Report for Project 3

I. Discussion:

The evaluation function is a crucial part of any AI-based game-playing algorithm. It helps determine the desirability of a given board state from the perspective of the AI player. In the provided TicTacToe code, the evaluation function is implemented in the "Evaluate()" method. The evaluation function should assign a numeric value to each board state, reflecting the AI's advantage or disadvantage. In my Java code, the evaluation function evaluates the board state by analyzing potential winning patterns (rows, columns, and diagonals) and counting the number of X's (computer's moves) and O's (player's moves) in each pattern. Based on this analysis, it assigns a score to the board state. Here's how my evaluation function works:

1. The function iterates through the board to check for winning patterns (rows and columns).
2. It counts the number of X's (CompCount) and O's (PlayerCount) in each pattern.
3. If the player has more moves in a pattern, the AI assigns a higher score to that pattern. This is done to prioritize defending against player wins.
4. If the AI has more moves (CompCount) and the number of blank cells (blanks) is equal to the number needed to complete a winning pattern (CONNECT), the AI assigns a higher score to that pattern. This is to encourage the AI to aim for positions that lead to a potential win.
5. If the player has more moves (PlayerCount) and the number of blank cells (blanks) is equal to the number needed to complete a winning pattern (CONNECT), the AI assigns a negative score to that pattern. This is to discourage the AI from allowing the player to complete a winning pattern

Project 3 was an invaluable experience that allowed me to delve into the world of game-playing algorithms, including Minimax with alpha-beta pruning. As someone who had never written an AI for a game before, the project presented both challenges and excitement. Implementing an AI for TicTacToe showed me that even seemingly simple games can have complex AI strategies, which can make the AI surprisingly challenging to play against. Moreover, this project prompted me to consider the optimization of the AI's performance, particularly when employing alpha-beta pruning. Balancing efficiency and search depth became crucial aspect of enhancing the AI's decision-making prowess. Overall, Project 3 sparked a deep appreciation for the intricacies of AI development and the continuous pursuit of refining and fine-tuning algorithms to create smarter and more capable AI systems.

