

**A PROJECT REPORT**

**on**

**AI-Based Snake Game**

**Submitted to**

**KIIT Deemed to be University**

**In Partial Fulfillment of the Requirement for the Award of**

**BACHELOR'S DEGREE IN**

**Computer Science And Engineering**

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**SCHOOL OF COMPUTER ENGINEERING**

**KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY**

**BHUBANESWAR, ODISHA - 751024**

**March 2025**

# KIIT Deemed to be University

School of Computer Engineering  
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## CERTIFICATE

This is certify that the project entitled

**AI-Based Snake Game**  
submitted by

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is a record of bonafide work carried out by them, in the partial fulfilment of the requirement for the award of Degree of Bachelor of Engineering (Computer Science & Engineering OR Information Technology) at KIIT Deemed to be university, Bhubaneswar. This work is done during year 2024-2025, under our guidance.

Date: 24/03/2025

Sricheta Parui  
Project Guide

## Acknowledgements

We are profoundly grateful to **Sricheta Parui** of **Affiliation** for his expert guidance and continuous encouragement throughout to see that this project rights its target since its commencement to its completion. ....

Ujjwal Kumar Singh  
Rupsa Biswas

## **ABSTRACT**

The project focuses on the artificial intelligence of the Snake game. The snake's goal is to eat the food continuously and fill the map with its bodies as soon as possible. This project presents an AI-powered Snake Game that enhances the traditional game by integrating artificial intelligence for autonomous gameplay. The AI-controlled snake uses the A\* pathfinding algorithm to navigate toward food while avoiding obstacles and self-collisions. The game is developed using Python and Pygame, featuring an interactive graphical interface with sound effects and a dynamic game environment.

The primary objective of this project is to demonstrate AI-based decision-making in real-time, making the game more challenging and engaging. Additional features include adaptive difficulty, background music, and an immersive experience with visual elements. This project not only improves upon classic arcade-style games but also explores the application of AI in game development.

### **Keywords:**

- **Artificial Intelligence**
- **Snake Game**
- **Python**
- **Pygame**
- **Pathfinding**
- **A\* Algorithm**
- **Game Development**

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# Chapter 1

## Introduction

This section discusses the current need for an AI-based Snake Game and the gaps in traditional snake game implementations. Classic snake games typically rely on player control, but with advancements in artificial intelligence, integrating AI-controlled snakes can enhance gameplay, provide competitive challenges, and introduce innovative mechanics.

This project explores the development of an AI-powered Snake Game, where the snake intelligently navigates the grid using pathfinding algorithms such as \*A (A-star)\*\*. The AI aims to collect food efficiently while avoiding obstacles and self-collisions. The game also incorporates power-ups, multiplayer support, and enhanced visuals to create a more engaging experience.

The importance of this project lies in its blend of **AI, game development, and real-time decision-making**, making it an excellent demonstration of AI in interactive environments. The structure of this report details the **design, implementation, and testing** of the AI-controlled snake, along with **future enhancements** for expanding the game's features.

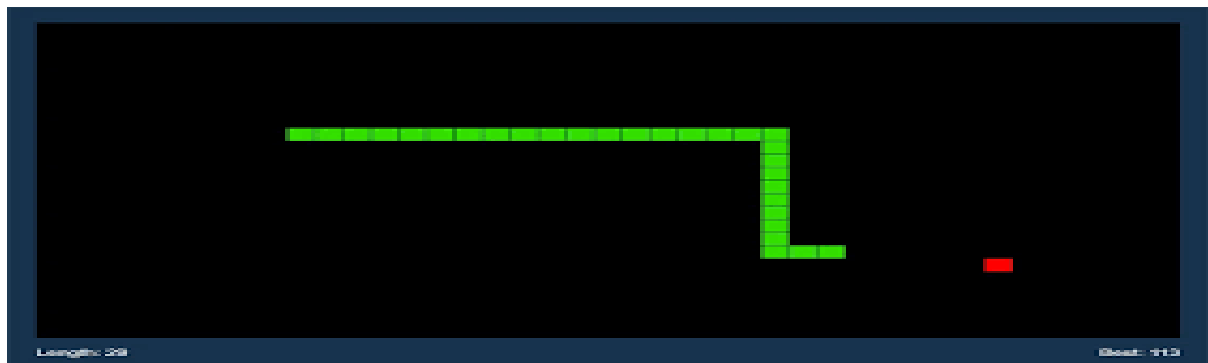


Figure: 1.1

# Chapter 2

## Basic Concepts/ Literature Review

### 2.1 Pygame

**Pygame** is a Python library used for game development. It provides modules for rendering graphics, handling events, and playing sounds. It enables smooth animations and dynamic interactions, making it suitable for AI-driven game development.

### 2.2 A\* Search Algorithm

The *A Search Algorithm*\* is a pathfinding and graph traversal algorithm that efficiently finds the shortest path between nodes. It combines **Dijkstra's algorithm** and **Greedy Best-First Search**, ensuring optimal pathfinding.

