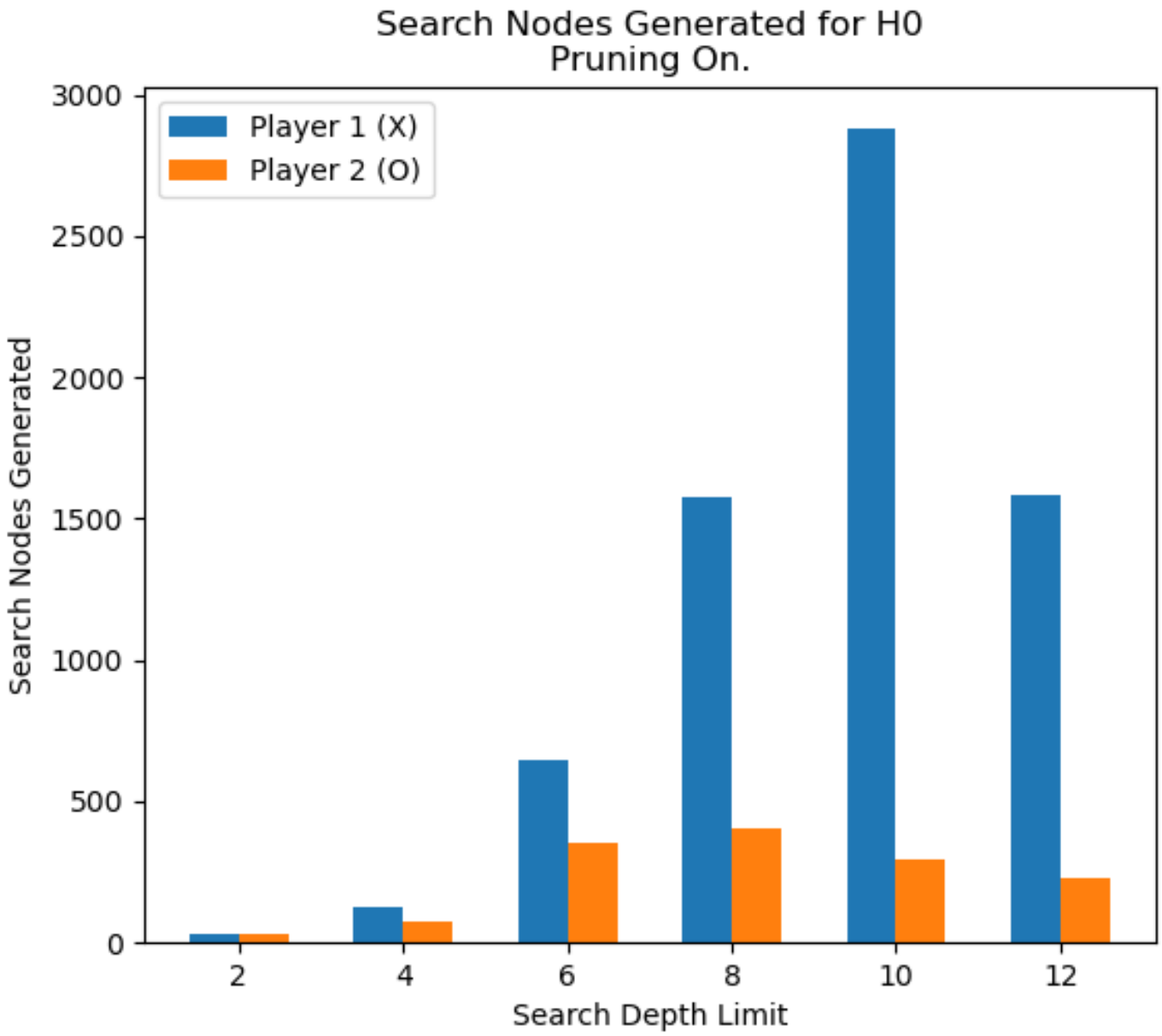
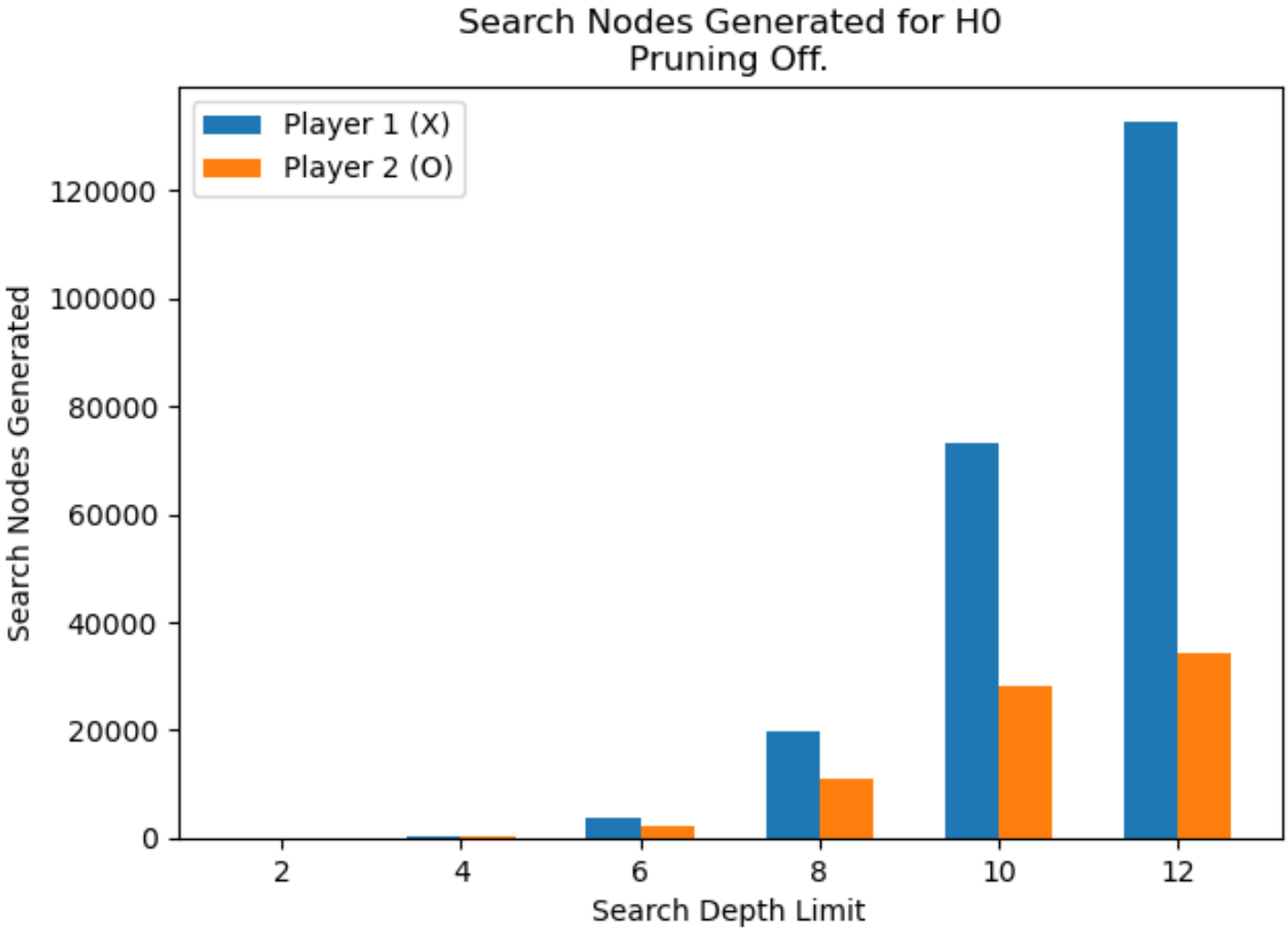
