INTRODUCTION

Objectives and Requirements:

This report provides the documentation of the Test-Driven Development (TDD) approach to implement a Hangman Game, which meets the following requirements:

Two Difficulty Levels:

There are two difficulty levels: Basic and Intermediate. The Basic level contains single words, the Intermediate Level contains multi-word phrases, and the words and phrases are generated randomly.

Validation of Dictionary:

All the words and phrases come from the valid dictionary files (dictionary.txt and phrases.txt)

Presentation of missing letters:

Presentation of underscores for the missing letters to be guessed.

Timed Input:

15-second timer per guess with automatic life deduction on timeout.

Revelation of letters:

A correct guess from the user reveals the correct instance of the letter throughout the word or phrase.

Life Deduction:

Wrong guesses from the user deduct the player's life.

Condition of Win:

The player must find all the missing words before the player's life becomes zero.

Control of Flow of the Game:

The game will continue until a win, a loss, or a manual quit.

Automated Unit Testing Tool

The Unittest was chosen for automated unit testing because of the following reasons:

Built-in Framework: Unittest, the standard library for Python, is readily available, compatible with several Python environments, and doesn't require any further installations.

Simple and familiar syntax: Test cases are defined as classes that inherit from Unittest in the class-based methodology used by the Unittest framework.Most developers are accustomed to using TestCase.

Assertion Techniques: Assertion methods such as assertEqual, assertIn, assertTrue help to compare the expected and actual results.

Test Discovery: The Automated test discovery feature of the Unittest framework makes it possible to find and run every test case in a directory or module.

Extensibility: The Unittest framework is designed to be expanded. Developers can create their own Testcase to add features or change existing methods.

IDE Integration: Unittest works combined with Python IDEs and code editors and also provides visual results for tests and debugging features that improve the developer performance.
Clear Reporting: The Unittest framework generates test reports in detail with clear success and failure messages, making debugging and identifying the issues in an efficient way.

PROCESS

Test-Driven Development Methodology

The implementation of this game strictly followed the Test-Driven Development (TDD) Approach using Red-Green-Refactor cycle:

Red Phase:

Before any implementation of code logic, I wrote failing tests for each and every requirement.

Green Phase:

Implemented the code or functionality to make the tests pass.

Refactor phase:

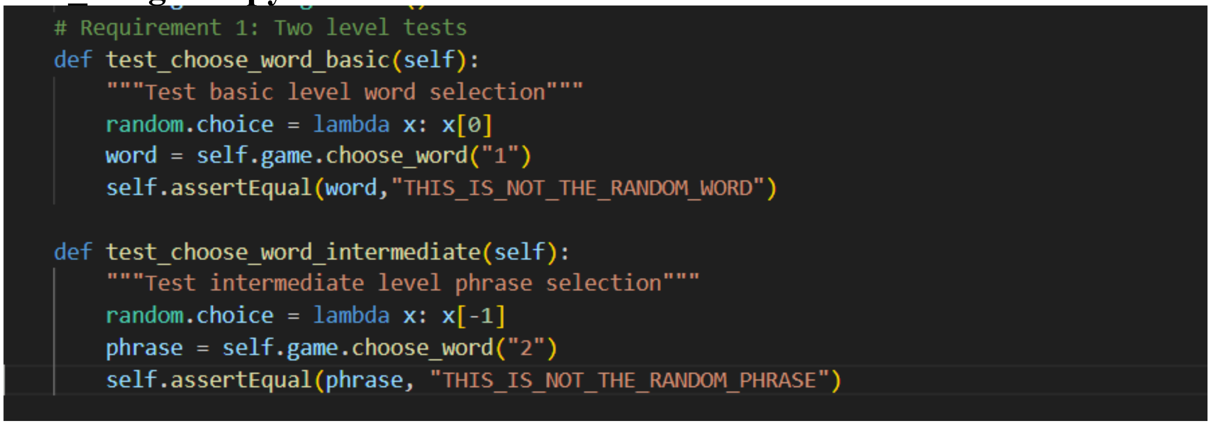
The quality of code was improved while maintaining all tests passing.

Requirement Implementation with evidence:

Requirement 1: Two difficulty levels

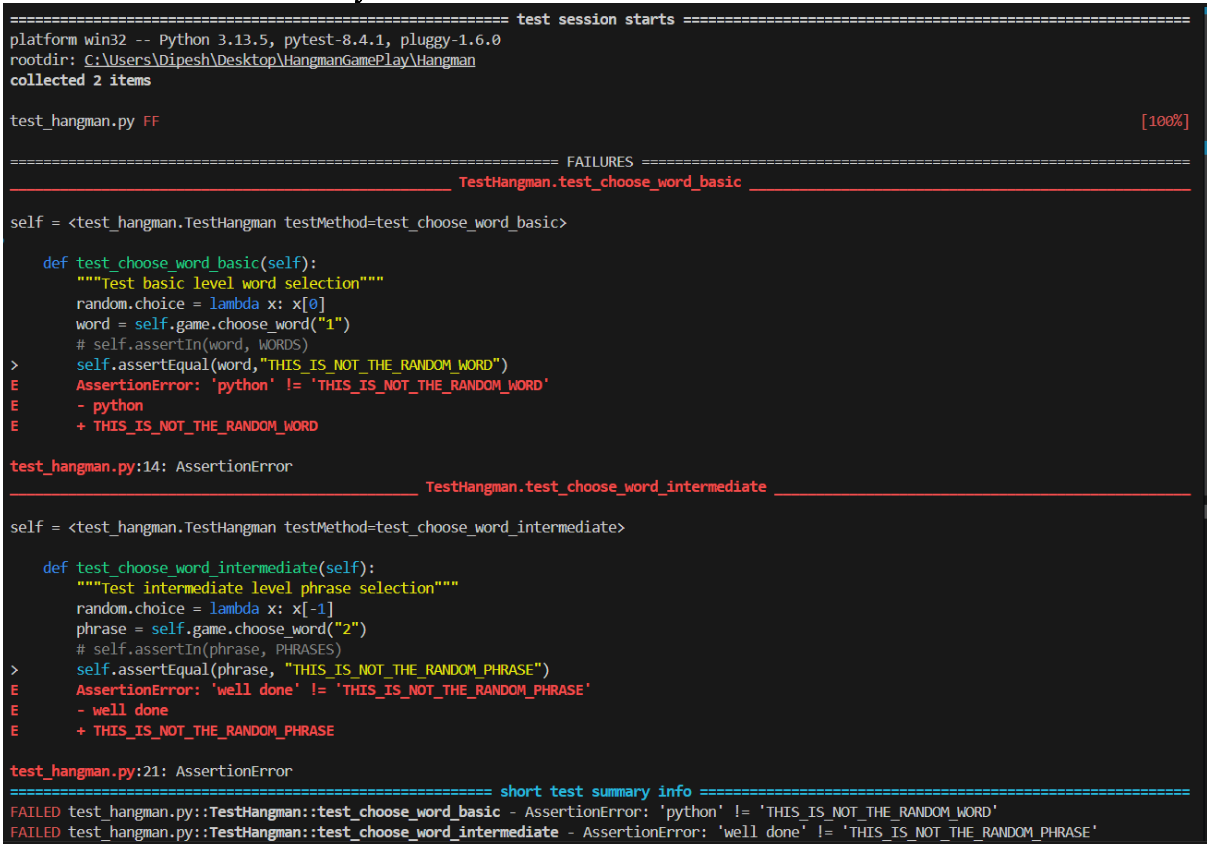
TDD Approach: Tests were written to verify that selection of level returns appropriate result from the correct dictionaries.

Test_hangman.py Code:



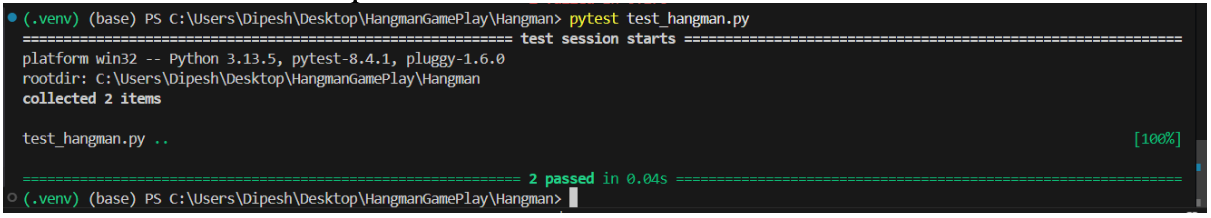
```python
    # Requirement 1: Two level tests
    def test_choose_word_basic(self):
        """Test basic level word selection"""
        random.choice = lambda x: x[0]
        word = self.game.choose_word("1")
        self.assertEqual(word,"THIS_IS_NOT_THE_RANDOM_WORD")

    def test_choose_word_intermediate(self):
        """Test intermediate level phrase selection"""
        random.choice = lambda x: x[-1]
        phrase = self.game.choose_word("2")
        self.assertEqual(phrase, "THIS_IS_NOT_THE_RANDOM_PHRASE")
```

Test failure for difficulty level selection:



