Log, debug and test!

B. Esteban

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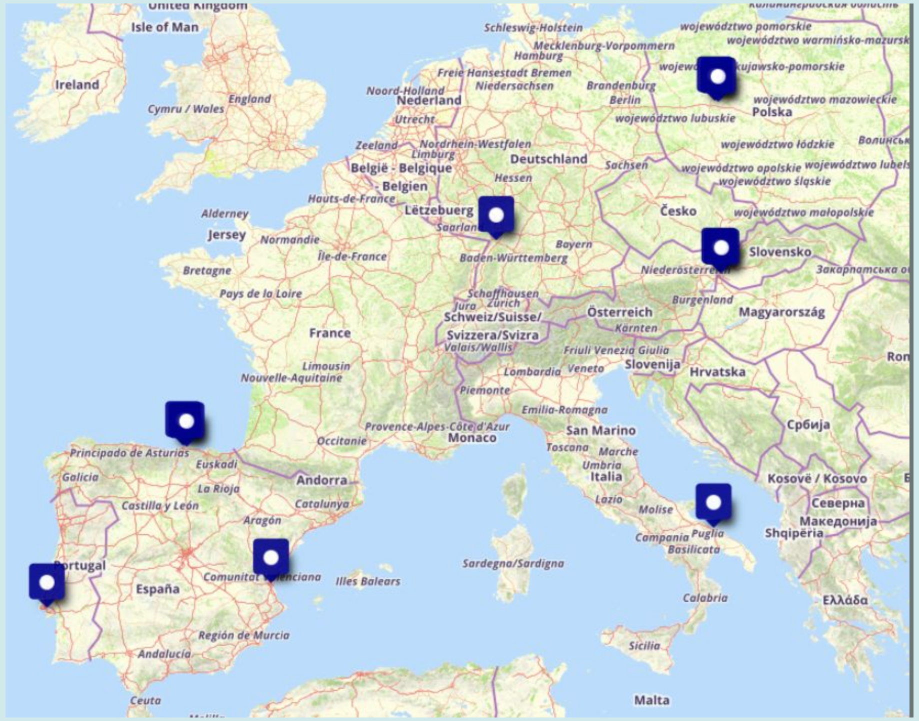

CSIC Consejo Superior de Investigaciones Científicas

KIT Karlsruher Institut für Technologie

LIP

Ústav Informatiky Slovenská Akadémia Vied

Universitat Politècnica de València

INFN Istituto Nazionale di Fisica Nucleare

PSNC

WODR

MicroStep-MIS

predictia

AI4EOSC

Artificial Intelligence for the #EOSC

- Evolution of the DEEP Hybrid DataCloud platform
- HORIZON-INFRA-2021-EOSC-01-04 call
- Runs September 1st 2022 – August 2025 (36 months)
- 7 academic partners
  + 2 SME
  + 1 non-profit organization

Advanced features for distributed, federated, composite learning, metadata provenance, MLOps, event-driven data processing, and provision of AI/ML/DL services

Objectives

Objective 1
Why to log?

Get useful information about program state and errors in development and production runtimes.
Helps to improve your program/service.

Objective 2
Why to test?

Reproduce program states and evaluate correct program behaviour.
Helps to improve your program/service.

Objective 3
Debug errors and bugs without dying in the attempt.

Goal
Make robust code with low errors.
Easily find and solve bugs.
Edit code without breaking requirements.

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Logging Cookbook in AI4EOSC

- Print to stdio (print command) output for users, not program status.
- Do not return program status via API, sensible information might leak. (Passwords, emails, IPs, user ids, etc.)
- Log program status through the terminal is generally safe.
- If you catch exceptions with try, log the error before continue the program.

Recommended links:

- Logging HOWTO: https://docs.python.org/3/howto/logging.html
- Logging Cookbook for Python3: https://docs.python.org/3/howto/logging-cookbook.html

Logging Flow

Two main components of logging (remember):

