

# CSCI 3202 Mancala Project

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## Implementation Details:

**Test Results: Derived from Mancala with 6 pits per player and 4 stones per pit with 20,000 simulated games**

- Random vs. Random:
  - Win Rates:
    - P1: 49.61%
    - P2: 46.14%
  - Average Moves to Win: [40, 42]
- Random vs. Minimax AI Player (tested at 5 plies):
  - Win Rates: (first 10000)
    - Minimax AI: 99.94%
    - Random: .025%
  - Average Moves to Win: [30, 32]
  - Differences between Minimax AI Player and Random
    - It is clear that the Minimax AI Player outperforms the Random player. This is intuitive because decisions made by the Minimax AI Player are more informed than those of the Random player. The extra information is the result of the minimax algorithm which provides the AI player with a lookahead into the game decision tree from which it selects the most favorable action. By choosing the most favorable action, the AI player is able to outplay the Random player.
- Random vs. Alpha-Beta AI Player:
  - 5 plies:
    - Time to Complete A Single Game: 0.011447658324241638
    - Win Rate:
      - Alpha-Beta: 99.945%
      - Random: .025%
    - Average Moves to Win: [31, 33]
    - Differences between Alpha-Beta and Minimax AI at 5 plies:
      - The results in respect to win rate and average moves to win are nearly identical between alpha beta and minimax. This similarity is expected however because alpha beta and minimax in the same situation should determine the same best action. Where the algorithms seem to differ lies in the speed in which actions are determined. Alpha beta was noticeably quicker at completing games than minimax at a depth of 5 plies and beyond. Again, this is expected because of alpha beta's ability to prune moves which

do not lead to favorable results thereby saving valuable computation time.

- 10 plies: (tested using 100 games)
  - Time to Complete A Single Game: 1.2427114176750182
  - Win Rate:
    - Alpha-Beta: 100%
    - Random: 0
  - Average Moves to Win: [30, 32]
  - Result of increasing plies:
    - The increase of plies did not have a significant effect in respect to improving win rate because the win rate for the AI player at a depth of 5 plies was already hovering between 99-100%. If this were not the case, though, it would be reasonable to expect that the AI player's performance would improve as the depth of plies increased. The increasing depth would allow the AI player to look deeper into the game decision tree and see effects of a particular move many moves down the line.