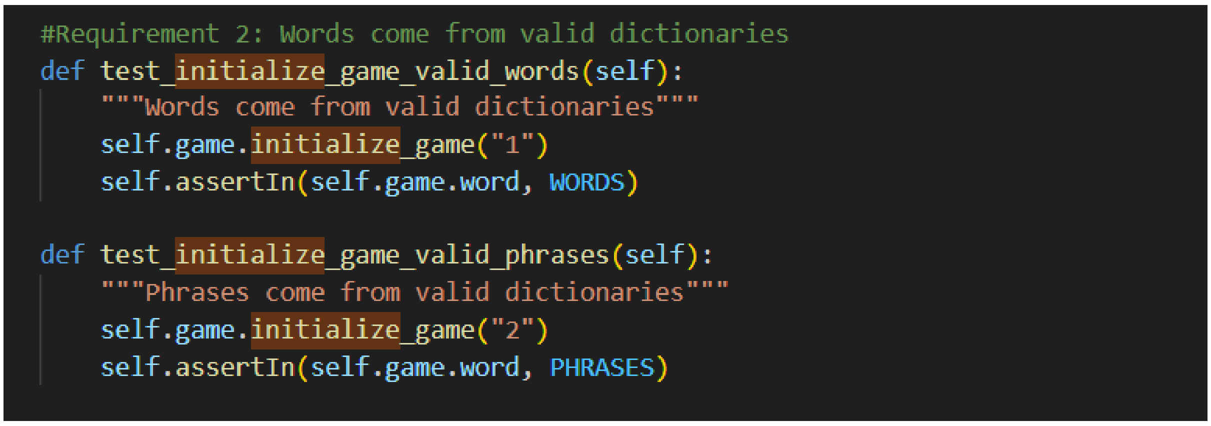
```
============================================================ test session starts ============================================================
platform win32 -- Python 3.13.5, pytest-8.4.1, pluggy-1.6.0
rootdir: C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman
collected 2 items

test_hangman.py FF                                                                                                                     [100%]

================================================================== FAILURES ==================================================================
_____________________________________________________ TestHangman.test_choose_word_basic _____________________________________________________

self = <test_hangman.TestHangman testMethod=test_choose_word_basic>

    def test_choose_word_basic(self):
        """Test basic level word selection"""
        random.choice = lambda x: x[0]
        word = self.game.choose_word("1")
        # self.assertIn(word, WORDS)
>       self.assertEqual(word,"THIS_IS_NOT_THE_RANDOM_WORD")
E       AssertionError: 'python' != 'THIS_IS_NOT_THE_RANDOM_WORD'
E       - python
E       + THIS_IS_NOT_THE_RANDOM_WORD

test_hangman.py:14: AssertionError
_________________________________________________ TestHangman.test_choose_word_intermediate _________________________________________________

self = <test_hangman.TestHangman testMethod=test_choose_word_intermediate>

    def test_choose_word_intermediate(self):
        """Test intermediate level phrase selection"""
        random.choice = lambda x: x[-1]
        phrase = self.game.choose_word("2")
        # self.assertIn(phrase, PHRASES)
>       self.assertEqual(phrase, "THIS_IS_NOT_THE_RANDOM_PHRASE")
E       AssertionError: 'well done' != 'THIS_IS_NOT_THE_RANDOM_PHRASE'
E       - well done
E       + THIS_IS_NOT_THE_RANDOM_PHRASE

test_hangman.py:21: AssertionError
========================================================== short test summary info ==========================================================
FAILED test_hangman.py::TestHangman::test_choose_word_basic - AssertionError: 'python' != 'THIS_IS_NOT_THE_RANDOM_WORD'
FAILED test_hangman.py::TestHangman::test_choose_word_intermediate - AssertionError: 'well done' != 'THIS_IS_NOT_THE_RANDOM_PHRASE'
```

Successful test after implementation of the method:



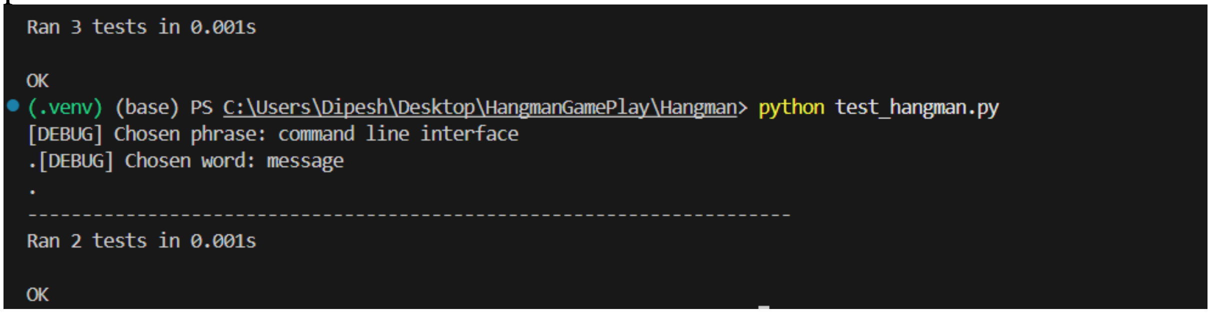
```
● (.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> pytest test_hangman.py
  ============================================================ test session starts ============================================================
  platform win32 -- Python 3.13.5, pytest-8.4.1, pluggy-1.6.0
  rootdir: C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman
  collected 2 items

  test_hangman.py ..                                                                                                                     [100%]

  ============================================================= 2 passed in 0.04s =============================================================
○ (.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman>
```

Requirement 2: Valid Dictionary Words
TDD Approach: Test verifies whether the basic or intermediate words come from predefined dictionaries or not.
Test_hangman.py Code:



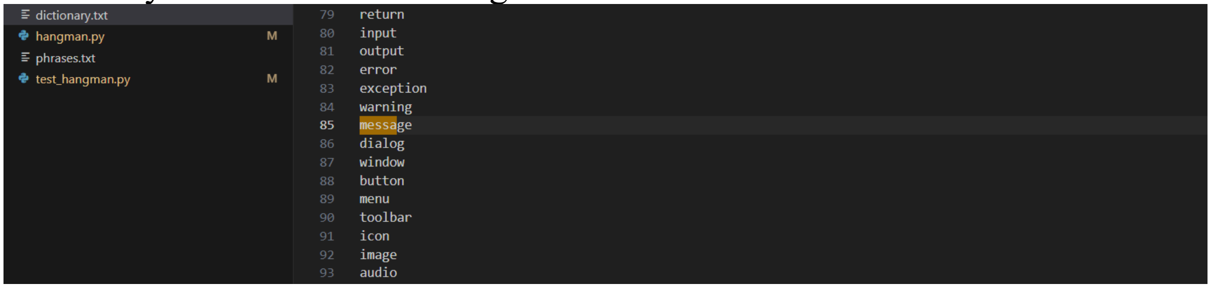
```python
#Requirement 2: Words come from valid dictionaries
def test_initialize_game_valid_words(self):
    """Words come from valid dictionaries"""
    self.game.initialize_game("1")
    self.assertIn(self.game.word, WORDS)

def test_initialize_game_valid_phrases(self):
    """Phrases come from valid dictionaries"""
    self.game.initialize_game("2")
    self.assertIn(self.game.word, PHRASES)
```

Successful Test execution validating that words or phrases come from predefined dictionaries:



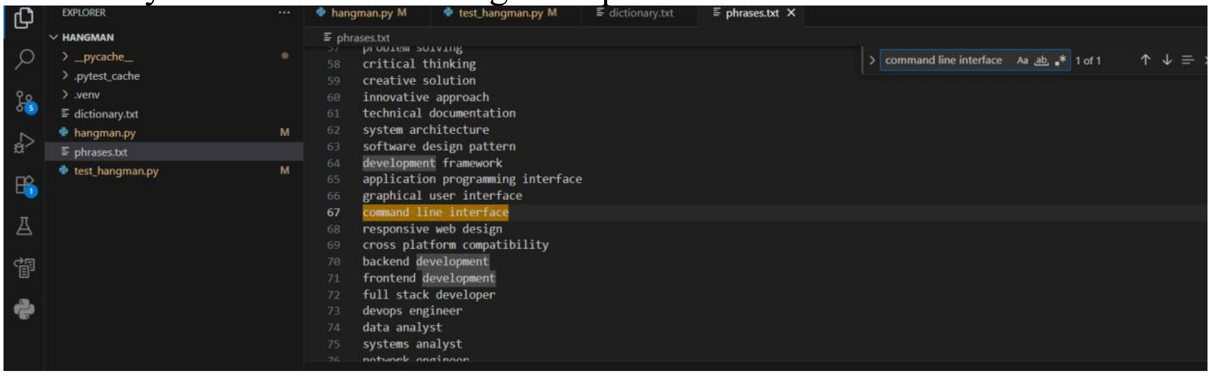
```
Ran 3 tests in 0.001s

OK
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> python test_hangman.py
[DEBUG] Chosen phrase: command line interface
.[DEBUG] Chosen word: message
.
----------------------------------------------------------------------
Ran 2 tests in 0.001s

OK
```