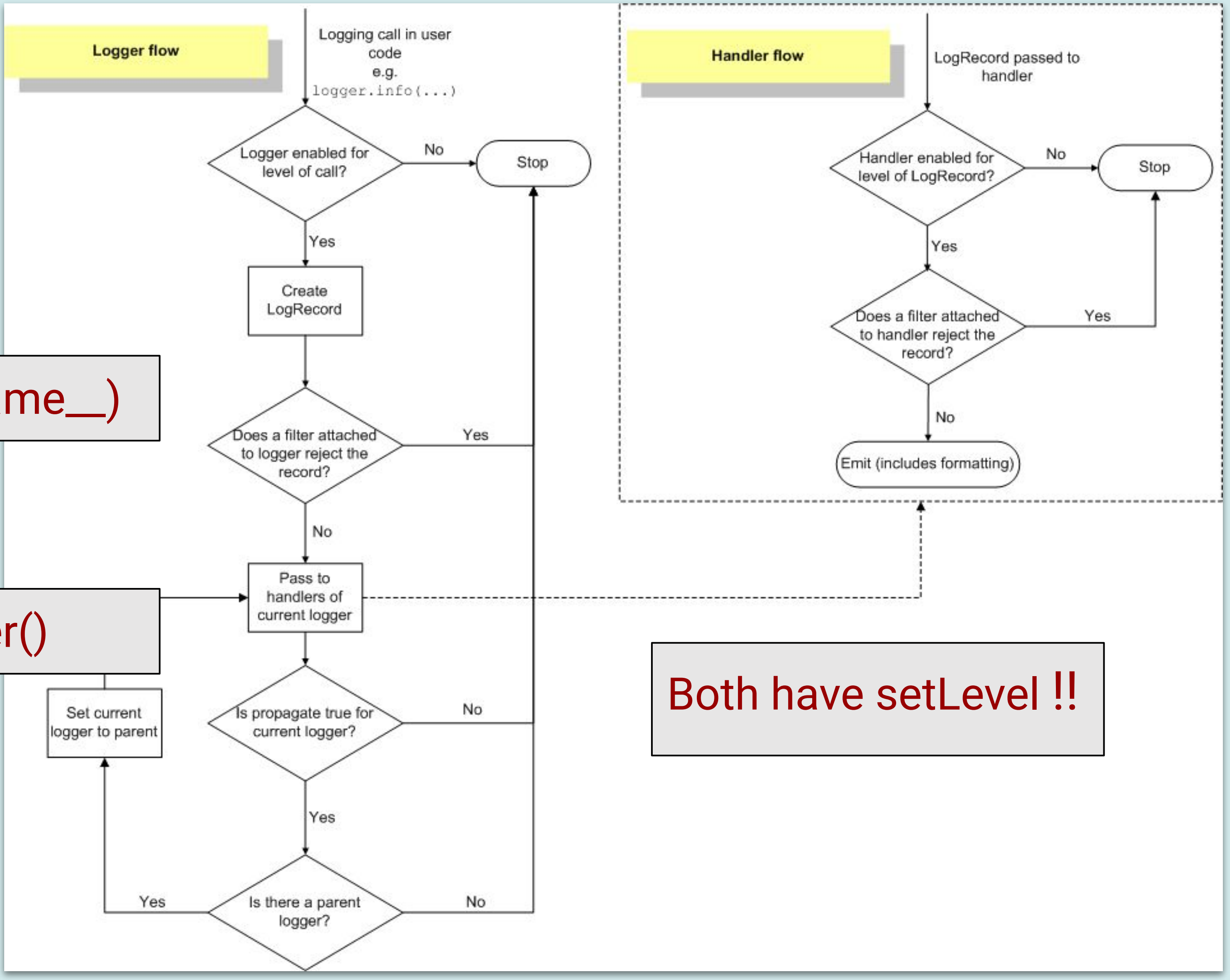
- Loggers:

```
logger = logging.getLogger(__name__)
```

- Handlers:
  (Not so important)

```
handler = logging.StreamHandler()
```

Why? There is normally a default handler for console or your web library.


Logger flow
Logging call in user code e.g. logger.info(...)
Logger enabled for level of call?
No
Stop
Yes
Create LogRecord
Does a filter attached to logger reject the record?
Yes
No
Pass to handlers of current logger
Set current logger to parent
Is propagate true for current logger?
No
Yes
Is there a parent logger?
Yes
No
Handler flow
LogRecord passed to handler
Handler enabled for level of LogRecord?
No
Stop
Yes
Does a filter attached to handler reject the record?
Yes
No
Emit (includes formatting)

Both have setLevel !!

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How to start logging?

- Generic scripts → use “logging.basicConfig”: logging.basicConfig(format=format, level=verbosity)
- Web frameworks → config file, e.i.; https://flask.palletsprojects.com/en/2.3.x/logging/#basic-configuration
- DEEPaaS → config file (also) → [debug = true] https://docs.deep-hybrid-datacloud.eu/projects/deepaas/en/stable/install/configuration/sample.html

