

# Assignment 8.4

**Name:** Karthikeya Uthuri

**Hall Ticket :**2303A51306

**Task 1: Developing a Utility Function Using TDD Scenario**

You are working on a small utility library for a larger software system. One of the required functions should calculate the square of a given number, and correctness is critical because other modules depend on it.

**Task Description**

Following the Test Driven Development (TDD) approach:

1. First, write unit test cases to verify that a function correctly returns the square of a number for multiple inputs.
2. After defining the test cases, use GitHub Copilot or Cursor AI to generate the function implementation so that all tests pass. Ensure that the function is written only after the tests are created. Expected

**Outcome**

- A separate test file and implementation file
- Clearly written test cases executed before implementation
- AI-assisted function implementation that passes all tests
- Demonstration of the TDD cycle: test → fail → implement → pass

**Code:**

```
[1]: import unittest
# ---- TEST CASES (written first in TDD) ----
class TestSquareFunction(unittest.TestCase):

    def test_positive_number(self):
        self.assertEqual(square(4), 16)

    def test_negative_number(self):
        self.assertEqual(square(-3), 9)

    def test_zero(self):
        self.assertEqual(square(0), 0)

    def test_large_number(self):
        self.assertEqual(square(100), 10000)

[2]: # ---- IMPLEMENTATION (written AFTER tests) ----
def square(n):
    return n * n
```

```
[1]: def test_positive_number(self):
    self.assertEqual(square(4), 16)

[2]: def test_negative_number(self):
    self.assertEqual(square(-3), 9)

[3]: def test_zero(self):
    self.assertEqual(square(0), 0)

[4]: def test_large_number(self):
    self.assertEqual(square(100), 10000)

# ---- IMPLEMENTATION (written AFTER tests) ----
def square(n):
    return n * n

unittest.main(argv=[''], verbosity=2, exit=False)
```

Output:

The screenshot shows a Jupyter Notebook interface with a dark theme. The title bar says "Untitled30.ipynb". The main area displays a command-line output of a Python test run:

```
test_large_number (__main__.TestSquareFunction.test_large_number) ... ok
...
test_negative_number (__main__.TestSquareFunction.test_negative_number) ... ok
test_positive_number (__main__.TestSquareFunction.test_positive_number) ... ok
test_zero (__main__.TestSquareFunction.test_zero) ... ok

Ran 4 tests in 0.009s

OK
<unittest.main.TestProgram at 0x7e0211f2cda0>
```

## Task 2: Email Validation for a User Registration System

### Scenario

You are developing the backend of a user registration system. One requirement is to validate user email addresses before storing them in the database.

### Task Description

Apply Test Driven Development by:

1. Writing unit test cases that define valid and invalid email formats (e.g., missing @, missing domain, incorrect structure).
2. Using AI assistance to implement the validate\_email() function based strictly on the behavior described by the test cases.

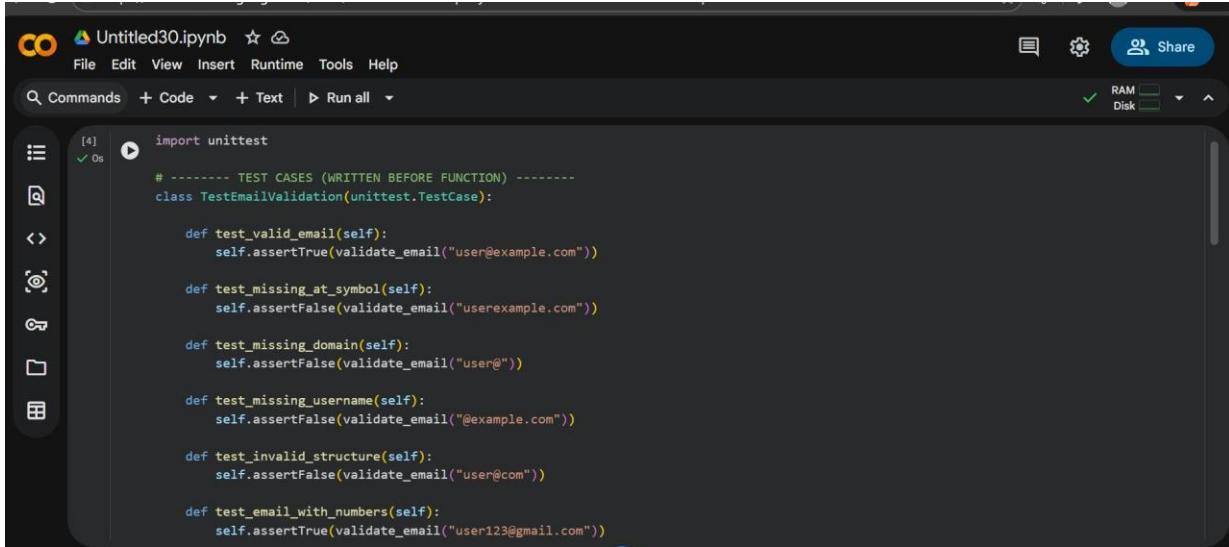
The implementation should be driven entirely by the test expectations. Expected

