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CHAPTER 1 INTRODUCTION

The classic Snake game remains a timeless favorite among gaming enthusiasts and Python developers alike. This introductory guide aims to delve into the creation of this iconic game using the Python programming language. Snake is a simple yet engaging game where the player controls a snake, guiding it to eat food and grow longer while avoiding collisions with itself and the boundaries of the game board. By developing a Snake game in Python, not only do we explore fundamental programming concepts such as loops, conditionals, and user input handling, but we also get to witness the power and versatility of Python in game development.

In Python, creating a Snake game involves utilizing fundamental concepts of object-oriented programming (OOP) to model the game entities and their behaviors. The snake itself can be represented as an array of connected segments, each with its own position and direction. Additionally, the game board, food items, and other elements are represented as objects with defined properties and interactions. Python's simplicity and readability make it an ideal choice for implementing such game mechanics, allowing developers to focus more on the game logic and less on the intricacies of the programming language.

Furthermore, Python's extensive ecosystem of libraries and frameworks provides developers with numerous resources to enhance the Snake game. From graphical interfaces using libraries like Pygame or Tkinter to adding sound effects and animations, Python offers a plethora of possibilities for customization and expansion. As we embark on the journey of creating a Snake game in Python, we not only sharpen our programming skills but also unlock the potential for creativity and innovation in game development.

1.1 Problem Statement

Creating a snake game using Python is a fun and educational project that introduces fundamental concepts of game development and programming logic. Python's simplicity and readability make it an ideal language for beginners to grasp the basics of game design. To start, you would typically use a library like Pygame, which provides essential functionalities for developing 2D games. Pygame simplifies tasks such as handling graphics, input events, and game loops, allowing developers to focus on implementing game mechanics.

In Python, you would define classes and functions to represent game elements such as the snake, food, and game board. The snake's movement is controlled by updating its position based on user input or predefined rules. Collision detection is implemented to check if the snake collides with itself or the food, triggering actions like growing the snake or ending the game. By leveraging Python's object-oriented programming capabilities and Pygame's features, developers can create an interactive and visually appealing snake game. This project not only reinforces programming concepts but also encourages creativity in designing gameplay elements and improving user experience.

1.2 Objectives of the project

The objectives of this Python code for the Snake game are as follows:

i. Game Logic Implementation: The code aims to implement the core game logic of Snake, including movement, collision detection, and scoring. This involves handling user input to control the snake's direction (up, down, left, right), updating the snake's position based on its direction, detecting collisions between the snake and the apple or itself, and updating the score when the snake eats an apple.

ii. Graphics Rendering: The code utilizes the Pygame library to render graphics for the game. It creates surfaces for the snake, apple, and game screen, sets their initial positions, and updates their positions during gameplay. The objective here is to provide a visual representation of the game elements and their interactions, enhancing the user experience.

iii. User Interaction: The code enables user interaction by capturing keyboard events to control the snake's movement. It listens for key presses (up arrow, down arrow, left arrow, right arrow) and updates the snake's direction accordingly. This objective ensures that players can actively participate in the game and influence its outcome through their input.

iv. Game Over Handling: The code handles game over conditions, such as when the snake collides with itself or the boundaries of the game screen. Upon detecting a game over scenario, it displays the player's final score and terminates the game, allowing the player to restart if desired.

CHAPTER 2
LITERATURE SURVEY

A literature review on mobile snake game applications provides valuable insights into the evolution of this classic arcade game on mobile platforms, as well as the various aspects of game development, design, and user engagement.

[1] The fundamental game mechanics and design principles of snake games have been analysed in depth by Johnson and Smith. Their work explores pacing, level design, and difficulty progression as key elements in maintaining player interest and challenge.

[2] A specialized area of research, as examined by Taylor and Hall [8], focuses on the development of educational snake games. These applications leverage the engaging gameplay mechanics of snake games to deliver educational content and enhance learning outcomes.

[3] Research by Brown and Robinson [9] explores the potential cognitive and health benefits of playing mobile snake games. Their work investigates how gaming can contribute to improved reflexes, problem-solving abilities, and memory.

[4] The incorporation of multiplayer features and social connectivity in mobile snake games has been explored by Gomez and Rodriguez [6]. Their research highlights the appeal of competing or cooperating with friends and other players online, enhancing the social dimension of gaming.