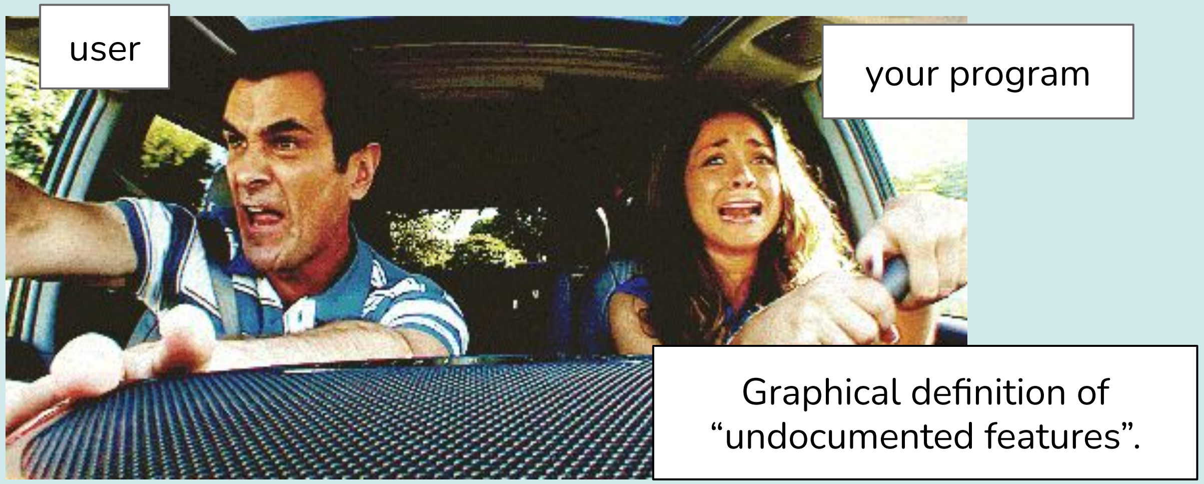
Small time for demo: advanced api

Logging Exercise:

- Clone repository from: https://github.com/BorjaEst/ai4eosc-exercises
- *Create/activate virtual environment with your favorite tool.
- Install model; use “pip install -e .”
- Open the model script to generate data at: “ai4eosc_exercises/data/create_dataset.py”.
- Edit the script to print log information in a file if “--debug” argument is true.
- Execute the script.
  python -m ai4eosc_exercises.data.create_dataset --debug my_data.txt
- Find the errors.

A bit of knowledge about TDD

- Software programming practice – Methodology where requirements are converted to test cases before software is fully developed.
- Origin – Developed by Kent Beck in the late 1990's as part of Extreme Programming.
- Relies on testing – A procedure intended to establish the quality, performance, or reliability of something, especially before it is taken into widespread use



A Software **DEFECT** / **BUG** / **FAULT** is a condition in a software product which does not meet a software requirement or end-user expectation.

