

Assignment 8.4 Ai Assisted Coding

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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:

The image displays two sequential screenshots of a Google Colab notebook titled 'Untitled30.ipynb'. The browser address bar shows the URL: https://colab.research.google.com/drive/18FWbv8LJlvCTXqsvYyNt7zYXoSnKhINR#scrollTo=cO1kcN_N8cWL.

Top Screenshot: The notebook contains two code cells. Cell [1] defines a class `TestSquareFunction` with four test methods: `test_positive_number`, `test_negative_number`, `test_zero`, and `test_large_number`. Cell [2] defines the `square` function. The status bar at the bottom indicates 'Python 3' and the time '9:40 AM'.

```
[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
```

Bottom Screenshot: The notebook has been updated with a third code cell. Cell [3] adds `unittest.main` to run the tests. The status bar remains the same.

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

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

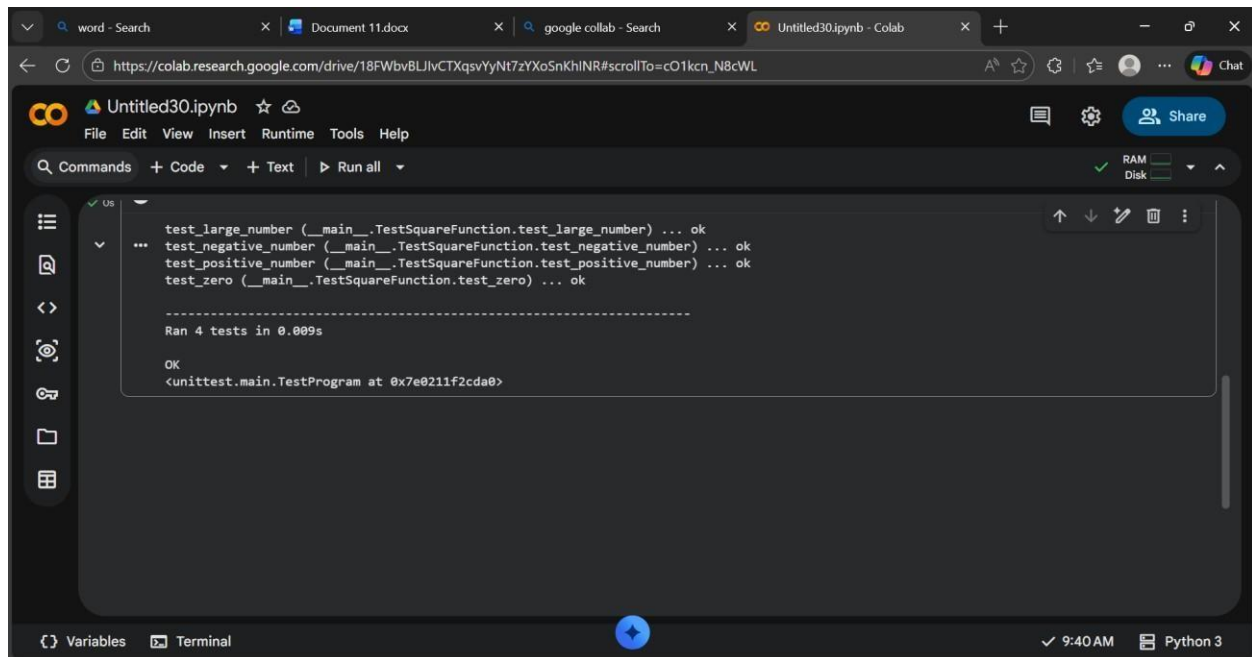
    def test_zero(self):
        self.assertEqual(square(0), 0)

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

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

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

Output:

A screenshot of a Google Colab notebook interface. The browser tabs at the top include 'word - Search', 'Document 11.docx', 'google colab - Search', and 'Untitled30.ipynb - Colab'. The notebook's address bar shows a URL from 'https://colab.research.google.com'. The notebook title is 'Untitled30.ipynb'. The menu bar includes 'File', 'Edit', 'View', 'Insert', 'Runtime', 'Tools', and 'Help'. Below the menu is a toolbar with 'Commands', '+ Code', '+ Text', and 'Run all'. The main code cell contains a Python script using unittest to test a 'TestSquareFunction' with four methods: 'test_large_number', 'test_negative_number', 'test_positive_number', and 'test_zero'. All tests pass, indicated by '... ok'. The output shows 'Ran 4 tests in 0.009s' and 'OK'. The bottom status bar indicates 'Variables', 'Terminal', '9:40 AM', and 'Python 3'.

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:

The image displays two screenshots of a Google Colab notebook, illustrating the process of writing test cases and then implementing a function to pass them.