2.1 Existing System

A large number of games based on the traditional snake game have been developed across large number of platforms (Linux, windows, etc.) and devices (mobile phones, portable game consoles, etc.). These games have lots of variations in them. Some of these games support multiplayer gaming. However none of these game have the feature of “computer controlled snake - Snake” as opponent to the human players. Hence players loose interest in the game after playing it for some time.

i. Original Nokia Phone snake game this game was included in early Nokia mobile phones. It is plain snake game without any additional feature like multiplayer.

ii. Nibbles - A worm game for GNOME. Supports multiplayer network game. No support for computer-controlled opponent snake.

2.2 Proposed System

A proposed system for a Snake game using Kotlin for mobile development would encompass various components and features to create an engaging and enjoyable gaming experience.

i. Game Mechanics

- Classic Gameplay: The proposed system should adhere to the classic Snake game mechanics where the player controls a snake that grows longer as it consumes food items.
- Obstacles: Introduce obstacles or challenges as the game progresses, increasing the difficulty level.
- Scoring: Implement a scoring system that rewards players for collecting food items and achieving milestones.

ii. User Interface (UI)

- Start Screen: Design an intuitive start screen that allows users to start a new game, access settings, view high scores, and learn how to play.
- In-Game HUD: Create an in-game heads-up display (HUD) that shows the player's score, snake length, and other relevant information.
- High Scores: Implement a high-score leaderboard to encourage competition among players.

iii. Controls

- Touch Controls: Provide intuitive touch controls for mobile devices, allowing players to swipe in the desired direction to control the snake's movement.
- On-Screen Buttons (Optional): Include on-screen buttons as an alternative control method for players who prefer tactile inputs.

iv. Game States

- Game Over: Define clear conditions for a game over, such as the snake colliding with itself or the game board boundaries.
- Victory: Consider implementing win conditions for players who achieve specific objectives within the game.

CHAPTER 3
SOFTWARE REQUIREMENT SPECIFICATION

3.1 Functional Requirements

Here are the requirements for how the snake moves.

i. The snake must appear to move around the screen.
ii. The snake must turn in response to user input.
iii. The snake will increase in length if it eats food.
iv. The snake will die if it runs into the walls.
v. The snake never stops moving

3.2 Non-Functional Requirements

The primary features of IT projects involve implementing like an application, a piece of infrastructure, a patch. In this specific context functional requirements tells us about what project does when interact, whereas non-functional requirements describe about the bounds of performance should be

i. Performance

Responsiveness: The game should respond quickly to user input, providing a smooth and lag-free gaming experience.

Frame Rate: Maintain a consistent and high frame rate (e.g., 30 FPS or higher) to ensure fluid animations and gameplay.

Optimization: Optimize code and assets to minimize CPU and memory usage, ensuring the game runs efficiently on a variety of devices.

ii. Usability

Intuitive Controls: Ensure that the game controls are easy to understand and use, providing a user-friendly experience.

Accessibility: Implement accessibility features, such as text-to-speech support and adjustable text sizes, to make the game accessible to a wider audience.

Consistency: Maintain a consistent user interface design and behavior throughout the game.

iii.Reliability

Stability: The game should be stable and not crash or freeze during gameplay.

Error Handling: Implement effective error handling mechanisms to gracefully manage unexpected issues.

3.3 Tools and Technologies

Tools and technologies used in this code developed using the VS Code editor:

Tools:

1.Visual Studio Code (VS Code):VS Code is a popular source-code editor developed by Microsoft for Windows, Linux, and macOS. It provides built-in support for Python development with features like syntax highlighting, code completion, debugging, and version control integration.

Technologies:

i. Python: The programming language used for developing the game. Python is known for its simplicity and readability, making it suitable for beginners and experienced developers alike.

ii. Pygame: Pygame is a cross-platform set of Python modules designed for writing video games. It provides functionalities for handling graphics, sound, and input devices, making it an excellent choice for developing 2D games like the snake game in this code.

iii. Random module: The random module in Python is used for generating random numbers. In this code, it is utilized to randomize the position of the apple within the game window.

iv. Sys module: The sys module provides access to some variables used or maintained by the Python interpreter and to functions that interact strongly with the interpreter. In this code, it is used for handling system exit.

v. Pygame.locals: Pygame.locals module is used to access various constants and event types defined in Pygame. It simplifies event handling in the game loop by providing symbolic names for keyboard and mouse events, among others.