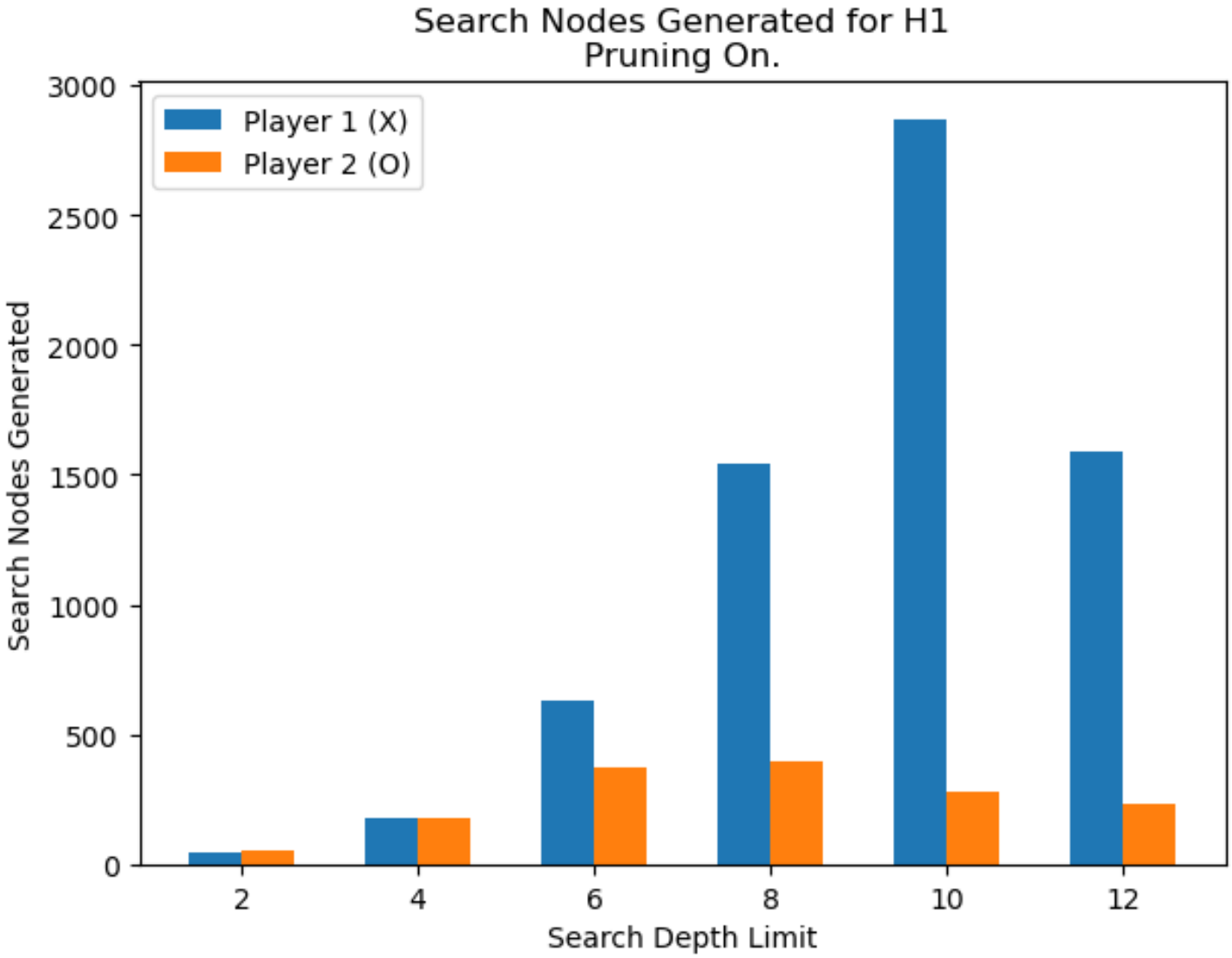
Joseph Balaty

