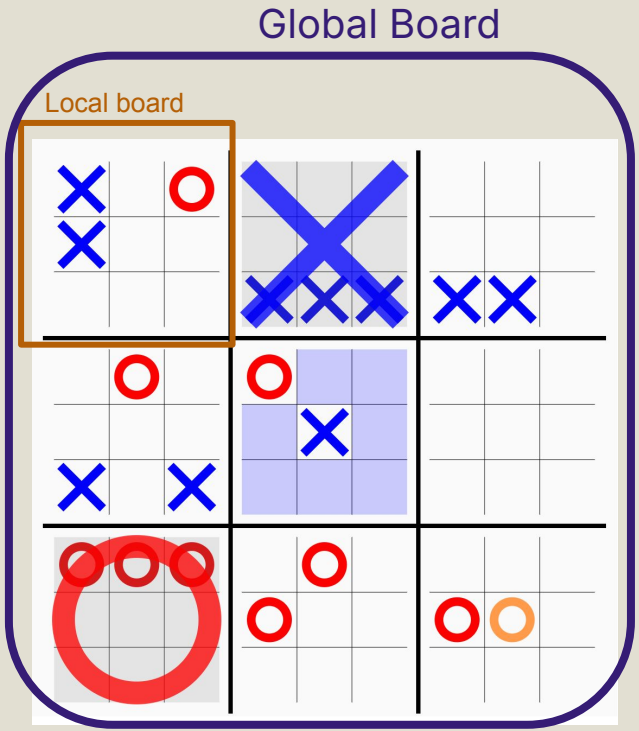
Game state: 3×3 grid of Standard TicTacToe boards

Game Progression: players take turns placing moves in a local board

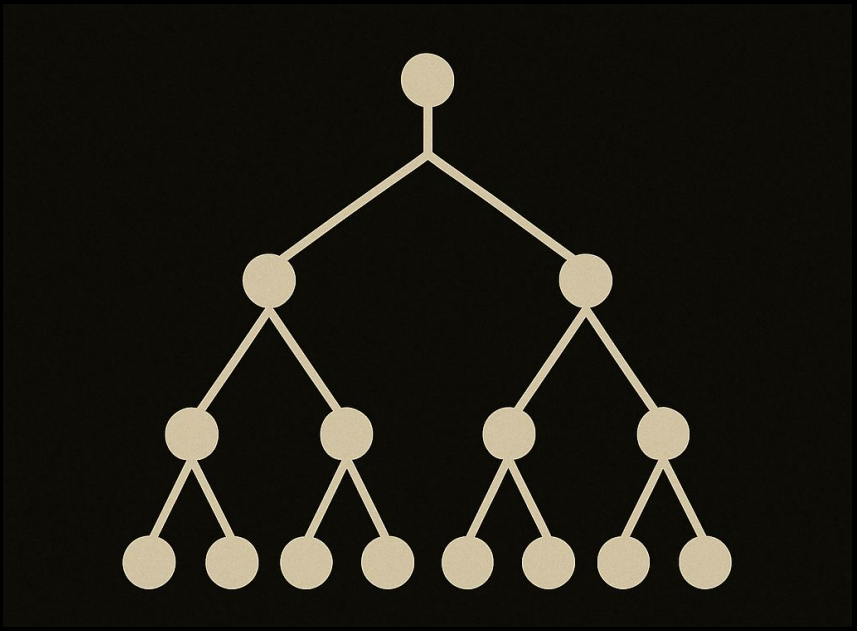
> **NOTE**: the position of grid that player places its move in a local board will be the position of local board that the next player have to place his move in the global board until that local board is won by a player

End Goal: game is won when a player secures three local boards in a row/col/diagonal
(each local board is won similarly in traditional tictactoe), otherwise compare the number of local boards won



Ultimate tic-tac-toe

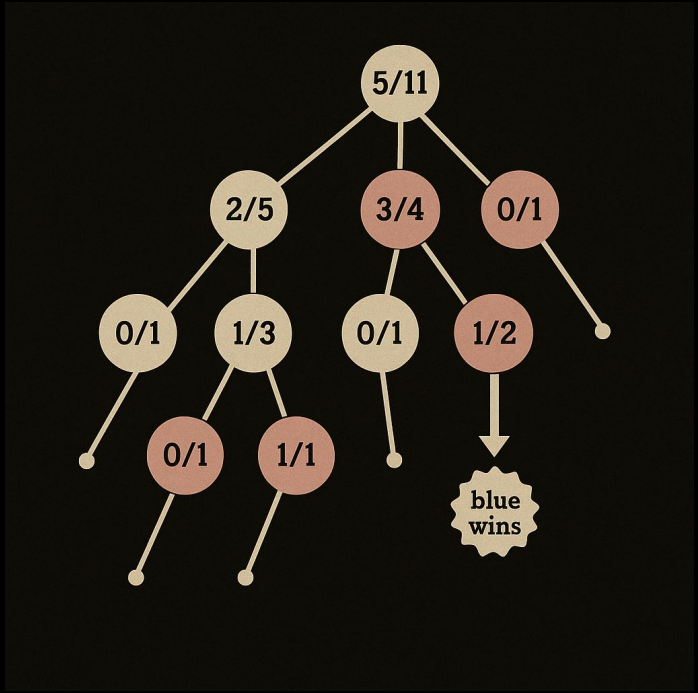
Victor, Duy, Zhi Sheng, Xiaoxiao



Minimax

Heuristic Evaluation Function
(given that we are ‘X’)

1. **+10 for board won, -10 for board lost**
2. Winning Opportunity: lines with 2 ‘X’ marks and 1 empty space are prioritized (+3)
3. Blocking Opponent: lines with 2 ‘O’ marks and 1 empty space are penalized (-4)
4. Early Formations: lines with 1 ‘X’ and 2 empty spaces are slightly rewarded (+1)
5. Opponent Formations: lines with 1 ‘O’ and 2 empty spaces are slightly penalized (-1)



MCTS

No heuristics evaluation function!

4 steps per iteration:

1. Select
2. Expand
3. Simulate
4. Backpropagate

$$UCB1 = \underbrace{\frac{w_i}{n_i}}_{winrate} + \underbrace{c\sqrt{\frac{\ln N_i}{n_i}}}_{exploration\ term}$$

Initial results:

1. Minimax: Bronze league
2. MCTS: Silver league
3. MCTS /w C++ Optimization: **GOLD LEAGUE!**