softwaretestingfundamentals.com/defect

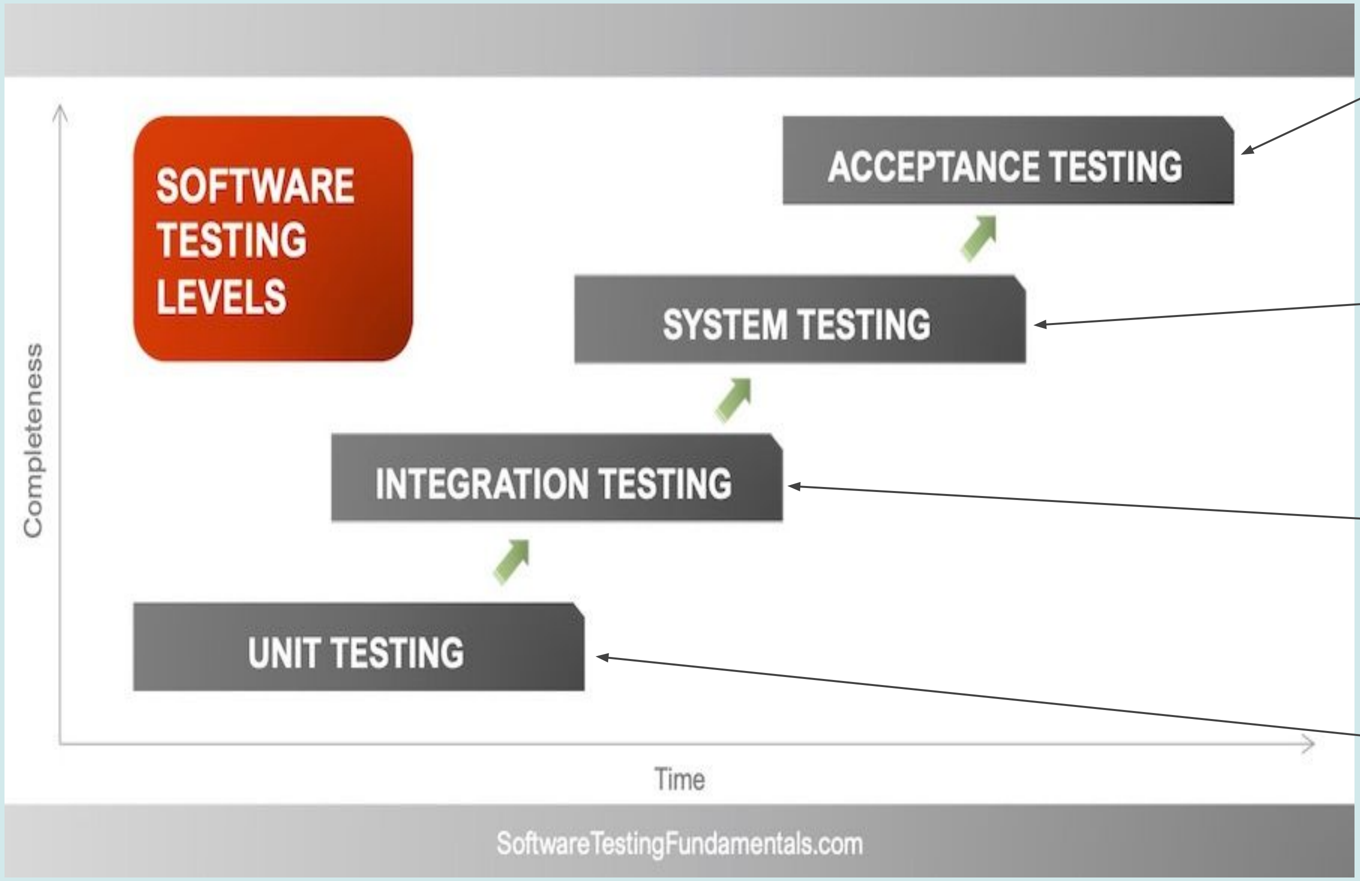
Testing Cookbook in AI4EOSC

- Pytest (library), Unittest (library) and unit testing (method).
  Are not the same! You should choose between unittest or pytest.
- Write generally tests as software requirements.
- Parametrization is generally better than 100% coverage.
- Using tox, helps you to ensure that it will run (almost) everywhere.
- CICD to ensure code contributions are always tested.

Recommended links:

- pytest: helps you write better programs: https://docs.pytest.org
- Python Unit testing framework: https://docs.python.org/3/library/unittest.html

Testing levels where you should test



Is AI4EOSC a nice framework?
Yes! (But I am not responsible of this)

Is DEEPaaS working?
Sure! (Also not responsible)

Does your software work in DEEPaaS?
Hope so 🤔 (Kind of responsible)

Does your software do what you want?
(Unfortunately I am responsible of this)

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Testing Flow and Scopes

Two main components of pytest testing (remember):

- Fixtures:

