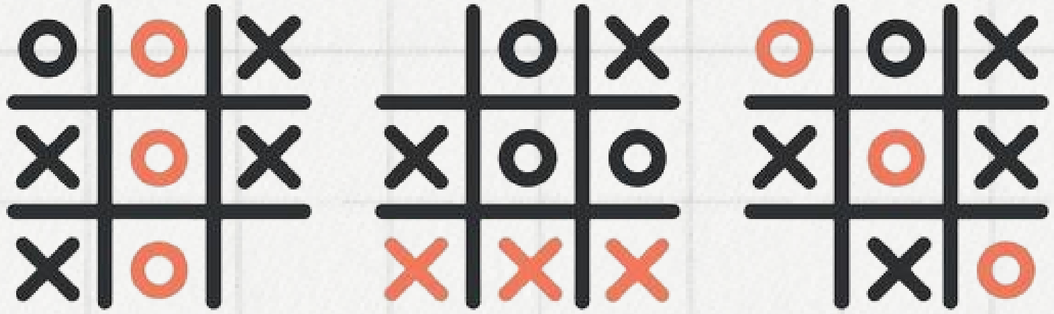
Tic-Tac-Toe Game Playing using Magic Square

Problem Statement

It’s a paper and pencil game of two players X and O, who choose to mark a space on a grid of 3×3.

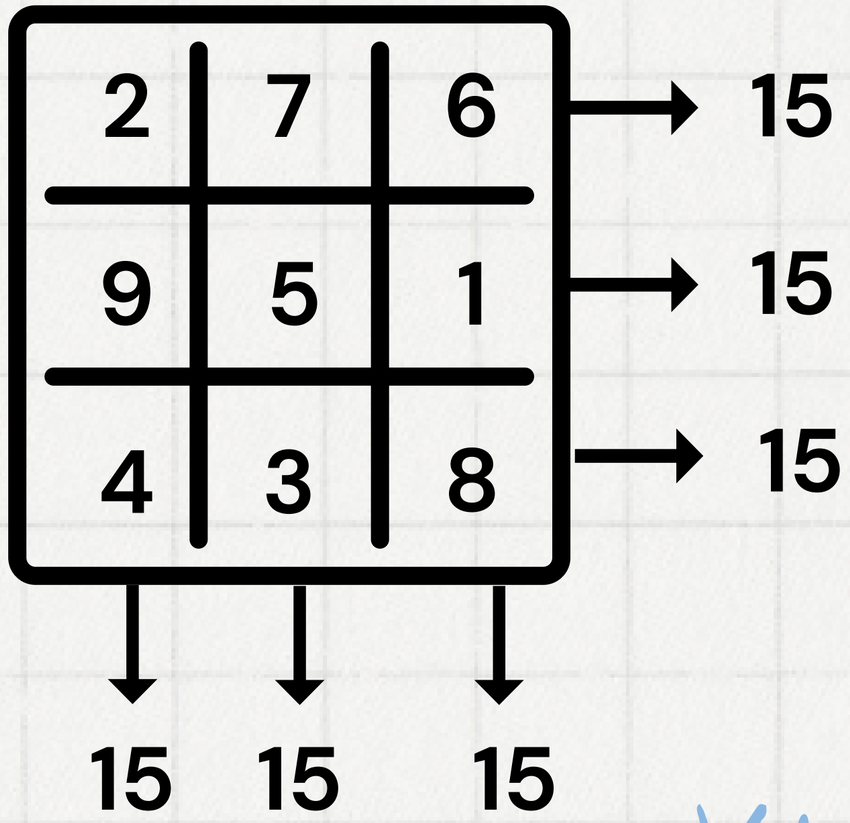
The game is won by the player who succeeds in putting three of their marks in a **horizontal line**, **vertical line**, or **diagonal line.**



This game is played by two players – One is a **human** and the other is a **computer**.

The objective is to write a computer program in such a way that the computer wins most of the time.

A magic square is a square grid of numbers where the sum of the numbers in each row, column, and diagonal is the same. For a 3x3 magic square, this sum is known as the magic sum.



Algorithm — Tic-Tac-Toe Game Playing using Magic Square —

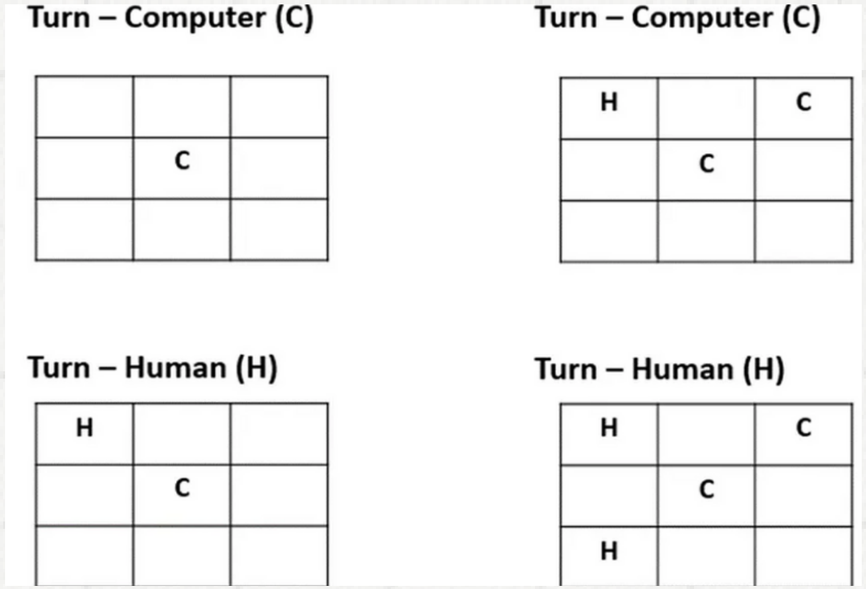
It checks if adding the numbers on two squares **equals 15**. If this difference is **not a positive number or if it is greater than 9**, it means the two squares are not in a straight line, so it ignores them as potential winning moves.