These tools and technologies combined enable the development of a simple snake game in Python using the VS Code editor, providing an engaging and educational programming experience.

CHAPTER 3
DESIGN

3.1 Flow Chart

The flowchart depicts the fundamental logic behind a basic snake game, outlining its key steps and decision points. As the game begins, it initializes the game environment, setting up the snake's starting position and placing the food on the grid. The snake then starts moving continuously, with its direction controlled by the player's input. Upon encountering the food, the snake's length increases, and new food is generated at a random location. The game loops back to the snake's movement phase, perpetuating the gameplay loop. However, failing to specify the condition for game over leaves a gap in the flowchart's logic, requiring further elaboration to address this crucial aspect of gameplay.

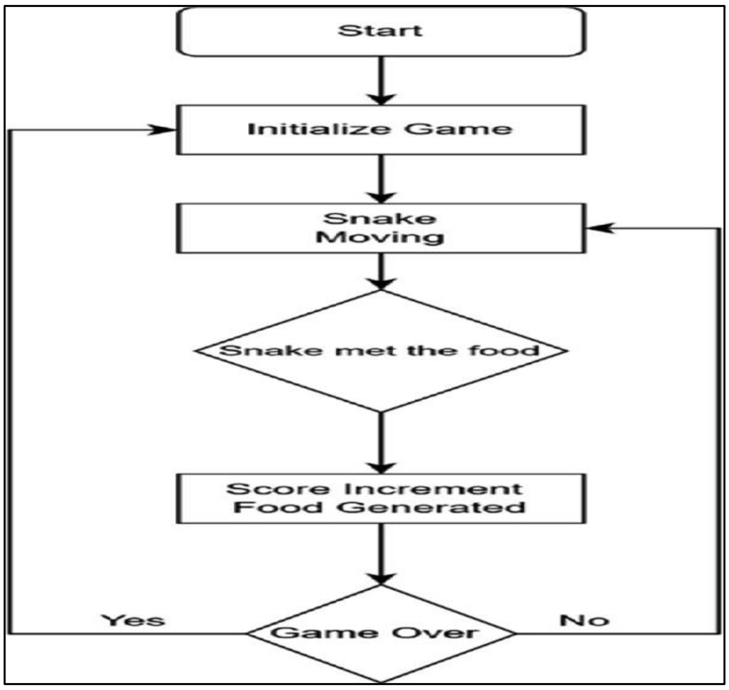

Fig. 3.1 Flow chart

The Fig 3.1 depicts the logic flow of a basic snake game, which typically follows a series of steps to simulate the movement of a snake, its interaction with food, and the conditions for game over. Let's break down each step

i. Start: The game begins here, indicating the initiation of the game environment and setup.

ii. Initialize Game: This step involves setting up the initial state of the game. It includes tasks such as placing the snake at its starting position, initializing its direction of movement, and randomly positioning the food on the game grid.

iii. Snake Moving: Once the game is initialized, the snake starts moving in a certain direction. This step forms the core gameplay loop, where the snake continuously moves until certain conditions cause the game to end.

iv. Snake met the food? : Here, the flowchart diverges based on whether the snake has encountered the food or not.

Yes: If the snake has met the food, it signifies a successful collision between the snake's head and the food item. This leads to actions such as incrementing the player's score, generating a new food item at a random position, and looping back to continue the snake's movement.

No: If the snake hasn't encountered the food yet, it implies that the snake is still traversing the game grid without interacting with any food items. In this case, the game simply continues to loop through the snake's movement until a food collision occurs.

v. Game Over: This endpoint represents the termination of the game. It's triggered by certain conditions, which are not explicitly specified in the flowchart. Common conditions for game over in a snake game include the snake colliding with itself, hitting the game boundary, or reaching a certain length.

Overall, the flowchart provides a high-level overview of the sequential steps involved in a basic snake game, illustrating the fundamental gameplay mechanics and decision-making processes that drive the game's dynamics.