### Outcome

- Well-defined unit tests using unittest or pytest
- An AI-generated email validation function
- All test cases passing successfully

- Clear alignment between test cases and function behavior

Code:



```

import unittest

# ----- TEST CASES (WRITTEN BEFORE FUNCTION) -----
class TestEmailValidation(unittest.TestCase):

    def test_valid_email(self):
        self.assertTrue(validate_email("user@example.com"))

    def test_missing_at_symbol(self):
        self.assertFalse(validate_email("userexample.com"))

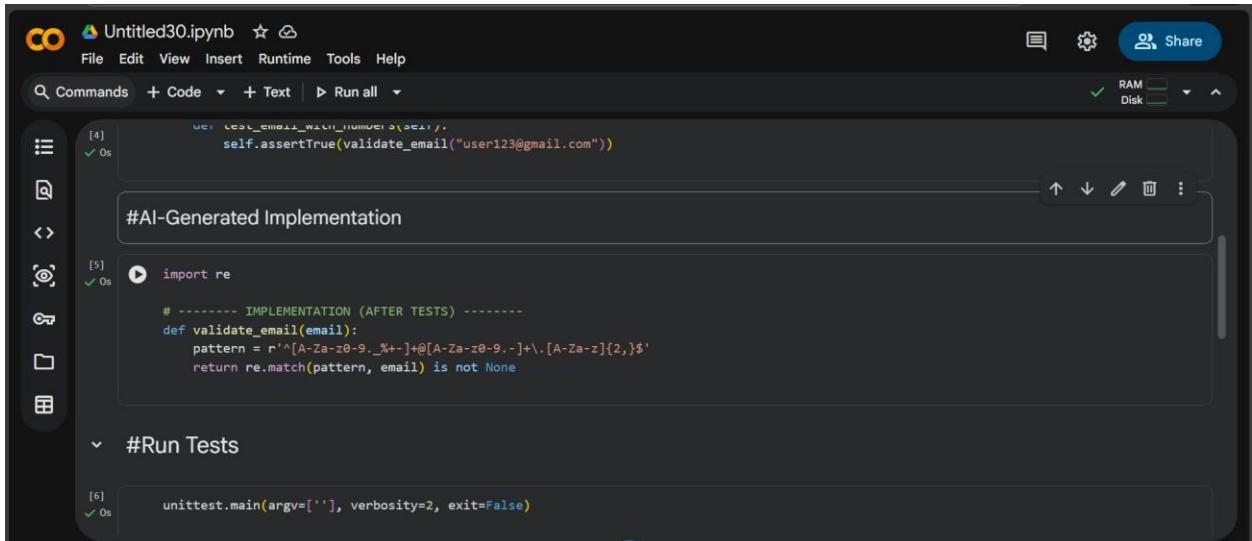
    def test_missing_domain(self):
        self.assertFalse(validate_email("user@"))

    def test_missing_username(self):
        self.assertFalse(validate_email("@example.com"))

    def test_invalid_structure(self):
        self.assertFalse(validate_email("user@com"))

    def test_email_with_numbers(self):
        self.assertTrue(validate_email("user123@gmail.com"))

