CS 364
AI LAB

TEAM JARVIS

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WEEK – 5
LAB ASSIGNMENT 4

Learning Objective

1

PLAYING AGENT

Playing agent in AI refers to a computer program or system designed to play games such as chess, Go, or video games. It uses various AI techniques such as game theory, reinforcement learning, decision making algorithms.

2

MINIMAX

It is a recursive algorithm that proceeds all the way down to the leaves of the tree and then backs up the minimax values through the tree as the recursion unwinds.

3

ALPHA-BETA PRUNING

The Alpha-beta pruning to a standard minimax algorithm returns the same move as the standard algorithm does, but it removes all the nodes which are not really affecting the final decision but making algorithm slow. Hence by pruning these nodes, it makes the algorithm fast.

PROBLEM STATEMENT :

- WHAT IS THE SIZE OF THE GAME TREE FOR NOUGHTS AND CROSSES? SKETCH THE GAME TREE.

- READ ABOUT THE GAME OF NIM (A PLAYER LEFT WITH NO MOVE LOSING THE GAME). FOR THE INITIAL CONFIGURATION OF THE GAME WITH THREE PILES OF OBJECTS AS SHOWN IN FIGURE, SHOW THAT REGARDLESS OF THE STRATEGY OF PLAYER-1, PLAYER-2 WILL ALWAYS WIN. TRY TO EXPLAIN THE REASON WITH THE MINIMAX VALUE BACKUP ARGUMENT ON THE GAME TREE.

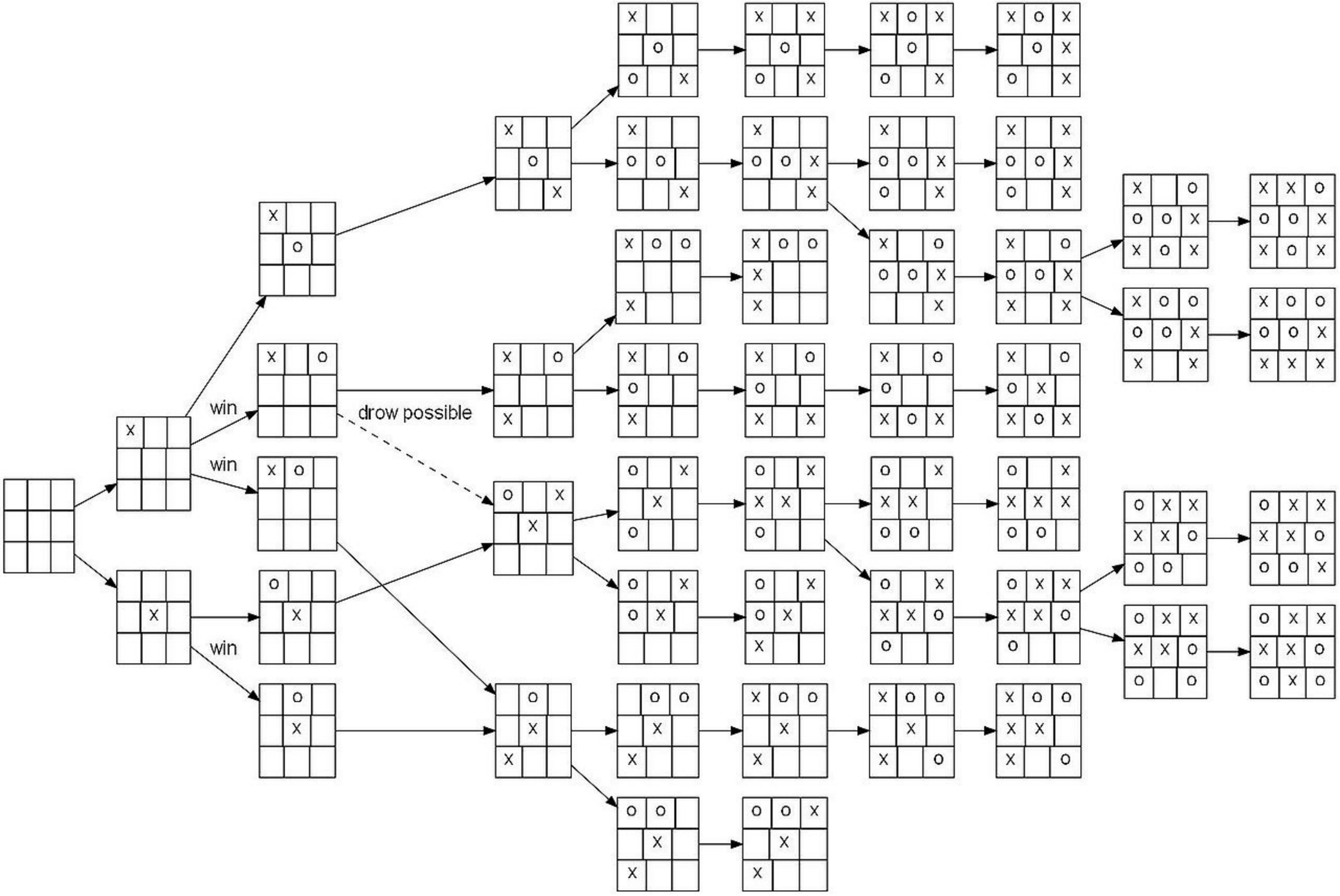
- IMPLEMENT MINIMAX AND ALPHA-BETA PRUNING AGENTS. REPORT ON NUMBER OF EVALUATED NODES FOR NOUGHTS AND CROSSES GAME TREE.