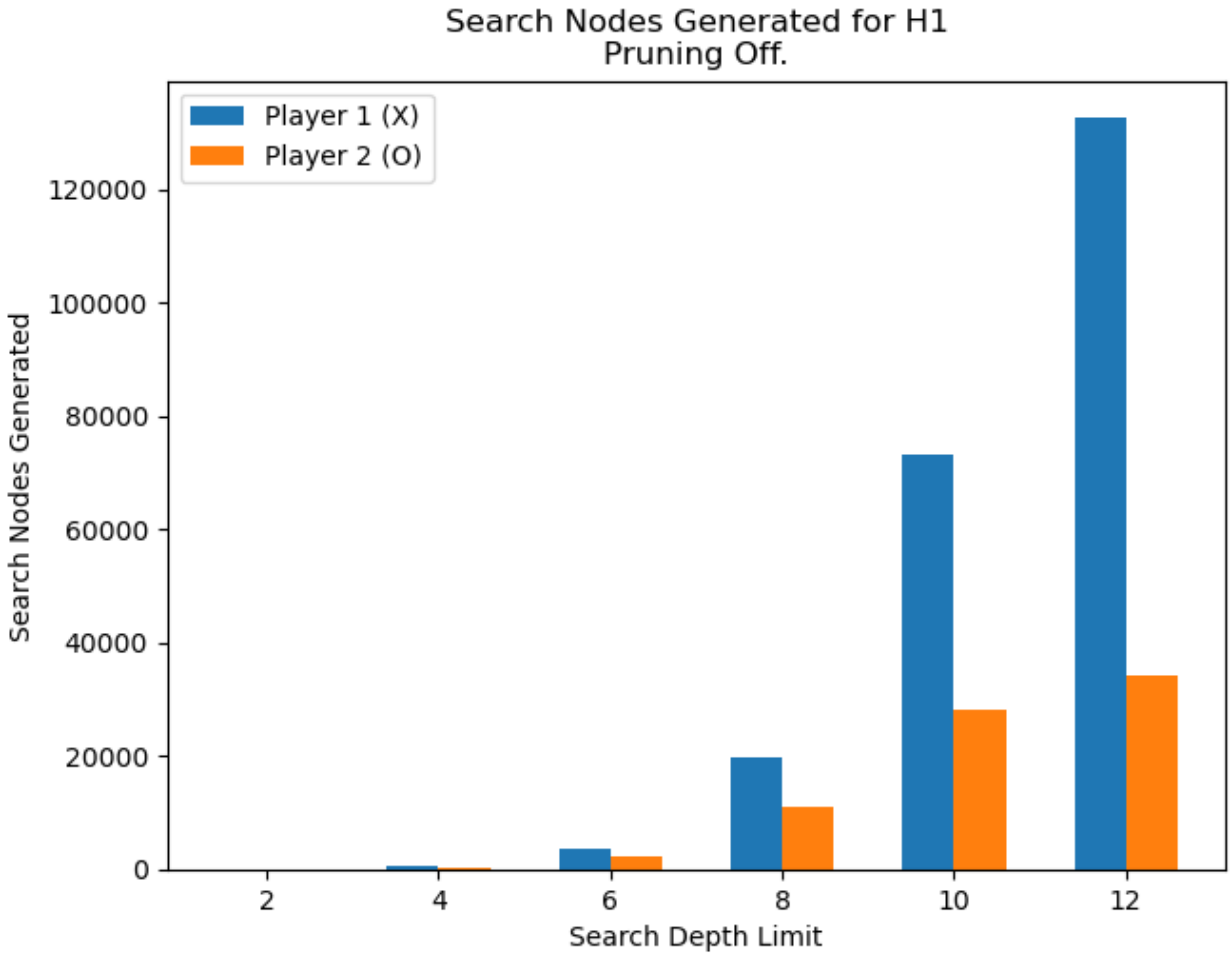
4x4 Simplified Othello Report

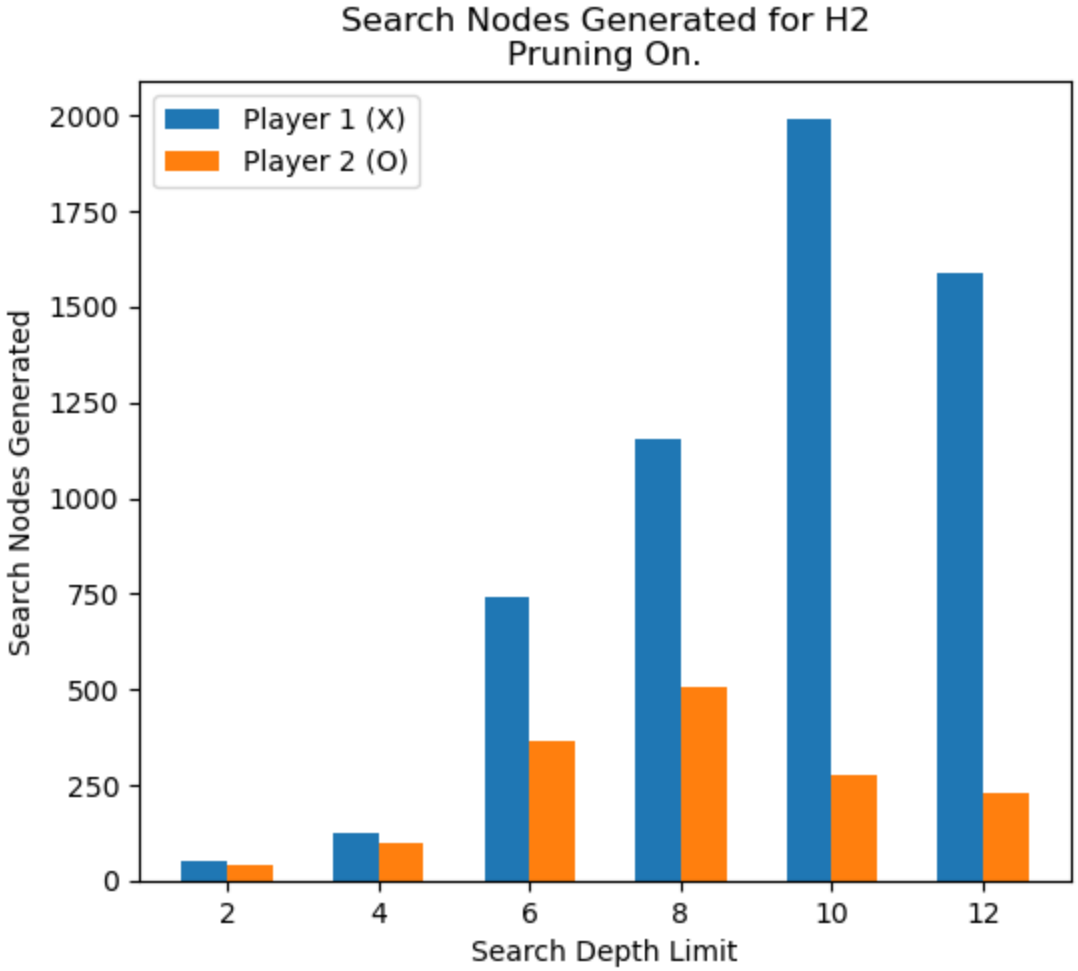
Plots of Search Nodes

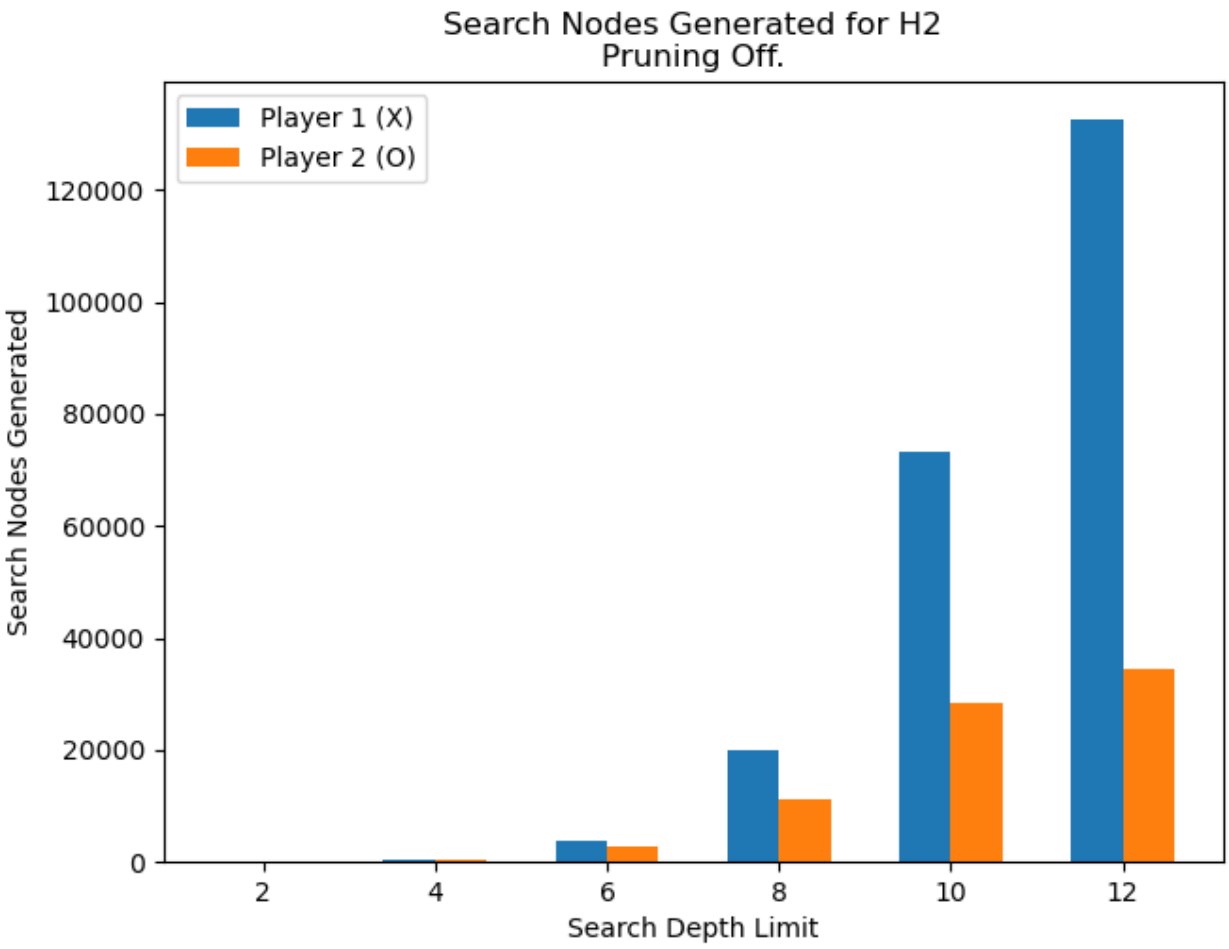



Search Nodes Generated for H0
Pruning Off.
Player 1 (X)
Player 2 (O)
Search Nodes Generated
0
20000
40000
60000
80000
100000
120000
2
4
6
8
10
12
Search Depth Limit