```



```

#AI-Generated Implementation

def test_email_with_numbers(self):
    self.assertTrue(validate_email("user123@gmail.com"))

# ----- IMPLEMENTATION (AFTER TESTS) -----
def validate_email(email):
    pattern = r'^[A-Za-z0-9._%+-]+@[A-Za-z0-9.-]+\.[A-Za-z]{2,}$'
    return re.match(pattern, email) is not None

#Run Tests

unittest.main(argv=[''], verbosity=2, exit=False)

```

```
File Edit View Insert Runtime Tools Help
Commands + Code + Text Run all

... test_email_with_numbers (_main_.TestEmailValidation.test_email_with_numbers) ... ok
test_invalid_structure (_main_.TestEmailValidation.test_invalid_structure) ... ok
test_missing_at_symbol (_main_.TestEmailValidation.test_missing_at_symbol) ... ok
test_missing_domain (_main_.TestEmailValidation.test_missing_domain) ... ok
test_missing_username (_main_.TestEmailValidation.test_missing_username) ... ok
test_valid_email (_main_.TestEmailValidation.test_valid_email) ... ok
test_large_number (_main_.TestSquareFunction.test_large_number) ... ok
test_negative_number (_main_.TestSquareFunction.test_negative_number) ... ok
test_positive_number (_main_.TestSquareFunction.test_positive_number) ... ok
test_zero (_main_.TestSquareFunction.test_zero) ... ok
-----
Ran 10 tests in 0.023s
OK
<unittest.main.TestProgram at 0x7e0211f2eb0>
```

### Task 3: Decision Logic Development Using TDD

#### Scenario

In a grading or evaluation module, a function is required to determine the maximum value among three inputs. Accuracy is essential, as incorrect results could affect downstream decision logic.

#### Task Description

Using the TDD methodology:

1. Write test cases that describe the expected output for different combinations of three numbers.
2. Prompt GitHub Copilot or Cursor AI to implement the function logic based on the written tests.

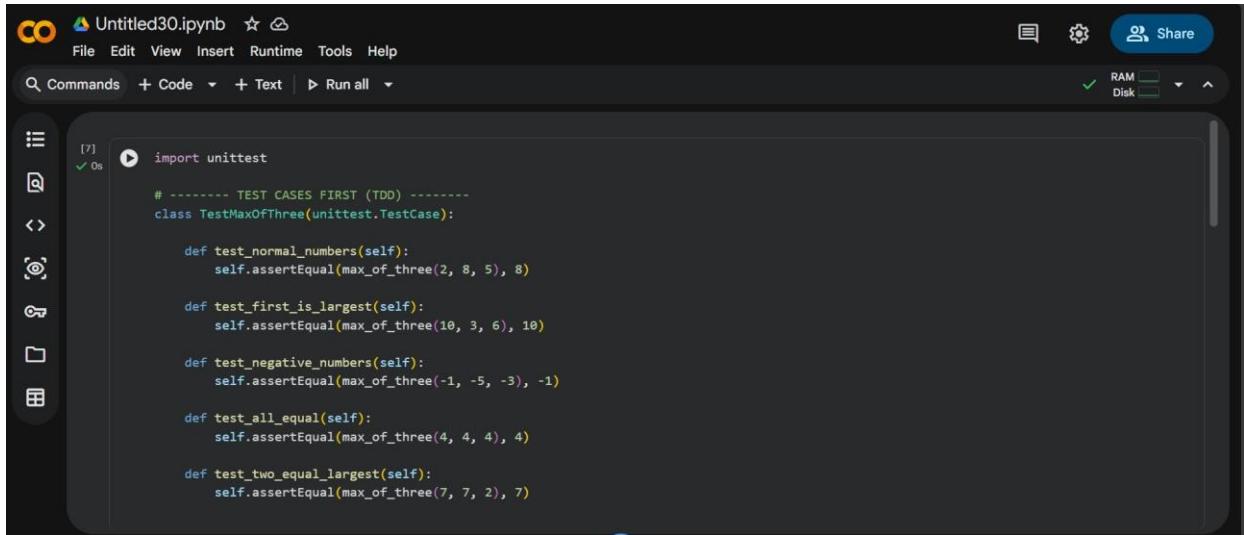
Avoid writing any logic before test cases are completed.