- USE RECURRENCE TO SHOW THAT UNDER PERFECT ORDERING OF LEAF NODES, THE ALPHA-BETA PRUNING TIME COMPLEXITY IS O(BM/2), WHERE B IS THE EFFECTIVE BRANCHING FACTOR AND M IS THE DEPTH OF THE TREE.

TIC TAC TOE(NOUGHTS AND CROSSES)

- TIC-TAC-TOE IS A TWO-PLAYER GAME WHICH IS PLAYED BY MARKING X'S AND 0'S ON A 3X3 BOARD.
- ONE WHO MARKS 3 X'S OR 3 0'S IN A STRAIGHT LINE FIRST, WINS.
- AS THE GAME STARTS, P1 HAS 9 POSSIBILITIES.
- P2 THEN HAS 8 POSSIBILITIES FOR EACH OF THE 9 POSSIBILITIES, THEN 7 FOR EACH OF THE PREVIOUS 8 AND SO ON.
- THUS, WE WILL GET AROUND 10 LAKH POSSIBILITIES AND THUS A TREE SIZE OF 10 LAKHS.
- BUT, THE GAME FINISHES WHEN ONE OF THE TWO PLAYERS WINS. THUS, MOST OF THE TIMES WE WON'T TRAVERSE ALL THE NODES. THUS, FINALLY WE WILL GET A TREE SIZE OF APPROXIMATELY 6 LAKH NODES.