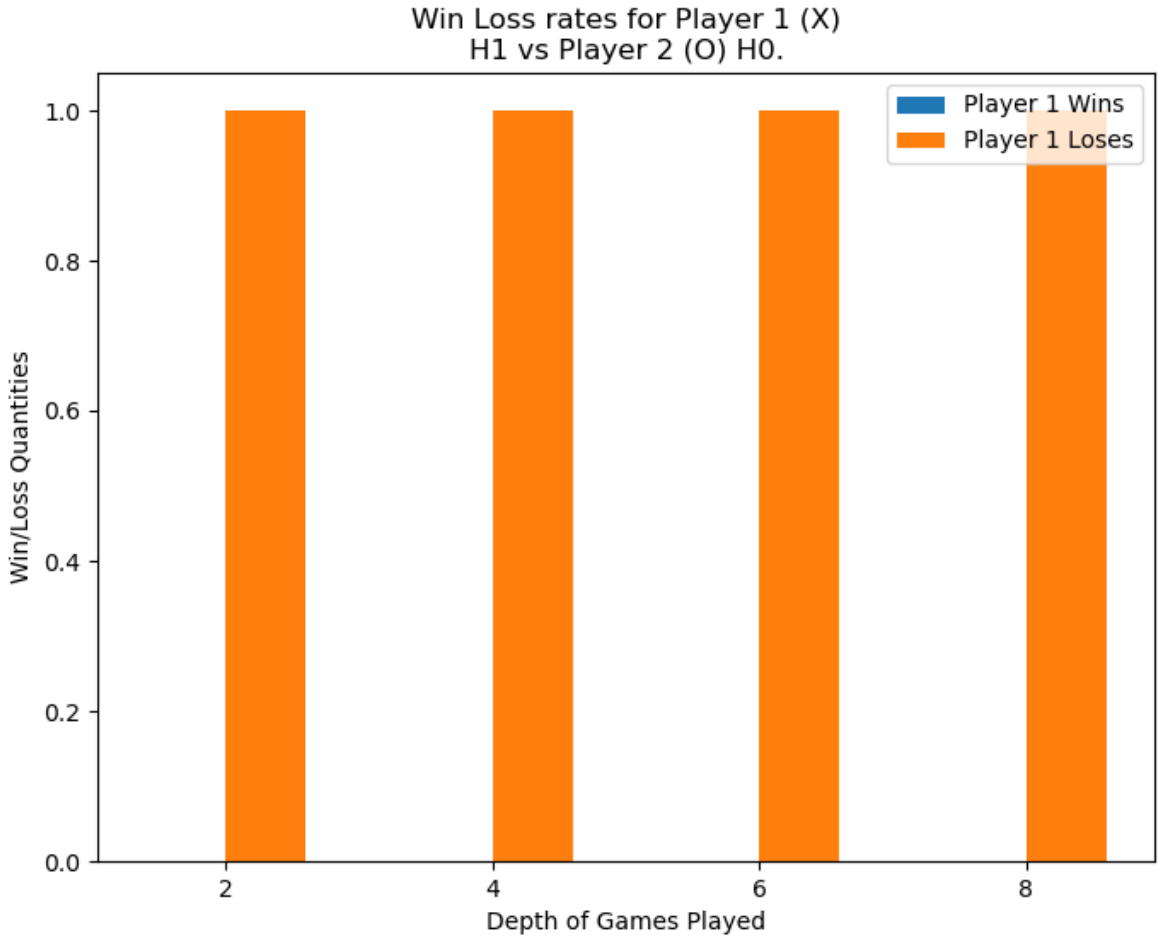

Search Nodes Generated for H1
Pruning On.
Player 1 (X)
Player 2 (O)
Search Nodes Generated
3000
2500
2000
1500
1000
500
0
2
4
6
8
10
12
Search Depth Limit

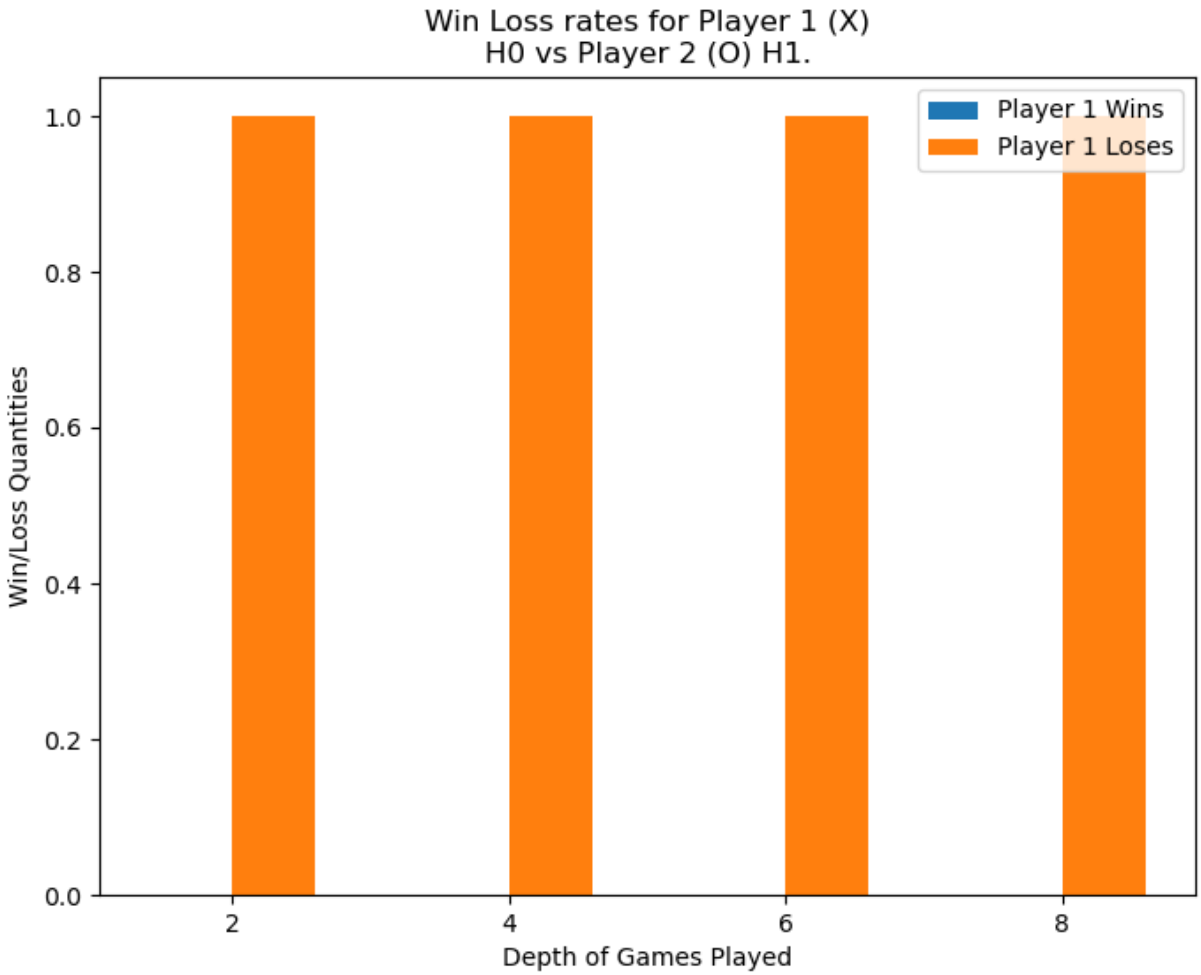

Search Nodes Generated for H1
Pruning Off.
Player 1 (X)
Player 2 (O)
Search Nodes Generated
120000
100000
80000
60000
40000
20000
0
2
4
6
8
10
12
Search Depth Limit

