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

Student Name: Sanat Patil **Roll No:9566**

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:

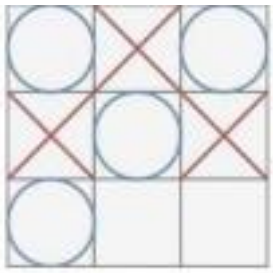
Experiment No: 1

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.

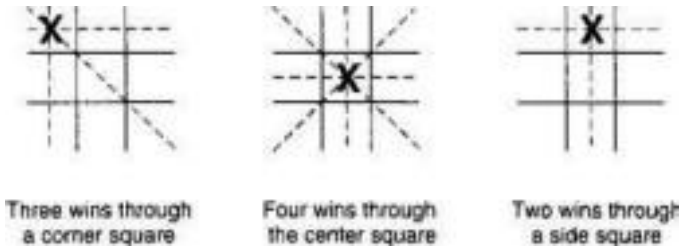
      c. Set board equal to that vector.

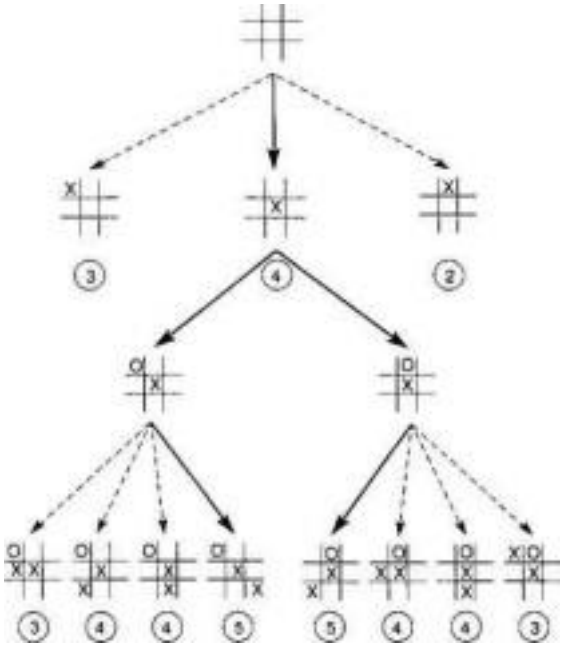
b) Heuristic Approach

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.