Fig-1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Minimax In TIC TAC TOE

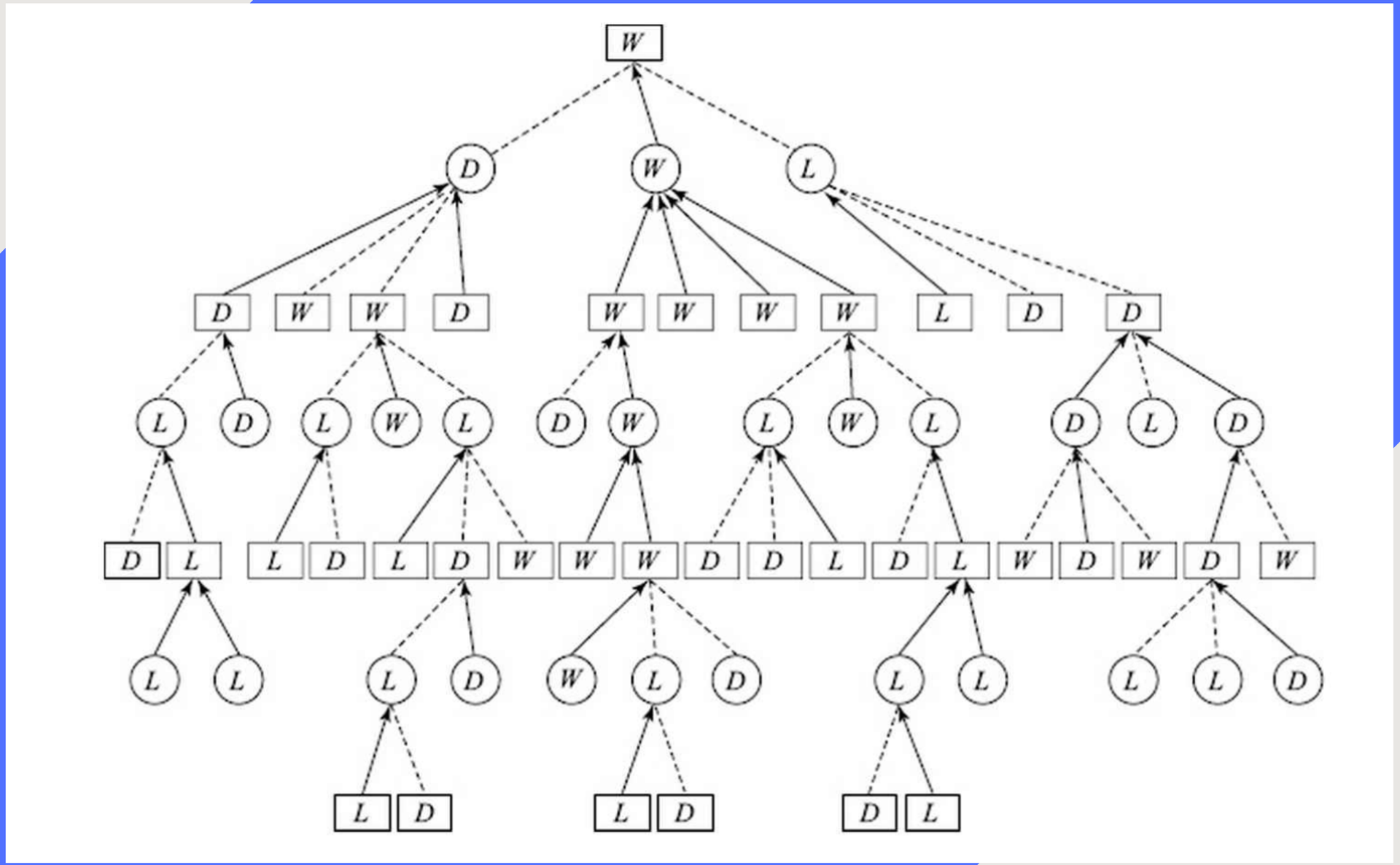


Fig-2

Alpha-Beta Pruning In TIC TAC TOE

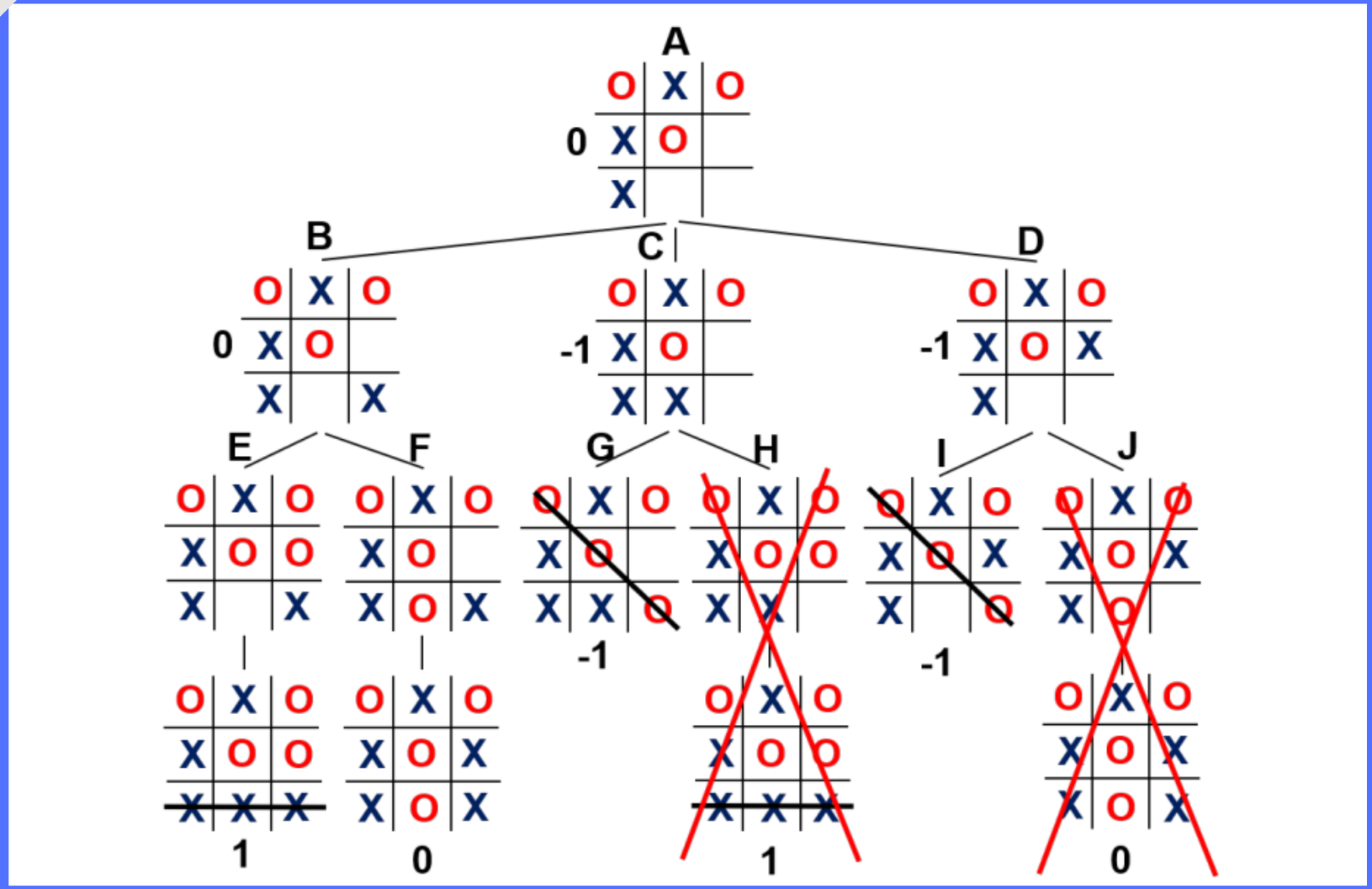


Fig-3

THE GAME OF NIM