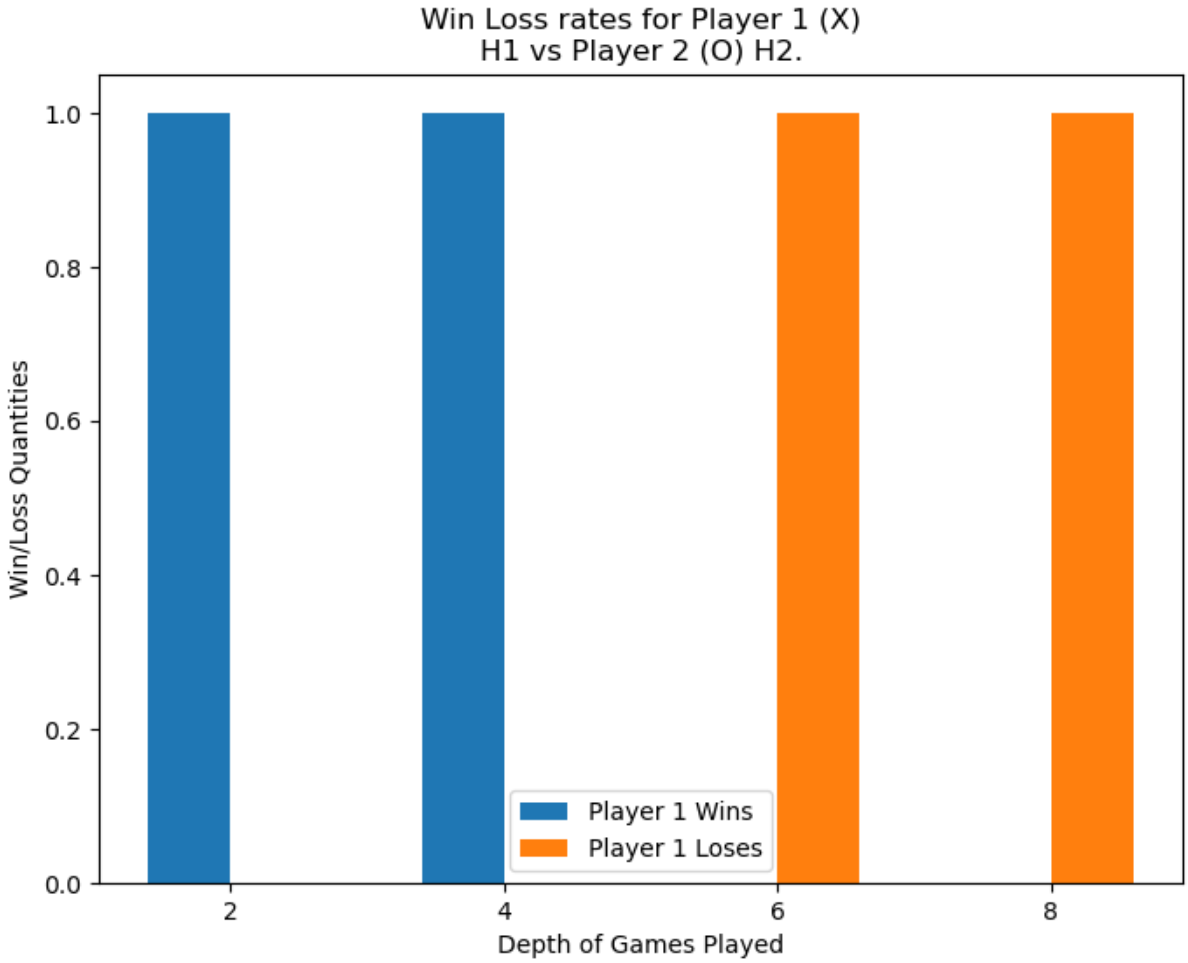

Search Nodes Generated for H2
Pruning On.
Player 1 (X)
Player 2 (O)
Search Nodes Generated
2000
1750
1500
1250
1000
750
500
250
0
2
4
6
8
10
12
Search Depth Limit