Top Screenshot: The notebook is titled "Untitled30.ipynb". The code cell [4] contains the following Python 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"))
```

The bottom status bar shows "9:46 AM" and "Python 3".

Bottom Screenshot: The notebook is still titled "Untitled30.ipynb". The code cell [5] contains the following Python code:

```
import re

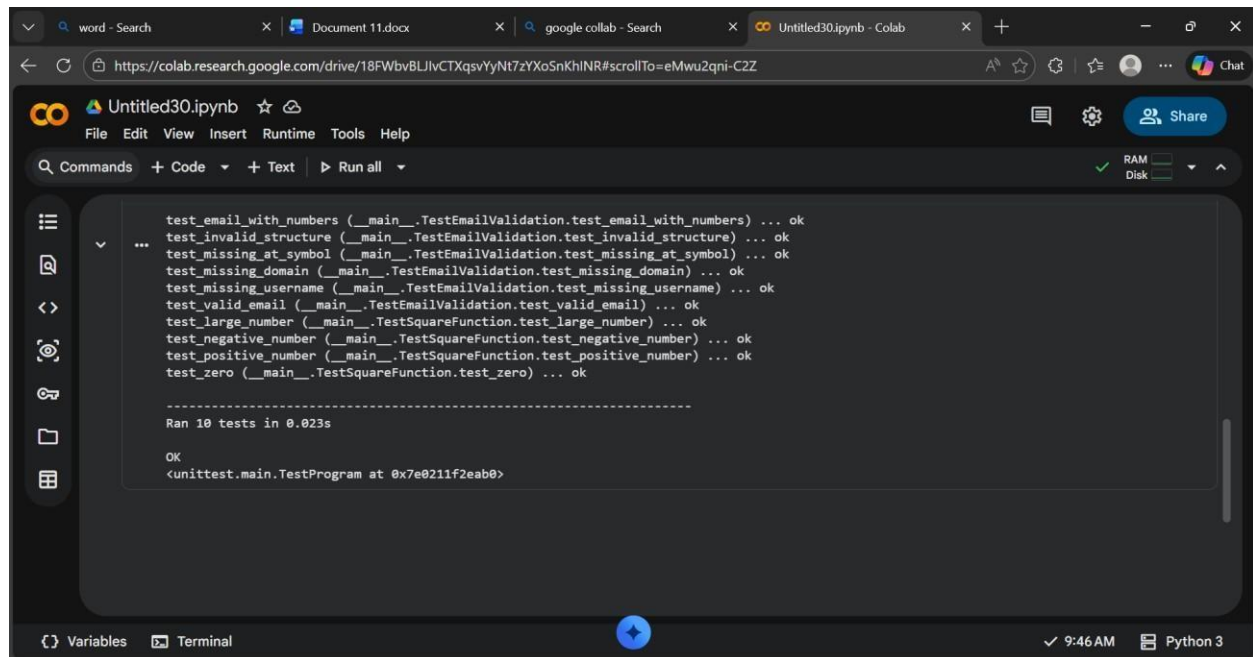
# ----- IMPLEMENTATION (AFTER TESTS) -----
def validate_email(email):
    pattern = r'^[A-Za-z0-9._%+-]+@[A-Za-z0-9.-]+\.[A-Za-z]{2,}$'
    return re.match(pattern, email) is not None
```

Below the implementation, there is a section titled "#Run Tests" with code cell [6] containing:

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

The bottom status bar shows "9:46 AM" and "Python 3".

Output:



The screenshot shows a Google Colab notebook titled 'Untitled30.ipynb'. The code cell contains a series of test cases for email validation and a square function. The output shows that all 10 tests passed successfully. The tests include: test_email_with_numbers, test_invalid_structure, test_missing_at_symbol, test_missing_domain, test_missing_username, test_valid_email, test_large_number, test_negative_number, test_positive_number, and test_zero. The output also indicates that 10 tests were run in 0.023 seconds and that the tests were executed using unittest.main.TestProgram.

```
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 0x7e0211f2eab0>
```

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:

The image consists of two screenshots of a Google Colab notebook, illustrating a Test-Driven Development (TDD) workflow.

Top Screenshot: The notebook shows the initial test cases. The code is as follows:

```
[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)
```

Bottom Screenshot: The notebook shows the implementation added after the tests. The code is as follows:

```
[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)

