AI Project Proposal: **Triple Threat: Tic Tac Toe**

Course: Artificial Intelligence
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Project Overview: Advanced Tic Tac Toe

Triple Threat: Tic Tac Toe reimagines the traditional 3x3 grid game by introducing a layered structure that brings depth, strategy, and increased complexity. In this version, each cell of a larger 3x3 grid contains its own smaller 3x3 Tic Tac Toe board. The objective remains to secure three in a row—but now, that victory must be achieved by winning three smaller boards aligned on the main grid. This project aims to develop a complete implementation of this game, featuring an intelligent AI opponent that uses the Minimax algorithm enhanced with alpha-beta pruning to make efficient and competitive move decisions.

Gameplay Mechanics and Rules

The game structure is composed of nine smaller Tic Tac Toe boards arranged to form a main 3x3 grid. Each move made within a small board directly influences the next move's location—specifically, the position within the main grid determines the next small board in which the opponent must play. If the directed board has already been won or is completely filled, the next player is free to move in any active board.

To win the game, a player must claim three small boards in a straight line—horizontally, vertically, or diagonally—on the main board. Winning a small board locks it with the player's symbol and renders it inactive. The first move is randomly assigned to either the human player or the AI. Notably, when a player wins a small board, they are granted an immediate extra turn, diverging from the usual alternating turn pattern. As development progresses, some of these rules may be refined to enhance gameplay dynamics and introduce novel challenges.

AI Strategy and Heuristic Evaluation

The core of the AI lies in its decision-making engine, powered by the Minimax algorithm with alpha-beta pruning. This technique allows the AI to anticipate future moves while efficiently eliminating suboptimal branches in the game tree. To guide the algorithm's choices and assess game states effectively, a heuristic evaluation function is implemented.

The heuristic system evaluates the game board based on several key factors. First, control of individual mini boards is crucial; boards won by the AI add to its score, while those won by the opponent subtract. Next, the AI considers win potential within each mini board, awarding points for near-winning lines and penalizing similar advantages for the opponent. Strategic

opportunities on the main board—such as forming two aligned mini board victories with a chance for a third—are heavily weighted to emphasize long-term goals. Additionally, control of central cells, both in the mini boards and the main grid, is encouraged due to their strategic significance.

The final evaluation for any given game state is computed as a weighted sum of all these heuristic factors. These weights are fine-tuned through iterative testing to enhance the AI's effectiveness and make it a formidable opponent.