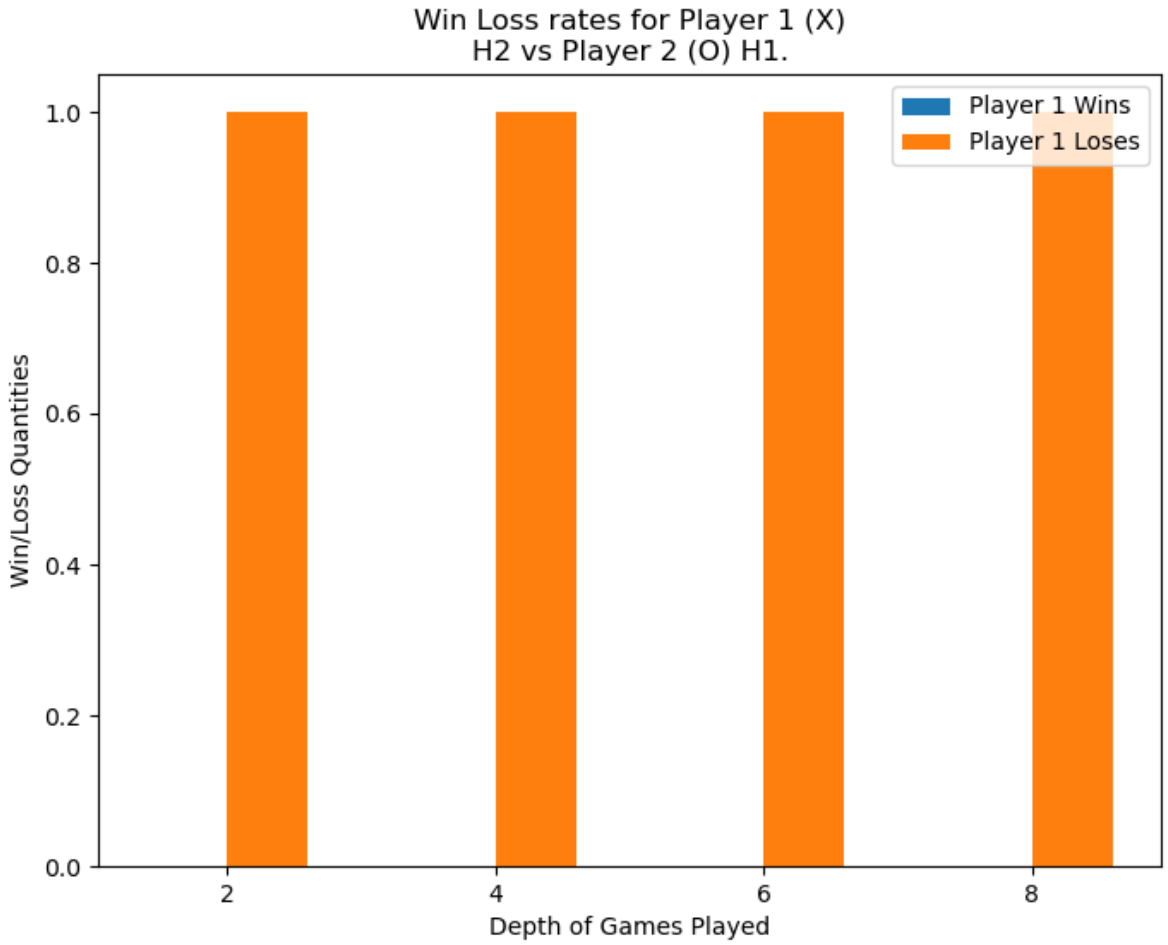

Search Nodes Generated for H2
Pruning Off.
Player 1 (X)
Player 2 (O)
Search Nodes Generated
120000
100000
80000
60000
40000
20000
0
2
4
6
8
10
12
Search Depth Limit

