Tic-Tac-Toe

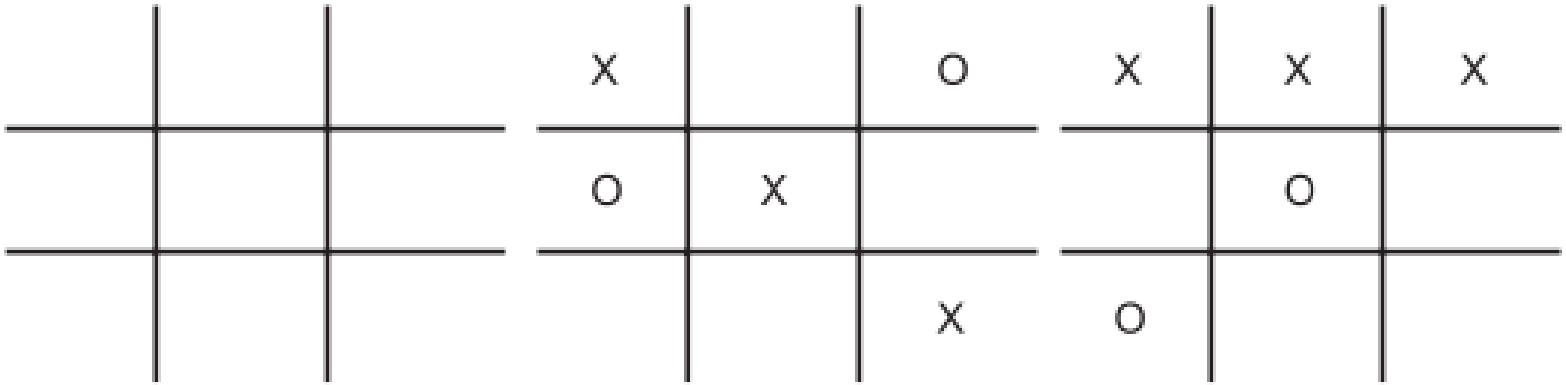
Board position: = {1,2,3,4,5,6,7,8,9}

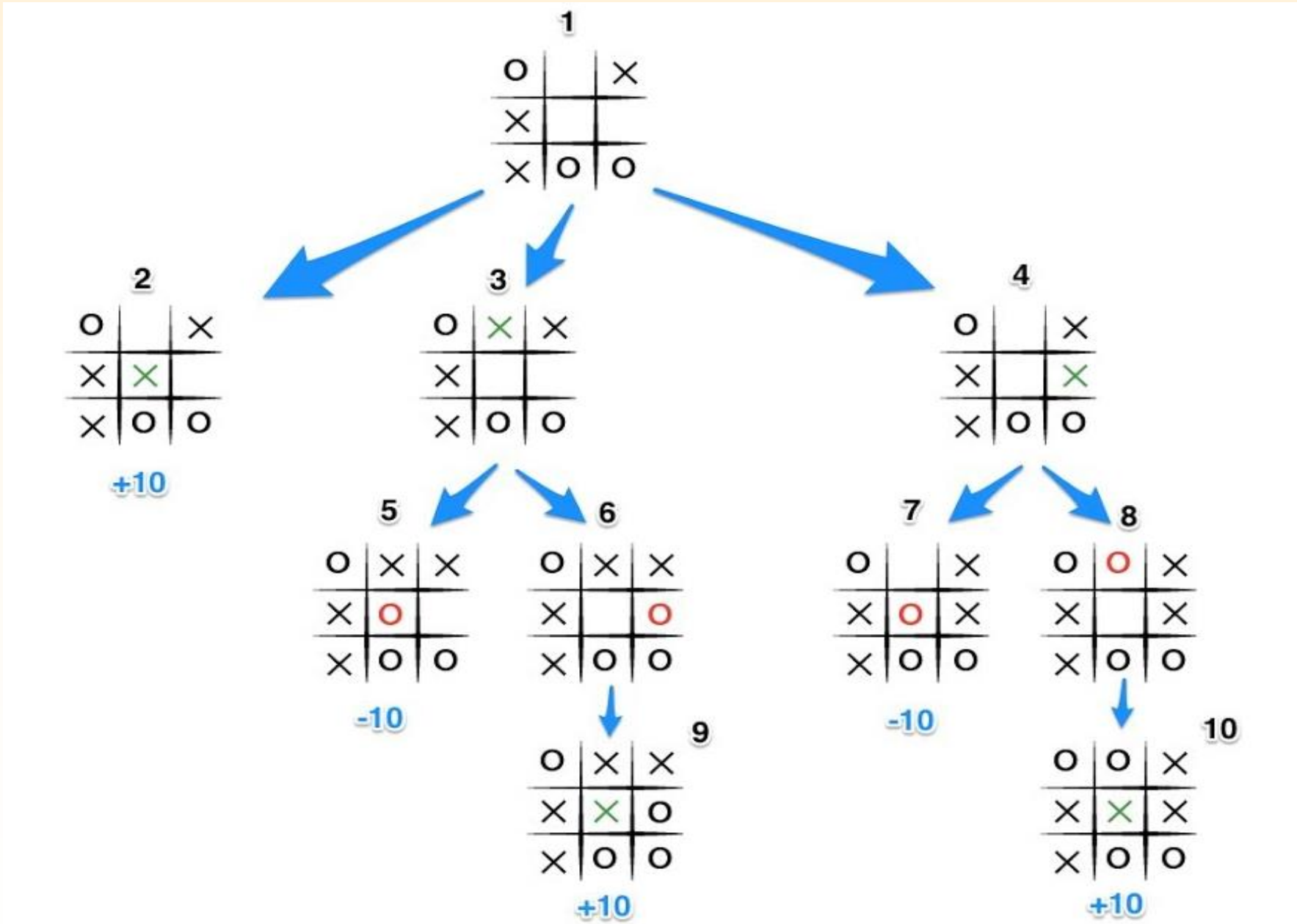
An element contains the value 0, if the corresponding square is blank; 1, if it is filled with "O" and 2, if it is filled with "X".