RULES:

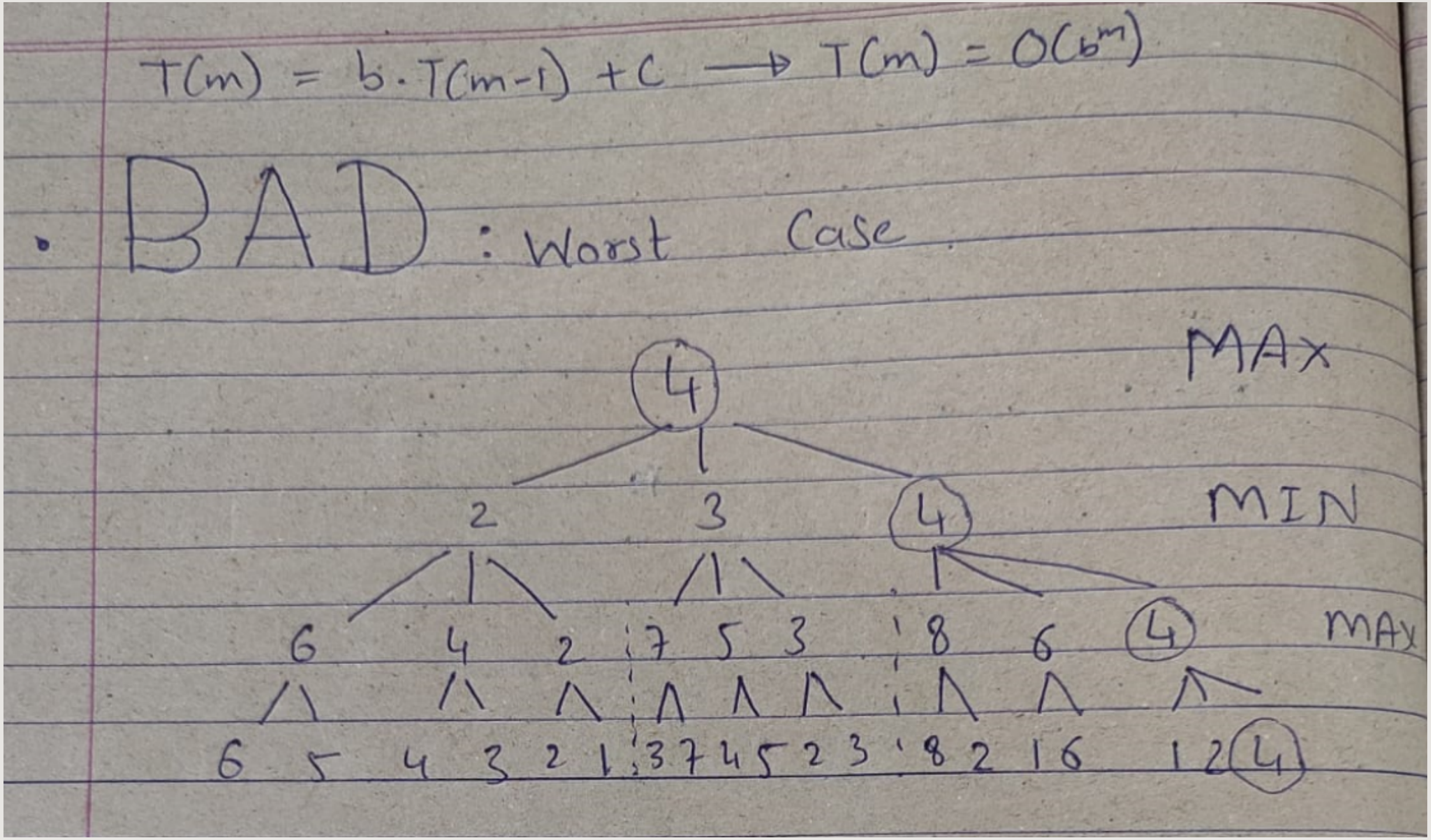
- THE GAME OF NIM IS PLAYED STARTING WITH PILES OR ROWS OF OBJECTS.
- PLAYERS TAKE TURNS TAKING ANY NUMBER OF OBJECTS FROM ONE OF THE PILES.
- WHOEVER TAKES THE LAST OF THE OBJECTS LOSES!

