Project Title:
Snakes and Ladders With Prediction Challenge

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Course:
AI

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1. Project Overview

Project Topic:
This project modifies the traditional Snakes and Ladders board game by introducing a prediction-based gameplay mechanic. Players (including an AI) predict the next dice roll, and correct guesses lead to bonus rewards such as skipping turns, doubling moves, or earning points. The AI player uses statistical prediction based on frequency analysis of previous outcomes.

Objective:
To develop a prediction-based AI that interacts in a turn-based board game environment and integrates decision-making mechanics. The aim is to study how simple statistical predictions can influence strategic gameplay and modify outcomes in a game originally based purely on chance.

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2. Game Description

Original Game Background:
Snakes and Ladders is a board game played with dice where players race to reach the final square. Landing on a ladder moves the player ahead, while landing on a snake sends them backward. There is no skill or strategy involved in the original game; progress is determined entirely by chance.

Innovations Introduced:

- Integration of a prediction phase where both the human and AI player predict dice rolls.

- Bonus options triggered by correct predictions: double move, skip opponent's turn, or gain points.
- AI can use points to neutralize the effect of snakes.
- Simple statistical AI uses frequency of past dice rolls for prediction.
- Interactive user interface with visual feedback for predictions and bonus actions.

These innovations increase strategic depth and player engagement in what is otherwise a chance-based game.

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3. AI Approach and Methodology

AI Techniques to be Used:

- **Statistical Analysis (Frequency-Based Prediction):** The AI predicts the next dice roll based on the most frequently occurring past outcomes using Python's `collections.Counter`.
- **Heuristic-Based Decision:** The AI chooses the best reward (e.g., skip, double, bonus) based on board position and game state.

Heuristic Design:

- AI evaluates position advantage, proximity to snakes/ladders, and relative distance to opponent to determine the best bonus reward upon correct prediction.

Complexity Analysis:

- The prediction logic is linear in terms of recent dice history (O(n)), and the decision-making uses simple conditional rules based on board coordinates, making the overall AI lightweight and efficient for real-time gameplay.

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4. Game Rules and Mechanics

Modified Rules:

- Each turn starts with a prediction by the player and AI.
- Correct prediction triggers a bonus choice: double the move, skip opponent's turn, or +10 points.
- 20 bonus points can be spent to neutralize snake effects.
- Ladders and snakes still function as in the original game, unless neutralized.

Winning Conditions:

- First player to reach the top-left cell wins the game.

Turn Sequence:

- Turns alternate between the AI (Red) and the Player (Blue).
- Each turn includes: prediction → dice roll → evaluation of prediction → movement → snake/ladder effects → possible bonus actions.

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5. Implementation Plan

Programming Language:

- Python

Libraries and Tools:

- **Pygame:** for GUI and interactive visuals
- **collections (Counter):** for prediction frequency analysis

Milestones and Timeline:

- **Week 1–2:** Define game logic, board design, and rule modifications
- **Week 3–4:** Implement prediction system and design AI behavior

- **Week 5–6:** Code the full game loop and integrate prediction with turn logic
- **Week 7:** Test AI interactions, bonus handling, and snake neutralization logic
- **Week 8:** Final refinements and documentation/report writing

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6. References

- Python Official Documentation
- Pygame Documentation
- Stack Overflow threads on event-driven logic and GUI rendering
- Online articles on game AI and turn-based game development