Meeting the Unittest

INTRODUCTION TO TESTING IN PYTHON

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Recap of OOP

- **OOP** - programming paradigm based on objects and classes.
- **Class** - a template of an object that can contain methods and attributes.
- **Method** - a function or procedure that belongs to a class.
- **Attribute** - a variable that belongs to a class.
- **Object** - an instance of a class.

- **Example of a Python class:**

```
class Rectangle:
  # Constructor of Rectangle
  def __init__(self, a, b):
      self.a = a
      self.b = b
  # Area method
  def get_area(self):
      return self.a * self.b
# Usage example
r = Rectangle(4, 5)
print(r.get_area())
```

```
>> 20
```

OOP Inheritance

- Classes can inherit properties from other classes.
- Put the **parent** class in the brackets after the name of the new class.

```
class RedRectangle(Rectangle):
  self.color = 'red'
```

What is unittest

- `unittest` - built-in Python framework for test automation (it is installed with `Python`).
- `unittest` - **not only** for unit tests alone.
- **Based on OOP**: each test case is a class, and each test is a method.
- **Test case** - is an instance of testing.
- **Test suite** - is a collection of test cases.

unittest vs. pytest

unittest

- OOP-based - requires to create test classes)
- Built-in (is installed with the `Python` distribution)
- More assertion methods

pytest

- Functon-based - searches for scripts and functions starting with `test_`
- Third-party package (has to be installed separately from the `Python` distribution)
- Less assertion methods

How to create a test with unittest

Test of the exponentiation operator:

```
import unittest


# Declaring the TestCase class
class TestSquared(unittest.TestCase):
    # Defining the test
    def test_negative(self):
        self.assertEqual((-3) ** 2, 9)
```

Assertion methods

- `.assertEqual()`, `.assertNotEqual()`
- `.assertTrue()`, `.assertFalse()`
- `.assertIs()`, `.assertIsNone()`
- `.assertIsInstance()`, `.assertIn()`
- `.assertRaises()`
- Many others

Summary

- `unittest` - OOP-based built-in Python framework for test automation
- **Test case** - is a testing instance in `unittest`
- **To create a test:**
  1. Declare a class inheriting from `unittest.TestCase`
  2. Define test functions
- Assertion methods

Let's practice!

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CLI Interface

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Example: code

Test of the exponentiation operator:

```
# test_sqneg.py
import unittest
# Declaring the TestCase class
class TestSquared(unittest.TestCase):
    # Defining the test
    def test_negative(self):
        self.assertEqual((-3) ** 2, 9)
```

CLI command:

```
python3 -m unittest test_sqneg.py
```

Run Python script `test_sqneg.py` using module `unittest`.

Example: output

The command: `python3 -m unittest test_sqneg.py`

The test output:

```
.
----------------------------------------------------------------------
Ran 1 test in 0.000s

OK
```

Keyword argument -k

`unittest -k` - run test methods and classes that match the pattern or substring

Command: `python3 -m unittest -k "SomeStringOrPattern" test_script.py`

Example: `python3 -m unittest -k "Squared" test_sqneg.py`

Output:

```
.
----------------------------------------------------------------------
Ran 1 test in 0.000s

OK
```

[1] https://docs.python.org/3/library/unittest.html

Fail fast flag -f

`unittest -f` - stop the test run on the first error or failure.

Command: `python3 -m unittest -f test_script.py`

Use case example: when all of tests are crucial, like testing the airplane before a flight.

```
======================================================================
FAIL: test_negative (test_sqneg.TestSquared)
----------------------------------------------------------------------
Traceback (most recent call last):
  File "/home/alexander/OneDrive/Work/DataCamp/materials/ch4/42_CLI/slides/test_sqneg.py", line 5, in test_negative
    self.assertEqual((-3) ** 2, 10)
AssertionError: 9 != 10

----------------------------------------------------------------------
Ran 1 test in 0.001s

FAILED (failures=1)
```

[1] https://docs.python.org/3/library/unittest.html

Catch flag -c

Catch flag `unittest -c` - lets to interrupt the test by pushing "**Ctrl - C**".

- If "**Ctrl - C**"
  - is pushed once, `unittest` waits for the current test to end and reports all the results so far.
  - is pushed twice, `unittest` raises the `KeyboardInterrupt` exception.

Command: `python3 -m unittest -c test_script.py`

Use case example: when debugging a big test suite

[1] https://docs.python.org/3/library/unittest.html

Verbose flag -v

`unittest -v` - run tests with more detail

Command: `python3 -m unittest -v test_script.py` .

Use case example: debugging purposes

Output example:

```
> python3 -m unittest -v test_sqneg.py
test_negative (test_sqneg.TestSquared) ... ok

----------------------------------------------------------------------
Ran 1 test in 0.000s

OK
```

[1] https://docs.python.org/3/library/unittest.html

Summary

- Basic command without arguments `python3 -m unittest test_script.py`
- Output in unittest
- Keyword argument: `python3 -m unittest -k "SomeStringOrPattern" test_script.py`
- Fail fast flag: `python3 -m unittest -f test_script.py`
- Catch flag: `python3 -m unittest -c test_script.py`
- Verbose flag: `python3 -m unittest -v test_script.py`

Let's practice!

