**EXERCISE-1**

**AIM:** Write a code to implement Water-jug problem.

**Description:**

**Water jug problem in Artificial Intelligence**

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 7th attempt, we reach a state which is our goal state. Therefore, at this state, our problem is solved.

**Source Code:**