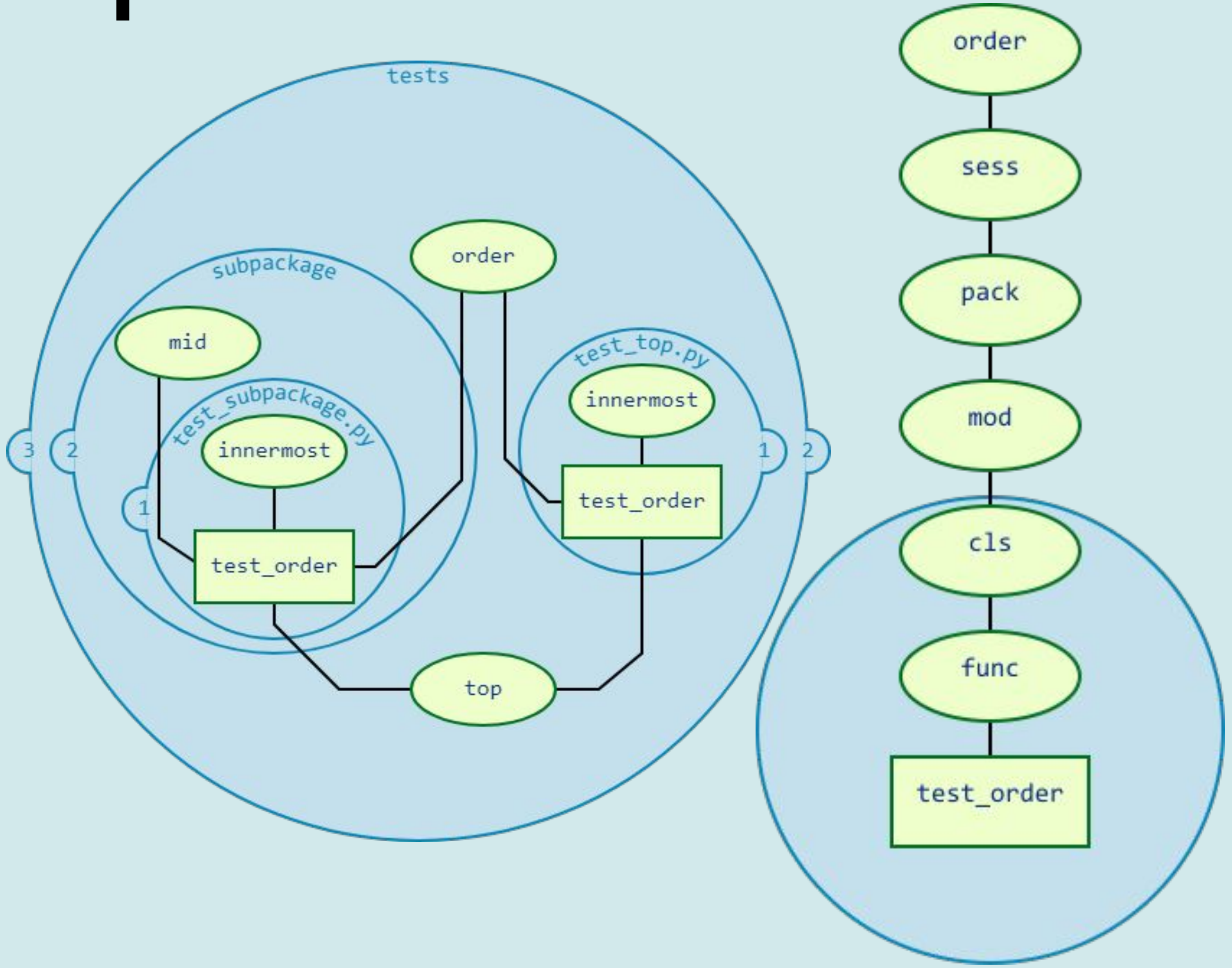
```
@pytest.fixture(scope=<scope>)
```

- Tests:

```
def test_<something>(<fixtures>):
```

Complicated? Do not worry, let's start by simply: Fixture == Setup so:

Fixture1 -> Fixture2 -> [test1, test2, test3]



https://docs.pytest.org/en/7.4.x/reference/fixtures.html#reference-fixtures

How to start testing?

- Simple testing → use “python -m pytest tests”:
  Run in local, does not handle installation of requirements.
- tox - automation project → use “tox -e <environment>”:
  Tests installation and execution of tests in different environments.
- CICD (Jenkins/github actions/etc.) → Just commit and push:
  Tests run in a remote machine automatically.

Small time for demo: advanced api

Testing Exercise:

- Clone repository from: https://github.com/BorjaEst/ai4eosc-exercises
- Install test requirements;
  “pip install -r requirements-test.txt .”
- Test your metadata completing tests at:
  “ai4eosc_exercises/tests/test_metadata/”.
- Create tests for predictions at:
  “ai4eosc_exercises/tests/test_predict/”.
- Prediction tests are currently using “test_dataset_1.txt” as unique input file, edit the fixtures for predictions to test also “test_dataset_2.txt”
- Can you repeat the steps for “tests/test_training/”?.

Debug is easy with the correct tools

- Log program status with python and DEEPaaS logging.
- Tests that point to the requirements that are failing.
- Debugger tools like breakpoints, to stop program execution.
- Python profilers to test your code efficiency.

-> Use IDE or Python pdb with:

```
> python -m pdb myscript.py
```

Recommended links:

- Debugging with vscode: https://code.visualstudio.com/docs/editor/debugging
- The Python Debugger: https://docs.python.org/3/library/pdb.html