MINIMAX AGENT AND ALPHA BETA AGENT CODES

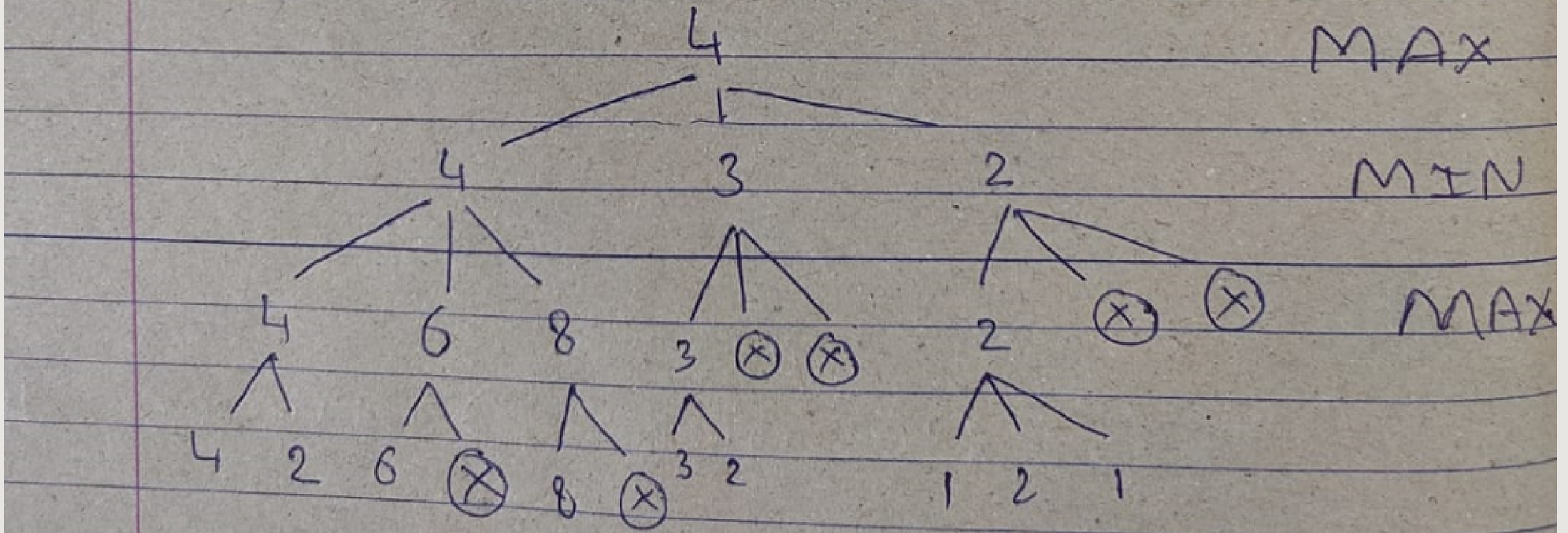
GITHUB LINK:
https://github.com/Kaushik4852/AI_Pres_Jarvis/blob/main/AI_pres_minmax_3x3_main.ipynb

https://colab.research.google.com/drive/1tls0NrJ8bqnOoeSFT2ze24Re0QPbfHmm?usp=sharing

