Effective Programming Practices for Economists

Software engineering

Idea of unit testing

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The assert statement

```
>>> assert 5 == 6, "Numbers are not equal."
---------------------------------------------------
AssertionError     Traceback (most recent call last)
/home/janos/file.py line 1
----> 1 assert 5 == 6, "Numbers are not equal"

AssertionError: Numbers are not equal
```

```
>>> assert False, "This always fails."
---------------------------------------------------
AssertionError     Traceback (most recent call last)
/home/janos/file.py line 1
----> 1 assert False, "This always fails"

AssertionError: This always fails
```

- `assert` raises an error if a condition is not fulfilled
- Often used to check that assumptions about inputs are fulfilled
- Can also be used to test the behavior of functions

Testing a simple function

```
def cobb_douglas(labor, capital, alpha):
    return labor ** alpha * capital ** (1 - alpha)

assert cobb_douglas(1, 1, 0.5) == 1
assert cobb_douglas(16, 1, 0.25) == 2
assert cobb_douglas(1, 16, 0.75) == 2
```

- Test cases can be calculated by hand for simple edge cases
- Sometimes you can get results from other libraries, textbooks, etc.
- If this runs without error, we are confident the function works for other inputs

Testing interfaces, not implementation

```python
def combine_keys_and_values(keys, values):
    return dict(zip(keys, values))


def combine_keys_and_values_2(keys, values):
    return {k: v for k, v in zip(keys, values)}

expected = {"a": 1, "b": 2}
got1 = combine_keys_and_values(["a", "b"], [1, 2])
got2 = combine_keys_and_values(["a", "b"], [1, 2])
```

- If you define good functions, their interface remains stable
- Can improve the implementation without worrying it will break things

This works for any project!

> Unit tests don’t work for scientific code. If we knew the result in advance it wouldn’t be science
> – Anonymous scientist

- Many scientists think they cannot use unit tests in their projects
- But any project can be decomposed into small steps for which you do know what they should do
- Test the steps, not the whole

What are testing frameworks

- In the above examples, python would abort after the first failed test
- Would be nicer to be able to:
  - run all tests and get a report in the end
  - quickly specify subsets of tests to run
  - run the same tests with multiple inputs
- Testing frameworks do just that
- Industry standard is pytest which is basically pytask for tests