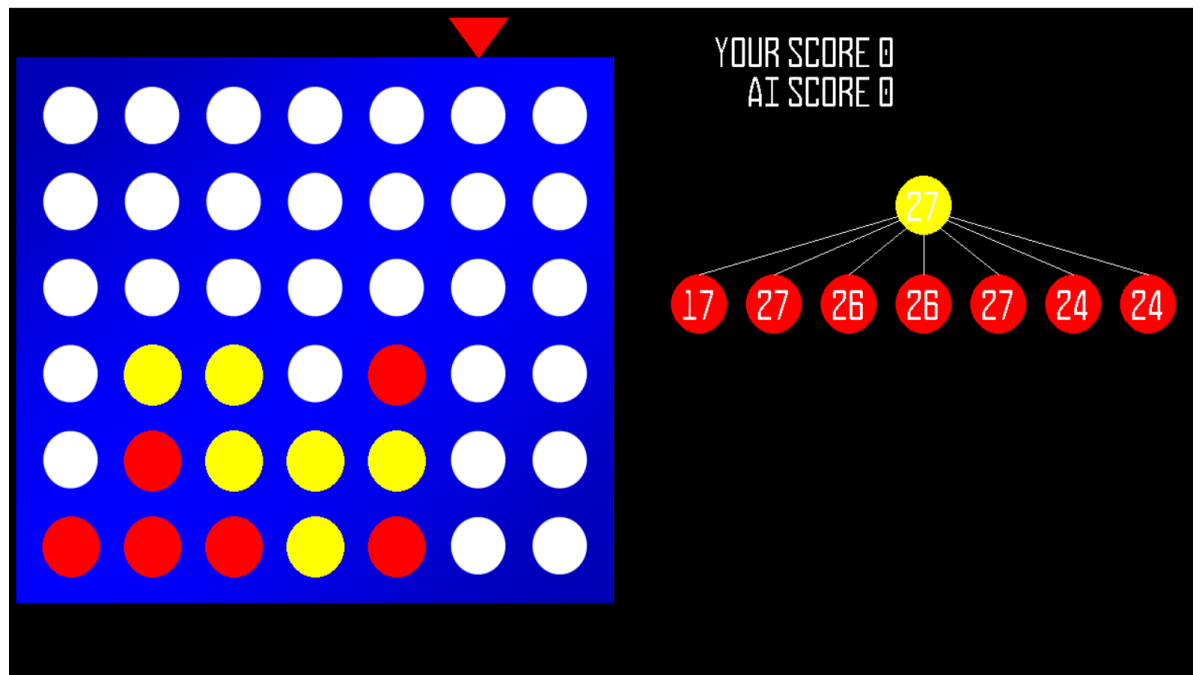


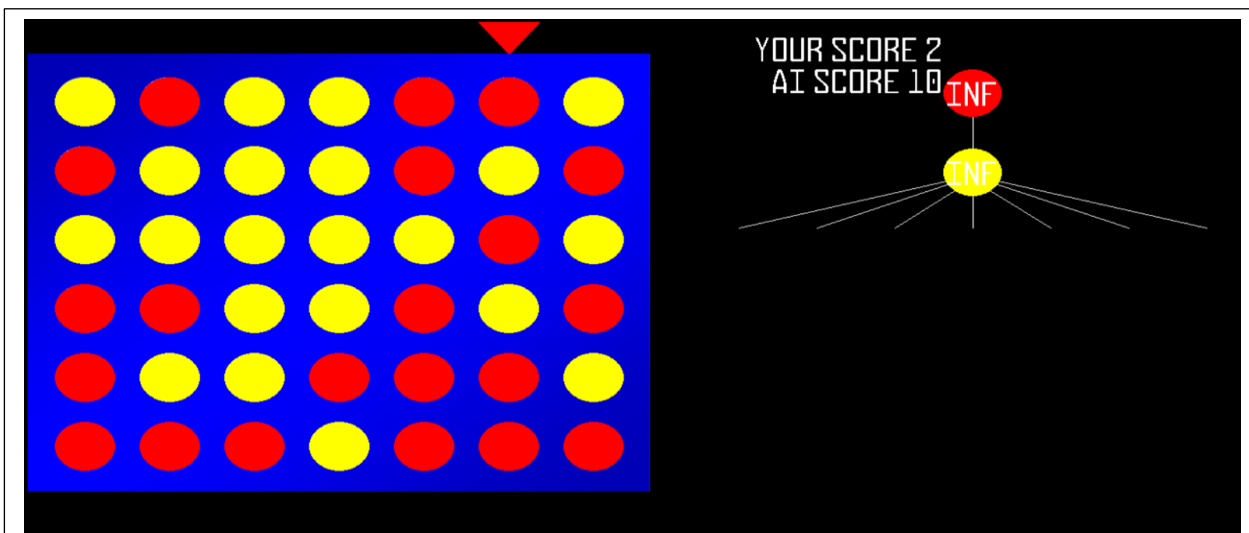
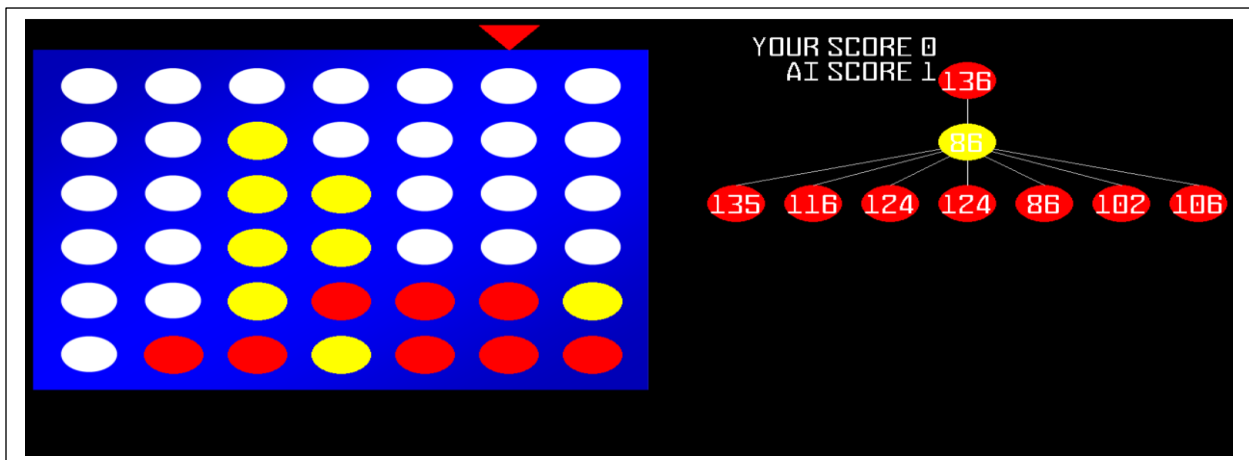
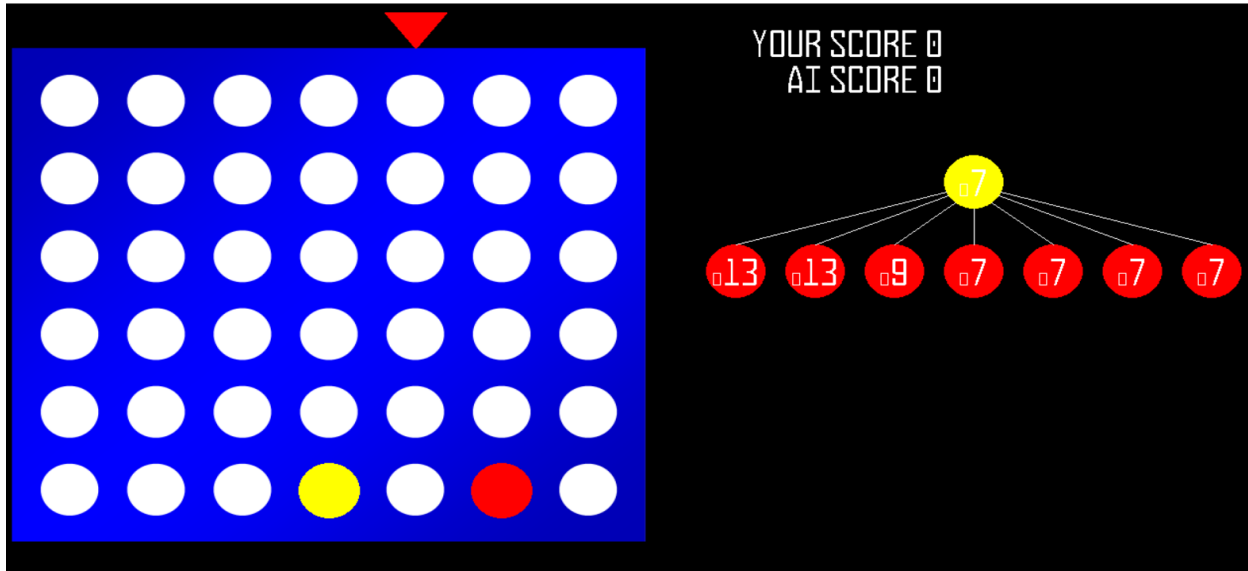
AI Lab2

Game Description

Connect 4 is a two-player game in which the players first choose a color and then take turns dropping their colored discs from the top into a grid. The pieces fall straight down, occupying the next available space within the column. The objective of the game is to connect-four of one's own discs of the same color next to each other vertically, horizontally, or diagonally. The two players keep playing until the board is full. The winner is the player having greater number of connected-fours.



Sample runs and their corresponding minimax trees.



comparison between the 2 algorithms in terms of time taken and nodes expanded at different K values.

We run random games over number of iterations and get the average time (ms) in minimax and in minimax with alpha beta (minimax ab) and average number of nodes expanded on the depth from 1 to 12.

over 100 iterations:

Depth(K)	Time minimax	Time alpha beta	Nodes minimax	Nodes alpha beta