Write your tests as requirements

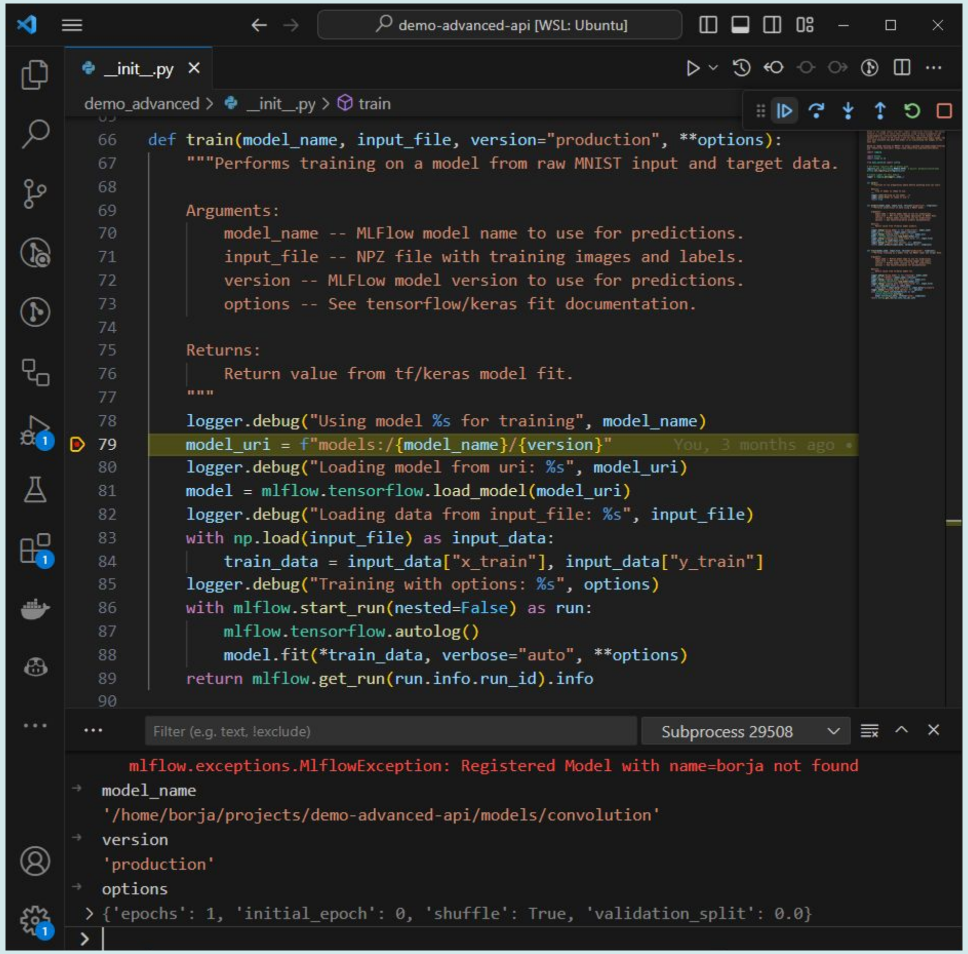
pizza_requirements/test_toppins.py

```
from pizza_factory import ingredients
from pytest import fixture

class TestPepperoni: # ----------------------------> Test case expressed as ‘class’
    @fixture(scope="class")
    def pepperoni(self): # ---------------------------> Fixture for case set up
        return ingredients.Pepperoni()

    def test_is_red(self, pepperoni): # -----------> Test case function/check
        assert pepperoni.color == "red"

    def test_is_round(self, pepperoni): # -------> Test case function/check
        assert pepperoni.shape == "round"
```

Will help you know what you cannot provide to your users.

If you do changes, you know can control the side effects.

What is a debugging breakpoint?


demo-advanced-api [WSL: Ubuntu]
__init__.py
demo_advanced > __init__.py > train
You, 3 months ago
Filter (e.g. text, !exclude)
Subprocess 29508

```python
def train(model_name, input_file, version="production", **options):
    """Performs training on a model from raw MNIST input and target data.

    Arguments:
        model_name -- MLFlow model name to use for predictions.
        input_file -- NPZ file with training images and labels.
        version -- MLFLow model version to use for predictions.
        options -- See tensorflow/keras fit documentation.

    Returns:
        Return value from tf/keras model fit.
    """
    logger.debug("Using model %s for training", model_name)
    model_uri = f"models:/{model_name}/{version}"
    logger.debug("Loading model from uri: %s", model_uri)
    model = mlflow.tensorflow.load_model(model_uri)
    logger.debug("Loading data from input_file: %s", input_file)
    with np.load(input_file) as input_data:
        train_data = input_data["x_train"], input_data["y_train"]
    logger.debug("Training with options: %s", options)
    with mlflow.start_run(nested=False) as run:
        mlflow.tensorflow.autolog()
        model.fit(*train_data, verbose="auto", **options)
    return mlflow.get_run(run.info.run_id).info
```

