COMP110

CL21: Importing and Writing Automated Tests for Functions

Announcements

- EX05 will be released today, and due Sunday at 11:59pm
  - Writing functions to test the correctness of the functions you wrote for EX04!

Code-along: Writing a Function that uses a list, set, and dict!

Together, we'll write a function named `bin_len` that "bins" a list of strings into a dictionary, where the key is an `int` length of a given string and the associated values are a `set` of strings of the key's length found in the original list.

For example:

`bin_len(["the", "quick", "fox"])` returns `{3: {"the", "fox"}, 5: {"quick"}}`

`bin_len(["the", "the", "fox"])` returns `{3: {"the", "fox"}}`

Before we write any code: what concepts from the course will we need to use?

Test-driven function-writing

Before writing a function, it's helpful to focus on concrete examples of *how the function should behave as if it were already implemented*.

Key questions to ask:

1. What are some usual arguments and expected return values?
   a. These are the ***use cases*** or ***expected cases***
2. What are some valid, but unusual arguments and expected return values?
   a. These are your ***edge cases***
   b. Example: empty inputs, incorrect inputs

Below are the examples of the `bin_len` function. Which of these represent use cases and edge cases, respectively?

`bin_len(["the", "quick", "fox"])` returns `{3: {"the", "fox"}, 5: {"quick"}}`

`bin_len([])` returns `{}`

`bin_len(["the", "the", "fox"])` returns `{3: {"the", "fox"}}`

Big idea: We can write functions that validate the correctness of other functions!

In software, this concept is called ***testing.***

Testing at a *function-level* is generally called *unit* testing in industry (a *unit* of functionality)

A. Helps you confirm correctness during development
B. Helps you avoid accidentally breaking things that were previously working (regressions)

The strategy:

1. Implement the "skeleton" of the function you are working on
   (function name, parameters, return type, and some dummy (wrong/naive!) return value)
2. Think of examples use cases of the function and what you expect it to return in each case
3. Write a test function that makes the call(s) and compares expected return value with actual
4. Once you have a failing test case running, go correctly implement the function's body
5. Repeat steps #3 and #4 until your function meets specifications

This gives you a framework for knowing your code is behaving as you expect

Testing is no substitute for critical thinking…

- Passing your own tests does not guarantee your function is correct!
  - Your tests must validate a useful range of cases
    - “Will my function behave correctly for every possible input(s)?”
  - It’s possible for your unit tests to be incorrect (!)
- Rules of thumb:
  - Test >= 2 use cases and >= 1 edge case per function
  - When a function has if-else statements, or loops, write a test per branch/body

Let’s write the skeleton for the **bin_len** function!

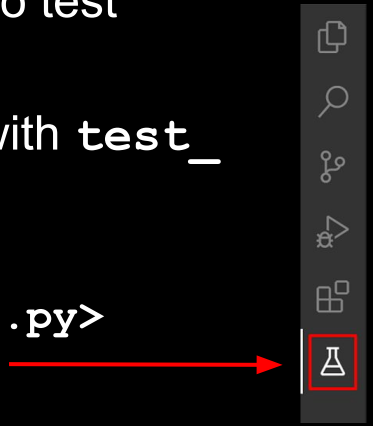
```python
def bin_len(words: list[str]) -> dict[int, set[str]]:
    """Sort the elements of a list into a dict based on their lengths."""
    result: dict[int, set[str]] = {}
    return result
```

Let’s write a test function for the **bin_len** function!

Steps to set up a *pytest* Test Module

To test the function definitions of a module:

1. Create a sibling module (a different file) with the same name, but ending in `_test`
   a. Example name of definitions module: `dictionary.py`
   b. Example name of test module: `dictionary_test.py`
   c. This convention is common to `pytest`
2. In the test module, import the function definitions you'd like to test
   a. Example: `from exercises.ex04.dictionary import bin_len`
3. Next, add tests which are procedures whose names begin with `test_`
   a. Example test name: `test_bin_len_empty`
4. To run the test(s), you have two options:
   a. In a new terminal: `python -m pytest <path/to/testfile.py>`
   b. Use the Python Extension in VSCode's Testing Pane (the beaker icon)



Syntax: Writing a unit test

Test file names: end with _test.py

Test function names: begin with test_

```
def test_name() -> None:
        assert <boolean expression>
```

Syntax: Writing a unit test

Test file names: end with _test.py

Test function names: begin with test_

```
def test_name() -> None:
        # Other code can go here!
        assert <boolean expression>
```

Code we wrote in **`exercises/ex04/dictionary.py`**:

```python
def bin_len(words: list[str]) -> dict[int, set[str]]:
    """Sort the elements of a list into a dict based on their lengths."""
    result: dict[int, set[str]] = {}
    for w in words:
        word_len: int = len(w)
        if word_len in result:
            result[word_len].add(w)
        else:
            result[word_len] = {w}
    return result
```

Testing For Desired Behavior

- Checking that your function does what you want it to do rather than just checking what it returns.
- This can be useful for functions that *mutate* their input.

Example in VSCode…

Syntax: Expecting an error

```
>>> with pytest.raises(ZeroDivisionError):
...     1/0
```