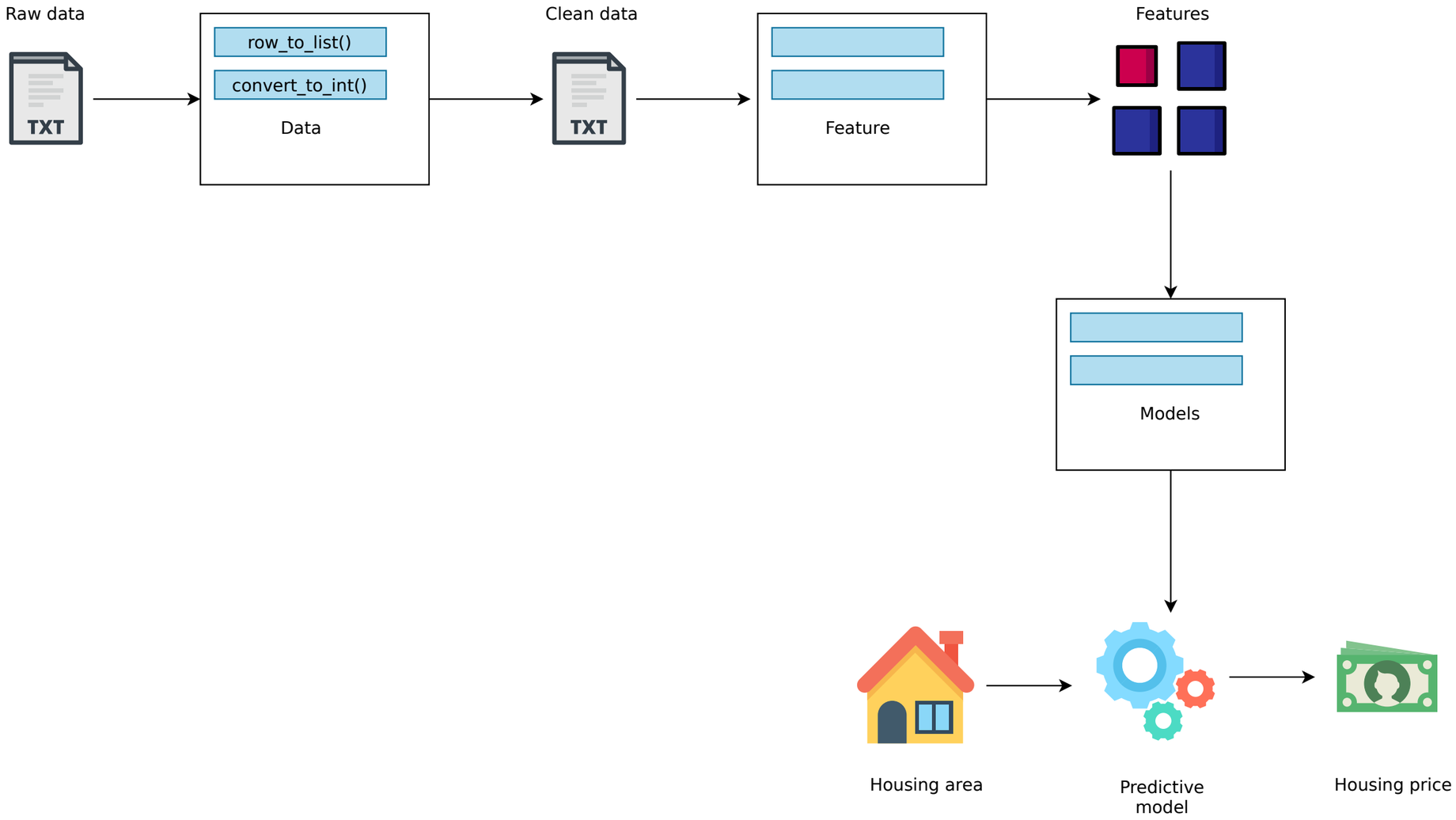
Data module



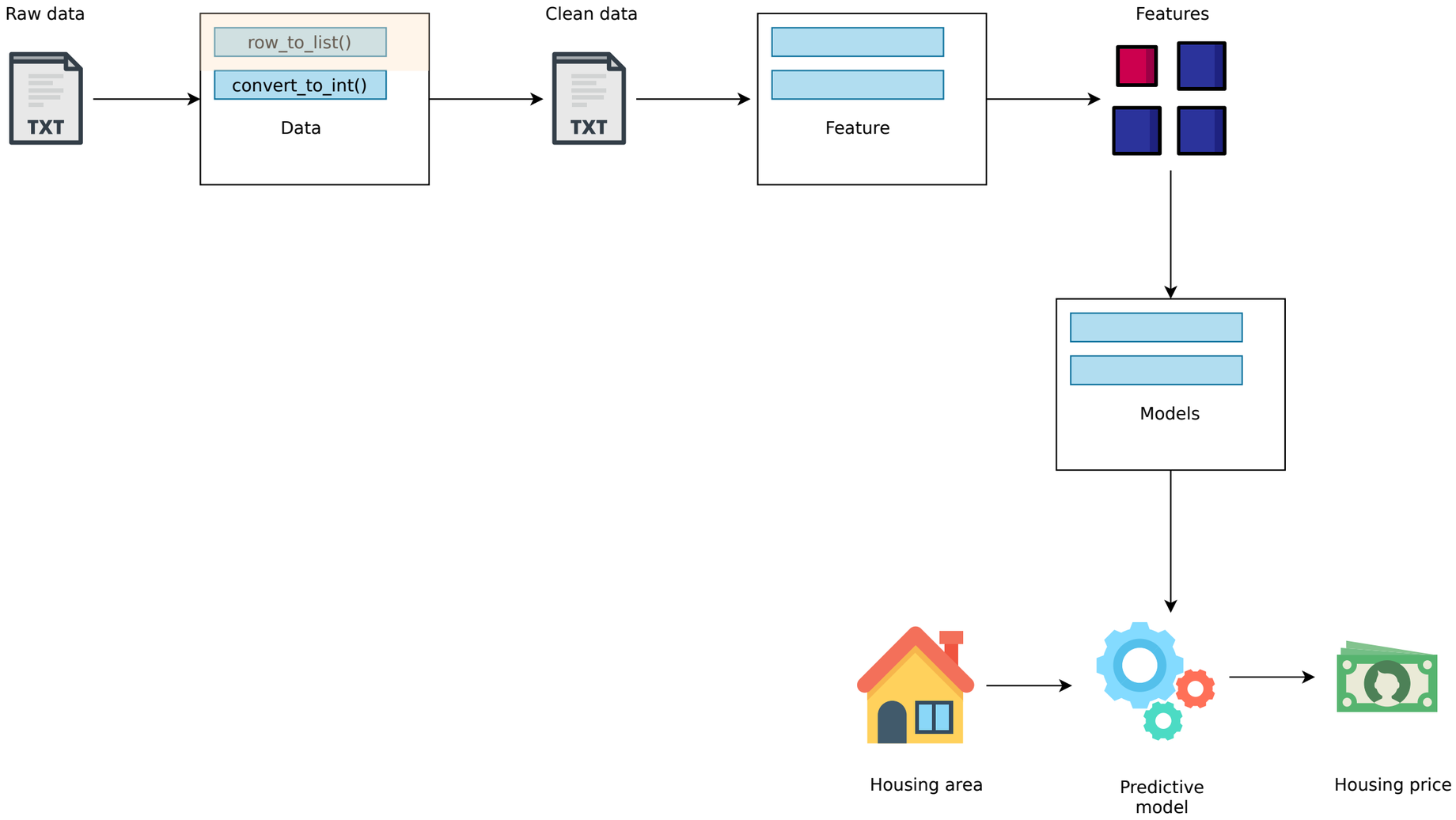