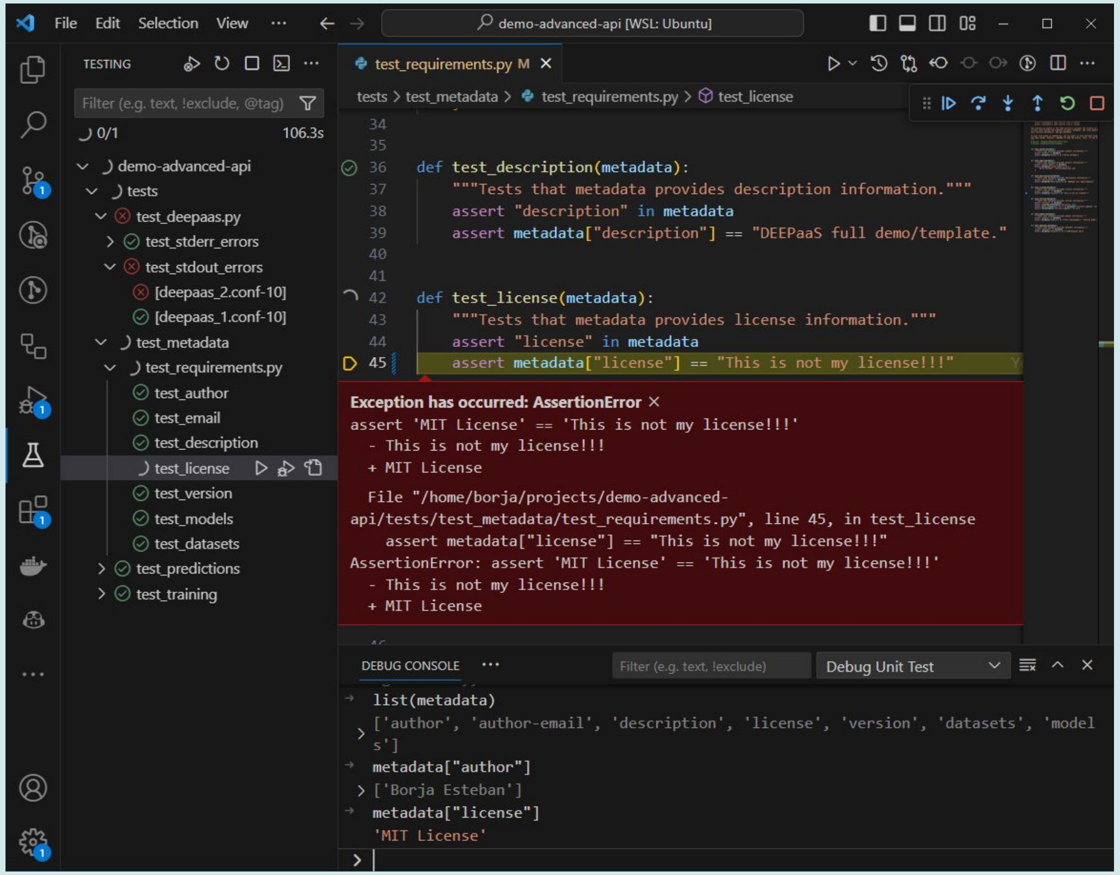
```
mlflow.exceptions.MlflowException: Registered Model with name=borja not found
→ model_name
'/home/borja/projects/demo-advanced-api/models/convolution'
→ version
'production'
→ options
> {'epochs': 1, 'initial_epoch': 0, 'shuffle': True, 'validation_split': 0.0}
>
```

Execution stops where you need:

- Defined red dots in the code.
- Defined commands in the code.
- When an exception is raised.
- When an exception is uncaught.
- etc.

Then you can print variables in the console and even execute commands.

You can easily integrate debugger tools with testing in most IDEs.



```python
def test_description(metadata):
    """Tests that metadata provides description information."""
    assert "description" in metadata
    assert metadata["description"] == "DEEPaaS full demo/template."


def test_license(metadata):
    """Tests that metadata provides license information."""
    assert "license" in metadata
    assert metadata["license"] == "This is not my license!!!"
```

```
Exception has occurred: AssertionError
assert 'MIT License' == 'This is not my license!!!'
  - This is not my license!!!
  + MIT License
  File "/home/borja/projects/demo-advanced-api/tests/test_metadata/test_requirements.py", line 45, in test_license
    assert metadata["license"] == "This is not my license!!!"
AssertionError: assert 'MIT License' == 'This is not my license!!!'
  - This is not my license!!!
  + MIT License
```

```
list(metadata)
['author', 'author-email', 'description', 'license', 'version', 'datasets', 'models']
metadata["author"]
['Borja Esteban']
metadata["license"]
'MIT License'
```

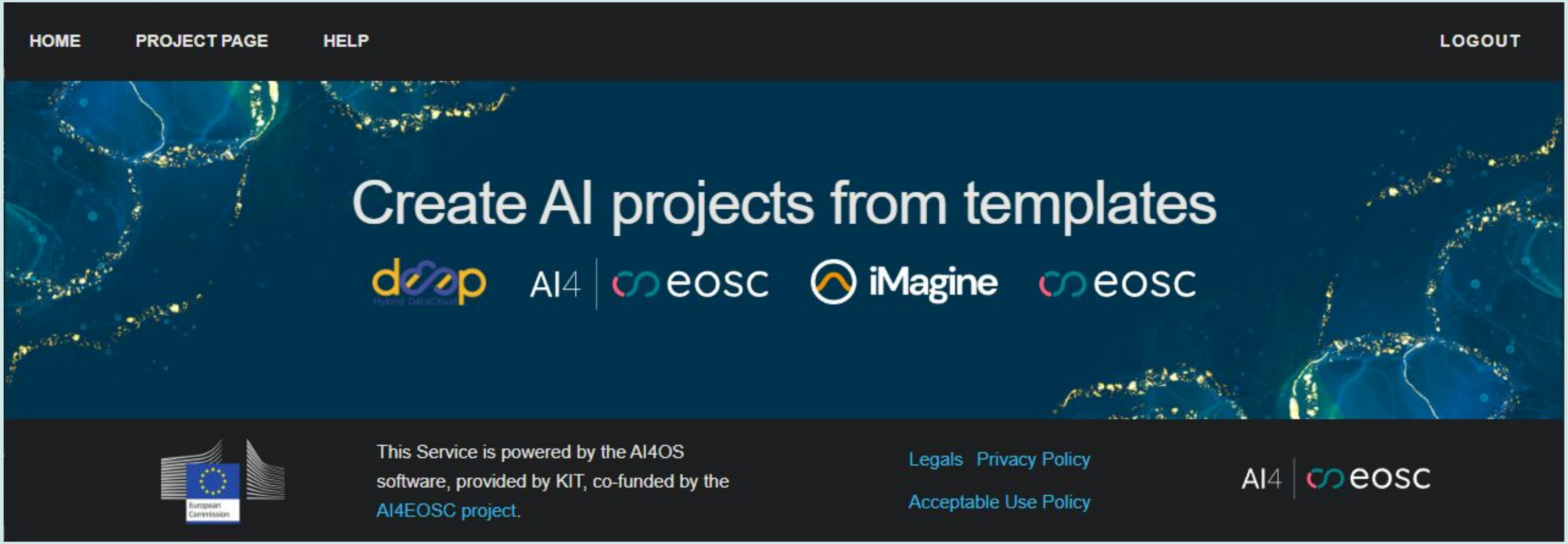
Time to see it in action?