Dictionary file content containing valid words



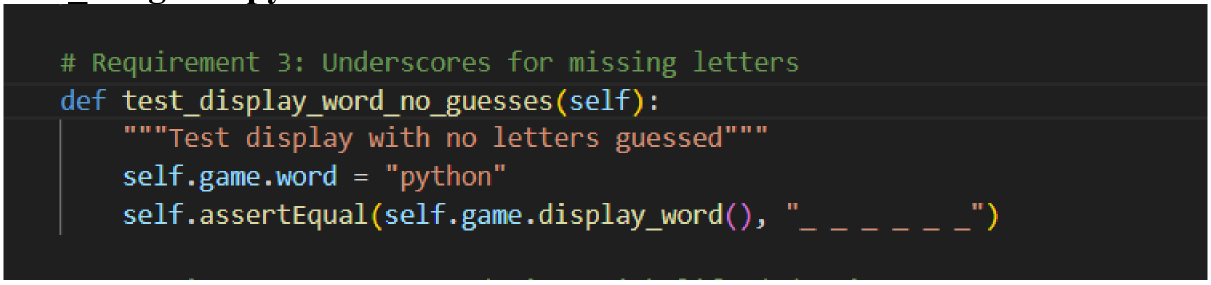
```
return
input
output
error
exception
warning
message
dialog
window
button
menu
toolbar
icon
image
audio
```

Dictionary file content containing valid phrases



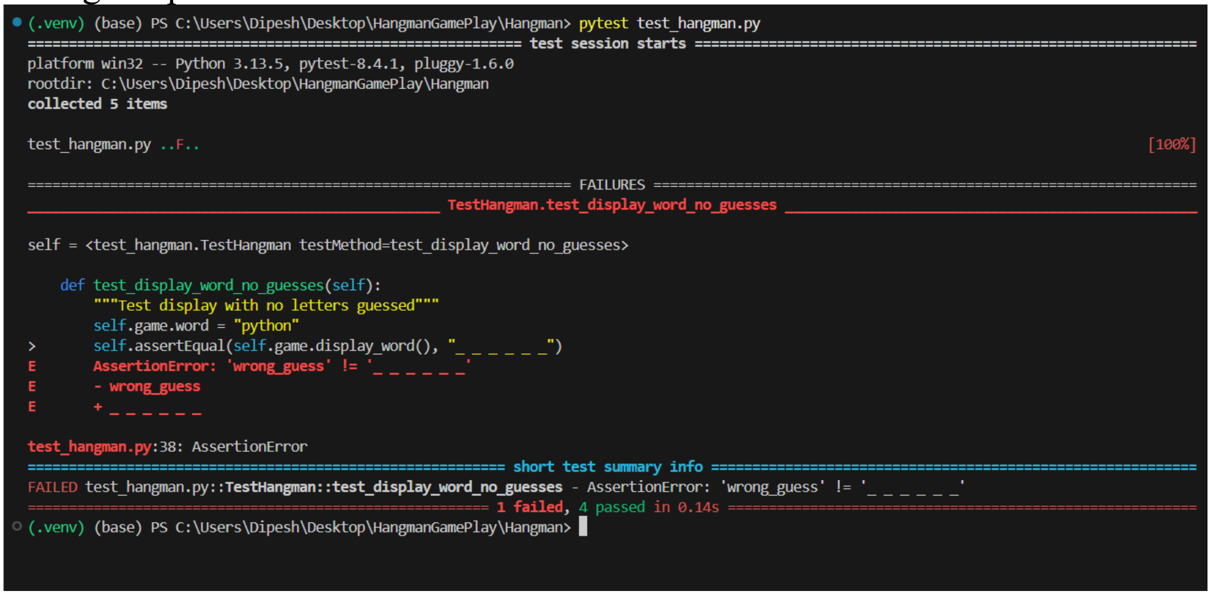
```
problem solving
critical thinking
creative solution
innovative approach
technical documentation
system architecture
software design pattern
development framework
application programming interface
graphical user interface
command line interface
responsive web design
cross platform compatibility
backend development
frontend development
full stack developer
devops engineer
data analyst
systems analyst
network engineer
```

Requirement 3: Displaying underscore for the missing letters
TDD Approach: The test makes sure that unguessed or missing letters are represented as underscores.
Test_hangman.py Code:



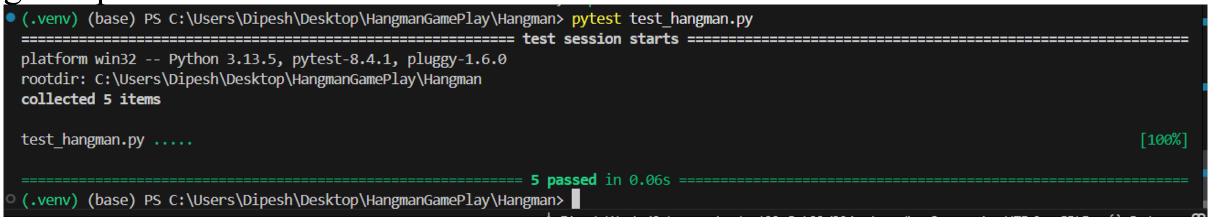
```
# Requirement 3: Underscores for missing letters
def test_display_word_no_guesses(self):
    """Test display with no letters guessed"""
    self.game.word = "python"
    self.assertEqual(self.game.display_word(), "_ _ _ _ _ _")
```

Failure in the execution of Test for displaying underscore for missing letters during red phase:



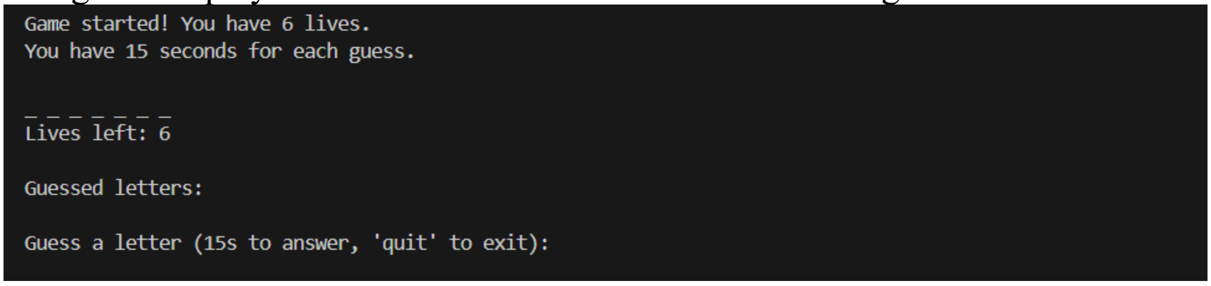
```
● (.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> pytest test_hangman.py
============================================================ test session starts ============================================================
platform win32 -- Python 3.13.5, pytest-8.4.1, pluggy-1.6.0
rootdir: C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman
collected 5 items

test_hangman.py ..F..                                                                                                                  [100%]

================================================================= FAILURES ==================================================================
_______________________________________________ TestHangman.test_display_word_no_guesses ____________________________________________________

self = <test_hangman.TestHangman testMethod=test_display_word_no_guesses>

    def test_display_word_no_guesses(self):
        """Test display with no letters guessed"""
        self.game.word = "python"
>       self.assertEqual(self.game.display_word(), "_ _ _ _ _ _")
E       AssertionError: 'wrong_guess' != '_ _ _ _ _ _'
E       - wrong_guess
E       + _ _ _ _ _ _

test_hangman.py:38: AssertionError
========================================================== short test summary info ==========================================================
FAILED test_hangman.py::TestHangman::test_display_word_no_guesses - AssertionError: 'wrong_guess' != '_ _ _ _ _ _'
======================================================== 1 failed, 4 passed in 0.14s ========================================================
○ (.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> 
```

Successful execution of Test for displaying underscore for missing letters during green phase:



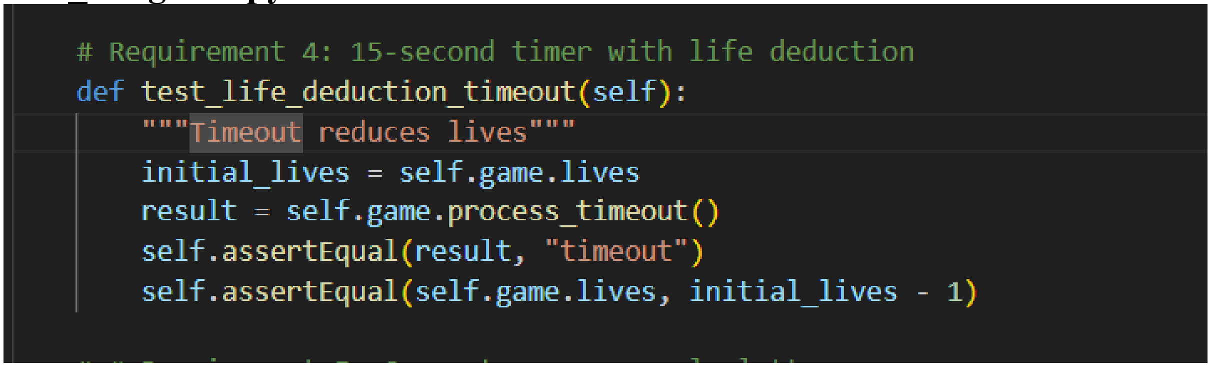
```
● (.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> pytest test_hangman.py
============================================================ test session starts ============================================================
platform win32 -- Python 3.13.5, pytest-8.4.1, pluggy-1.6.0
rootdir: C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman
collected 5 items

test_hangman.py .....                                                                                                                  [100%]

============================================================= 5 passed in 0.06s =============================================================
○ (.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> 
```