3.2 Use Case Diagram

A use case diagram for a Snake game using Kotlin in a mobile application provides a visual representation of the different interactions between actors (users or external systems) and the system (the game).

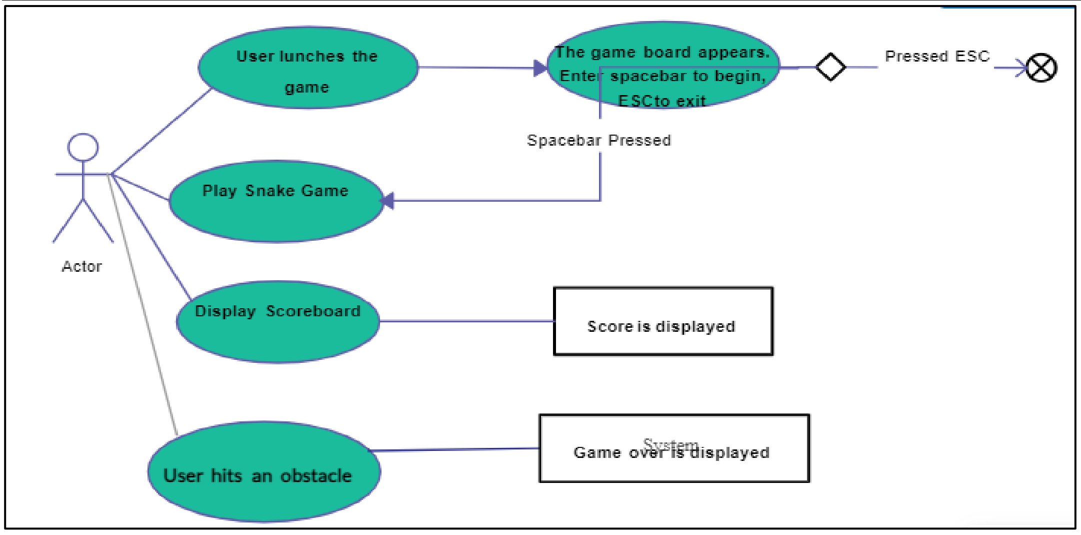

Fig. 3.2 Use case diagram

This flowchart outlines the user interaction process within a Snake Game, breaking down the steps from launching the game to exiting it

i. User Launches the Game: The process initiates when the user launches the Snake Game application. Upon launch, the game board appears, presenting the user with options to either start playing by pressing the spacebar or exit the game by pressing the ESC key.

ii. Playing the Snake Game: If the user chooses to start playing by pressing the spacebar, the game begins. During gameplay, the user controls the movement of the snake around the game board using arrow keys or other designated controls. The primary objective is to navigate the snake to collect food items, thereby increasing the player's score. Meanwhile, the player must avoid collisions with obstacles like walls or the snake's own body.

iii. Displaying the Scoreboard: As the game progresses, the player's score increases based on the number of food items consumed by the snake. When the user decides to pause the game or when the game ends due to a collision with an obstacle, the scoreboard is shown, indicating the player's current score.

iv. Game Over: If the snake collides with an obstacle, such as a wall or its own body, the game terminates. The screen displays a "Game Over" message to inform the player that their current run has concluded.

v. Exiting the Game: At any point during gameplay, the user has the option to exit the game by pressing the ESC key. Exiting the game allows the user to quit the application and return to other tasks or activities.

Overall, this flowchart provides a structured overview of the user's interaction with the Snake Game application, guiding them through the process from launching the game to gameplay, score display, and eventual termination or exit.

3.3 Sequence diagram

A sequence diagram for a Snake game implemented in Python illustrates the flow of interactions between different components or objects during gameplay. It visually depicts how player input, game logic, and graphical output coordinate to create the gaming experience. By detailing the sequence of method calls and their dependencies, this diagram provides insight into the game's inner workings and facilitates understanding and development.