Feature module



Models module



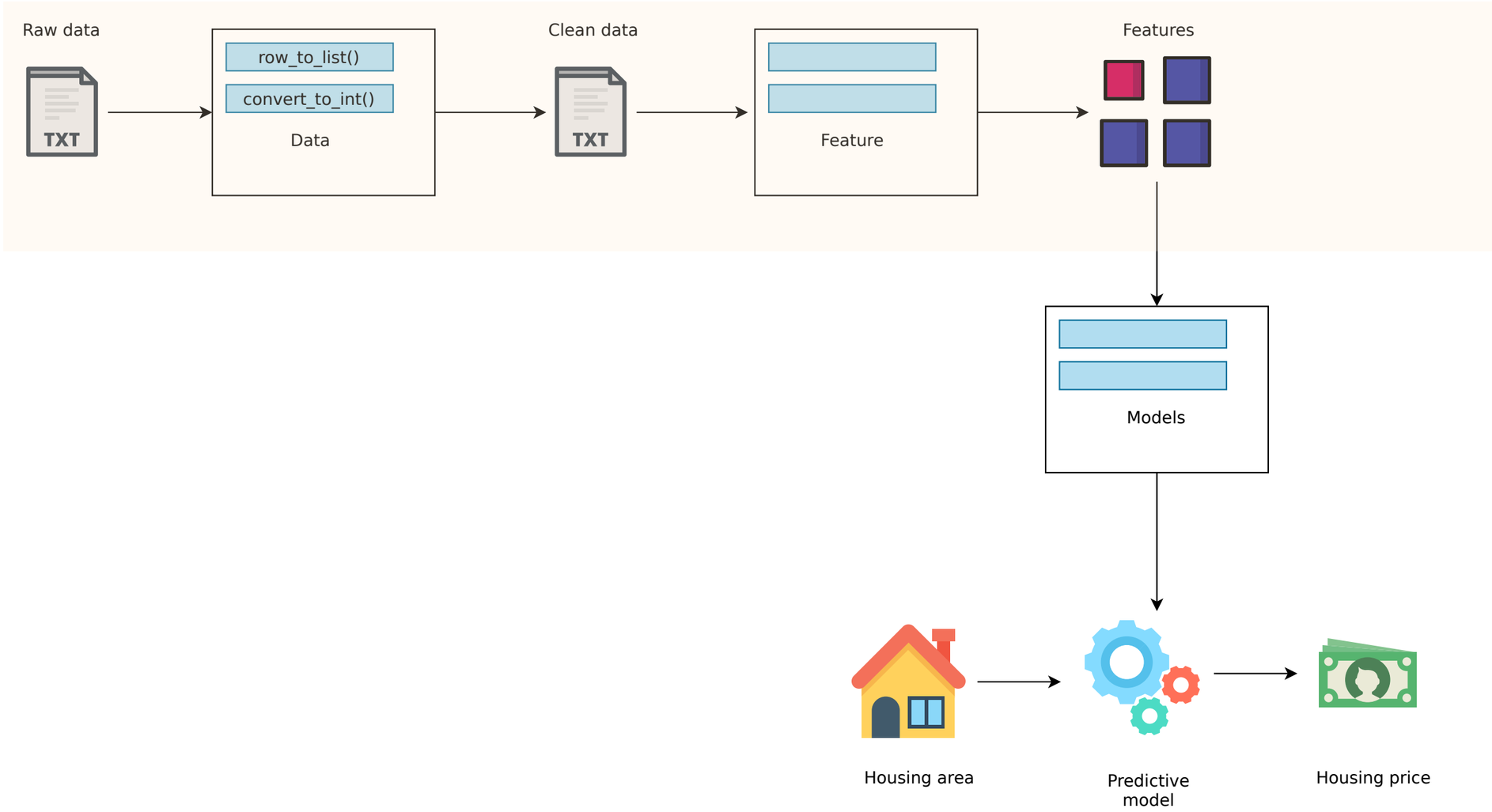
Unit test


Raw data
TXT
row_to_list()
convert_to_int()
Data
Clean data
TXT
Feature
Features
Models
Housing area
Predictive model
Housing price

