**📘 Tasks**

**Task 1: Representing the Game**

1. Draw an initial empty 3x3 board.
2. List all possible first moves for Player X.
3. How many possible unique board states are there after the first move?
4. *#1. Draw an initial empty 3x3 board.*
5. board = ["-", "-", "-",
6. "-", "-", "-",
7. "-", "-", "-"]
8. *#2. List all possible first moves for Player X.*
9. possible\_moves\_for\_X = [
10. """
11. X, -, -,
12. -, -, -,
13. -, -, -
14. """,
15. """
16. -, X, -,
17. -, -, -,
18. -, -, -
19. """,
20. """
21. -, -, X,
22. -, -, -,
23. -, -, -
24. """,
25. """
26. -, -, -,
27. X, -, -,
28. -, -, -
29. """,
30. """
31. -, -, -,
32. -, X, -,
33. -, -, -
34. """,
35. """
36. -, --, -,
37. -, -, X,
38. -, -, -
39. """,
40. """
41. -, , -,
42. -, -, -,
43. X, -, -
44. """,
45. """
46. -, -, -,
47. -, -, -,
48. -, X, -
49. """,
50. """
51. -, , -,
52. -, -, -,
53. -, -, X
54. """
55. ]
56. *#3. How many possible unique board states are there after the first move?*
57. After Player X makes the first move, one cell will have an X and the remaining 8 cells will be empty.
58. Since there are 9 empty positions initially, and placing X in any one of them creates a unique state:
59. There are 9 possible unique board states after the first move.

**Task 2: Game Tree Exploration**

1. Create a small **search tree** of Tic-Tac-Toe up to depth 2:
   * Root node: initial board
   * Depth 1: All possible moves by X
   * Depth 2: All possible responses by O
2. Label each node with the board state.

Great — here’s a clean structured sample from the **full Tic-Tac-Toe game tree up to Depth 2**.

**Game Tree (Depth 0 to 2)**

**Root (Depth 0)**

- - -

- - -

- - -

**Depth 1 (X moves)**

**X1:**

X - -

- - -

- - -

**X2:**

- X -

- - -

- - -

**X3:**

- - X

- - -

- - -

**... up to X9**

**Depth 2 (O moves — sample for first few)**

**From X1:**

**X1-O2**

X O -

- - -

- - -

**X1-O3**

X - O

- - -

- - -

**X1-O4**

X - -

O - -

- - -

**... up to X1-O9**

**From X2:**

**X2-O1**

O X -

- - -

- - -

**X2-O3**

- X O

- - -

- - -

**... up to X2-O9**

**From X3:**

**X3-O1**

O - X

- - -

- - -

**X3-O2**

- O X

- - -

- - -

**... up to X3-O9**

**✅ Full Tree:**

* **9 Depth 1 nodes (X moves)**
* **72 Depth 2 nodes (O moves — 8 per X move)**

**Task 3: Classifying the Problem**

Answer the following questions:

1. Is this a **goal-based agent** problem?
2. Is Tic-Tac-Toe a **deterministic** game? Why?
3. Is it a **fully observable** environment?
4. Is it a **single-agent** or **multi-agent** problem?

**1️⃣ Is this a goal-based agent problem?**

**✅ Yes.**  
Tic-Tac-Toe is a **goal-based agent problem** because the agents (players) choose actions based on achieving a specific goal — **to win the game by placing three of their marks in a row (horizontally, vertically, or diagonally)**, or at least to avoid losing (draw if possible).  
The agent evaluates possible future states to decide on the best move toward its goal.

**2️⃣ Is Tic-Tac-Toe a deterministic game? Why?**

**✅ Yes.**  
Tic-Tac-Toe is a **deterministic game** because:

* The **outcome of each move is fully determined by the current state and the action taken**.
* There’s **no randomness involved** in the game — given a particular board state and a player’s move, the resulting state is always predictable and fixed.
* No dice rolls, random cards, or hidden information elements exist in Tic-Tac-Toe.

**3️⃣ Is it a fully observable environment?**

**✅ Yes.**  
Tic-Tac-Toe is a **fully observable environment** because:

* **Both players can see the entire board at all times**.
* **There’s no hidden information** — every cell’s state (empty, X, or O) is visible.
* All agents have complete knowledge of the environment when making decisions.

**4️⃣ Is it a single-agent or multi-agent problem?**

**✅ Multi-agent problem.**  
Tic-Tac-Toe involves **two agents (players X and O)**, each making decisions that directly affect the other.

* It’s a **competitive, adversarial, two-player zero-sum game** where one agent’s gain is the other’s loss.
* Agents must consider the opponent’s possible moves and counter-moves when planning their strategy.