**Project Title:** Tower Trap – An Unconventional 3-Player Strategic Board Game

**Submitted By:**Sandeep Kumar (22K-4723), Aaryan Kumar (22K-4768), Adeel (22K-4790)

**Course:** AI  
**Instructor:** Miss Mahek Mazhar  
**Submission Date:** 11 May 2025

### **1. Project Overview**

**Project Topic:**We developed an original and unconventional board game titled "Tower Trap," designed for 3 players on a triangular board. The game introduces hidden traps, minimal pieces (one tower per player), and unique movement mechanics with a triangular layout.

**Objective:**To implement a strategic multi-player board game incorporating hidden information, heuristic-based decision making, and complete AI gameplay using the Minimax algorithm. Our goal was to simulate fair and intelligent behavior for both human and AI participants.

### **2. Game Description**

**Original Game Background:**Tower Trap is a new and unique board game not directly based on any conventional board game. It loosely draws inspiration from chess and minesweeper concepts, incorporating movement and hidden traps as core elements.

**Innovations Introduced:**

* A triangular board with 15 valid positions arranged across 5 rows.
* 3-player dynamic with one AI opponent.
* Players begin with one tower each; turns involve moving or placing a trap.
* Unlimited trap placements allowed per player.
* If a player moves into any trap (including their own), they are eliminated.

**Impact on Gameplay:**

* High uncertainty and strategic planning due to trap mechanics.
* Equal rules for all participants (AI and human).
* Promotes risk assessment, prediction, and spatial awareness.

### **3. AI Approach and Methodology**

**AI Techniques Used:**

* Minimax Algorithm with 2-ply depth.
* Heuristic scoring to evaluate future states.

**Heuristic Design:**

* +10 points per surviving tower.
* +5 for adjacency to enemy towers.
* -3 if surrounded.

**Complexity Analysis:**

* The branching factor increases with each open tile.
* Complexity is approximately O(b^d) with b as legal moves and d as depth.
* Managed efficiently via depth-limited Minimax.

### **4. Game Rules and Mechanics**

**Modified Rules:**

* The game is played on a triangular grid of 15 cells.
* Players can move to adjacent cells or place a trap anywhere unoccupied.
* Trap limit has been removed for all players.
* Stepping on any trap (own or enemy) eliminates the tower.

**Winning Conditions:**

* Last surviving player wins.
* If no towers survive, the game is a draw.

**Turn Sequence:**

* Turn-based clockwise rotation.
* Eliminated players are skipped.

### 

### 

### **5. Implementation Plan**

**Programming Language:** Python

**Libraries and Tools:**

* Pygame (for GUI and board interaction)

**Milestones and Timeline:**

* Week 1-2: Game design and board layout
* Week 3-4: Movement mechanics and GUI
* Week 5-6: AI integration using Minimax + heuristic
* Week 7-8: Testing, trap logic, and final fixes

### **6. References**

* Russell, S., & Norvig, P. (2020). Artificial Intelligence: A Modern Approach.
* Pygame Documentation: https://www.pygame.org/docs/
* Multi-agent Minimax Theory: https://www.cs.cmu.edu/~ggordon/780/papers/littman94markov.pdf