The game displays an underscore for letters that are missing:



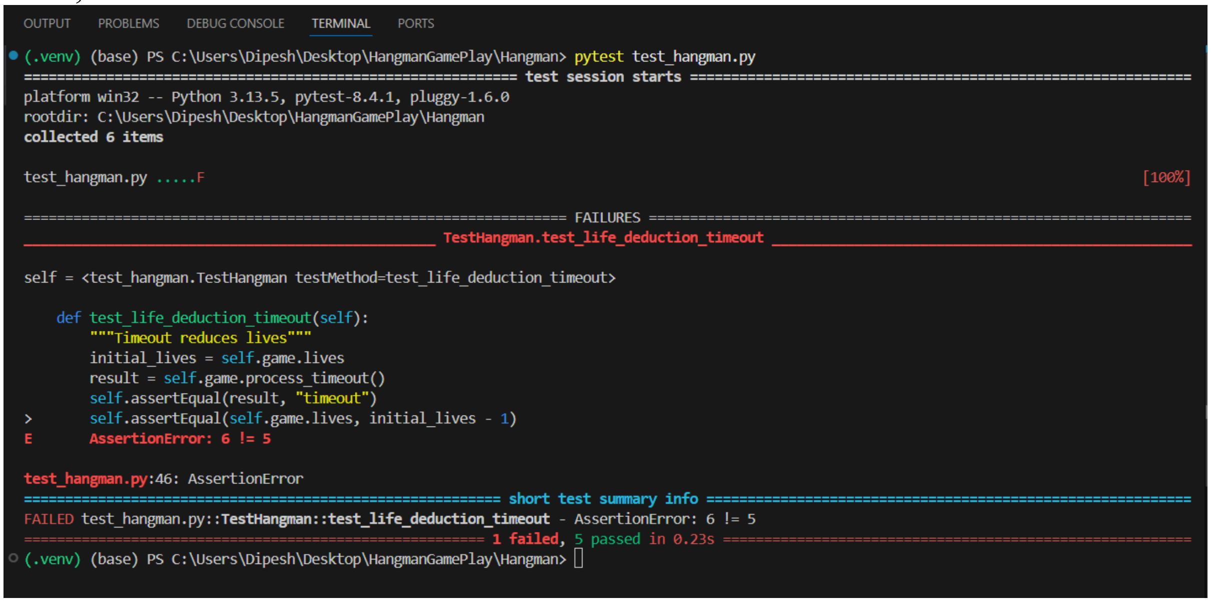
```
Game started! You have 6 lives.
You have 15 seconds for each guess.


_ _ _ _ _ _ _
Lives left: 6

Guessed letters:

Guess a letter (15s to answer, 'quit' to exit):
```

Requirement 4: 15-second countdown timer that deducts life
TDD Approach: This Test makes sure that the timeout functionality reduces the players' lives.
Test_hangman.py Code:



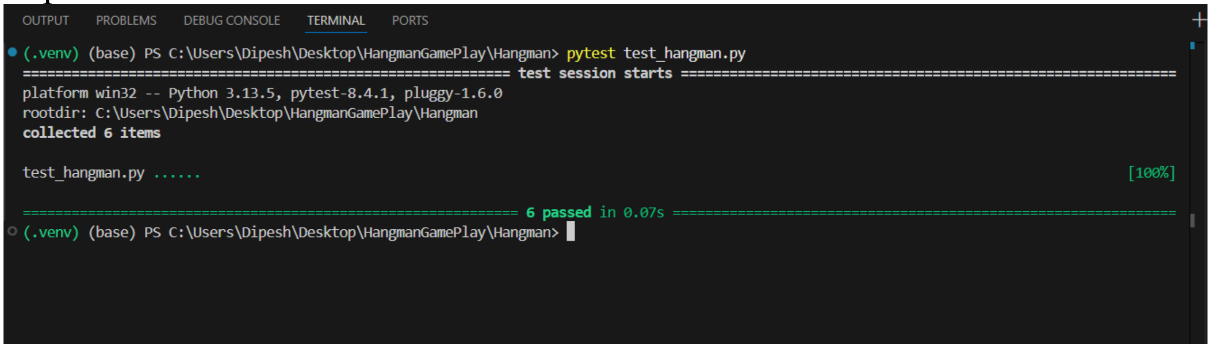
```
    # Requirement 4: 15-second timer with life deduction
    def test_life_deduction_timeout(self):
        """Timeout reduces lives"""
        initial_lives = self.game.lives
        result = self.game.process_timeout()
        self.assertEqual(result, "timeout")
        self.assertEqual(self.game.lives, initial_lives - 1)
```

Due to the lack of implementation of the process_timeout() method to reduce lives, the test first failed with AssertionError: 6!= 5.



```
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> pytest test_hangman.py
============================================================ test session starts =============================================================
platform win32 -- Python 3.13.5, pytest-8.4.1, pluggy-1.6.0
rootdir: C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman
collected 6 items

test_hangman.py .....F                                                                                                                  [100%]

================================================================== FAILURES ==================================================================
__________________________________________________ TestHangman.test_life_deduction_timeout ___________________________________________________

self = <test_hangman.TestHangman testMethod=test_life_deduction_timeout>

    def test_life_deduction_timeout(self):
        """Timeout reduces lives"""
        initial_lives = self.game.lives
        result = self.game.process_timeout()
        self.assertEqual(result, "timeout")
>       self.assertEqual(self.game.lives, initial_lives - 1)
E       AssertionError: 6 != 5

test_hangman.py:46: AssertionError
========================================================== short test summary info ===========================================================
FAILED test_hangman.py::TestHangman::test_life_deduction_timeout - AssertionError: 6 != 5
========================================================= 1 failed, 5 passed in 0.23s ========================================================
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman>
```

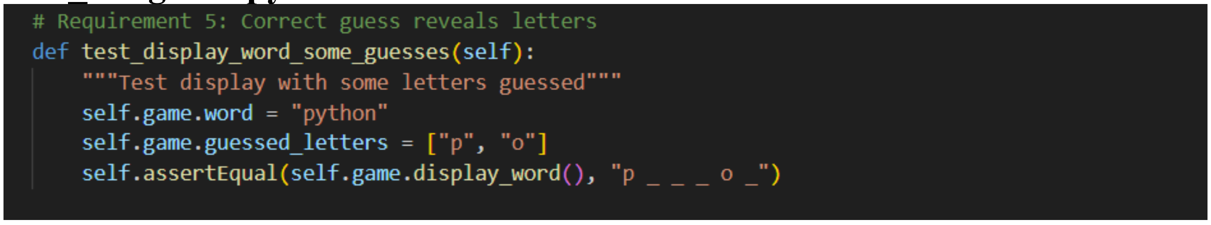
The test was successful after the life deduction logic (self.lives -= 1) was implemented.



```
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> pytest test_hangman.py
============================================================ test session starts ============================================================
platform win32 -- Python 3.13.5, pytest-8.4.1, pluggy-1.6.0
rootdir: C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman
collected 6 items

test_hangman.py ......                                                                                                                 [100%]

============================================================= 6 passed in 0.07s =============================================================
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman>
```

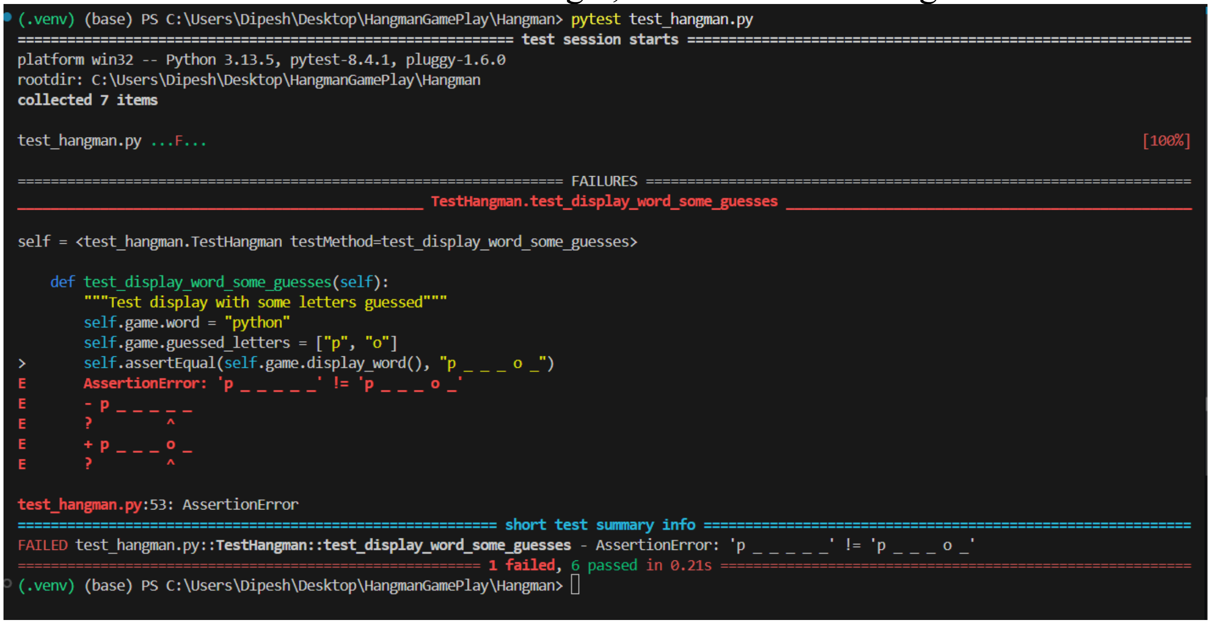
Requirement 5: Revelation of the correctly guessed letter.
TDD Approach: The test confirms that if the player's chosen letter exists in the answer, then all places in the answer where that letter appears will be revealed.