Alpha-Beta Pruning Analysis



GOOD: Best Case



BEST CASE:

COMPLEXITY: b^(d/2)

(ALPHA-BETA)

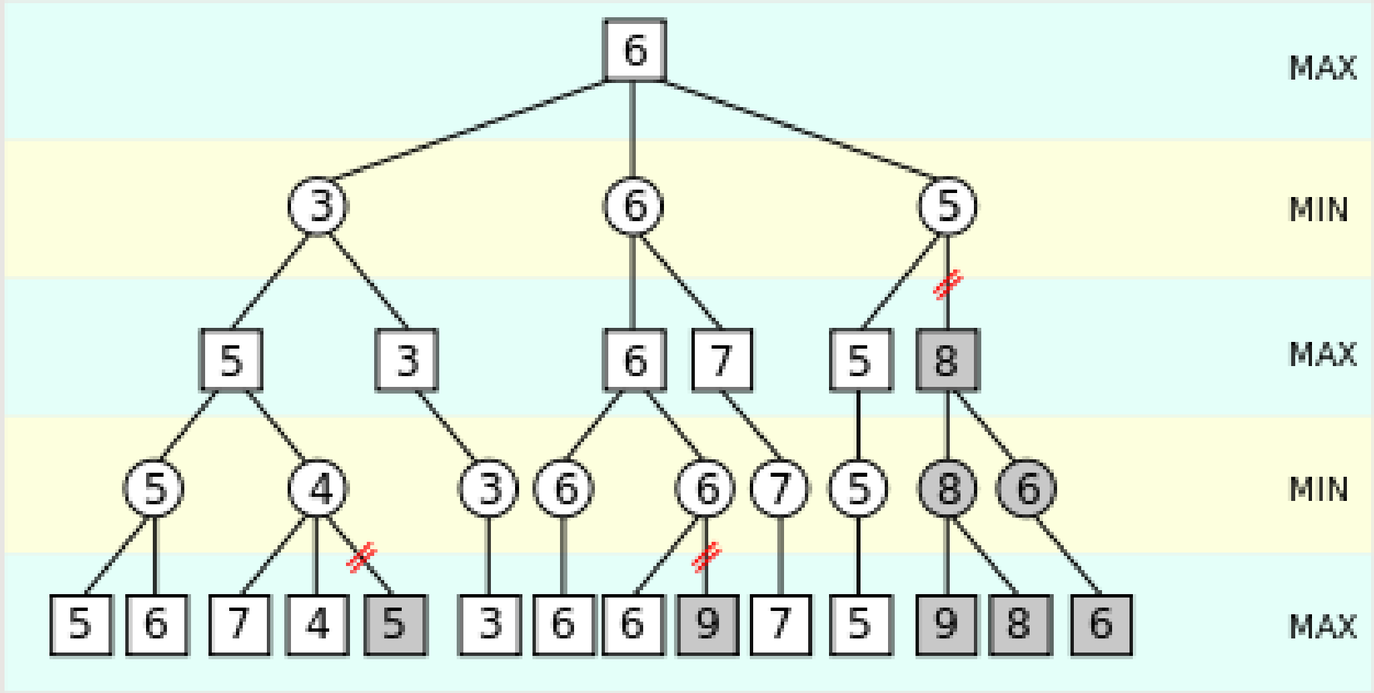
RANDOM CASE:

COMPLEXITY: b^(3d/4)

WORST CASE:

COMPEXITY: b^(d)

(MINIMAX)



REFERENCE

(FIGURE 8.7) Deepak Khemani, A First Course in Artificial Intelligence, IIT Madras. McGrawHill Education Pvt.Ltd., 2013.

https://teaching.csse.uwa.edu.au/units/CITS3001/Semester1/lectures/lectures/3001%20Game-playing.pdf

https://github.com/TanmayAmbadkar/CS302-AI/tree/master/Lab4

https://rb.gy/sz1qcu

https://www.youtube.com/watch?v=trKjYdBASyQ