1	0.589527	0.770576	6.28	6.28
2	2.668852	2.03078	40.08	26.88
3	11.494369	6.029689	258.84	128.07
4	50.58515	18.403167	1247.09	447.6
5	234.785038	64.590183	5619.25	1490.64
6	815.071209	185.32483	1111.07	4701.08
7	3183.231483	531.34647	7452.83	13012.31
8	10880.319663	1839.67476	50453.87	39744.48

over 30 iterations

Depth(K)	Time minimax	Time alpha beta	Nodes minimax	Nodes alpha beta
9	30126.47872	3797.0766666666664	842564.6	103320.9
10	77054.8093167	9706.6846334	2506690.1665	294748.4
11	222608.69592	23970.43330333	7437531.83333	738634.3
12	-	73679.80964666668	-	2086291.06666

Conclusion:

- The maximum depth the minimax can run under one minute is 9 .
- The maximum depth the minimax alpha beta can run under one minute is 12.

Data Structure:

Dictionary (Hash Map)	Use in the heuristic function that help us to evaluate.
Array	Use to store the state (nodes)

Algorithms:

In heuristic function we evaluate the approximate value by make a window of four cell and check the plays in it and return specific value and get the next node and pop node from first that to handle the pipeline this iterate over each row and column and the two diagonals.