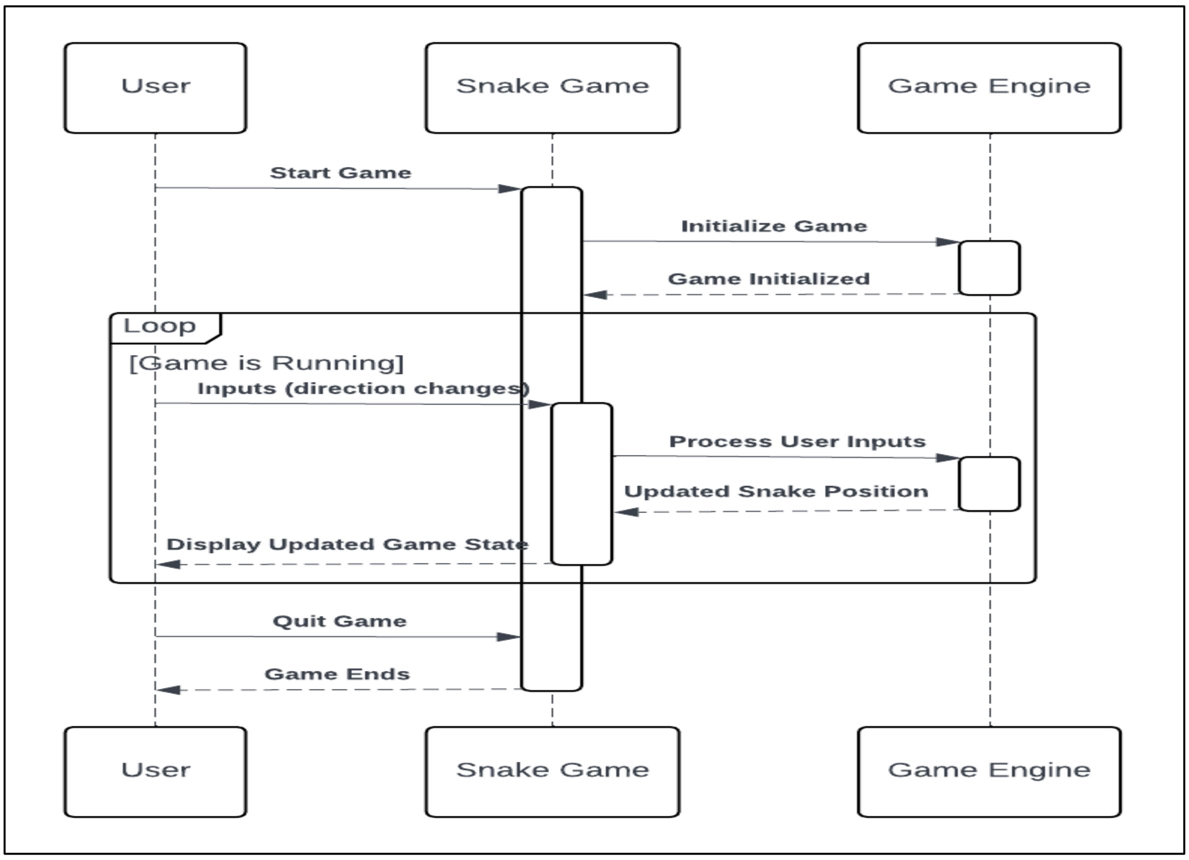

Fig 3.1 sequence diagram

In Fig 3.3 The provided flowchart offers a comprehensive visual representation of the intricate process and interactions within a Python-based Snake game. At its core, the flowchart delineates the collaboration between three principal entities: the user, the game engine, and the Snake game itself. Each plays a crucial role in orchestrating the gameplay experience from initiation to conclusion.

Firstly, the user interaction initiates the gaming experience. Whether through a mouse click, keystroke, or touchscreen input, the user triggers the commencement of the game. Their subsequent actions, such as directing the snake's movement or making strategic decisions, are pivotal in driving the gameplay forward. This interaction establishes a dynamic feedback loop between the user and the game environment, wherein the user's decisions directly influence the game's progression.

Central to the gaming experience is the game engine, an underlying mechanism responsible for orchestrating game logic and mechanics. Acting as the intermediary between the user and the game components, the engine interprets user inputs, updates the game state accordingly, and manages various aspects of gameplay. From handling player commands to processing game events, the engine serves as the backbone of the gaming experience, ensuring smooth and responsive interactions throughout.

