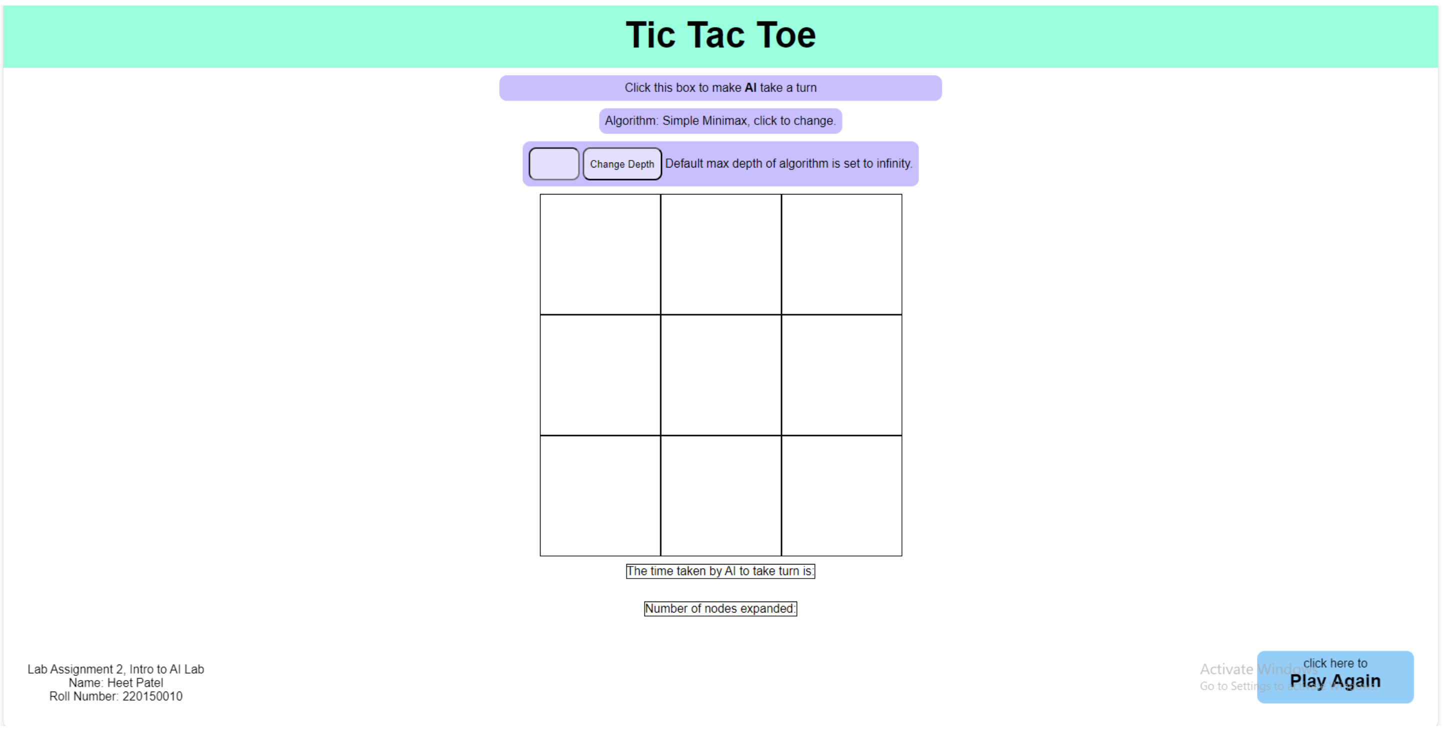
Tic Tac Toe
using MiniMax
with and without alpha/beta pruning

I Designed the Tic Tac Toe game in Vanilla JS using the Minimax search algorithm, with and without alpha pruning.



Tic Tac Toe

Click this box to make **AI** take a turn

Algorithm: Simple Minimax, click to change.

Change Depth Default max depth of algorithm is set to infinity.

The time taken by AI to take turn is:

Number of nodes expanded:

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click here to
Play Again

Here's the link to the hosted game:
https://heet434.github.io/tic_tac_toe_minimax/