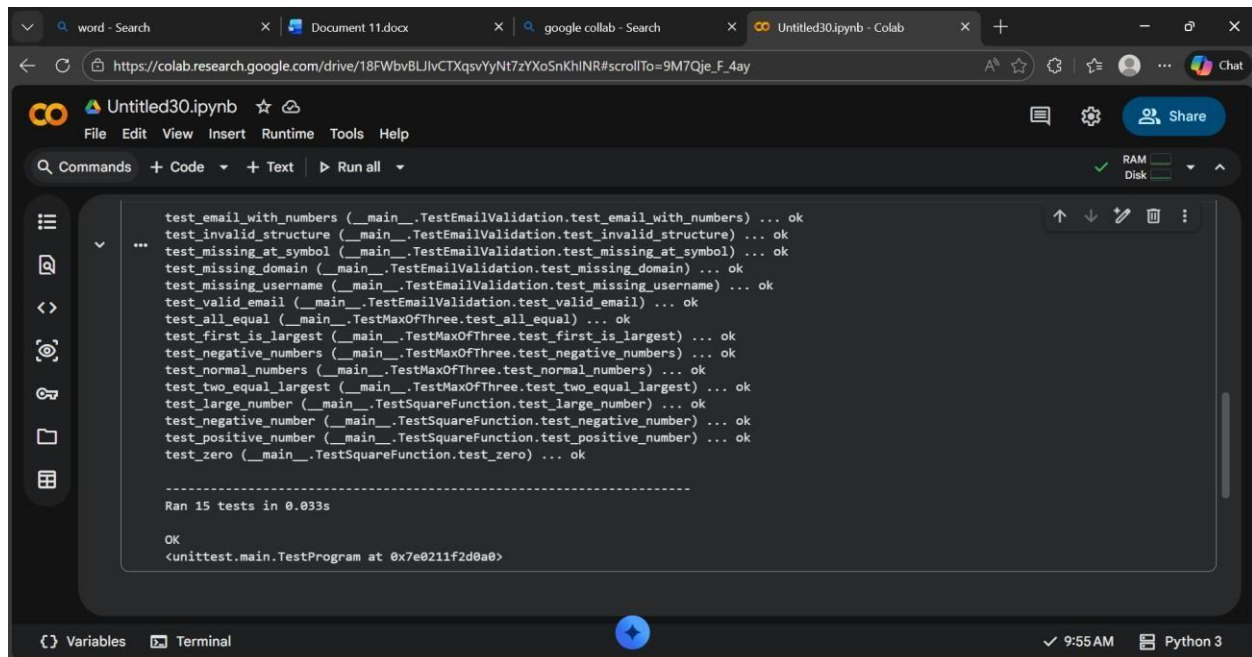
# AI-Generated Implementation

[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)
```

Output:



The screenshot shows a Google Colab notebook titled 'Untitled30.ipynb'. The notebook contains 15 unit tests that have all passed successfully. The tests are organized into three groups: email validation, a 'TestMaxOfThree' class, and a 'TestSquareFunction' class. The output shows 'Ran 15 tests in 0.033s' and 'OK'.

```
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:

The image displays two screenshots of a Google Colab notebook titled 'Untitled30.ipynb', illustrating the Test-Driven Development (TDD) process for a class-based design.

Top Screenshot: The notebook shows a code cell with the following Python code:

```
[10] 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)
```

The code cell is executed, and the output shows the tests passing successfully. The status bar at the bottom indicates '9:58 AM' and 'Python 3'.

Bottom Screenshot: The notebook shows a code cell with the following Python code, titled '#AI-Generated Implementation':

```
[11] # ----- 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 code cell is executed, and the output shows the implementation passing the tests. The status bar at the bottom indicates '9:58 AM' and 'Python 3'.

The screenshot shows a Google Colab notebook titled 'Untitled30.ipynb'. The code defines a `ShoppingCart` class with methods `__init__`, `add_item`, `remove_item`, and `calculate_total`. Below the class definition, there is a section for running tests using `unittest`. A 'Snipping Tool' notification is visible on the right side of the screen.

```
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())

#Run Tests

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

Output:

The screenshot shows the output of the test runner from the previous notebook. It lists 19 tests that all passed, including tests for email validation, shopping cart operations, and square function calculations. The output concludes with 'Ran 19 tests in 0.029s' and '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_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:

The image displays two sequential screenshots of a Google Colab notebook titled "Untitled30.ipynb".

Top Screenshot: Shows the initial code in cell [13]. It imports `unittest` and defines a `TestPalindrome` class with five test methods: `test_simple_palindrome`, `test_not_palindrome`, `test_case_insensitive`, `test_with_spaces`, and `test_single_character`. The code is as follows:

```
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"))
```

Bottom Screenshot: Shows the notebook after adding an implementation and running tests. Cell [14] contains the `is_palindrome` function implementation:

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

Cell [15] runs the tests using `unittest.main`:

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

The interface includes a left sidebar with navigation icons, a top menu bar (File, Edit, View, Insert, Runtime, Tools, Help), and a bottom status bar showing "Python 3" and the time "10:05 AM".

Output:

word - Search x Document 11.docx x google colab - Search x Untitled30.ipynb - Colab x

https://colab.research.google.com/drive/18FWbvBLJlvCTXqsvYyNt7zYXoSnKhINR#scrollTo=LpQRy_SmCH9E

Untitled30.ipynb ☆ Saving...

File Edit View Insert Runtime Tools Help

Commands + Code + Text ▶ Run all

RAM Disk

```
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__.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 24 tests in 0.032s

OK
<unittest.main.TestProgram at 0x7e0211f3cc80>
```

Variables Terminal

✓ 10:05 AM Python 3