#### Expected Outcome

- Comprehensive test cases covering normal and edge cases
- AI-generated function implementation
- Passing test results demonstrating correctness

- Evidence that logic was derived from tests, not assumptions

Code:



```
[7]  import unittest
# ----- TEST CASES FIRST (TDD) -----
class TestMaxOfThree(unittest.TestCase):

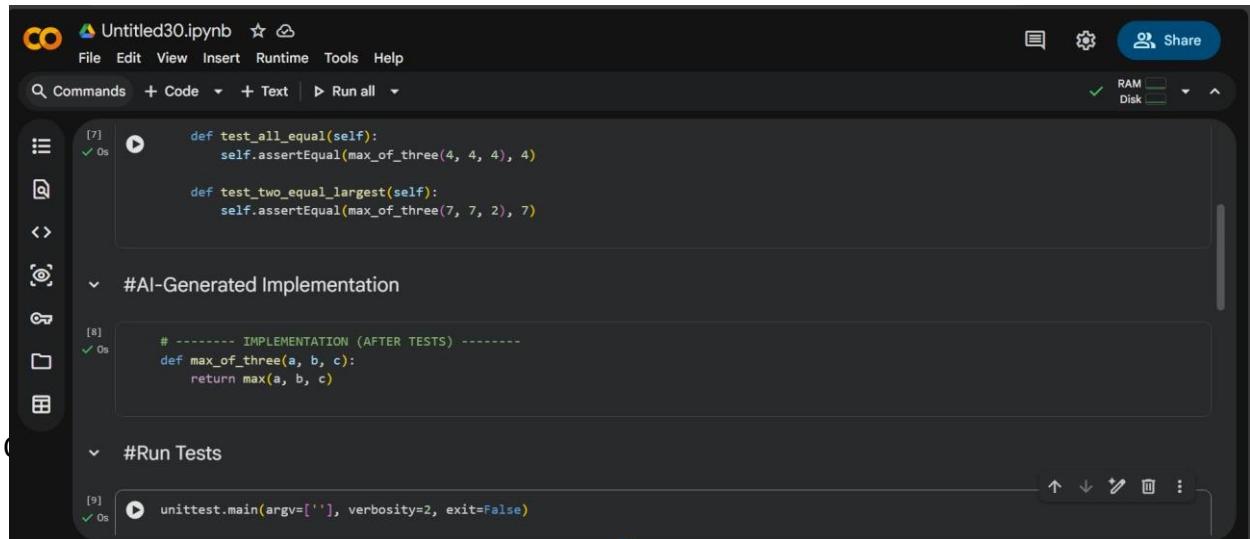
    def test_normal_numbers(self):
        self.assertEqual(max_of_three(2, 8, 5), 8)

    def test_first_is_largest(self):
        self.assertEqual(max_of_three(10, 3, 6), 10)

    def test_negative_numbers(self):
        self.assertEqual(max_of_three(-1, -5, -3), -1)

    def test_all_equal(self):
        self.assertEqual(max_of_three(4, 4, 4), 4)

    def test_two_equal_largest(self):
        self.assertEqual(max_of_three(7, 7, 2), 7)
```



```
[7]  def test_all_equal(self):
        self.assertEqual(max_of_three(4, 4, 4), 4)

    def test_two_equal_largest(self):
        self.assertEqual(max_of_three(7, 7, 2), 7)

#AI-Generated Implementation

[8]  # ----- IMPLEMENTATION (AFTER TESTS) -----
def max_of_three(a, b, c):
    return max(a, b, c)

#Run Tests

[9]  unittest.main(argv=[''], verbosity=2, exit=False)
```

```
File Edit View Insert Runtime Tools Help
Commands + Code + Text Run all

test_email_with_numbers (_main_.TestEmailValidation.test_email_with_numbers) ... ok
test_invalid_structure (_main_.TestEmailValidation.test_invalid_structure) ... ok
test_missing_at_symbol (_main_.TestEmailValidation.test_missing_at_symbol) ... ok
test_missing_domain (_main_.TestEmailValidation.test_missing_domain) ... ok
test_missing_username (_main_.TestEmailValidation.test_missing_username) ... ok
test_valid_email (_main_.TestEmailValidation.test_valid_email) ... ok
test_all_equal (_main_.TestMaxOfThree.test_all_equal) ... ok
test_first_is_largest (_main_.TestMaxOfThree.test_first_is_largest) ... ok
test_negative_numbers (_main_.TestMaxOfThree.test_negative_numbers) ... ok
test_normal_numbers (_main_.TestMaxOfThree.test_normal_numbers) ... ok
test_two_equal_largest (_main_.TestMaxOfThree.test_two_equal_largest) ... ok
test_large_number (_main_.TestSquareFunction.test_large_number) ... ok
test_negative_number (_main_.TestSquareFunction.test_negative_number) ... ok
test_positive_number (_main_.TestSquareFunction.test_positive_number) ... ok
test_zero (_main_.TestSquareFunction.test_zero) ... ok

Ran 15 tests in 0.033s
OK
<unittest.main.TestProgram at 0x7e0211f2d0a0>
```