II. Output Samples:

```
Max amount of time allowed for AI [1-30] in seconds: 5
Do you want to move first [Y/N]? Y
  1 2 3 4 5 6 7 8
A - - - - - - - -
B - - - - - - - -
C - - - - - - - -
D - - - - - - - -
E - - - - - - - -
F - - - - - - - -
G - - - - - - - -
H - - - - - - - -
Enter your move: D4
  1 2 3 4 5 6 7 8
A - - - - - - - -
B - - - - - - - -
C - - - - - - - -
D - - - O - - - -
E - - - - - - - -
F - - - - - - - -
G - - - - - - - -
H - - - - - - - -
My move is B 2
  1 2 3 4 5 6 7 8
A - - - - - - - -
B - X - - - - - -
C - - - - - - - -
D - - - O - - - -
E - - - - - - - -
F - - - - - - - -
G - - - - - - - -
H - - - - - - - -

Enter your move: D5
  1 2 3 4 5 6 7 8
A - - - - - - - -
B - X - - - - - -
C - - - - - - - -
D - - - O O - - -
E - - - - - - - -
F - - - - - - - -
G - - - - - - - -
H - - - - - - - -
My move is D 6
  1 2 3 4 5 6 7 8
A - - - - - - - -
B - X - - - - - -
C - - - - - - - -
D - - - O O X - -
E - - - - - - - -
F - - - - - - - -
G - - - - - - - -
H - - - - - - - -
```

```
Enter your move: E4
  1 2 3 4 5 6 7 8
A - - - - - - - -
B - X - - - - - -
C - - - - - - - -
D - - - O O X - -
E - - - O - - - -
F - - - - - - - -
G - - - - - - - -
H - - - - - - - -
My move is C 4
  1 2 3 4 5 6 7 8
A - - - - - - - -
B - X - - - - - -
C - - - X - - - -
D - - - O O X - -
E - - - O - - - -
F - - - - - - - -
G - - - - - - - -
H - - - - - - - -

Enter your move: F4
  1 2 3 4 5 6 7 8
A - - - - - - - -
B - X - - - - - -
C - - - X - - - -
D - - - O O X - -
E - - - O - - - -
F - - - O - - - -
G - - - - - - - -
H - - - - - - - -
My move is G 4
  1 2 3 4 5 6 7 8
A - - - - - - - -
B - X - - - - - -
C - - - X - - - -
D - - - O O X - -
E - - - O - - - -
F - - - O - - - -
G - - - X - - - -
H - - - - - - - -
```

```
Enter your move: D3
  1 2 3 4 5 6 7 8
A - - - - - - - -
B - X - - - - - -
C - - - X - - - -
D - - O O O X - -
E - - - O - - - -
F - - - O - - - -
G - - - X - - - -
H - - - - - - - -
My move is D 2
  1 2 3 4 5 6 7 8
A - - - - - - - -
B - X - - - - - -
C - - - X - - - -
D - X O O O X - -
E - - - O - - - -
F - - - O - - - -
G - - - X - - - -
H - - - - - - - -

Enter your move: E3
  1 2 3 4 5 6 7 8
A - - - - - - - -
B - X - - - - - -
C - - - X - - - -
D - X O O O X - -
E - - O O - - - -
F - - - O - - - -
G - - - X - - - -
H - - - - - - - -
My move is C 2
  1 2 3 4 5 6 7 8
A - - - - - - - -
B - X - - - - - -
C - X - X - - - -
D - X O O O X - -
E - - O O - - - -
F - - - O - - - -
G - - - X - - - -
H - - - - - - - -
```

```
Enter your move: E2
  1 2 3 4 5 6 7 8
A - - - - - - - -
B - X - - - - - -
C - X - X - - - -
D - X O O O X - -
E - O O O - - - -
F - - - O - - - -
G - - - X - - - -
H - - - - - - - -
My move is A 2
  1 2 3 4 5 6 7 8
A - X - - - - - -
B - X - - - - - -
C - X - X - - - -
D - X O O O X - -
E - O O O - - - -
F - - - O - - - -
G - - - X - - - -
H - - - - - - - -
Opponent win
Thank you for playing!
Exiting...
```

```
Max amount of time allowed for AI [1-30] in seconds: 5
Do you want to move first [Y/N]? N
My move is A 1
  1 2 3 4 5 6 7 8
A X - - - - - - -
B - - - - - - - -
C - - - - - - - -
D - - - - - - - -
E - - - - - - - -
F - - - - - - - -
G - - - - - - - -
H - - - - - - - -
Enter your move: E5
  1 2 3 4 5 6 7 8
A X - - - - - - -
B - - - - - - - -
C - - - - - - - -
D - - - - - - - -
E - - - - O - - -
F - - - - - - - -
G - - - - - - - -
H - - - - - - - -
My move is C 4
  1 2 3 4 5 6 7 8
A X - - - - - - -
B - - - - - - - -
C - - - X - - - -
D - - - - - - - -
E - - - - O - - -
F - - - - - - - -
G - - - - - - - -
H - - - - - - - -

Enter your move: F6
  1 2 3 4 5 6 7 8
A X - - - - - - -
B - - - - - - - -
C - - - X - - - -
D - - - - - - - -
E - - - - O - - -
F - - - - - O - -
G - - - - - - - -
H - - - - - - - -
My move is B 3
  1 2 3 4 5 6 7 8
A X - - - - - - -
B - - X - - - - -
C - - - X - - - -
D - - - - - - - -
E - - - - O - - -
F - - - - - O - -
G - - - - - - - -
H - - - - - - - -
```

```
Enter your move: E6
  1 2 3 4 5 6 7 8
A X - - - - - - -
B - - X - - - - -
C - - - X - - - -
D - - - - - - - -
E - - - - O O - -
F - - - - - O - -
G - - - - - - - -
H - - - - - - - -
My move is G 6
  1 2 3 4 5 6 7 8
A X - - - - - - -
B - - X - - - - -
C - - - X - - - -
D - - - - - - - -
E - - - - O O - -
F - - - - - O - -
G - - - - - X - -
H - - - - - - - -

Enter your move: E5
Illegal Move! Please enter a valid move in the format 'A1', 'B3', etc.
Enter your move: E4
  1 2 3 4 5 6 7 8
A X - - - - - - -
B - - X - - - - -
C - - - X - - - -
D - - - - - - - -
E - - - O O O - -
F - - - - - O - -
G - - - - - X - -
H - - - - - - - -
My move is E 3
  1 2 3 4 5 6 7 8
A X - - - - - - -
B - - X - - - - -
C - - - X - - - -
D - - - - - - - -
E - - X O O O - -
F - - - - - O - -
G - - - - - X - -
H - - - - - - - -

Enter your move: E7
  1 2 3 4 5 6 7 8
A X - - - - - - -
B - - X - - - - -
C - - - X - - - -
D - - - - - - - -
E - - X O O O O -
F - - - - - O - -
G - - - - - X - -
H - - - - - - - -
You win
Thank you for playing!
```