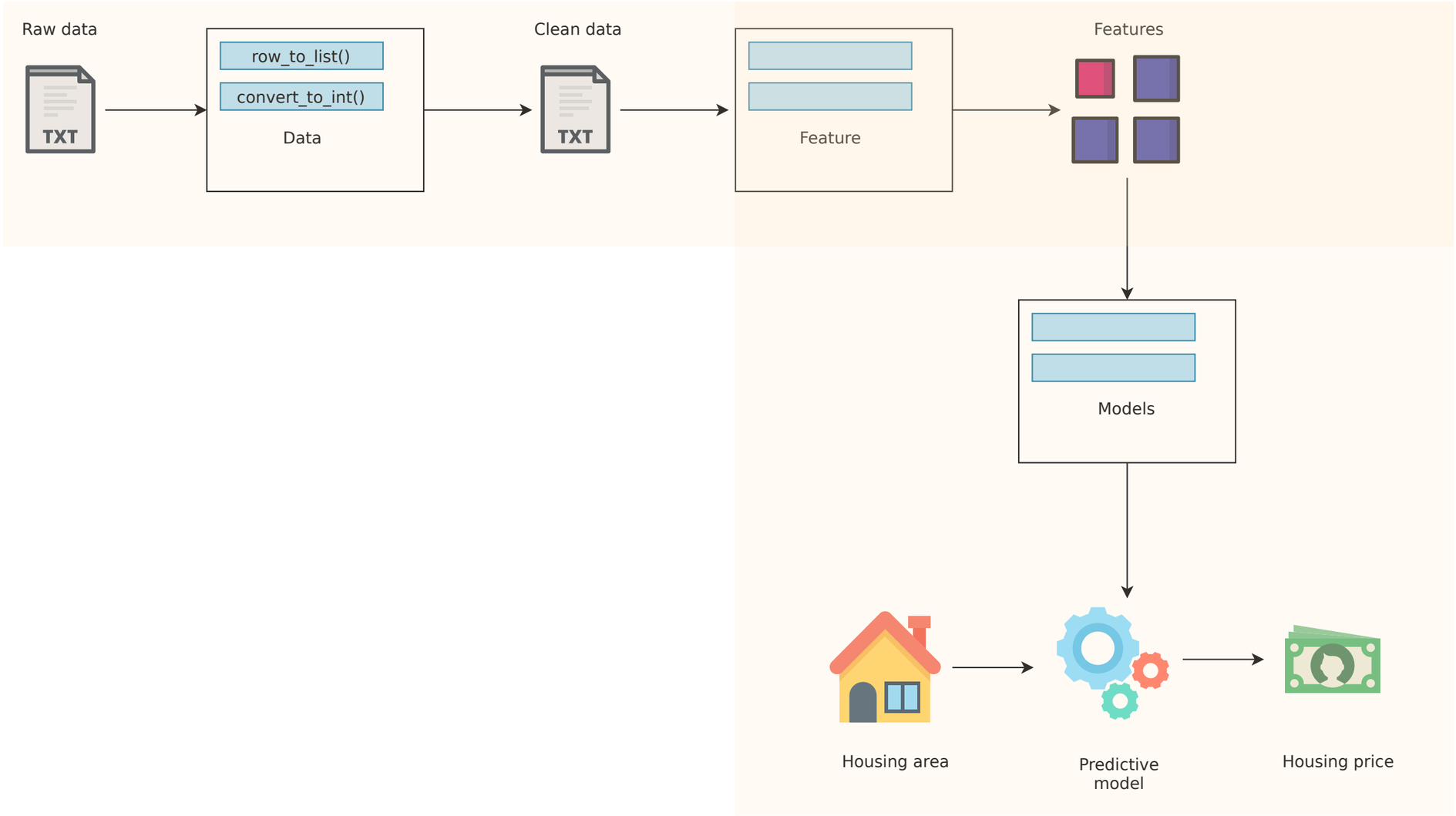
What is a unit?

- Small, independent piece of code.
- Python function or class.

Integration test



End to end test



This course focuses on unit tests

- Writing unit tests is the best way to learn pytest.

In Chapter 2...

- Learn more pytest.
- Write more advanced unit tests.
- Work with functions in the `features` and `models` modules.

Let's practice these concepts!

UNIT TESTING FOR DATA SCIENCE IN PYTHON