## Task 4: Shopping Cart Development with AI-Assisted TDD

### Scenario

You are building a simple shopping cart module for an e-commerce application.

The cart must support adding items, removing items, and calculating the total price accurately.

### Task Description

Follow a test-driven approach:

1. Write unit tests for each required behavior:

- o Adding an item

- o Removing an item

- o Calculating the total price

2. After defining all tests, use AI tools to generate the ShoppingCart class and its methods so that the tests pass.

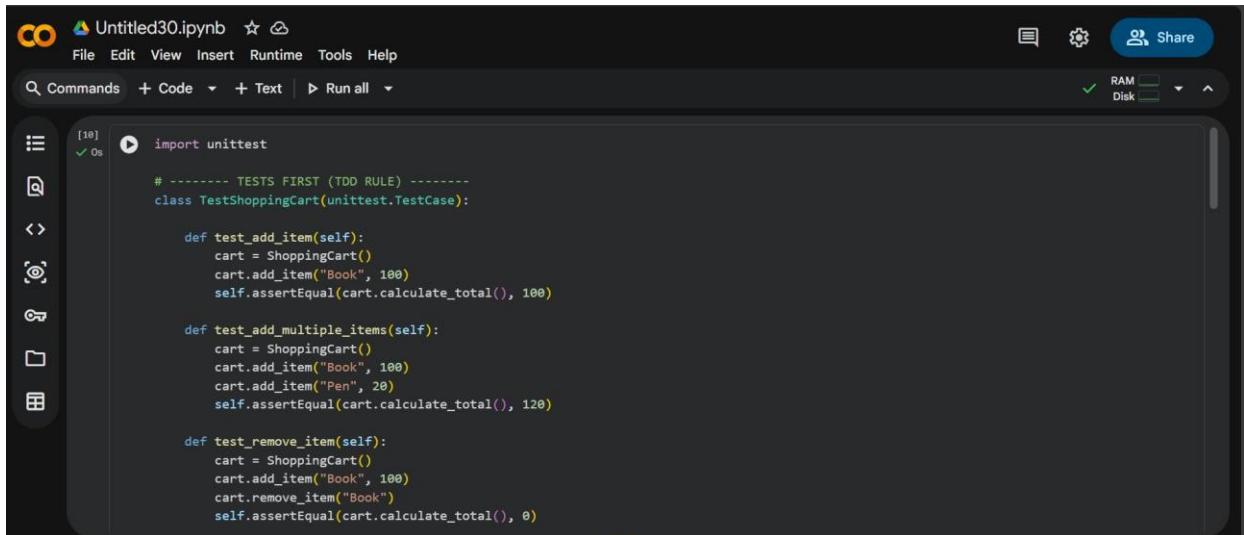
Focus on behavior-driven testing rather than implementation details. Expected