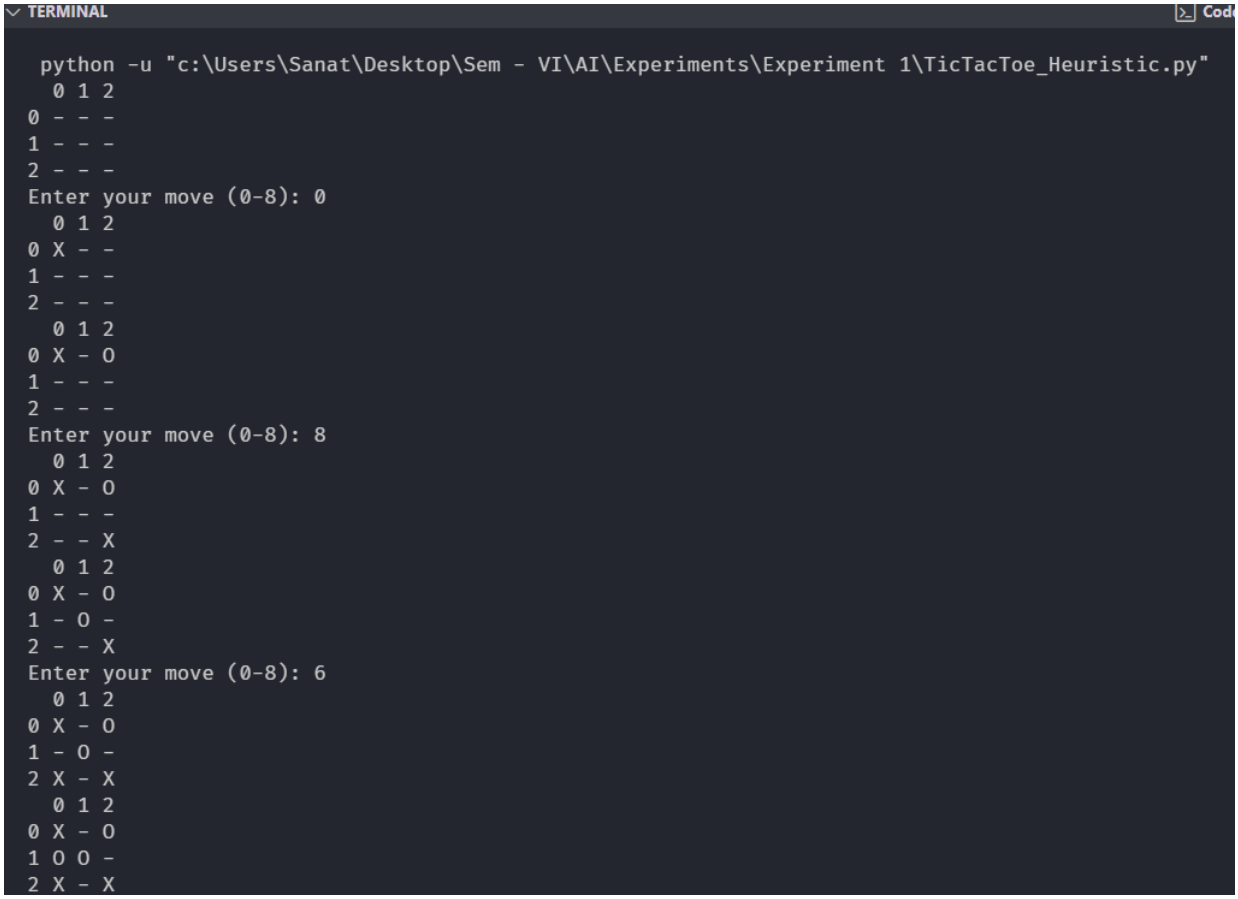
OUTPUT:

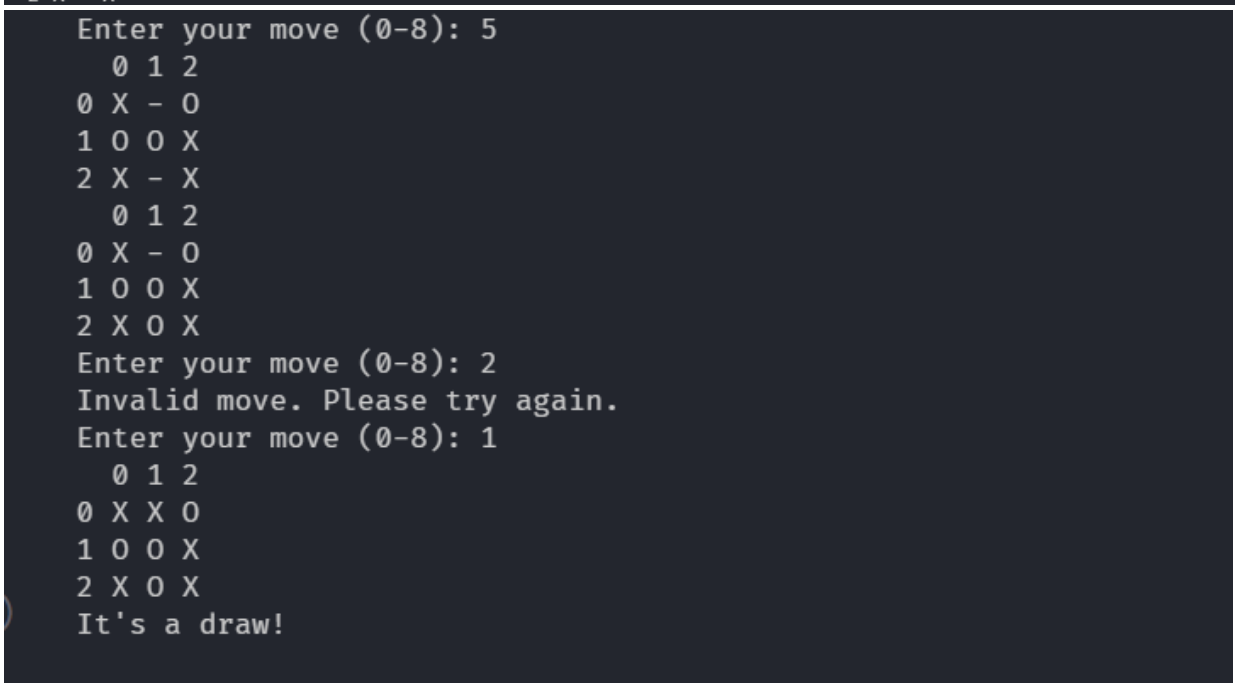
BRUTE FORCE METHOD:

```
Sanat@Sanz-PC MINGW64 ~/Desktop/Sem - VI/AI/Experiments/E
xperiment 1
 python -u "c:\Users\Sanat\Desktop\Sem - VI\AI\Experiment
s\Experiment 1\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 O - -
1 - X -
2 - - -
Enter row (0, 1, or 2): 2
Enter column (0, 1, or 2): 2
  0 1 2
0 O - -
1 - X -
2 - - X
  0 1 2
0 O - O
1 - X -
2 - - X
Enter row (0, 1, or 2): 0
Enter column (0, 1, or 2): 2
Invalid move. Please try again.
Enter row (0, 1, or 2): 0
Enter column (0, 1, or 2): 1
  0 1 2
0 O X O
1 - X -
2 - - X
  0 1 2
0 O X O
1 - X -
2 - O X
```

```
  0 1 2
0 O X O
1 - X -
2 - - X
  0 1 2
0 O X O
1 - X -
2 - O X
Enter row (0, 1, or 2): 1
Enter column (0, 1, or 2): 0
  0 1 2
0 O X O
1 X X -
2 - O X
  0 1 2
0 O X O
1 X X O
2 - O X
Enter row (0, 1, or 2): 2
Enter column (0, 1, or 2): 0
  0 1 2
0 O X O
1 X X O
2 X O X
It's a draw!
```

HEURISTIC METHOD:





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

Postlab Experiment-1

Q1] What is the easiest trick to win Tic Tac Toe

→ The easiest trick to win Tic Tac Toe is as follows

- Start by placing your first mark on the center square
- If your opponent doesn't place their mark on a corner square place your second mark on any corner
- Otherwise, place your second mark in a corner opposite to your first mark
- From your third move onwards, prioritize completing rows, columns or diagonals while blocking your opponents moves

Q2] What is the algorithm to follow to win a 5*5 Tic Tac Toe?

Ans] Algorithm

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 combination & block opponents move

Q3] Is there a way to never lose at Tic Tac Toe

↳ ① Start in the corner: Always begin with the center square for more winning opportunities & board control

② Create & block: Prioritize forming winning combinations while blocking your opponents moves to maintain control & increase your chances of winning

③ Adapt Strategy: Adjust your approach based on the board state & opponents moves to stay ahead & maximize your winning potential

Q4] What can tic-tac-toe help you with?

① Strategic thinking: Planning & executing moves to outmaneuver your opponent

② Problem Solving: Analysing the game state & finding optimal moves to achieve victory

③ Pattern Recognition: Identifying pattern & potential winning combinations on board

④ Score Good Grade: Studying tic tac toe will help to gain ~~boor~~ marks in AI

⑤ Decision Making