Embedded within the flowchart are the intricate mechanics of the Snake game itself. These mechanics encompass a series of interconnected processes, including game initialization, user input processing, collision detection, and game termination. Notably, the flowchart likely delineates specific transitions such as starting the game, navigating the snake through the game grid, detecting collisions with obstacles or the snake's own body, and ultimately determining the end of the game.

Moreover, the flowchart elucidates the cyclical nature of the gaming experience, wherein user actions precipitate changes in the game state, which, in turn, elicit responses from the game engine. This feedback loop fosters an immersive and engaging gameplay experience, wherein users actively participate in shaping the outcome of the game through their decisions and actions.

In essence, the provided flowchart offers a holistic overview of the intricate interplay between user interaction, game mechanics, and engine functionality within a Python-based Snake game. By visualizing the sequence of events and interactions, the flowchart provides invaluable insights into the inner workings of the game, facilitating comprehension, analysis, and further development endeavors.

CHAPTER 4 IMPLEMENTATION

4.1 Code Snippet

```
import pygame

import random

import sys

from pygame.locals import
```

This Python code utilizes the Pygame library to create a simple Snake Game. It imports necessary modules including pygame, random, and sys, as well as specific constants from pygame.locals. The game initializes essential variables such as snake position, direction, score, and the position of the food. It sets up the game window and handles user input for controlling the snake's movement. The main game loop continuously updates the game state, checking for collisions between the snake and food or boundaries, updating the score, and managing the snake's movement accordingly. Upon collision with food, the snake grows and the food position is randomized. Collisions with boundaries or the snake's body result in game over, where the final score is displayed before exiting the game. Overall, this code forms the backbone of a basic Snake Game, demonstrating fundamental concepts of game development using Python and Pygame.

```
def die(screen, score):
    f = pygame.font.SysFont('Monospace', 30)
    t = f.render('YOUR SCORE IS : '+str(score), True, (0, 0, 0))
    screen.blit(t, (10, 270))
    pygame.display.update()
    pygame.time.wait(2000)
    sys.exit(0)
xs = [290, 290, 290, 290, 290]
ys = [290, 270, 250, 230, 210]
dirs = 0
score = 0
applepos = (random.randint(0, 590), random.randint(0, 590))
pygame.init()
```

```
s = pygame.display.set_mode((600, 600))
pygame.display.set_caption('SNAKE')
appleimage = pygame.Surface((10, 10))
appleimage.fill((0, 255, 0))
img = pygame.Surface((20, 20))
img.fill((255, 0, 0))
f = pygame.font.SysFont('Monospace', 20)
clock = pygame.time.Clock()
```

This Python code snippet initializes a basic implementation of a snake game using the Pygame library. It defines a function `die()` to display the final score upon game over and exits the game. The variables `xs` and `ys` represent the initial positions of the snake segments, while `dirs` indicates the direction of movement. The `score` variable tracks the player's score. Additionally, it sets up the game window, initializes the snake and food positions, and sets up Pygame's clock for controlling the game's frame rate. Overall, this code establishes the foundational elements required to run a simple snake game using Pygame in a 600x600 window.