### Outcome

- Unit tests defining expected shopping cart behavior

- AI-generated class implementation
- All tests passing successfully
- Clear demonstration of TDD applied to a class-based design

Code:



```
[10] Untitled30.ipynb
File Edit View Insert Runtime Tools Help
Commands + Code + Text Run all
import unittest

# ----- TESTS FIRST (TDD RULE) -----
class TestShoppingCart(unittest.TestCase):

    def test_add_item(self):
        cart = ShoppingCart()
        cart.add_item("Book", 100)
        self.assertEqual(cart.calculate_total(), 100)

    def test_add_multiple_items(self):
        cart = ShoppingCart()
        cart.add_item("Book", 100)
        cart.add_item("Pen", 20)
        self.assertEqual(cart.calculate_total(), 120)

    def test_remove_item(self):
        cart = ShoppingCart()
        cart.add_item("Book", 100)
        cart.remove_item("Book")
        self.assertEqual(cart.calculate_total(), 0)
```



```
[11] Untitled30.ipynb
File Edit View Insert Runtime Tools Help
Commands + Code + Text Run all
#AI-Generated Implementation

# ----- IMPLEMENTATION AFTER TESTS -----
class ShoppingCart:

    def __init__(self):
        self.items = {}

    def add_item(self, name, price):
        self.items[name] = price

    def remove_item(self, name):
        if name in self.items:
            del self.items[name]

    def calculate_total(self):
        return sum(self.items.values())
```

The screenshot shows a Google Colab notebook titled "Untitled30.ipynb". The code cell [11] contains the following Python code:

```
class ShoppingCart:
    def __init__(self):
        self.items = {}

    def add_item(self, name, price):
        self.items[name] = price

    def remove_item(self, name):
        if name in self.items:
            del self.items[name]

    def calculate_total(self):
        return sum(self.items.values())
```

Below the code cell, there is a section titled "#Run Tests". The code cell [12] contains the following command:

```
unittest.main(argv=[''], verbosity=2, exit=False)
```

Output:

The screenshot shows the output of the unittest run from the previous code cell. The output is as follows:

```
test_invalid_structure (_main_.TestEmailValidation.test_invalid_structure) ... ok
test_missing_at_symbol (_main_.TestEmailValidation.test_missing_at_symbol) ... ok
test_missing_domain (_main_.TestEmailValidation.test_missing_domain) ... ok
test_missing_username (_main_.TestEmailValidation.test_missing_username) ... ok
test_valid_email (_main_.TestEmailValidation.test_valid_email) ... ok
test_all_equal (_main_.TestMaxOfThree.test_all_equal) ... ok
test_first_is_largest (_main_.TestMaxOfThree.test_first_is_largest) ... ok
test_negative_numbers (_main_.TestMaxOfThree.test_negative_numbers) ... ok
test_normal_numbers (_main_.TestMaxOfThree.test_normal_numbers) ... ok
test_two_equal_largest (_main_.TestMaxOfThree.test_two_equal_largest) ... ok
test_add_item (_main_.TestShoppingCart.test_add_item) ... ok
test_add_multiple_items (_main_.TestShoppingCart.test_add_multiple_items) ... ok
test_remove_item (_main_.TestShoppingCart.test_remove_item) ... ok
test_remove_non_existing_item (_main_.TestShoppingCart.test_remove_non_existing_item) ... ok
test_large_number (_main_.TestSquareFunction.test_large_number) ... ok
test_negative_number (_main_.TestSquareFunction.test_negative_number) ... ok
test_positive_number (_main_.TestSquareFunction.test_positive_number) ... ok
test_zero (_main_.TestSquareFunction.test_zero) ... ok

-----
Ran 19 tests in 0.029s
OK
<unittest.main.TestProgram at 0x7e0211f2d700>
```

## Task 5: String Validation Module Using TDD

### Scenario

You are working on a text-processing module where a function is required to identify whether a given string is a palindrome. The function must handle different cases and inputs reliably.

## Task Description

Using Test Driven Development:

1. Write test cases for a palindrome checker covering:

- o Simple palindromes
- o Non-palindromes
- o Case variations

2. Use GitHub Copilot or Cursor AI to generate the `is_palindrome()`

function based on the test case expectations.