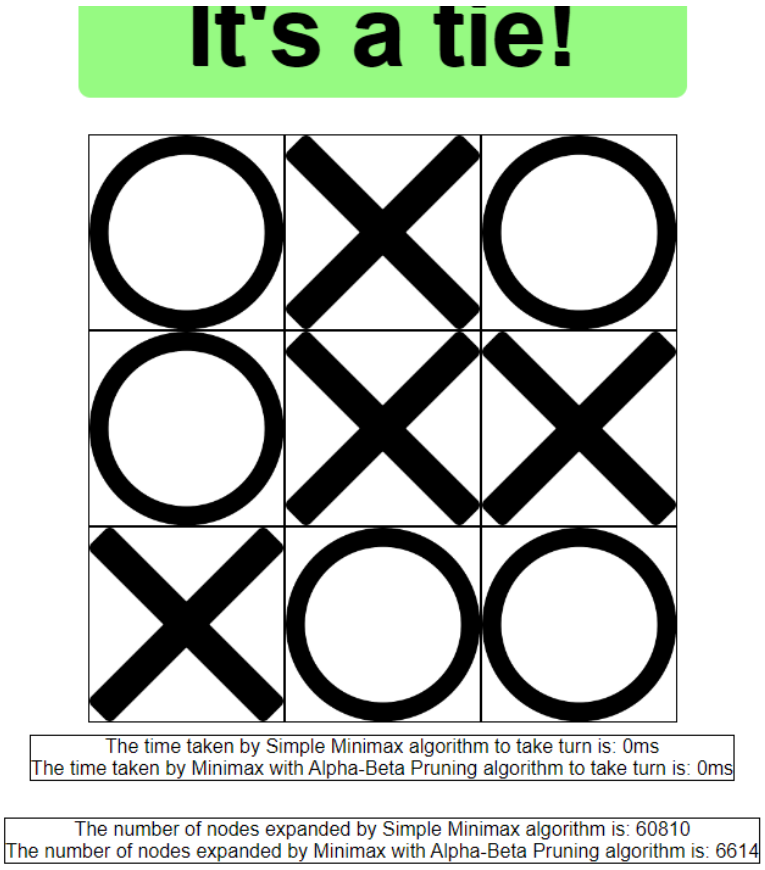
There are features to make AI take turn at any point of time, change algorithm to with alpha-beta pruning and without alpha-beta pruning and to change the depth function according to the user.

Number of nodes expanded per algorithm and time taken per algorithm are also displayed.

A graph generated towards the left compares the time taken per algorithm on each turn.

Comparing the two algorithms:

Here is the graph for a complete game (tie game) shown below:



It's a tie!

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The time taken by Simple Minimax algorithm to take turn is: 0ms
The time taken by Minimax with Alpha-Beta Pruning algorithm to take turn is: 0ms

