

# Code Warriors: The Art of Testing

Catch Bugs Early, Write Better Code

Michael Borck

## Table of contents

Objectives	2
Why Test?	2
Types of Testing	2
Understanding Different Types of Errors	2
Example Runtime Errors	3
Tools for Testing	3
Example: Using <code>assert</code> for Validation	4
Example: Checking conditions	4
Example: Using <code>unittest</code>	4
Example: Using <code>pytest</code>	5
What is <code>doctest</code> ?	5
Example of <code>doctest</code>	5
Running <code>doctest</code>	6
Adding <code>doctest</code> to Functions	6
<code>fetch_data.py</code> with <code>doctest</code>	6
Running doctests	7

<b>Testing Data Processing Functions</b>	<b>7</b>
<b>Running All doctests</b>	<b>7</b>
<b>Integrating doctest into Your Workflow</b>	<b>7</b>
<b>Homework</b>	<b>8</b>
<b>Summary</b>	<b>8</b>
<b>Next Sessions</b>	<b>8</b>

## Objectives

- Learn the importance of testing in software development.
- Understand how to write tests using `doctest`.
- Run tests using `doctest`

## Why Test?

- Ensure code correctness
- Improve software quality
- Detect bugs early
- Validate functionality
- Facilitate maintenance

## Types of Testing

Test Type	Description
Unit	Test an individual isolated component
Integration	Test multiple units work together
End-to-End	Act as user, test entire stack
Acceptance Test	Verify user story works as expected

## Understanding Different Types of Errors

Error Type	Description	Example
<b>Syntax Error</b>	Occurs when the code violates the syntax rules of the programming language.	<code>print("Hello World</code> (missing closing parenthesis)
<b>Runtime Error</b>	Occurs during the execution of the program, causing it to terminate abruptly.	Division by zero: <code>1 / 0</code>
<b>Logical Error</b>	Occurs when the code runs without crashing but produces incorrect results.	Using <code>=</code> instead of <code>==</code> in a conditional statement

## Example Runtime Errors

Exception	Description	Example
<b>Type Error</b>	Occurs when an operation or function is applied to an object of inappropriate type.	Trying to add a string and an integer: <code>"2" + 2</code>
<b>Name Error</b>	Occurs when a variable or function name is not found.	Using an undefined variable: <code>print(x)</code> (where <code>x</code> is not defined)
<b>Index Error</b>	Occurs when trying to access an element outside the bounds of a list.	Accessing a non-existent list index: <code>my_list[10]</code> (for a list of length <code>&lt; 11</code> )
<b>Attribute Error</b>	Occurs when an invalid attribute reference or assignment is made.	Accessing a non-existent attribute: <code>my_obj.non_existent_attribute</code>
<b>Value Error</b>	Occurs when a function receives an argument of the right type but inappropriate value.	Converting an invalid string to an integer: <code>int("abc")</code>

## Tools for Testing

- `assert`
- `unittest`
- `pytest`
- `doctest`

Certainly! Here are two slides on using `assert` outside of any testing framework:

**What is assert?** - A built-in statement used to test conditions - Raises an `AssertionError` if the condition is `False` - Quick and easy way to test code - Useful for catching bugs early - Immediate feedback on failed conditions - Enhances code reliability and correctness

### Basic Usage

```
def add(a, b):  
    return a + b  
  
result = add(2, 3)  
assert result == 5, f"Expected 5, got {result}"
```

### Example: Using assert for Validation

```
def multiply(a, b):  
    return a * b  
  
# Test cases  
assert multiply(2, 3) == 6, "Test case 1 failed"  
assert multiply(-1, 5) == -5, "Test case 2 failed"  
assert multiply(0, 10) == 0, "Test case 3 failed"
```

### Example: Checking conditions

```
def divide(a, b):  
    assert b != 0, "Denominator cannot be zero"  
    return a / b  
  
# Test cases  
assert divide(10, 2) == 5, "Test case 1 failed"  
assert divide(9, 3) == 3, "Test case 2 failed"
```

### Example: Using unittest

```

import unittest

def add(a, b):
    return a + b

class TestAdd(unittest.TestCase):
    def test_add(self):
        self.assertEqual(add(2, 3), 5)
        self.assertEqual(add(-1, 1), 0)

if __name__ == '__main__':
    unittest.main()

```

## Example: Using pytest

```

def add(a, b):
    return a + b

def test_add():
    assert add(2, 3) == 5
    assert add(-1, 1) == 0

```

## What is doctest?

- doctest allows writing tests within docstrings.
- Verify code functionality directly in documentation.

## Example of doctest

```

def add(a, b):
    """
    Add two numbers and return the result.

    Args:
        a (int or float): The first number.
    """

```

```

    b (int or float): The second number.

Returns:
    int or float: The sum of `a` and `b`.

Examples:
>>> add(2, 3)
5
>>> add(1.5, 2.5)
4.0
"""
return a + b

```

## Running doctest

- Run doctest using the following command:

```
!python -m doctest -v your_script.py
```

## Adding doctest to Functions

- Add doctest to the `fetch_weather_data` function in `fetch_data.py`.

### fetch\_data.py with doctest

```

def fetch_weather_data(api_key, location):
    """
    Fetch weather data from the OpenWeatherMap API.
    ...

    Examples:
    >>> fetch_weather_data('invalid_api_key', 'London') is None
    True
    >>> isinstance(fetch_weather_data('valid_api_key', 'London'), dict)
    True
    """

```

```
url = ....  
...
```

## Running doctests

- Run doctests using the following command:

```
!python -m doctest -v scripts/fetch_data.py
```

## Testing Data Processing Functions

- Add doctest to data processing functions to ensure correctness.

```
def convert_temp_kelvin_to_celsius(kelvin):  
    """  
    Convert temperature from Kelvin to Celsius.  
    ...  
  
    >>> convert_temp_kelvin_to_celsius(273.15)  
    0.0  
    >>> convert_temp_kelvin_to_celsius(0)  
    -273.15  
    >>> convert_temp_kelvin_to_celsius(373.15)  
    100.0  
    """  
    return kelvin - 273.15
```

## Running All doctests

- Run all doctests in the project using:

```
!python -m doctest -v scripts/*.py
```

## Integrating doctest into Your Workflow

- Ensure all functions have appropriate doctests.
- Run doctests regularly to verify functionality.

## Homework

- Add more `doctest` cases to cover edge cases and different scenarios.
- Explore the official `doctest` documentation for more advanced usage.

## Summary

- Learned the importance of testing.
- Wrote and ran tests using `doctest`.
- Tested weather fetching and data processing functions.

## Next Sessions

- Focus on debugging
- Add documentation
- Distribution methods