Test_hangman.py Code:



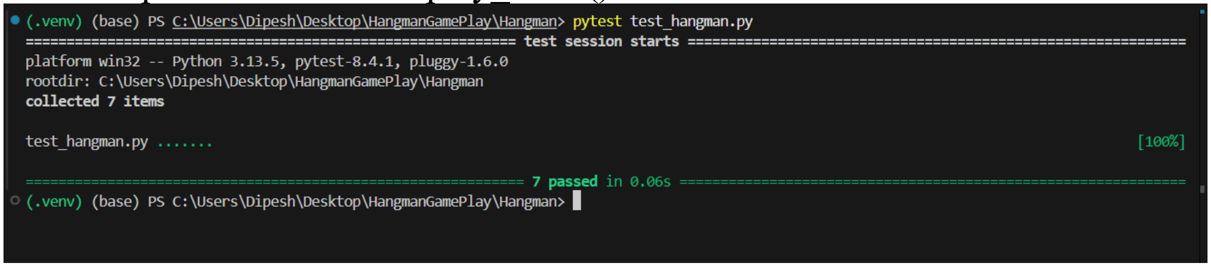
```python
# Requirement 5: Correct guess reveals letters
def test_display_word_some_guesses(self):
    """Test display with some letters guessed"""
    self.game.word = "python"
    self.game.guessed_letters = ["p", "o"]
    self.assertEqual(self.game.display_word(), "p _ _ _ o _")
```

Due to insufficient letter revelation logic, the test failed during the execution.



```
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> pytest test_hangman.py
============================================================ test session starts ============================================================
platform win32 -- Python 3.13.5, pytest-8.4.1, pluggy-1.6.0
rootdir: C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman
collected 7 items

test_hangman.py ...F...                                                                                                              [100%]

================================================================= FAILURES =================================================================
_______________________________________________ TestHangman.test_display_word_some_guesses ________________________________________________

self = <test_hangman.TestHangman testMethod=test_display_word_some_guesses>

    def test_display_word_some_guesses(self):
        """Test display with some letters guessed"""
        self.game.word = "python"
        self.game.guessed_letters = ["p", "o"]
>       self.assertEqual(self.game.display_word(), "p _ _ _ o _")
E       AssertionError: 'p _ _ _ _ _' != 'p _ _ _ o _'
E       - p _ _ _ _ _
E       ?         ^
E       + p _ _ _ o _
E       ?         ^

test_hangman.py:53: AssertionError
========================================================== short test summary info ==========================================================
FAILED test_hangman.py::TestHangman::test_display_word_some_guesses - AssertionError: 'p _ _ _ _ _' != 'p _ _ _ o _'
========================================================= 1 failed, 6 passed in 0.21s =========================================================
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> 
```

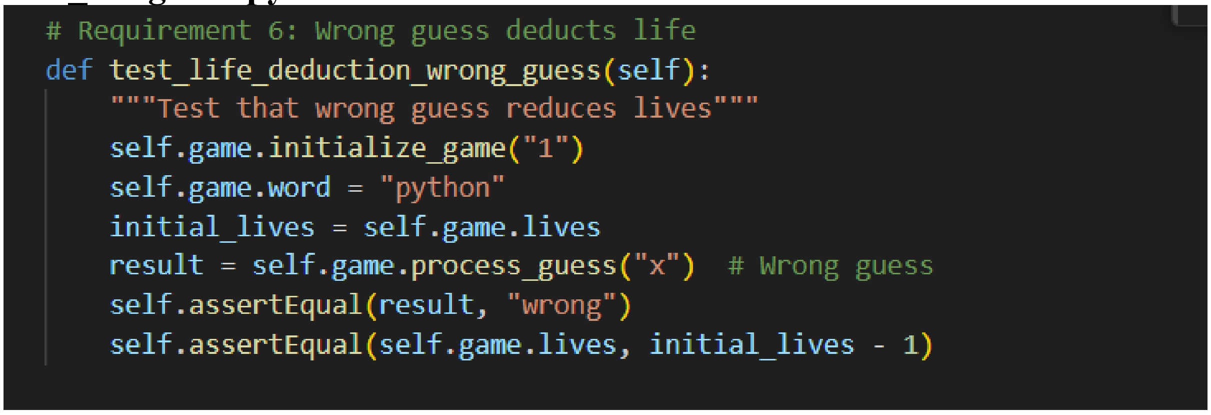
The test passed after the display_word() method was fixed.



```
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> pytest test_hangman.py
============================================================ test session starts ============================================================
platform win32 -- Python 3.13.5, pytest-8.4.1, pluggy-1.6.0
rootdir: C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman
collected 7 items

test_hangman.py .......                                                                                                              [100%]

============================================================= 7 passed in 0.06s =============================================================
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> 
```

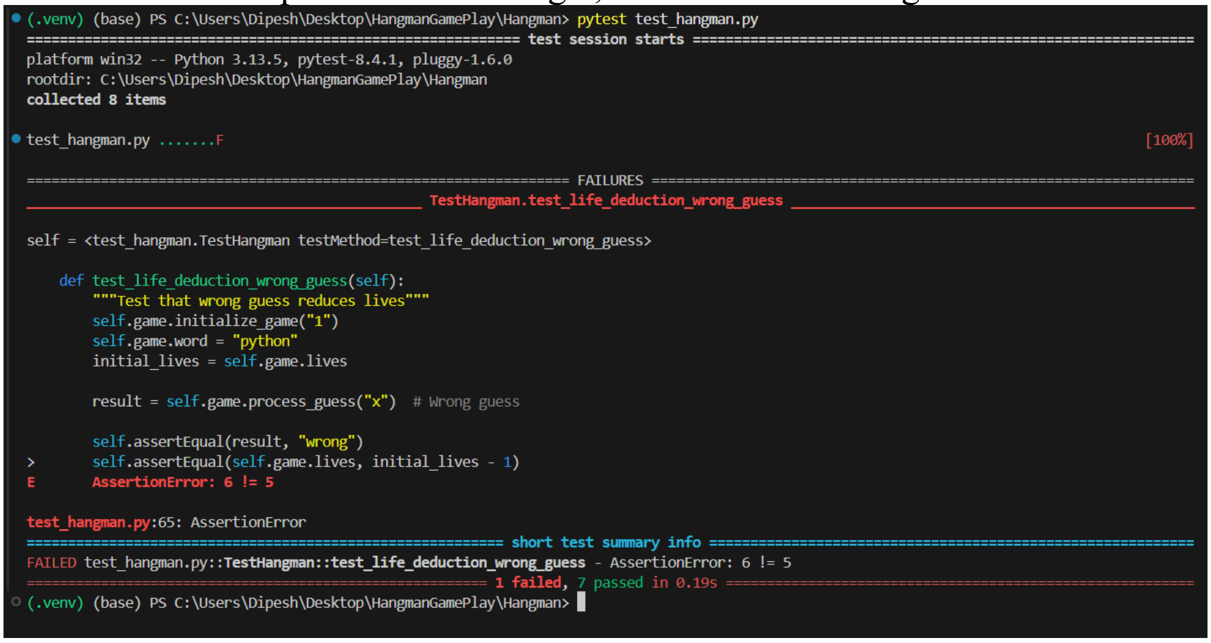
Requirement 6: Player's life reduction for the wrong guess.
TDD Approach: The test ensures that every time the player guesses a letter wrong, the player’s life would be deducted.