### 2.3 Collision Detection in Games

Collision detection ensures the snake does not crash into walls or itself. This is achieved through:

- **Boundary Detection:** Restricting movement within screen limits.
- **Self-Collision Check:** Validating whether the snake overlaps itself.



# Chapter 3

## Problem Statement / Requirement Specifications

In this section, we define the problem statement for the project and outline the key requirements necessary for its successful implementation. The AI Snake Game aims to integrate artificial intelligence into the classic snake game, enabling autonomous navigation using the A\* search algorithm. This chapter also covers project planning, analysis, and system design, adhering to standard software engineering practices.

### 3.1 Project Planning

To develop the AI Snake Game, the following steps will be followed:

- Defining the project scope and objectives.
- Identifying the game logic and AI pathfinding approach.
- Choosing the development environment (Python, Pygame).
- Implementing collision detection, scoring system, and UI elements.
- Testing the AI behavior for efficiency and accuracy.
- The project requirements are structured based on user expectations and desired game features, ensuring smooth gameplay and AI-driven interactions.

### 3.2 Project Analysis

Before implementation, an in-depth analysis is conducted to:

- Examine potential challenges in AI-based movement.
- Validate the effectiveness of the A\* search algorithm.
- Identify and mitigate possible bugs such as unexpected collisions or inefficient pathfinding.
- Ensure that the game meets performance and usability criteria.
- The analysis helps eliminate ambiguities and ensures a clear development roadmap.

### 3.3 System Design

#### 3.3.1 Design Constraints

The project operates in the following software and hardware environment:

- Programming Language: Python
- Game Development Library: Pygame

- AI Algorithm: A\* Search Algorithm
- Operating System: Windows / Ubuntu
- Development Tools: VS Code, Jupyter Notebook
- Any additional experimental setups, such as testing on different screen resolutions or integrating advanced AI heuristics, will be documented accordingly.

### **3.3.2 System Architecture OR Block Diagram**

The system design consists of:

- Game State Management: Handles the snake movement, food spawning, and collision detection.
- AI Decision-Making Module: Implements the A\* pathfinding algorithm to guide the snake.
- Rendering Engine: Uses Pygame to display graphics and animations.
- User Interface: Provides a scoreboard, game controls, and visual effects.
- A block diagram illustrating the system architecture will be included to visually represent these components.

# Chapter 4

## Implementation

In this section, we present the implementation process of the AI Snake Game, including methodologies, testing strategies, result analysis, and quality assurance measures.

### 4.1 Methodology OR Proposal

The AI Snake Game is implemented using Python and Pygame for game development, while the A\* search algorithm is used for pathfinding. The steps followed during development include:

- Defining the snake’s movement logic and collision detection.
- Implementing the A\* search algorithm to find optimal paths.
- Creating the game environment with Pygame, including food spawning and game over conditions.
- Testing the game mechanics to ensure smooth AI navigation.
- Optimizing the algorithm to improve efficiency and response time.

### 4.2 Testing OR Verification Plan

After development, the game is tested using predefined test cases to ensure accuracy and efficiency. The testing phase focuses on verifying the AI behavior, collision detection, and response time. The following test cases illustrate different aspects of verification:

Test ID	Test Case Title	Test Condition	System Behavior	Expected Result
T01	AI Movement	Food appears near	AI moves optimally	Shortest Path Taken
T02	Collison Detection	AI reaches wall	Game over triggers	Game restarts
T03	Pathfinding Efficiency	Multiple obstacles present	AI avoids obstacles	Optimal path selected

### **4.3 Result Analysis OR Screenshots**

The results of the AI Snake Game are analyzed using different test scenarios. Performance is measured based on AI response time, path accuracy, and game stability. The following observations were recorded:

- The A\* algorithm efficiently finds the shortest path in most scenarios.
- Game performance remains smooth with no major lag issues.
- Screenshots of test results, including game states and AI decision-making, are documented for reference.

### **4.4 Quality Assurance**

Quality assurance is conducted to ensure the reliability and efficiency of the AI Snake Game. The testing phase validates that all features perform correctly under different conditions. Key aspects of quality assurance include:

- Verifying that the AI selects optimal paths without unnecessary movements.
- Ensuring smooth and responsive game controls.
- Minimizing performance issues and optimizing game logic for better execution.
- These measures ensure that the final implementation meets the expected quality standards.

# Chapter 5

## Standards Adopted

### 5.1 Design Standards

In all engineering streams, predefined design standards such as IEEE and ISO are present. These standards help in ensuring quality and consistency in project design. In software development, UML diagrams and database design standards can also be followed. The recommended practices for the AI Snake Game design include:

- Following structured software development methodologies.
- Using UML diagrams for better visualization of system architecture.
- Ensuring modularity and reusability of code components.

