

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

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**Roll No:9570**

<b>Practical No:</b>	<b>1</b>
<b>Title:</b>	Tic Tac Toe game implementation by a) Brute Force Method b) Heuristic Approach
<b>Date of Performance:</b>	29/01/2024
<b>Date of Submission:</b>	05/02/2024

**Rubrics for Evaluation:**

<b>Sr. No</b>	<b>Performance Indicator</b>	<b>Excellent</b>	<b>Good</b>	<b>Below Average</b>	<b>Marks</b>
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)	
<b>Total</b>					

**Signature of the Teacher:**



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# Experiment No: 1

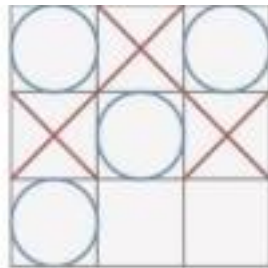
**Title:** Tic Tac Toe game implementation by

- 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.

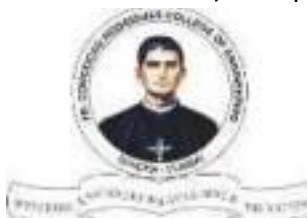


The blue player won because he aligned 3 blue circles on the diagonal

## 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:
- View the vector (board) as a ternary number and convert it to its corresponding decimal number.
  - Use the computed number as an index into the MT and access the vector stored there.
    - The selected vector represents the way the board will look after the move.
  - 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.

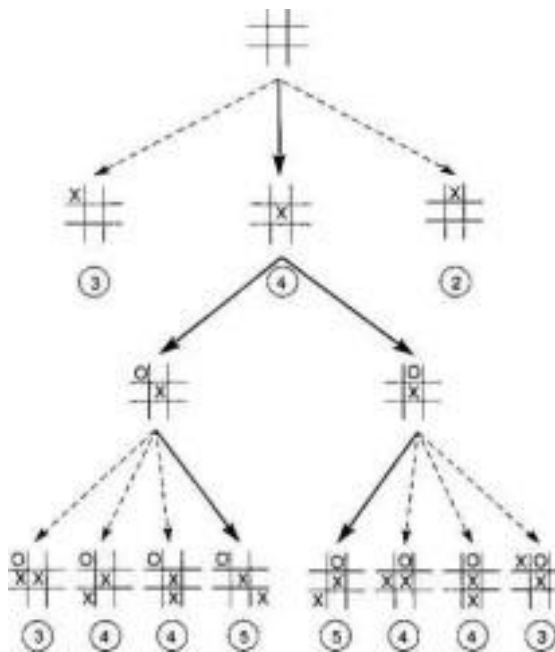
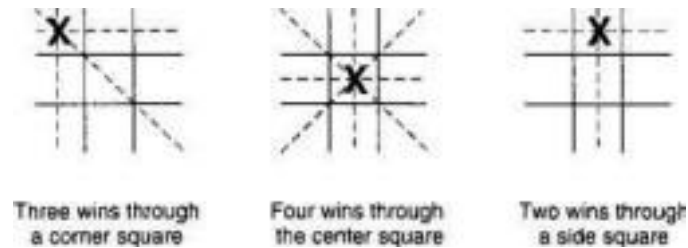
Without considering symmetry the search space is  $9!$  using symmetry the search space is

$12 * 7!$  A simple heuristic is the number of solution paths still open when there are 8 total



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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:

```
Microsoft Windows [Version 10.0.22631.3085]
(c) Microsoft Corporation. All rights reserved.

C:\Users\SANJAY RAI\OneDrive\Desktop\TE_VI\AI_pracs>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 - X -
2 - 0 X
Enter row (0, 1, or 2): 1
Enter column (0, 1, or 2): 2
 0 1 2
0 0 X 0
1 - X X
2 - 0 X
 0 1 2
0 0 X 0
1 0 X X
2 - 0 X
Enter row (0, 1, or 2): 2
Enter column (0, 1, or 2): 1
Invalid move. Please try again.
Enter row (0, 1, or 2): 2
Enter column (0, 1, or 2): 0
 0 1 2
0 0 X 0
1 0 X X
2 X 0 X
It's a draw!
```

## HEURISTIC METHOD:

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Microsoft Windows [Version 10.0.22631.3085]
(c) Microsoft Corporation. All rights reserved.

C:\Users\SANJAY RAI\OneDrive\Desktop\TE_VI\AI_pracs>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 - - -
```

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
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): 8
 0 1 2
0 0 - 0
1 0 X X
2 X - X
 0 1 2
0 0 0 0
1 0 X X
2 X - X
0 wins!

C:\Users\SANJAY RAI\OneDrive\Desktop\TE_VI\AI_pracs>
```