Alternatively, the machine also looks at its opponent's moves to block any chances of the opponent winning.

After each move, you check if any row, column, or diagonal sums up to the magic constant.

Example

8	3	4
1	5	9
6	7	2



calculate the difference between the 15 and the sum of two positions.

Diff = 15 — (5+4) = 6

6 is not empty, hence Computer can’t win the game

Now, the computer checks the possibility of opponents winning the match. If the opponent is winning black it.

Diff = 15 — (8+6) = 1

1 is empty, hence the human can win the game.

Hence Computer Blocks it.

Turn – Computer (C)

H		C
C	C	
H		

Computer go to 1

8	3	4
1	5	9
6	7	2

Turn – Human (H)

H		C
C	C	
H	H	

Now, the computer will check its possibility of winning the game.

Diff = 15 — (5+4) = 6

6 is not empty, hence Computer can't win the game.

Diff = 15 — (1+4) = 10

10 is greater than 9, hence Computer can't win the game.

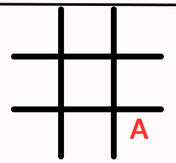
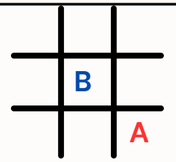
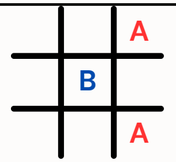
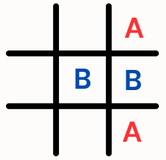
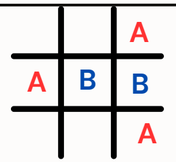
Diff = 15 — (1+5) = 9

9 is empty, hence Computer can win the game. Computer — go to 9

Turn – Computer (C)

H		C
C	C	C
H	H	

Computer wins

PLAYER A	PLAYER B	MOVES	POSTION
Take square 8		Random start	
	Take sqaure 5	15-87. Player B should take an appropriate square to prevent A from winning. B could choose one of 5,2 or 6,1 or 4.3 (sums to 7)	
Take sqaure 6		A needs a score of 7 now. Since 5 is taken 2,5 diagonal has no chance of winning. A should go for 6,1 or 4,3 combination	
	Take sqaure 1	A now has 8+6= 14. B must take 15-14=1 to stop A from winning	
Take sqaure 9		B now has 5+1 = 6. A must now take 15-6=9 to stop B from winning	

At this point, the game is drawn – B takes square 7 or 3, which has better chance of winning, then A blocks the win by taking 3 or 7 and so on.

4 X 4 MATRIX

1	8	12	13
14	11	7	12
15	10	6	3
4	5	9	16

sum of every row and col – 34

Results

```
PS C:\Users\hp> python -u "c:\Users\hp\Downloads\Tic Tac Toe implemented by Magic Square.py"
Welcome to Tic-Tac-Toe using Magic Square technique!
  |   |
-------------
  |   |
-------------
  |   |
-------------
Enter your move (1-9): 1
X |   |
-------------
  |   |
-------------
  |   |
-------------
Computer chooses position 6
X |   |
-------------
  |   | O
-------------
  |   |
-------------
Enter your move (1-9): 4
X |   |
-------------
X |   | O
-------------
  |   |
-------------
Computer chooses position 7
X |   |
-------------
X |   | O
-------------
O |   |
-------------
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```
Enter your move (1-9): 3
X |   | X
-------------
X |   | O
-------------
O |   |
-------------
Computer chooses position 2
X | O | X
-------------
X |   | O
-------------
O |   |
-------------
Enter your move (1-9): 5
X | O | X
-------------
X | X | O
-------------
O |   |
-------------
Computer chooses position 9
X | O | X
-------------
X | X | O
-------------
O |   | O
-------------
Enter your move (1-9): 8
X | O | X
-------------
X | X | O
-------------
O | X | O
-------------
It's a tie!
```

Implementation link:

https://docs.google.com/document/d/1WyEHWPIBkPTK8KLu93cFSEbD3XxZWALgtOuz8C7KYRw/edit

Advantages of Magic Square Method in Tic Tac Toe:

Balanced Gameplay: Ensures fairness by giving equal opportunities to players.
Strategic Depth: Allows for deeper planning and decision-making based on square values.
Reduced Predictability: Adds excitement and challenge by making outcomes less predictable.

Disadvantages of Magic Square Method in Tic Tac Toe

Complexity: Adds complexity, potentially discouraging those seeking simplicity.
Learning Curve: Requires understanding of magic squares, posing a challenge for new players.
Increased Time: Analyzing squares and planning may prolong games, unsuitable for quick matches.

Thankyou !