The number of nodes expanded by Simple Minimax algorithm is: 60810
The number of nodes expanded by Minimax with Alpha-Beta Pruning algorithm is: 6614
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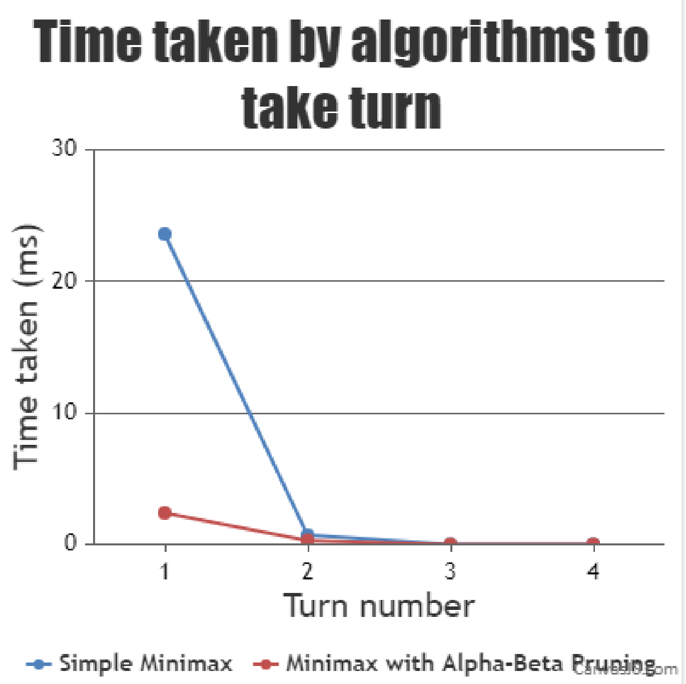
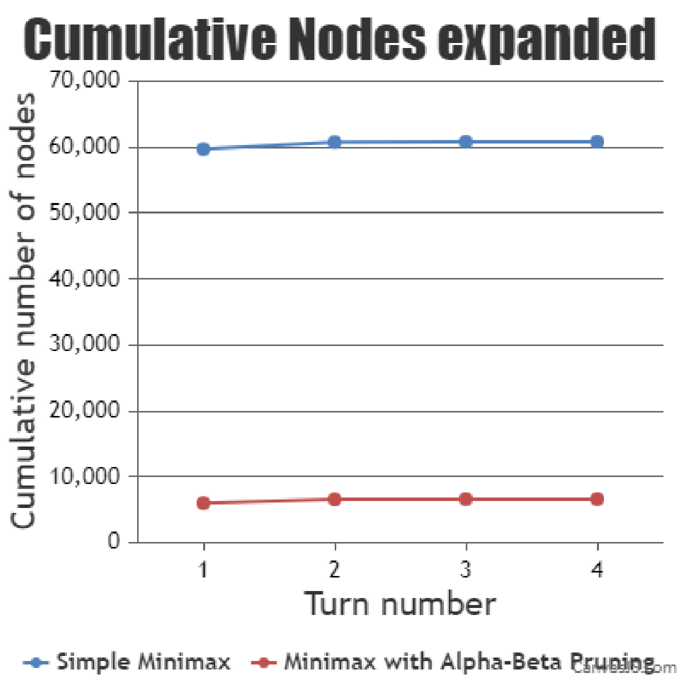
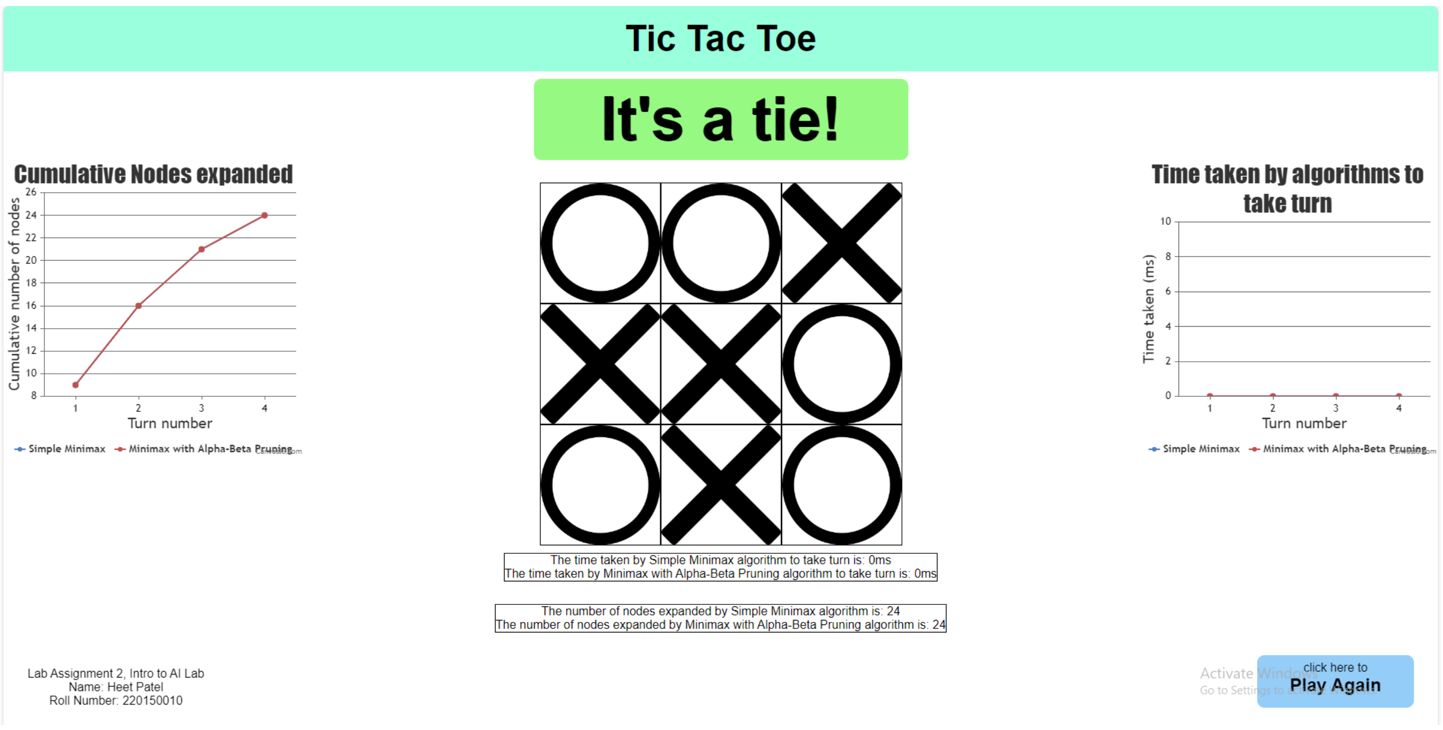




Note that the charts shown here are displayed for depth = infinity, hence the entire game tree is searched.

It is clearly visible from the charts that Alpha-Beta pruning significantly optimizes the minimax search algorithm by reducing our search space.

ANALYSIS FOR DEPTH 1:


Cumulative Nodes expanded
Cumulative number of nodes
Turn number
Simple Minimax
Minimax with Alpha-Beta Pruning
Time taken by algorithms to take turn
Time taken (ms)
Turn number
Simple Minimax
Minimax with Alpha-Beta Pruning
Activate Windows
Go to Settings to activate Windows.

Tic Tac Toe

It's a tie!

The time taken by Simple Minimax algorithm to take turn is: 0ms
The time taken by Minimax with Alpha-Beta Pruning algorithm to take turn is: 0ms

The number of nodes expanded by Simple Minimax algorithm is: 24
The number of nodes expanded by Minimax with Alpha-Beta Pruning algorithm is: 24

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click here to
Play Again

As visible by the graphs and numbers, for depth 1, both algorithms perform almost the same. Although, for depth 1, AI player does not play optimally. The total nodes expanded by both with and without alpha beta pruning are 24. This is because no further nodes are expanded after the next level for depth 1.