

Class: B.E (Computer), Sem – VI Subject Name: Artificial Intelligence Student Name:

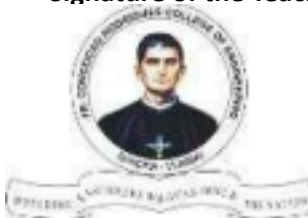
Roll No. **9543** Name: **Madhav Jha**

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|----------------------|--|
| Practical No: | 1 |
| Title: | Tic Tac Toe game implementation by a) Brute Force Method b) Heuristic Approach |
| Date of Performance: | 03-02-2024 |
| Date of Submission: | 04-02-2024 |

Rubrics for Evaluation:

| Sr. No | Performance Indicator | Excellent | Good | Below Average | Marks |
|--------------|---|---------------|-----------------------|----------------------|-------|
| 1 | On time Completion & Submission (01) | 01 (On Time) | NA | 00 (Not on Time) | |
| 2 | Logic/Algorithm Complexity analysis (03) | 03(Correct) | 02(Partial) | 01 (Tried) | |
| 3 | Coding Standards (03): Comments/indentation/Naming conventions Test Cases /Output | 03(All used) | 02 (Partial) | 01 (rarely followed) | |
| 4 | Post Lab Assignment (03) | 03(done well) | 2 (Partially Correct) | 1(submitted) | |
| Total | | | | | |

Signature of the Teacher:



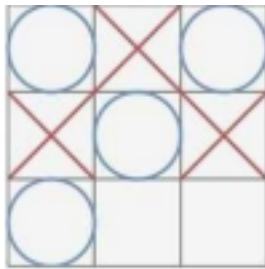
Experiment No: 1

Title: Tic Tac Toe game implementation by

- a) Brute Force Method
- b) Heuristic Approach

Objective: To write a computer program in such a way that computer wins most of the time
Theory:

This is a 2 players game where each player should put a cross or a circle on a 3 x 3 grid. The first player that has 3 crosses or 3 circles aligned (be it vertically, horizontally or diagonally) wins the game.



The blue player won because he aligned 3 blue circles on the diagonal

a) Brute Force Method

A brute force approach is an approach that finds all the possible solutions to find a satisfactory solution to a given problem. The brute force algorithm tries out all the possibilities till a satisfactory solution is not found.

- a) Consider a Board having nine element vectors.
- b) Each element will contain
 - i) 0 for blank
 - ii) 1 indicating 'X' player move
 - iii) 2 indicating 'O' player move
- c) Computer may play as an 'X' or O player.
- d) First player always plays as 'X'.



- 2) MT is a vector of 3^9 elements, each element of which is a nine-element vector representing board position.
- 3) MT is a vector of 3^9 elements, each element of which is a nine-element vector representing board position.
 - a) Move Table (MT) is a vector of 39 elements, each element of which is a nine element vector representing board position.

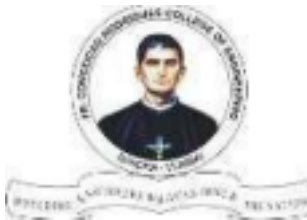
| Index | Current Board position | New Board position |
|-------|------------------------|--------------------|
| 0 | 000000000 | 000010000 |
| 1 | 000000001 | 020000001 |
| 2 | 000000002 | 000100002 |
| 3 | 000000010 | 002000010 |

- b) To make a move, do the following:
 - a. View the vector (board) as a ternary number and convert it to its corresponding decimal number.
 - b. Use the computed number as an index into the MT and access the vector stored there.
 - i. The selected vector represents the way the board will look after the move.
 - c. Set board equal to that vector.

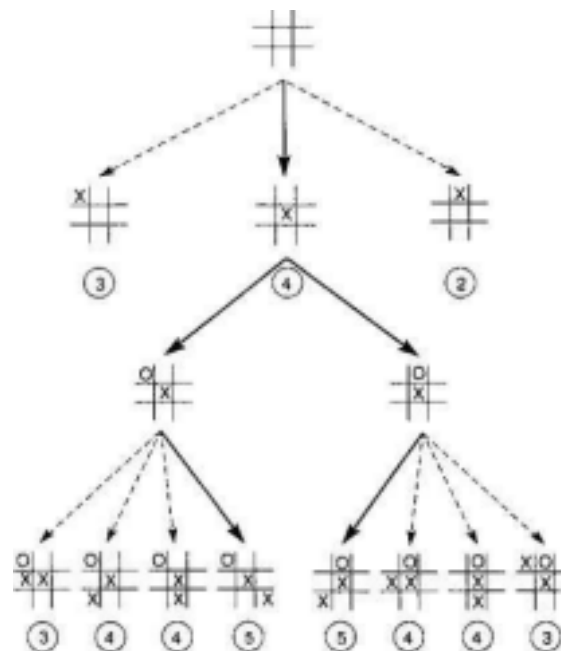
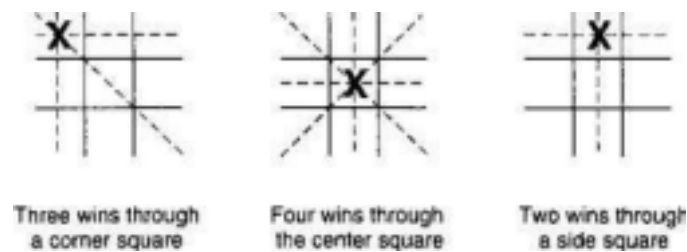
b) Heuristic Approach

Heuristics are essentially problem-solving tools that can be used for solving non-routine and challenging problems. A heuristic method is a practical approach for a short-term goal, such as solving a problem. The approach might not be perfect but can help find a quick solution to help move towards a reasonable way to resolve a problem.