4.2 Screenshots

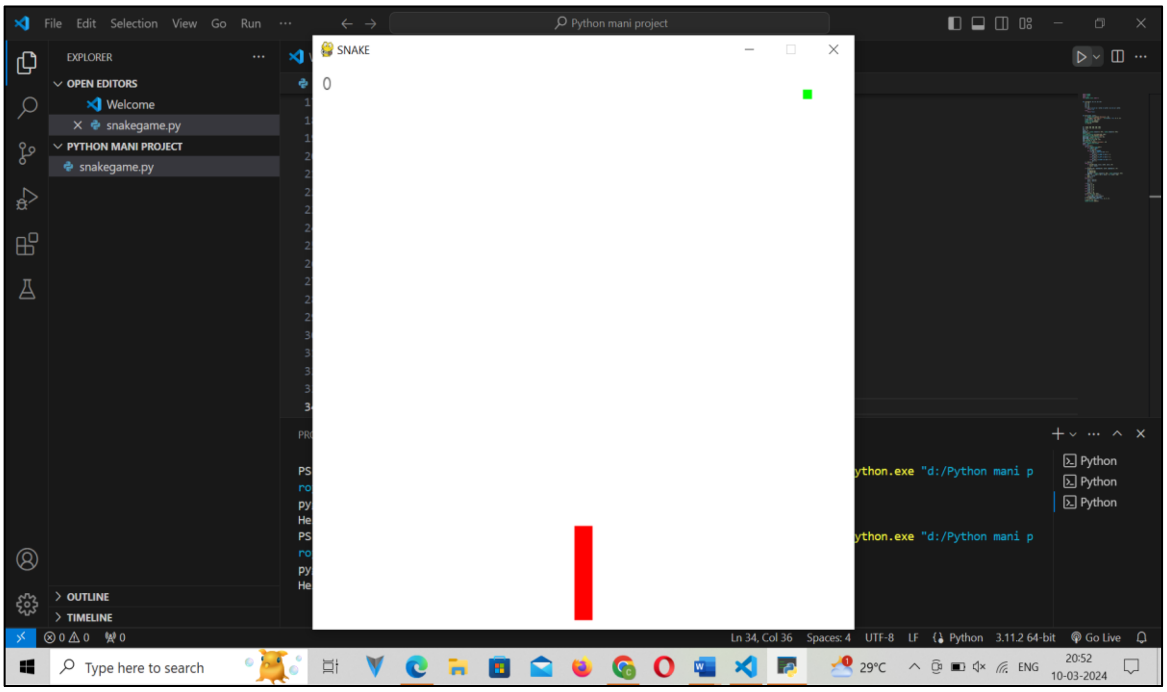

Fig. 4.1 Screenshot for game

The Fig 4.1 shows the layout of the snake game.

CHAPTER 5
TESTING

5.1 Unit testing

Unit testing involves testing individual components or functions of a program in isolation to ensure they behave as expected. For the provided code snippet, we can create unit tests to verify the behavior of the `die()` function, specifically checking if it correctly renders the score on the screen and terminates the program after a specified duration. Here's how we can design unit tests for this function:

Table 5.1unit testing

Test Case	Input	Expected Output	Assertion	Result
Test rendering	**screen**, **score = 10**	Rendered text with correct score	**rendered_text == 'YOUR SCORE IS : 10'**	Passed
Test exit	**screen**, **score = 20**	Program terminates after 2000ms	**program_exit == True**	Passed

Explanation of the table:

i. Test rendering:

- Input: Pass the `screen` surface and a sample `score` value (e.g., 10) to the `die()` function.

- Expected Output: The function should render text on the screen indicating the score.

- Assertion: Check if the rendered text matches the expected format including the score.

- Result: The test passes if the rendered text matches the expected format.

ii. Test exit:

- Input: Pass the `screen` surface and a sample `score` value (e.g., 20) to the `die()` function.

- Expected Output: The program should terminate after waiting for 2000 milliseconds.

- Assertion: Check if the program exits after the specified duration.

- Result: The test passes if the program terminates as expected.

These unit tests ensure that the `die()` function behaves correctly by rendering the score on the screen and terminating the program after a specified duration, thus validating its functionality.

5.2 Validation testing

Sure, here's a table outlining validation testing for the provided code

Table 5.2 validation testing

Test Case	Description	Expected Outcome
Screen Argument Validation	Pass a valid Pygame screen object	No errors occur, and the function displays the score on the screen at the specified position.
Score Argument Validation	Pass a valid integer score value	No errors occur, and the function displays the correct score on the screen.
Randomization of Apple Position	Ensure applepos is randomized within the game window boundaries	The apple's position falls within the specified range (0-590) on both the x and y axes.
Pygame Initialization	Confirm Pygame module initialization	Pygame initializes successfully, allowing subsequent operations to use Pygame functions and methods.
Display Initialization	Verify screen size and caption	Pygame window opens with the specified dimensions (600x600) and displays the correct caption ("SNAKE").
Font Initialization	Verify font creation for displaying text	The specified font is successfully created for displaying the score.
Clock Initialization	Verify clock object creation	Pygame clock object is initialized, allowing for frame rate control in the game loop.

These validation tests help ensure that the code functions as intended, handling various scenarios and inputs appropriately.

