Project Title:

Snake, Ladder Ludo Game

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1. Project Overview

The "Snake, Ladder & Ludo Game" is an innovative board game that combines elements of Snakes & Ladders and Ludo while introducing unique mechanics that enhance strategy and player engagement. Unlike traditional versions, this game includes dynamic board elements, power-ups, and player-controlled actions that influence the game outcome.

Objectives:

The main goal of this project is to develop a visually engaging and strategically rich board game that challenges players with new mechanics beyond simple dice rolls. The game will feature unconventional elements such as moving snakes and ladders, power-ups, and an AI component to enhance gameplay difficulty and unpredictability.

2. Game Description

Original Game Background:

- **Snakes & Ladders** is a chance-based board game where players roll dice to move their token along a numbered grid. Landing on a ladder advances the player, while landing on a snake sends them backward.
- **Ludo** is a strategy-based board game where players roll dice to move their tokens around the board and reach the center before their opponents.

Innovation Introduced:

- **Dynamic Board Layout:** Snakes and ladders change positions randomly after every few turns, altering the game's strategy.
- **Power-Ups & Traps:** Players can land on special tiles that provide bonuses (extra rolls, immunity from snakes) or penalties (skip turns, forced backward moves).
- **Multiple Dice System:** Players roll two dice instead of one and can distribute the sum across different moves.

- **AI-Driven Opponent (Optional):** If playing solo, an AI opponent will make strategic decisions rather than purely relying on dice rolls.

3. AI Approach and Methodology

AI Techniques To Be Used:

- **Minimax Algorithm:** Optimized for multi-player decision-making where AI selects the best move based on available choices.
- **Reinforcement Learning (Optional):** AI adapts its movement strategies based on past games, improving difficulty over time.
- **Randomized Decision Trees:** The AI will use probability-based logic to introduce unpredictability in solo play.

Heuristics Design:

- AI evaluates game states based on potential advancements, avoiding risky snake zones, and utilizing power-ups efficiently.

Complexity Analysis:

- Time complexity will vary based on AI implementation; heuristic-based movement will operate in **O(1)** time, while Minimax may run in **O(b^d)**, where b is the branching factor and d is depth.

4. Game Rules and Mechanics

Modified Rules:

1. **Snakes and Ladders Move:** After every 3 turns, some snakes and ladders change positions, forcing players to adapt.
2. **Power-Up Tiles:** Special tiles offer extra rolls, immunity from snakes, or forced movement of opponents.
3. **Multi-Dice System:** Players can roll two dice and strategically decide how to distribute their moves.

Winning Conditions:

- The first player to reach **position 100** wins.
- If AI mode is enabled, the AI follows similar winning conditions with strategic movement.

Turn Sequence:

- Players roll dice and decide their movement.
- If they land on a power-up tile, the effect is applied immediately.
- Every **3 turns, snakes and ladders reposition** dynamically.
- The AI (if enabled) analyzes the board and takes its turn.

5. Implementation Plan

Programming Language:

- Python

Libraries And Tools:

- **Pygame/Tkinter:** GUI development and board visualization.
- **NumPy:** Handling randomization and AI logic.
- **Scikit-learn (Optional):** If reinforcement learning is implemented.

Milestones And Timeline:

- **Week 1-2:** Plan the game, decide on rules, and create a basic design.
- **Week 3-4:** Build the board, dice roll mechanics, and player movement.
- **Week 5-6:** Add AI and test how it plays the game.
- **Week 7:** Add multiplayer mode and special power-ups.
- **Week 8:** Final testing, fix any problems, and prepare the final report.