Without considering symmetry the search space is $9!$ using symmetry the search space is $12 * 7!$ A simple heuristic is the number of solution paths still open when there are 8 total



paths (3 rows, 3 columns, 2 diagonals). Here is the search space using this heuristic. The total search space is now reduced to about 40, depending on the opponents play.



Ashram, Bandstand, Bandra (W), Mumbai - 400050

OUTPUT:

BRUTE FORCE METHOD:

```
Go Run ... SEM 6
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

C:\Users\bisht\OneDrive\Desktop\SEM 6>cd AI
C:\Users\bisht\OneDrive\Desktop\SEM 6\AI>python TicTacToe_Brute_force.py
 0 1 2
0 - - -
1 - - -
2 - - -
Enter row (0, 1, or 2): 1
Enter column (0, 1, or 2): 1
 0 1 2
0 - - -
1 - X -
2 - - -
 0 1 2
0 0 - -
1 - X -
2 - - -
Enter row (0, 1, or 2): 2
Enter column (0, 1, or 2): 2
 0 1 2
0 0 - -
1 - X -
2 - - X
 0 1 2
0 0 - 0
1 - X -
2 - - X
Enter row (0, 1, or 2): 0
Enter column (0, 1, or 2): 1
 0 1 2
0 0 X 0
1 - X -
2 - - X
 0 1 2
0 0 X 0
1 0 X X
2 X 0 X
It's a draw!

C:\Users\bisht\OneDrive\Desktop\SEM 6\AI>
```

HEURISTIC METHOD:

```
Microsoft Windows [Version 10.0.19045.3930]
(c) Microsoft Corporation. All rights reserved.

C:\Users\bisht\OneDrive\Desktop\SEM 6>cd AI

C:\Users\bisht\OneDrive\Desktop\SEM 6\AI>python TicTacToe_Heuristic.py
  0 1 2
  0 - - -
  1 - - -
  2 - - -
Enter your move (0-8): 5
  0 1 2
  0 - - -
  1 - - X
  2 - - -
  0 1 2
  0 0 - -
  1 - - X
  2 - - -
Enter your move (0-8): 4
  0 1 2
  0 0 - -
  1 - X X
  2 - - -
  0 1 2
  0 0 - -
  1 0 X X
  2 - - -
Enter your move (0-8): 6
  0 1 2
  0 0 - -
  1 0 X X
  2 X - -
  0 1 2
  0 0 - 0
  1 0 X X
  2 X - -
```

```
Enter your move (0-8): 4
  0 1 2
  0 0 - -
  1 - X X
  2 - - -
  0 1 2
  0 0 - -
  1 0 X X
  2 - - -
Enter your move (0-8): 6
  0 1 2
  0 0 - -
  1 0 X X
  2 X - -
  0 1 2
  0 0 - 0
  1 0 X X
  2 X - -
Enter your move (0-8): 1
  0 1 2
  0 0 X 0
  1 0 X X
  2 X - -
  0 1 2
  0 0 X 0
  1 0 X X
  2 X 0 -
Enter your move (0-8): 8
  0 1 2
  0 0 X 0
  1 0 X X
  2 X 0 X
It's a draw!

C:\Users\bisht\OneDrive\Desktop\SEM 6\AI>
```

Post Lab Assignment:

1. What is the easiest trick to win Tic Tac Toe?
2. What is the algorithm to follow to win a 5*5 Tic Tac Toe?
3. Is there a way to never lose at Tic-Tac-Toe?
4. What can tic-tac-toe help you with?

Q. No.

No.

Pushpendrasingh Bisht 9526 TE COMPS A

Post Lab Assignment: Experiment - 1

1]

What is the easiest trick to win Tic Tac Toe?

⇒ The easiest trick to win Tic-Tac-Toe is as follows:

1. Start by placing your first mark in the center square.
2. If your opponent doesn't place their mark in a ~~corner~~ corner square, place your second mark in any corner.
3. Otherwise, place your second mark in a corner opposite to your first mark.
4. From your third move onwards, prioritize completing rows, columns or diagonals while blocking your opponent's moves.

2]

What is the algorithm to follow to win a 5x5 Tic Tac Toe?

⇒

Algorithms:

1. Control the center square.
2. Create two-in-a-row, three-in-a-row or four-in-a-row combination horizontally, vertically or diagonally.
3. Secure adjacent corner square to create multiple winning paths.
4. Control edge squares to add flexibility to winning combinations and block opponent's moves.
5. Anticipate opponents moves and block potential winning moves while advancing your own strategy.
6. Be flexible and adapt strategy based on the current state of the board and opponent's moves.

3
=>

Is there a way to never lose at Tic-Tac-Toe?

1. Start in the center: Always begin with the center square for more winning opportunities and board control.
2. Create and block: Prioritize forming winning combinations while blocking your opponent's moves to maintain control and increase your chances of winning.
3. Adapt strategy: Adjust your approach based on the board's state and opponent's moves to stay ahead and maximize your winning potential.

4
=>

What can tic-tac-toe help you with?

1. Strategic Thinking: Planning and executing moves to outmaneuver your opponent.
2. Problem-Solving: Analyzing the game state and finding optimal moves to achieve victory.
3. Pattern Recognition: Identifying patterns and potential winning combinations on board.
4. Score good grade: Studying tic-tac-toe will help to gain marks in AI.
5. Decision-Making: Evaluating different options and selecting the best course of action.
6. Critical Thinking: Assessing the consequences of each move and predicting ~~your~~ your opponent's responses.