# Pac-Man Game

# Team Members:

UCE2023503 - Asmita Ahire
UCE2023506 - Swaliha Attar
UCE2023513 - Bhargavi Dange
UCE2023548 - Sanskruti Patil

# Introduction

- Pacman is a maze-navigating game in which the player collects pellets while avoiding being killed by ghosts.
- **Objective:** Eat all pellets in the maze without getting caught by ghosts.
- **Game Elements:**
  - Pacman (player)
  - Ghosts (enemies)
  - Normal pellets and Power pellets
- **Our Project Goal:** Make Pacman fully autonomous using AI techniques to maximize score while avoiding danger.
- **AI Features:** Hierarchical decision-making, threat avoidance, chasing vulnerable ghosts, and efficient pellet collection.

# Game Overview

- **Maze Structure:** Grid-based, tile system with walls, empty spaces, pellets, and spawn points.
- **Player & Enemies:**
  - Pacman: Primarily AI-controlled for autonomous gameplay; can be manually controlled.
  - Ghosts: Move randomly, avoid backtracking, unpredictable
- **Pellets & Power-Ups:**
  - Normal pellets: +10 points
  - Power pellets: +25 points, temporarily make ghosts vulnerable.
  - Vulnerable Ghosts: +50 points if eaten while in vulnerable state.

# Game Engine Layers

01

Loads the ASCII map, stores tiles, and defines the maze structure.

Maze & Data Layer

02

Handles movement, collisions, pellet collection, scoring, and game state.

Game Logic Layer

03

Makes decisions using priority rules and BFS pathfinding

AI Layer

04

Draws animations, maze, pellets, and HUD at 30 FPS.

Rendering Layer

# AI Decision-Making

### Threat Avoidance

Escapes nearby ghosts by moving to the safest tile within 2-tile range.

### Opportunity Pursuit

Chases vulnerable ghosts using BFS to find the shortest path.

### Resource Collection

Moves toward the nearest pellet, based on feature extracted, if above conditions are not met.

**How decisions are made:**

1] Uses feature extraction: distances to ghosts, distances to pellets, and remaining pellet count and positions.

2] Priorities are evaluated hierarchically: the highest applicable priority is executed first.

# Priority 1: Threat Avoidance

- **Goal:** Avoid immediate danger before chasing pellets or vulnerable ghosts.’
- **Trigger:** Activated when a normal ghost is within 2 tiles of Pacman.
- **Decision Process:** Pacman evaluates up, down, left, right and chooses the move that maximizes distance from the nearest ghost.
- **Distance Measurement:** Uses Manhattan distance

$$D = |x_{\text{Pac}} - x_{\text{Ghost}}| + |y_{\text{Pac}} - y_{\text{Ghost}}|$$

# Priority 2: BFS Pathfinding

- **Goal:** Hunt ghosts efficiently while avoiding walls and danger zones.
- **Trigger:** Activated when any of the ghosts become/are vulnerable.
- **Pathfinding Method:** Uses Breadth-First Search (BFS) to find the shortest path to the target ghost.
- **Distance Grid:** BFS computes distances for all reachable tiles from the ghost(s).
- **Decision:** Pacman moves to the adjacent tile that reduces distance to the nearest vulnerable ghost.

# Priority 3: Pellet Collection

- **Goal:** Collect pellets efficiently while avoiding ghosts
- **Default Action:** Activated when no immediate threat or vulnerable ghost exists.
- **Target Selection:** Pacman finds the nearest safe pellet (normal or power) using feature extraction and pathfinding.
- **Fallback:** If no safe path exists, Pacman selects a random valid move.

# Ghost Behavior

- **Movement:** Ghosts move randomly in valid directions (up / down / left / right).
- **No Backtracking:** Ghosts avoid reversing their previous move (no 180° flips).
- **Unpredictability:** Random movement ensures Pacman cannot easily anticipate ghost paths.
- **Collision Handling:** Ghosts avoid walls and illegal moves, maintaining fair and balanced gameplay.

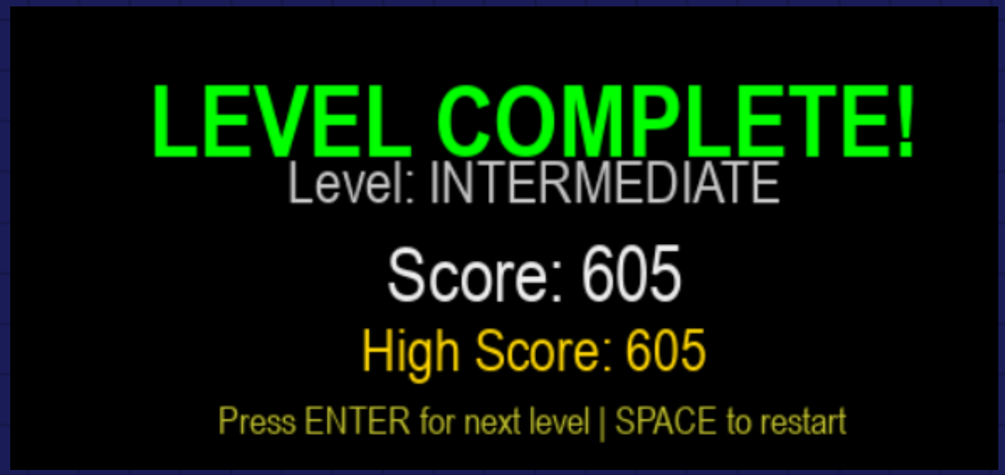
# Results & Performance

- **Smooth Gameplay:** Runs at **30 FPS** with <16ms per frame, ensuring smooth animation.
- **Pacman AI Behavior:**
  - **Wins 88%** of games in total test runs.
  - Successfully **catches vulnerable ghosts** in **~98%** of the games played.
- **Scoring efficiency:**
  - During test sessions, the AI achieved high scores of around **700 points** on the current maze setup.

- Overall, the gameplay demonstrates intelligent risk assessment, smooth movement, and a balanced offense and defense strategy.

# Modifications

- **Strategy Based Styling:** Vulnerable Ghosts speed decreases and it runs away from pacman ,earlier it was randomized
- **Level addition:** Beginner ➡ Intermediate ➡ Pro
- **Dynamic maze generation:** for every new iteration of game new random maze will be displayed




Display window

# Thank You