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

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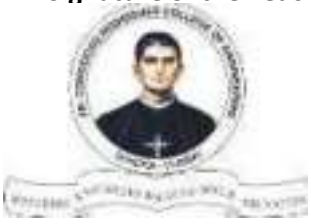
Practical No:	**1**
Title:	Tic Tac Toe game implementation by a) Brute Force Method b) Heuristic Approach
Date of Performance:	
Date of Submission:	

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/indention/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

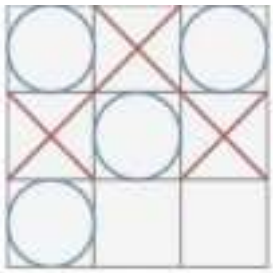
Title: Tic Tac Toe game implementation by

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 diagona

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

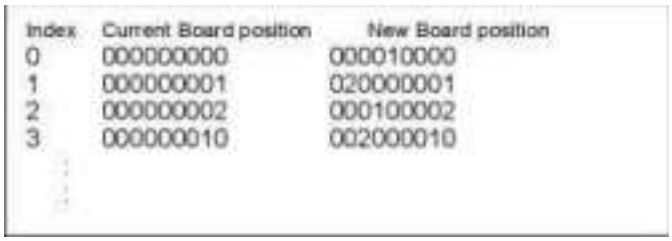
ii) 1 indicating 'X' player move

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

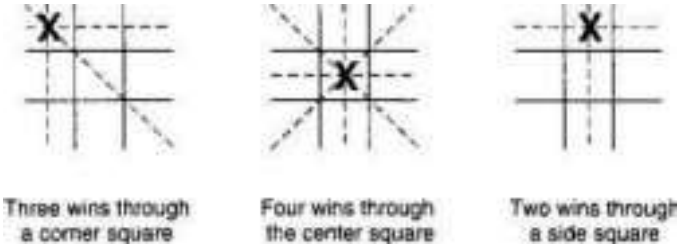
      c. Set board equal to that vector.

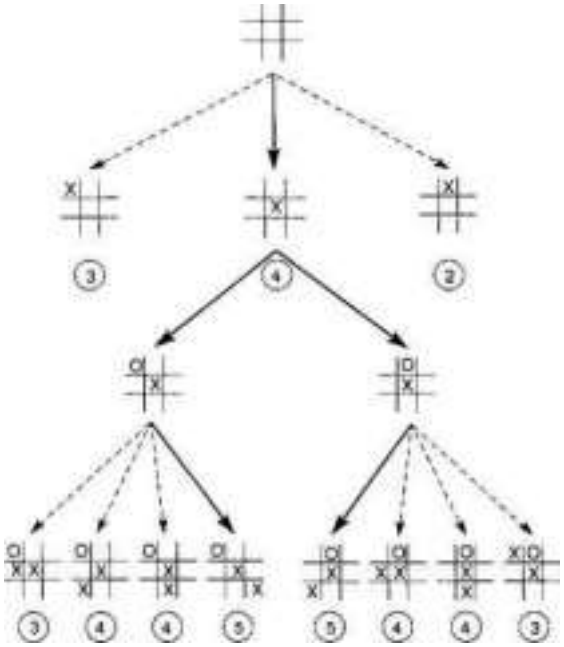
b) Heuristic Approach

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.





OUTPUT:

BRUTE FORCE METHOD:

```
PS C:\Users\hacke\OneDrive\Desktop\SEM VI\AI> & C:/Users/hacke/AppData/Local/Programs/Python/Python311/py
thon.exe "c:/Users/hacke/OneDrive/Desktop/SEM VI/AI/TicTacToe_Brute_force.py"
  0 1 2
0 - - -
1 - - -
2 - - -
Enter row (0, 1, or 2): 0
Enter column (0, 1, or 2): 0
  0 1 2
0 X - -
1 - - -
2 - - -
  0 1 2
0 X - -
1 - O -
2 - - -
Enter row (0, 1, or 2): 0
Enter column (0, 1, or 2): 2
  0 1 2
0 X - X
1 - O -
2 - - -
  0 1 2
```

```
  0 1 2
0 X O X
1 - O -
2 - - -
Enter row (0, 1, or 2): 2
Enter column (0, 1, or 2): 1
  0 1 2
0 X O X
1 - O -
2 - X -
  0 1 2
0 X O X
1 O O -
2 - X -
Enter row (0, 1, or 2): 2
Enter column (0, 1, or 2): 0
  0 1 2
0 X O X
1 O O -
2 X X -
```

```
  0 1 2
0 X O X
1 O O O
2 X X -
O wins!
```

HEURISTIC METHOD:

```
PS C:\Users\hacke\OneDrive\Desktop\SEM VI\AI> & C:/Users/hacke/AppData/Local/Programs/Python/Python311/
python.exe "c:/Users/hacke/OneDrive/Desktop/SEM VI/AI/TicTacToe_Heuristic.py"
  0 1 2
0 - - -
1 - - -
2 - - -
Enter your move (0-8): 0 0
Invalid input. Please enter a number.
Enter your move (0-8): 0
  0 1 2
0 X - -
1 - - -
2 - - -
  0 1 2
0 X - O
1 - - -
2 - - -
Enter your move (0-8): 4
  0 1 2
0 X - O
1 - X -
2 - - -
```

```
  0 1 2
0 X - O
1 - X -
2 - - O
Enter your move (0-8): 6
  0 1 2
0 X - O
1 - X -
2 X - O
  0 1 2
0 X - O
1 - X O
2 X - O
O wins!
```

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?

John J Kadu
Roll No. 9548
TE Comps A

Postlab Experiment : 1

Q1 What is easiest way to win tic-toe game?

→ 1. Start by playing your first mark in Centre of Square
2. If your opponent doesn't place their mark in corner Square place your mark there
3. Otherwise place your mark opposite to your first move.
4. From your third move onward prioritize completing row, column or diagonal while blocking opponent moves

Q2 What is algorithm to win 5*5 Tic Tac Toe?

→ 1. Control the Centre Square
2. Create row in a row, three in a row, combination horizontal vertical or diagonally
3. Secure adjacent corner square to create multiple winning path
4. Control edge squares to add flexibility to winning combination and block moves
5. Anticipate opponent moves and block potential winning moves while advancing your own strategy
6. Be Flexible and adapt strategy based on current state and opponent moves

Q3 Is there way to never loss a Tic Tac Toe?

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

4. What can tic tac toe help you with?

1. Strategic Thinking: Planning & executing moves to suit your approach
2. Problem solving: Analyse the game state & find optimal moves to achieve victory
3. Pattern recognition: Identifying patterns & potential winning combinations
4. Score good grade: Helps in gain marks for A/Z
5. Decision making: Evaluating different options and selecting best course of action
6. Critical thinking: Assessing consequences of each move and predicting opponent's response