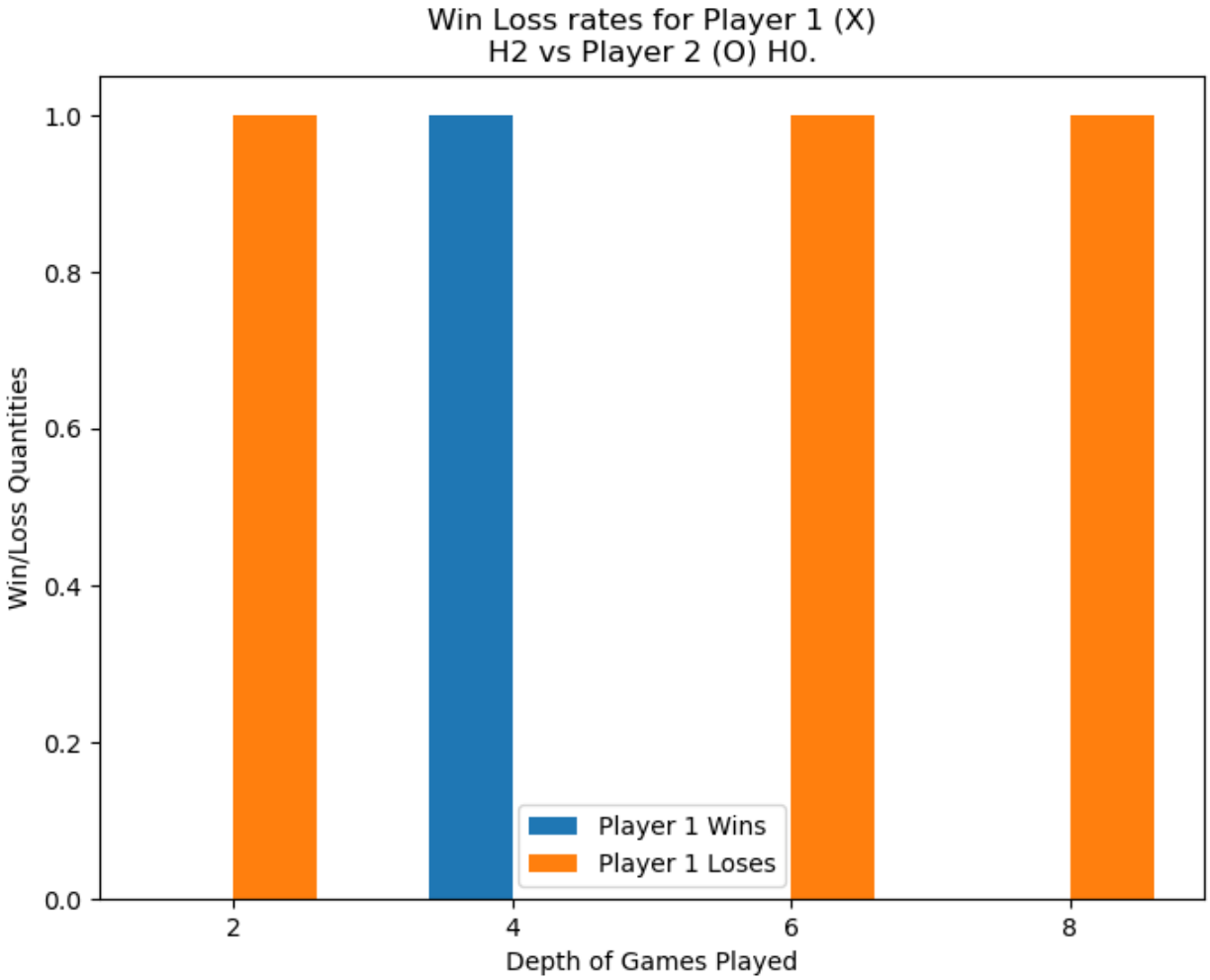
Plots of Win/Loss Rates

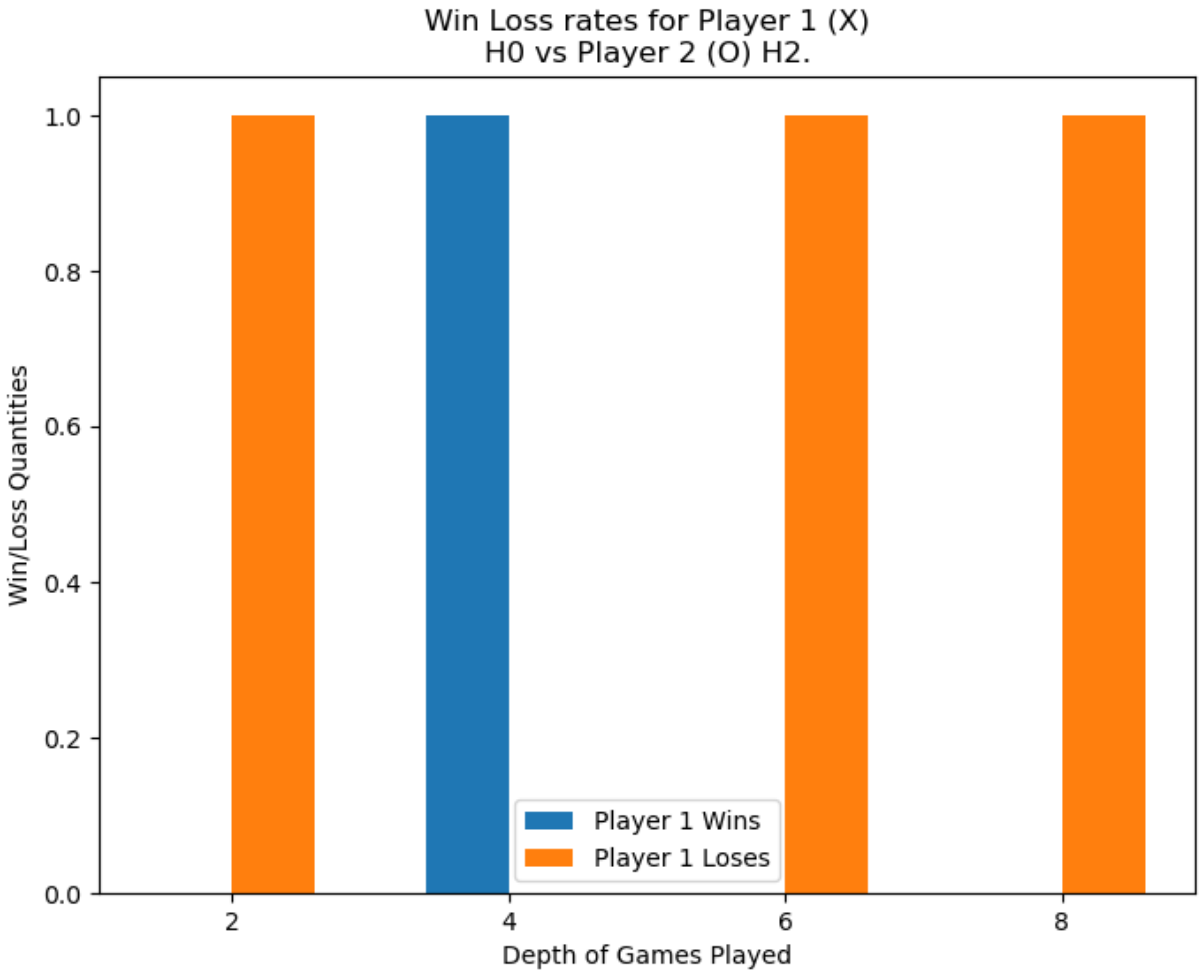



Win Loss rates for Player 1 (X)
H0 vs Player 2 (O) H1.
Player 1 Wins
Player 1 Loses
Win/Loss Quantities
1.0
0.8
0.6
0.4
0.2
0.0
2
4
6
8
Depth of Games Played


Win Loss rates for Player 1 (X)
H1 vs Player 2 (O) H2.
Win/Loss Quantities
1.0
0.8
0.6
0.4
0.2
0.0
2
4
6
8
Depth of Games Played
Player 1 Wins
Player 1 Loses


Win Loss rates for Player 1 (X)
H2 vs Player 2 (O) H1.
Player 1 Wins
Player 1 Loses
Win/Loss Quantities
1.0
0.8
0.6
0.4
0.2
0.0
2
4
6
8
Depth of Games Played


Win Loss rates for Player 1 (X)
H2 vs Player 2 (O) H0.
Win/Loss Quantities
1.0
0.8
0.6
0.4
0.2
0.0
2
4
6
8
Depth of Games Played
Player 1 Wins
Player 1 Loses



Report Overview:

In nodes searched, player 1 always had a significantly higher search node count because it had the highest depth of nodes to search (player 2 would have one less depth to search in the next turn). With pruning off, searched nodes would exceed 100,000 at large depths. With pruning on, however, the number of nodes searched, even for the highest depths, was dramatically reduced (down to a few thousand for the largest depths). We can also see that as the depth increases, the number of nodes searched resembles an exponential shape, where every two steps we increase the depth results in far more nodes searched. The outlier is in pruning, where if we go down to the maximum depth of 12, we end up with fewer nodes searched overall than at the previous depth of 10. H2 had the lowest amount of search nodes generated with pruning on, although it had similar levels to the other heuristics when pruning was turned off.

In win-loss rates, Player 2 (expectedly) has the advantage over Player 1, which results in many more losses for Player 1 and wins for 2. The heuristics had mixed results, where sometimes my custom heuristic, H2, would occasionally outperform the opponent's heuristic, like H0, although these results are again mixed as Player 2 using H2 had good win rates, and Player 1 using H2 had worse win rates than Player 2. It also appeared that the player order was more important than the heuristic used, as H0 used by Player 2 had a 100%-win rate when Player 1 used H1, but when Player 2 used H1 and Player 1 used H0, Player 2 still had a 100%-win rate at all depths, which was surprising. There was a little more variation with H2, where sometimes Player 1 could eke out a win against Player 2 when either was using H2, but this wasn't a consistent result across all depths.