Test_hangman.py Code:



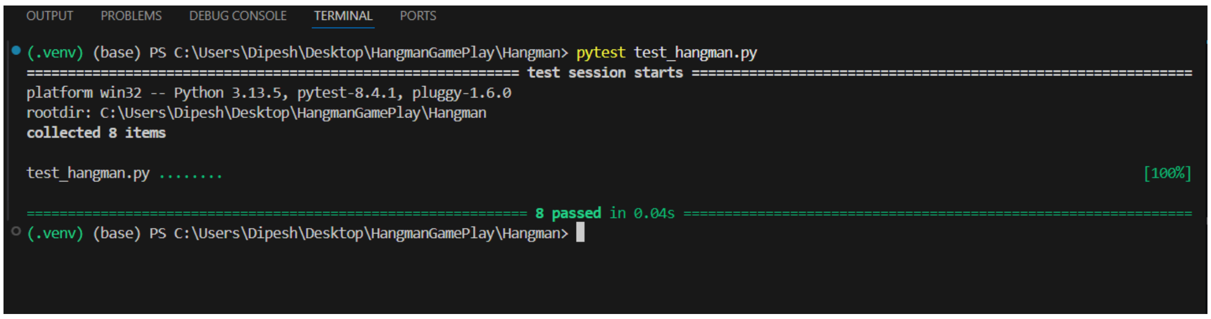
```python
# Requirement 6: Wrong guess deducts life
def test_life_deduction_wrong_guess(self):
    """Test that wrong guess reduces lives"""
    self.game.initialize_game("1")
    self.game.word = "python"
    initial_lives = self.game.lives
    result = self.game.process_guess("x")  # Wrong guess
    self.assertEqual(result, "wrong")
    self.assertEqual(self.game.lives, initial_lives - 1)
```

Because of incomplete deduction logic, the test failed during the execution.



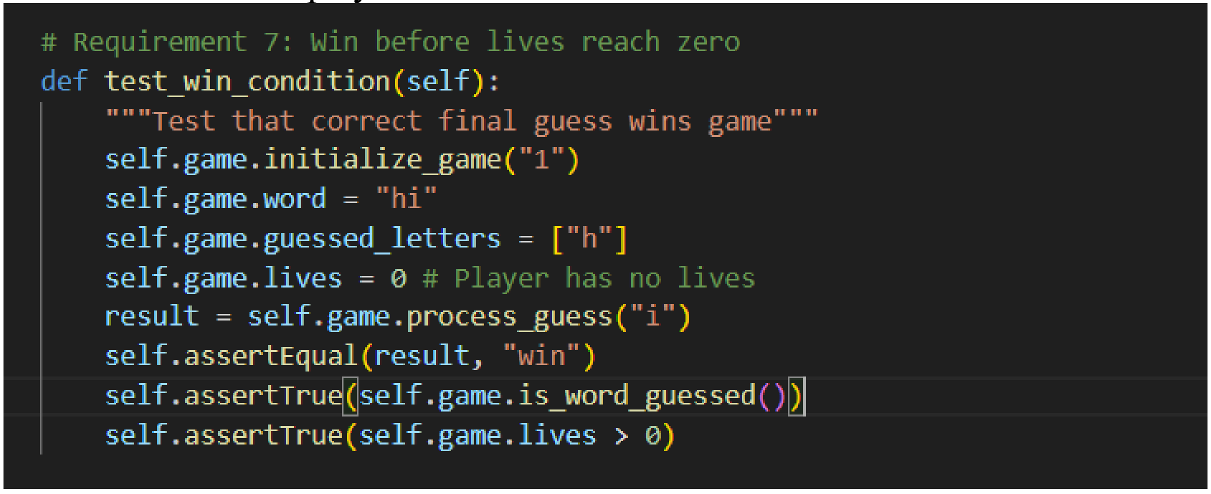
```
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> pytest test_hangman.py
============================================================ test session starts ============================================================
platform win32 -- Python 3.13.5, pytest-8.4.1, pluggy-1.6.0
rootdir: C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman
collected 8 items

test_hangman.py .......F                                                                                                              [100%]

================================================================= FAILURES =================================================================
_________________________________________________ TestHangman.test_life_deduction_wrong_guess _________________________________________________

self = <test_hangman.TestHangman testMethod=test_life_deduction_wrong_guess>

    def test_life_deduction_wrong_guess(self):
        """Test that wrong guess reduces lives"""
        self.game.initialize_game("1")
        self.game.word = "python"
        initial_lives = self.game.lives

        result = self.game.process_guess("x")  # Wrong guess

        self.assertEqual(result, "wrong")
>       self.assertEqual(self.game.lives, initial_lives - 1)
E       AssertionError: 6 != 5

test_hangman.py:65: AssertionError
========================================================== short test summary info ==========================================================
FAILED test_hangman.py::TestHangman::test_life_deduction_wrong_guess - AssertionError: 6 != 5
======================================================== 1 failed, 7 passed in 0.19s ========================================================
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman>
```

After the implementation of the logic for deduction of lives (self.lives -= 1), the test execution was successful.



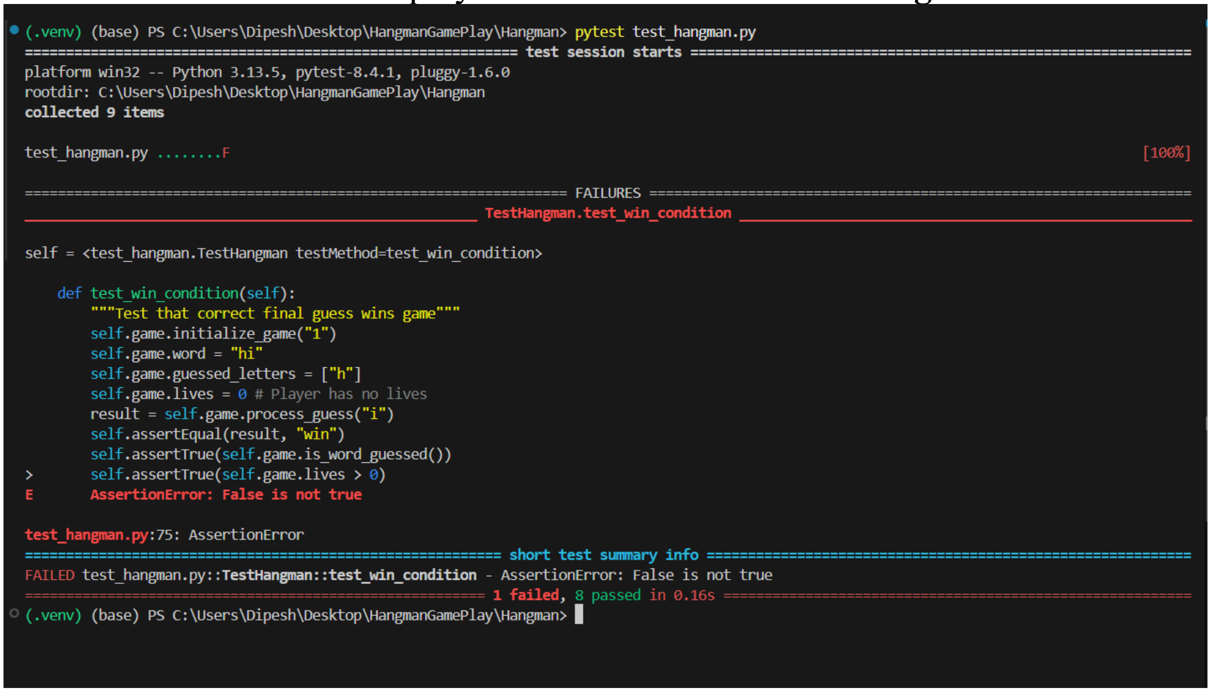
```
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> pytest test_hangman.py
============================================================ test session starts ============================================================
platform win32 -- Python 3.13.5, pytest-8.4.1, pluggy-1.6.0
rootdir: C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman
collected 8 items

test_hangman.py ........                                                                                                              [100%]

============================================================= 8 passed in 0.04s =============================================================
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman>
```

Requirement 7: The player must find the missing word before the player's life becomes zero.
TDD Approach: The test makes sure that players are capable of winning before their lives go out.
Test_hangman.py Code:
Condition when the player runs out of his/her life:



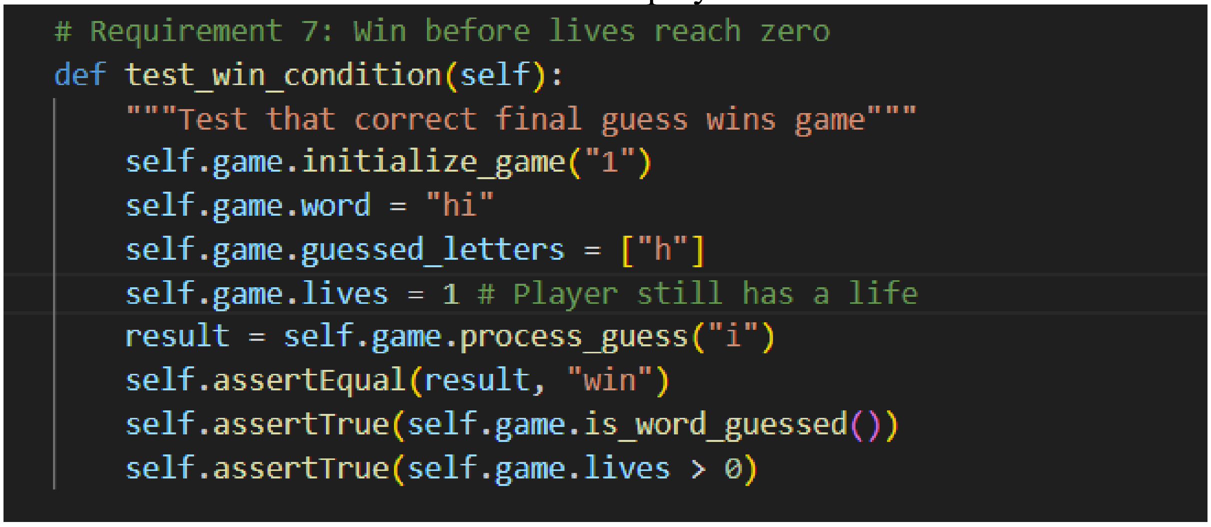
```python
# Requirement 7: Win before lives reach zero
def test_win_condition(self):
    """Test that correct final guess wins game"""
    self.game.initialize_game("1")
    self.game.word = "hi"
    self.game.guessed_letters = ["h"]
    self.game.lives = 0 # Player has no lives
    result = self.game.process_guess("i")
    self.assertEqual(result, "win")
    self.assertTrue(self.game.is_word_guessed())
    self.assertTrue(self.game.lives > 0)
```