Hence starting state is {0,0,0,0,0,0,0,0,0}

The goal state or winning combination will be board position having "O" or "X" separately in the combination of ({1,2,3}, {4,5,6}, {7,8,9},{1,4,7},{2,5,8}, {3,6,9}, {1,5,9}, { 3,5,7}) element values. Hence two goal states can be {2,0,1,1,2,0,0,0,2} and {2,2,2,0,1,0,1,0,0}. These values correspond to the goal states shown in the figure.

The start and goal state are shown in Fig. 2.2.




1
2
+10
3
4
5
-10
6
7
-10
8
9
+10
10
+10

Water-Jug Problem

- In the **water jug problem in Artificial Intelligence**, we are provided with two jugs:
- one having the capacity to hold 3 gallons of water and
- the other has the capacity to hold 4 gallons of water.
- There is no other measuring equipment available and the jugs also do not have any kind of marking on them.
- So, the agent's task here is to fill the 4-gallon jug with 2 gallons of water by using only these two jugs and no other material.
- Initially, both our jugs are empty.

So, to solve this problem, following set of rules were proposed:
Production rules for solving the water jug problem
Here, let ***x*** *denote the 4-gallon jug and* ***y*** *denote the 3-gallon jug.*

S.No.	Initial State	Condition	Final state	Description of action taken
1.	(x,y)	If x<4	(4,y)	Fill the 4 gallon jug completely
2.	(x,y)	if y<3	(x,3)	Fill the 3 gallon jug completely
3.	(x,y)	If x>0	(x-d,y)	Pour some part from the 4 gallon jug
4.	(x,y)	If y>0	(x,y-d)	Pour some part from the 3 gallon jug
5.	(x,y)	If x>0	(0,y)	Empty the 4 gallon jug
6.	(x,y)	If y>0	(x,0)	Empty the 3 gallon jug
7.	(x,y)	If (x+y)<7	(4, y-[4-x])	Pour some water from the 3 gallon jug to fill the four gallon jug
8.	(x,y)	If (x+y)<7	(x-[3-y],y)	Pour some water from the 4 gallon jug to fill the 3 gallon jug.
9.	(x,y)	If (x+y)<4	(x+y,0)	Pour all water from 3 gallon jug to the 4 gallon jug
10.	(x,y)	if (x+y)<3	(0, x+y)	Pour all water from the 4 gallon jug to the 3 gallon jug

The listed production rules contain all the actions that could be performed by the agent in transferring the contents of jugs. But, to solve the water jug problem in a minimum number of moves, following set of rules in the given sequence should be performed:

Solution of water jug problem according to the production rules:

S.No.	4 gallon jug contents	3 gallon jug contents	Rule followed
1.	0 gallon	0 gallon	Initial state
2.	0 gallon	3 gallons	Rule no.2
3.	3 gallons	0 gallon	Rule no. 9
4.	3 gallons	3 gallons	Rule no. 2
5.	4 gallons	2 gallons	Rule no. 7
6.	0 gallon	2 gallons	Rule no. 5
7.	2 gallons	0 gallon	Rule no. 9

On reaching the 7^{th} attempt, we reach a state which is our goal state. Therefore, at this state, our problem is solved.