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Fixtures in unittest

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Fixtures recap

- **Fixture**
  - a prepared environment for a test
  - separate the preparation from the test code
- **Fixture setup** - setting up resources for tests
- **Fixture teardown** - cleaning up ("tearing down") resources that were allocated
- **Example:** preparing the food for a picnic and the cleaning at the end

Fixtures in the unittest library

- **Fixture in unittest** - the preparaton needed to perform one or more tests
- `.setUp()` - a method called to prepare the test fixture before the actual test
- `.tearDown()` - a method called after the test method to clean the environment

[1] https://docs.python.org/3/library/unittest.html

Example code

```
import unittest

class TestLi(unittest.TestCase):
    # Fixture setup method
    def setUp(self):
        self.li = [i for i in range(100)]

    # Fixture teardown method
    def tearDown(self):
        self.li.clear()

    # Test method
    def test_your_list(self):
        self.assertIn(99, self.li)
        self.assertNotIn(100, self.li)
```

Capital U and capital D

- The correct syntax: `setUp` with capital **U** and `tearDown` with capital **D**.

```
class TestLi(unittest.TestCase):
  # Fixture setup method
  def setUp(self):
      self.li = [i for i in range(100)]

  # Fixture teardown method
  def tearDown(self):
      self.li.clear()
```

Example output

The command: `python3 -m unittest test_in_list.py`

Output of a run with a `.setUp()` and `.tearDown()`:

```
> python3 -m unittest test_in_list.py
.
----------------------------------------------------------------------
Ran 1 test in 0.000s

OK
```

Incorrectly named methods

Output of a run with a `.set_up()` :

```
======================================================================
ERROR: test_your_list (test_in_list.TestLi)
----------------------------------------------------------------------
Traceback (most recent call last):
  File "/home/alexander/OneDrive/Work/DataCamp/materials/ch4/43_fixtures/slides/test_in_list.py", line 14, in
 test_your_list
    self.assertIn(99, self.li)
AttributeError: 'TestLi' object has no attribute 'li'

======================================================================
ERROR: test_your_list (test_in_list.TestLi)
----------------------------------------------------------------------
Traceback (most recent call last):
  File "/home/alexander/OneDrive/Work/DataCamp/materials/ch4/43_fixtures/slides/test_in_list.py", line 10, in
 tearDown
    self.li.clear()
AttributeError: 'TestLi' object has no attribute 'li'

----------------------------------------------------------------------
Ran 1 test in 0.001s

FAILED (errors=2)
```

Summary

- **Fixture in unittest** - the preparation needed to perform one or more tests
- To create a fixture:
  - Implement the `.setUp()` method
  - Implement the `.tearDown()` method
- `.setUp()` - a method called to prepare the test fixture before the actual test.
- `.tearDown()` - a method called after the test method to clean the environment.

Let's practice!

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Practical examples

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Data and pipeline

Data: salaries in data science.

Each row contains information about a data science worker with his salary, title and other attributes.

	A	B	C	D	E	F
1	work_year	experience_level	employment_type	job_title	salary	salary_currenc
2	2023	SE	FT	Principal Data Scientist	80000	EUR
3	2023	MI	CT	ML Engineer	30000	USD
4	2023	MI	CT	ML Engineer	25500	USD
5	2023	SE	FT	Data Scientist	175000	USD
6	2023	SE	FT	Data Scientist	120000	USD
7	2023	SE	FT	Applied Scientist	222200	USD
8	2023	SE	FT	Applied Scientist	136000	USD
9	2023	SE	FT	Data Scientist	219000	USD
10	2023	SE	FT	Data Scientist	141000	USD
11	2023	SE	FT	Data Scientist	147100	USD

Pipeline: to get the mean salary:

1. Read the data
2. Filter by employment type
3. Get the mean salary
4. Save the results

Code of the pipeline

```
import pandas as pd


# Fixture to get the data
@pytest.fixture
def read_df():
    return pd.read_csv('ds_salaries.csv')
# Function to filter the data
def filter_df(df):
    return df[df['employment_type'] == 'FT']
# Function to get the mean
def get_mean(df):
    return df['salary_in_usd'].mean()
```

Integration tests

Test cases:

- Reading the data
- Writing to the file

Code:

```
def test_read_df(read_df):
    # Check the type of the dataframe
    assert isinstance(read_df, pd.DataFrame)
    # Check that df contains rows
    assert read_df.shape[0] > 0
```

Integration tests

Example of checking that Python can create files.

```
def test_write():
    # Opening a file in writing mode
    with open('temp.txt', 'w') as wfile:
        # Writing the text to the file
        wfile.write('Testing stuff is awesome')
    # Checking the file exists
    assert os.path.exists('temp.txt')
    # Don't forget to clean after yourself
    os.remove('temp.txt')
```