The test failed because the player had run out of life as **"self.game.lives=0".**



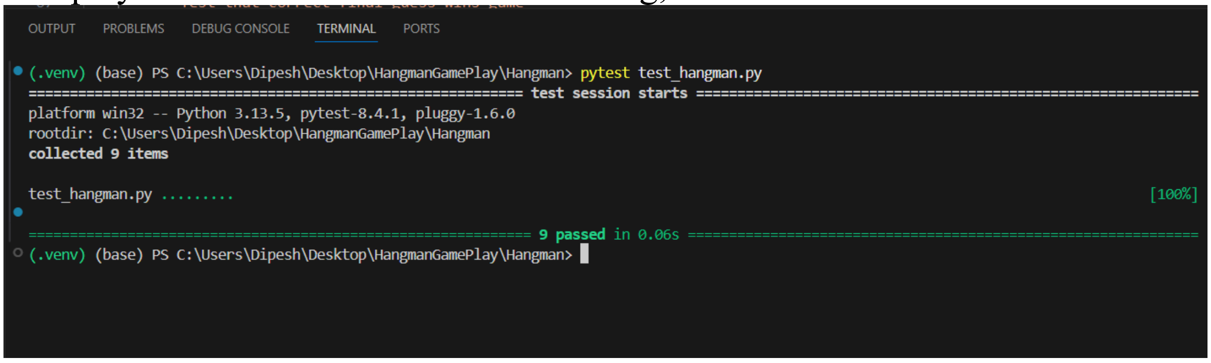
```
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> pytest test_hangman.py
============================================================ test session starts ============================================================
platform win32 -- Python 3.13.5, pytest-8.4.1, pluggy-1.6.0
rootdir: C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman
collected 9 items

test_hangman.py ........F                                                                                                             [100%]

================================================================= FAILURES ==================================================================
________________________________________________________ TestHangman.test_win_condition ________________________________________________________

self = <test_hangman.TestHangman testMethod=test_win_condition>

    def test_win_condition(self):
        """Test that correct final guess wins game"""
        self.game.initialize_game("1")
        self.game.word = "hi"
        self.game.guessed_letters = ["h"]
        self.game.lives = 0 # Player has no lives
        result = self.game.process_guess("i")
        self.assertEqual(result, "win")
        self.assertTrue(self.game.is_word_guessed())
>       self.assertTrue(self.game.lives > 0)
E       AssertionError: False is not true

test_hangman.py:75: AssertionError
========================================================== short test summary info ==========================================================
FAILED test_hangman.py::TestHangman::test_win_condition - AssertionError: False is not true
======================================================== 1 failed, 8 passed in 0.16s ========================================================
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman>
```

Condition when there is still life left in the player's life:



```python
# Requirement 7: Win before lives reach zero
def test_win_condition(self):
    """Test that correct final guess wins game"""
    self.game.initialize_game("1")
    self.game.word = "hi"
    self.game.guessed_letters = ["h"]
    self.game.lives = 1 # Player still has a life
    result = self.game.process_guess("i")
    self.assertEqual(result, "win")
    self.assertTrue(self.game.is_word_guessed())
    self.assertTrue(self.game.lives > 0)
```

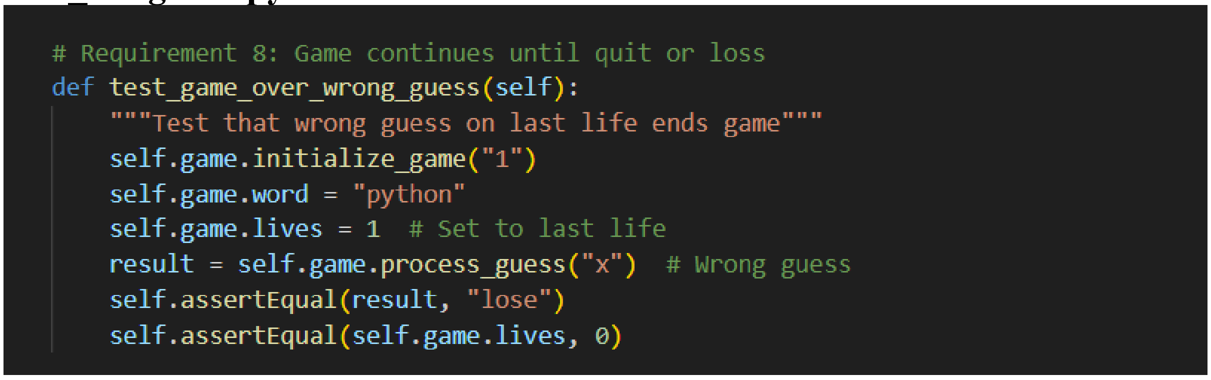
The player still has one more life remaining, hence the test was successful.



```
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> pytest test_hangman.py
============================================================ test session starts ============================================================
platform win32 -- Python 3.13.5, pytest-8.4.1, pluggy-1.6.0
rootdir: C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman
collected 9 items

test_hangman.py .........                                                                                                              [100%]

============================================================= 9 passed in 0.06s =============================================================
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman>
```

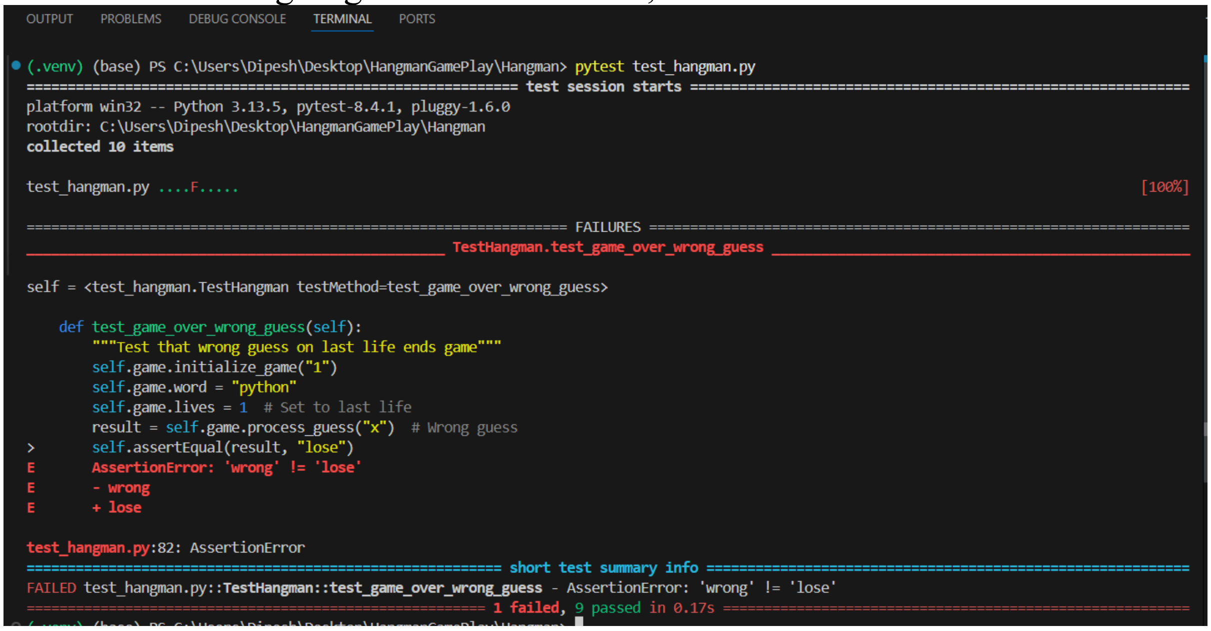
Requirement 8: The game should keep going until the end.
TDD Approach: The Test makes sure that the game will keep going until the player quits the game or life becomes zero.