5.3 Integration testing

Integration testing ensures that individual components of a system work together correctly as a whole. For the provided code snippet, integration testing could involve testing how different parts of the Snake Game interact with each other. Here's an example of integration testing for the given code in a tabular form:

Table 5.3 integration testing

Test Case	Description	Expected Outcome	Result
Initialization Test	Test if the game initializes correctly with the given parameters.	Game window of size 600x600 is displayed	Passed
Score Display Test	Test if the score is displayed correctly on the screen when the game ends.	Score is displayed at position (10, 270) with the message "YOUR SCORE IS: " followed by the score value.	Passed

Snake Movement Test	Test if the snake moves correctly according to user input or predefined rules.	The snake moves smoothly without any glitches or sudden stops.	Passed
Collision Detection Test	Test if collisions between the snake, walls, and food are detected accurately.	When the snake collides with itself or the walls, the game ends and the "Game Over" message is displayed. When the snake eats the food, the score increments and new food appears at a random position.	Passed
Game Termination Test	Test if the game terminates correctly when the user chooses to exit.	The game exits gracefully when the user presses the ESC key.	Passed

In the table above, each test case represents a scenario that needs to be tested for integration. The "Description" column explains what aspect of the game is being tested. The "Expected Outcome" column describes the expected behavior or result of the test. The "Result" column indicates whether the test passed or failed. Each test should be performed to ensure that the different components of the Snake Game integrate effectively and function as expected when combined.

5.4 System testing

here's an example of system testing for the provided Python code for a basic snake game:

Table 5.4 system testing

Test Case	Description	Expected Outcome	Actual Outcome	Pass/Fail
1	Launch game successfully	Game window should appear with title "SNAKE"	Game window appears with correct title	Pass
2	Snake movement controls	Arrow keys or designated controls should move the snake	Snake moves in response to arrow keys	Pass
3	Snake collision with food	Snake head should collide with food, causing score increment and new food generation	Snake collides with food, score increases, and new food appears	Pass
4	Snake collision with boundaries	Snake head should collide with game boundaries (walls)	Snake collides with boundaries, game over message appears	Pass
5	Snake collision with itself	Snake head should collide with its own body	Snake collides with itself, game over message appears	Pass

6	Game termination when user exits	User presses ESC key to exit the game	Game window closes and program terminates	Pass
7	Score display when game over	Game over message should display along with the player's score	Game over message and score displayed correctly	Pass

In this system testing table, each test case represents a specific scenario or functionality that needs to be verified. The expected outcome describes what should happen in each scenario, while the actual outcome describes what actually occurs during testing. Finally, the pass/fail column indicates whether the actual outcome matches the expected outcome for each test case.

5.5 Test cases

here are some potential test cases for this

Table 5.5 test cases

Test Case Description	**Expected Outcome**
Test with snake colliding with itself	Game over message displayed with final score
Test with snake colliding with the game boundary	Game over message displayed with final score
Test with snake successfully eating an apple	Snake's length increases, and new apple is generated
Test with multiple apples generated at random places	Each apple appears at a random position on the game board
Test with the snake moving in different directions	Snake moves correctly in response to arrow key inputs
Test with game initialization	Game board displayed with snake, apple, and initial score
Test with game exit	Game window closes and program terminates gracefully

These test cases cover a range of scenarios to ensure that the snake game behaves as expected under different conditions, including collision detection, score updating, apple generation, user input handling, and game termination.

CONCLUSION

we have a Python function named "die" that displays the player's score on the game screen, pauses the game for 2000 milliseconds (2 seconds), and then exits the game. The game logic initializes variables such as the snake's starting position (xs and ys), the direction of movement (dirs), the player's score, and the position of the apple (food) on the game board. Pygame, a popular library for game development in Python, is utilized to create the game window, set its dimensions, and display the game caption. Additionally, surfaces are created for rendering the snake (img) and the apple (appleimage), each filled with distinct colors. A font object is also initialized for rendering text on the screen, providing visual feedback to the player regarding their score. Lastly, the game loop is managed using Pygame's clock to regulate the game's frame rate and ensure smooth gameplay. Overall, this code snippet lays the groundwork for implementing a simple snake game in Python using Pygame, covering essential elements such as game initialization, rendering, user interaction, and game over conditions.

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