Small time for demo: advanced api

Debugging Exercise:

- Clone repository from: https://github.com/BorjaEst/ai4eosc-exercises
- Can you rewrite your tests and fixtures to make them look like model requirements?
- Pause execution when testing test_emails.
  If you are not using an IDE, use: `pdb.set_trace()`
  Can you tell the value for metadata[“license”] ?
- Run DEEPaaS with a debugger. Open the browser at the local URL and call for “GET /models/ai4eosc_exercises”
  Can you pause the execution when calling the method?
- Can you use “logger.debug” to print information when calling again “GET /models/ai4eosc_exercises”. What is missing?
  Hint: Look at “.vscode/launch.json” -> “Line 12””.

Time for questions



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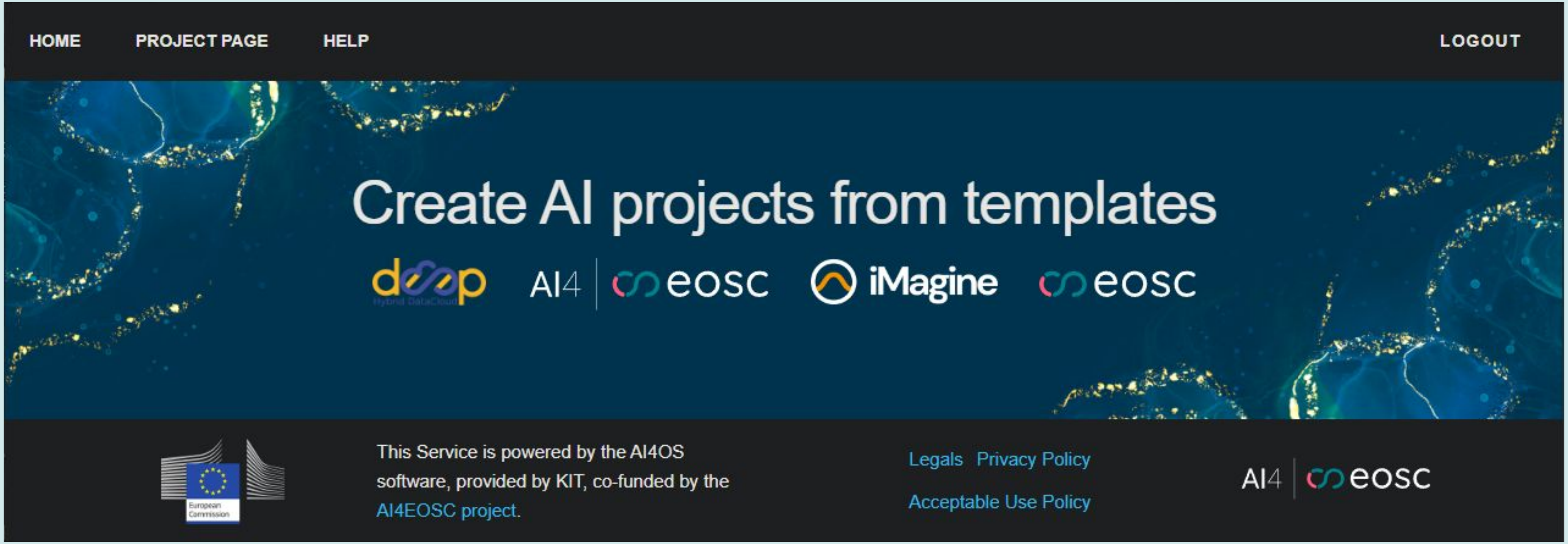
Thank you for your time!



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FAQ

- Flask returns debug info in web page!
  Yes, but for frontend debug purposes, DEEPaaS API is not a frontend framework (Yet).