### 5.2 Coding Standards

Coding standards define the best practices and rules to be followed during development. The AI Snake Game follows the following coding standards:

- Writing concise and optimized code for better performance.
- Using appropriate naming conventions for variables and functions.
- Segmenting blocks of code logically for better readability.
- Using indentation to mark the beginning and end of control structures.
- Ensuring that each function performs a single, well-defined task.
- Maintaining proper documentation and comments for better understanding.

### 5.3 Testing Standards

Testing standards ensure that the software is reliable and free from major errors. The AI Snake Game follows IEEE and ISO testing standards for quality assurance. The key aspects of testing include:

- Conducting unit testing for individual components.
- Performing functional testing to verify AI movement and pathfinding accuracy.
- Running stress tests to check performance under different conditions.
- Ensuring compliance with software testing methodologies to validate results.
- These standards help in maintaining the overall efficiency and correctness of the project.

# Chapter 6

## Conclusion and Future Scope

### 6.1 Conclusion

The AI Snake Game project successfully implements an intelligent approach to navigating a snake within a confined environment. By utilizing search algorithms and optimization techniques, the project demonstrates an effective way of solving pathfinding problems in a dynamic setting. The game provides a robust platform for testing AI behavior and decision-making strategies, showcasing the potential of artificial intelligence in game development.

### 6.2 Future Scope

The project has various possibilities for future enhancements:

- Integrating advanced AI techniques such as reinforcement learning to improve snake movement efficiency.
- Enhancing the graphical user interface for better visualization and player interaction.
- Expanding the game environment with dynamic obstacles and varying difficulty levels.
- Developing a multiplayer mode where AI competes against human players.
- Optimizing the algorithm to handle larger grids with real-time processing.
- By implementing these advancements, the AI Snake Game can evolve into a more sophisticated and intelligent system.

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## **SAMPLE INDIVIDUAL CONTRIBUTION REPORT:**

### **AI-Based Snake Game**

Ujjwal Kumar Singh  
22052428

**Abstract:** The project focuses on the artificial intelligence of the Snake game. The snake's goal is to eat the food continuously and fill the map with its bodies as soon as possible. This project presents an AI-powered Snake Game that enhances the traditional game by integrating artificial intelligence for autonomous gameplay. The AI-controlled snake uses the A\* pathfinding algorithm to navigate toward food while avoiding obstacles and self-collisions. The game is developed using Python and Pygame, featuring an interactive graphical interface with sound effects and a dynamic game environment.

#### **Individual contribution and findings:**

I was responsible for implementing the *A algorithm*\* in the project. This involved developing an efficient pathfinding system to enhance the AI-controlled snake's decision-making process. I researched and analyzed different pathfinding techniques before finalizing A\* for optimal performance. During the implementation, I focused on optimizing the algorithm to ensure smooth real-time movement and responsiveness.

#### **Individual contribution to project report preparation:**

I contributed to the **project report preparation** by writing the **Abstract, Table of Contents, Introduction, Conclusion, and Future Scope** sections. These sections provide an overview of the project, its objectives, expected outcomes, and potential future enhancements.

#### **Individual contribution for project presentation and demonstration:**

For the **project presentation and demonstration**, I helped in structuring the slides and explaining the technical aspects of the A\* algorithm during the demonstration. I ensured that the presentation clearly conveyed the significance of AI pathfinding in the game and how it improves gameplay.

Full Signature of Supervisor:

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Full signature of the student:

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## **SAMPLE INDIVIDUAL CONTRIBUTION REPORT:**

### **AI-Based Snake Game**

Rupsa Biswas  
22052498

**Abstract:** The project focuses on the artificial intelligence of the Snake game. The snake's goal is to eat the food continuously and fill the map with its body as soon as possible. This project presents an AI-powered Snake Game that enhances the traditional game by integrating artificial intelligence for autonomous gameplay. The game is developed using Python and Pygame, featuring an interactive graphical interface with sound effects and a dynamic game environment.

#### **Individual contribution and findings:**

I contributed to the development and enhancement of various game features to improve user experience and gameplay dynamics. My primary role included implementing sound effects, score tracking, and game mechanics enhancements. I ensured that the game provided an engaging experience with smooth animations and responsive controls. Additionally, I worked on UI improvements to make the interface more user-friendly and visually appealing.

#### **Individual contribution to project report preparation:**

I was responsible for writing and refining the technical implementation, methodology, results, and challenges sections of the report. These sections document the detailed working of the game, the implementation of AI-based gameplay, and the challenges faced during development, along with their solutions. Individual contribution for project presentation and demonstration:

#### **Individual contribution for project presentation and demonstration:**

For the project presentation, I assisted in designing visual slides and graphical representations to effectively showcase the game's features. I also participated in demonstrating the gameplay, explaining the user experience improvements, and answering queries related to the game's mechanics.

Full Signature of Supervisor:

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Full signature of the student:

.....

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