The function should be implemented only after tests are written. Expected

Outcome

- Clearly written test cases defining expected behavior
- AI-assisted implementation of the palindrome checker
- All test cases passing successfully
- Evidence of TDD methodology applied correctly

Code:

A screenshot of a Jupyter Notebook cell. The cell number is [13]. The code imports unittest and defines a TestPalindrome class with several test methods: test\_simple\_palindrome, test\_not\_palindrome, test\_case\_insensitive, test\_with\_spaces, and test\_single\_character. Each method uses self.assertTrue or self.assertFalse to check if the is\_palindrome function returns the expected result.

```
import unittest

# ----- TEST CASES FIRST (TDD) -----
class TestPalindrome(unittest.TestCase):

    def test_simple_palindrome(self):
        self.assertTrue(is_palindrome("madam"))

    def test_not_palindrome(self):
        self.assertFalse(is_palindrome("hello"))

    def test_case_insensitive(self):
        self.assertTrue(is_palindrome("Madam"))

    def test_with_spaces(self):
        self.assertTrue(is_palindrome("nurses run"))

    def test_single_character(self):
        self.assertTrue(is_palindrome("a"))
```

A screenshot of a Jupyter Notebook cell. The cell number is [13]. It shows the same test code as the previous screenshot. Below it, under the heading "#AI Implemented Code", is cell [14] with the number 0s. The code defines an is\_palindrome function that replaces spaces with nothing and converts the string to lowercase before checking if it's equal to its reverse. Cell [15] with the number 0s contains the command unittest.main(argv=[''], verbosity=2, exit=False) to run the tests.

```
seir.assertTrue(is_palindrome("nurses run"))

def test_single_character(self):
    self.assertTrue(is_palindrome("a"))

#AI Implemented Code

# ----- IMPLEMENTATION AFTER TESTS -----
def is_palindrome(s):
    s = s.replace(" ", "").lower()
    return s == s[::-1]

#Run Tests

unittest.main(argv=[''], verbosity=2, exit=False)
```

Output:

A screenshot of a terminal window showing the results of a Python unittest run. The terminal has a dark theme with light-colored text. At the top, there are tabs for 'Commands', '+ Code', '+ Text', and 'Run all'. On the right side, there are icons for RAM (green checkmark) and Disk (grey). The main area of the terminal displays the following output:

```
test_all_equal (__main__.TestMaxOfThree.test_all_equal) ... ok
test_first_is_largest (__main__.TestMaxOfThree.test_first_is_largest) ... ok
test_negative_numbers (__main__.TestMaxOfThree.test_negative_numbers) ... ok
test_normal_numbers (__main__.TestMaxOfThree.test_normal_numbers) ... ok
test_two_equal_largest (__main__.TestMaxOfThree.test_two_equal_largest) ... ok
test_case_insensitive (__main__.TestPalindrome.test_case_insensitive) ... ok
test_not_palindrome (__main__.TestPalindrome.test_not_palindrome) ... ok
test_simple_palindrome (__main__.TestPalindrome.test_simple_palindrome) ... ok
test_single_character (__main__.TestPalindrome.test_single_character) ... ok
test_with_spaces (__main__.TestPalindrome.test_with_spaces) ... ok
test_add_item (__main__.Test ShoppingCart.test_add_item) ... ok
test_add_multiple_items (__main__.Test ShoppingCart.test_add_multiple_items) ... ok
test_remove_item (__main__.Test ShoppingCart.test_remove_item) ... ok
test_remove_non_existing_item (__main__.Test ShoppingCart.test_remove_non_existing_item) ... ok
test_large_number (__main__.Test SquareFunction.test_large_number) ... ok
test_negative_number (__main__.Test SquareFunction.test_negative_number) ... ok
test_positive_number (__main__.Test SquareFunction.test_positive_number) ... ok
test_zero (__main__.Test SquareFunction.test_zero) ... ok

-----
Ran 24 tests in 0.032s
OK
<unittest.main.TestProgram at 0x7e0211f3cc86>
```