Test_hangman.py Code:



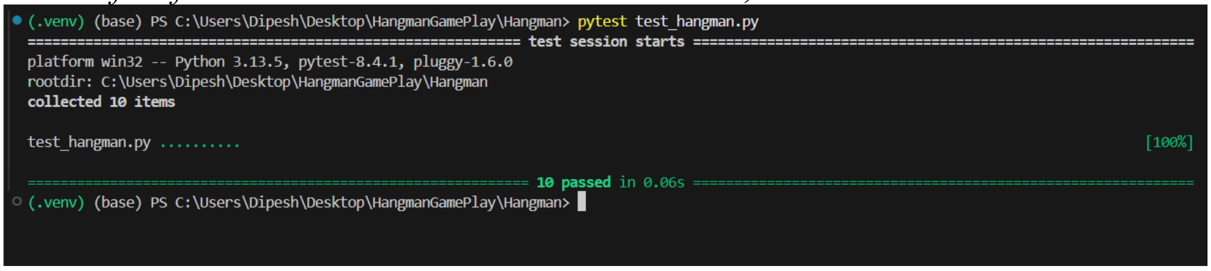
```python
# Requirement 8: Game continues until quit or loss
def test_game_over_wrong_guess(self):
    """Test that wrong guess on last life ends game"""
    self.game.initialize_game("1")
    self.game.word = "python"
    self.game.lives = 1  # Set to last life
    result = self.game.process_guess("x")  # Wrong guess
    self.assertEqual(result, "lose")
    self.assertEqual(self.game.lives, 0)
```

Due to the missing of game over detection, the test failed.



```
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> pytest test_hangman.py
============================================================ test session starts ============================================================
platform win32 -- Python 3.13.5, pytest-8.4.1, pluggy-1.6.0
rootdir: C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman
collected 10 items

test_hangman.py ....F.....                                                                                                          [100%]

================================================================= FAILURES ==================================================================
___________________________________________________ TestHangman.test_game_over_wrong_guess __________________________________________________

self = <test_hangman.TestHangman testMethod=test_game_over_wrong_guess>

    def test_game_over_wrong_guess(self):
        """Test that wrong guess on last life ends game"""
        self.game.initialize_game("1")
        self.game.word = "python"
        self.game.lives = 1  # Set to last life
        result = self.game.process_guess("x")  # Wrong guess
>       self.assertEqual(result, "lose")
E       AssertionError: 'wrong' != 'lose'
E       - wrong
E       + lose

test_hangman.py:82: AssertionError
========================================================== short test summary info ==========================================================
FAILED test_hangman.py::TestHangman::test_game_over_wrong_guess - AssertionError: 'wrong' != 'lose'
======================================================== 1 failed, 9 passed in 0.17s ========================================================
```

Once ‘*if self.lives == 0: return "lose"*’ was added, the test was successful.



```
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> pytest test_hangman.py
============================================================ test session starts ============================================================
platform win32 -- Python 3.13.5, pytest-8.4.1, pluggy-1.6.0
rootdir: C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman
collected 10 items

test_hangman.py ..........                                                                                                          [100%]

============================================================= 10 passed in 0.06s =============================================================
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman>
```

CONCLUSION

What went well:

i. **Structured Implementation:** The TDD approach made sure that all the requirements were met and also whether it offered a clear pathway for development.

ii. **Detection of Error at an earlier Stage:** Writing the test cases at an early stage helped in the detection of edge case scenarios, which saved a lot of time later in the development phase.

iii. **Code Quality:** The code's design became simpler and more testable.

iv. **Documentation:** The test aids all the new developers by showing them how the system works.

v. **Confidence in Changes:** If anything in the system doesn’t function properly, the test would reveal it immediately, and with the help of it, it is safer to improve and make changes in the existing system.

Areas for improvement:

i. **Testing of Async Code:** Initially, it was hard to test the countdown timer functionality. Further research was therefore required to determine the most effective method for measuring running time in tests without waiting 15 seconds.

ii. **User Interface (UI) Testing:** The current tests validate the game logic perfectly, but testing the text-based user interface (e.g., what is printed to the console) is more complex and was not fully implemented.

Future enhancement opportunities:

i. **Graphical User Interface (GUI):** The game could be enhanced by upgrading to a graphical one instead of using a command-line interface. For e.g.: “pygame”

ii. **Challenging Difficulty Levels:** By making the game more difficult with the addition of a "Hard" level. This level will have longer words and fewer clues.

iii. **Continuous Integration/Continuous Deployment (CI/CD):** With the help of a CI/CD pipeline, the test suite would be automatically executed on every code change with quality.

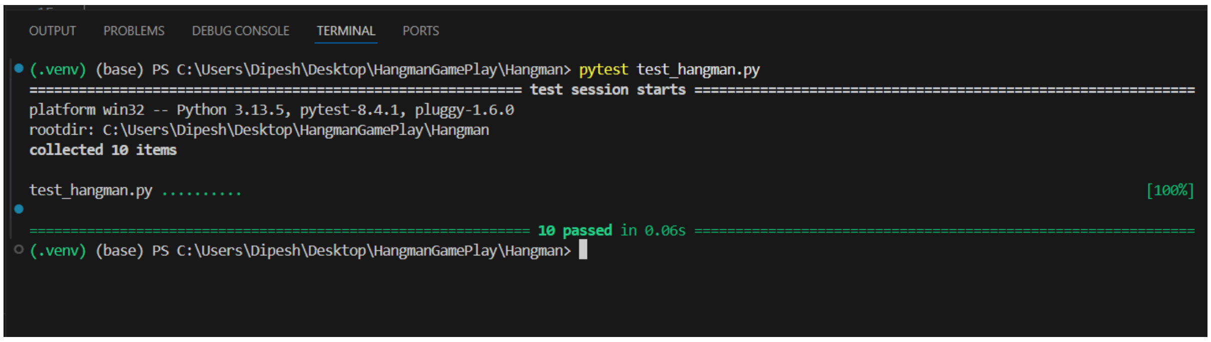
iv. **Player Statistics:** By adding the additional features that track victories, defeats, and fastest speeds, which would increase the long-term player engagement.

The final source code, unit test file, words/phrases file, and the comprehensive report are available at:
https://github.com/dapesh/HangmanGamePlay.git

The repository includes:
hangman.py: Main game implementation file
test_hangman.py: Comprehensive test suite
dictionary.txt: Words for basic level
phrases.txt: Phrases for intermediate level
SoftwareEngineeringFinalReport.pdf: This is a complete documentation file

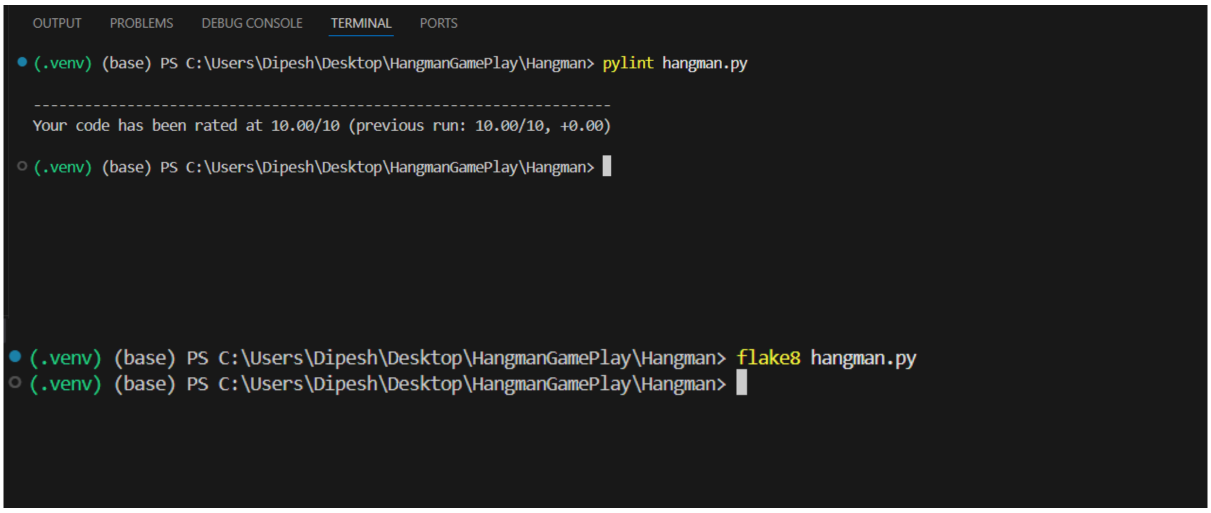
Appendix: Test Execution Summary

All tests passing successfully:



```
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> pytest test_hangman.py
============================================================ test session starts ============================================================
platform win32 -- Python 3.13.5, pytest-8.4.1, pluggy-1.6.0
rootdir: C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman
collected 10 items

test_hangman.py ..........                                                                                                           [100%]

============================================================= 10 passed in 0.06s =============================================================
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman>
```

Pylint and **Flake8** compliance reports:



```
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> pylint hangman.py

--------------------------------------------------------------------
Your code has been rated at 10.00/10 (previous run: 10.00/10, +0.00)

(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman>
```

```
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman> flake8 hangman.py
(.venv) (base) PS C:\Users\Dipesh\Desktop\HangmanGamePlay\Hangman>
```