Unit tests

Test cases:

- Filtered dataset contains only 'FT' employment type
- The `get_mean()` function returns a number

Code:

```
def test_units(read_df):
    filtered = filter_df(read_df)
    assert filtered['employment_type'].unique() == ['FT']
    assert isinstance(get_mean(filtered), float)
```

Feature tests

Test cases:

- The mean is greater than zero
- The mean is not bigger than the maximum salary in the dataset

Code:

```
def test_feature(read_df):
    # Filtering the data
    filtered = filter_df(read_df)
    # Test case: mean is greater than zero
    assert get_mean(filtered) > 0
    # Test case: mean is not bigger than the maximum
    assert get_mean(filtered) <= read_df['salary_in_usd'].max()
```

Performance tests

Test cases:

- Pipeline execution time from the start to the end

Code:

```
def test_performance(benchmark, read_df):
    # Benchmark decorator
    @benchmark
    # Function to measure
    def get_result():
        filtered = filter_df(read_df)
        return get_mean(filtered)
```

Final test suite

```
import pytest

## Integration Tests
def test_read_df(read_df):
      # Check the type of the dataframe
    assert isinstance(read_df, pd.DataFrame)
    # Check that df contains rows
    assert read_df.shape[0] > 0
def test_write():
    with open('temp.txt', 'w') as wfile:
        wfile.write('12345')
    assert os.path.exists('temp.txt')
    os.remove('temp.txt')

## Unit Tests
def test_units(read_df):
    filtered = filter_df(read_df)
    assert filtered['employment_type'].unique() == ['FT']
    assert isinstance(get_mean(filtered), float)
```

```
## Feature Tests
def test_feature(read_df):
    # Filtering the data
    filtered = filter_df(read_df)
    # Test case: mean is greater than zero
    assert get_mean(filtered) > 0
    # Test case: mean is not bigger than the maximum
    assert get_mean(filtered) <= read_df['salary_in_usd'].max()

## Performance Tests
def test_performance(benchmark, read_df):
    # Benchmark decorator
    @benchmark
    # Function to measure
    def pipeline():
        filtered = filter_df(read_df)
        return get_mean(filtered)
```

Let's practice!

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Congratulations!

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Chapter 1 - Creating tests with pytest

- Testing and `pytest`
- CLI: `pytest test_script.py`
- Test markers

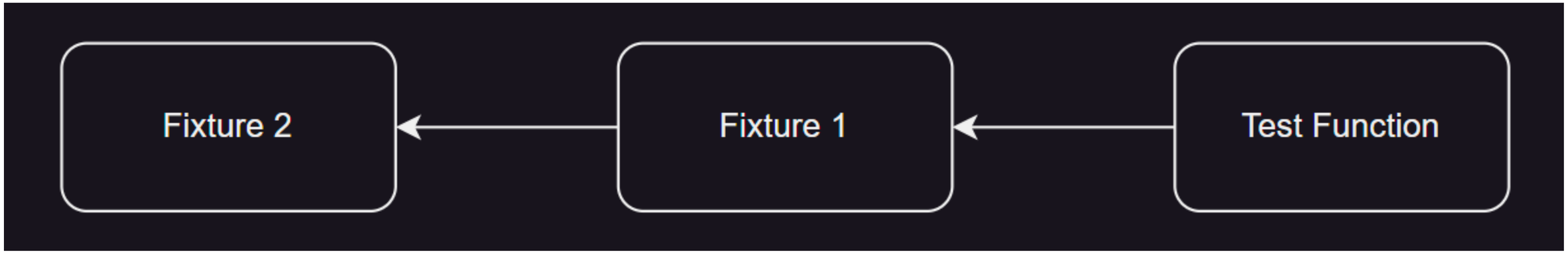
```
PS
============================================================ test session starts ============================================================
platform win32 -- Python 3.11.2, pytest-7.2.2, pluggy-1.0.0
benchmark: 4.0.0 (defaults: timer=time.perf_counter disable_gc=False min_rounds=5 min_time=0.000005 max_time=1.0 calibration_precision=10 w
armup=False warmup_iterations=100000)
rootdir:
plugins: benchmark-4.0.0
collected 3 items

slides.py ...                                                                                                                      [100%]

============================================================= 3 passed in 0.01s =============================================================
PS
```

Chapter 2 - Pytest fixtures

- Introduction to fixtures
- Chain fixtures requests



- Fixtures autouse
- Fixtures teardown

Chapter 3 - Basic Testing Types

- Unit testing
- Feature testing
- Integration testing
- Performance testing

Chapter 4 - Writing tests with unittest

- Meeting the unittest

```
import unittest
class TestSquared(unittest.TestCase):
  def test_negative(self):
      self.assertEqual((-3) ** 2, 9)
```

- Unittest CLI

```
> python3 -m unittest slides_sqneg.py
.
----------------------------------------------------------------------
Ran 1 test in 0.000s

OK
```

- Fixtures in unittest
- Practical examples

Congratulations!

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