**Water jug problem**

1. J1 and j2 are two jugs
2. (x, y) : order pair
3. x: maximum water storage capacity of jug1 is 4 gallons i.e. x=4
4. y: maximum water storage capacity of jug2 is 3 gallons i.e. y=3
5. No mark on jug
6. Pump to fill the water into the jug

**Question:**

How can you get exactly 2 gallon of water into the 4-gallons jug?

**Solution:**

Solution-1: exactly 2 gallon of water into the 4-gallons jug and exactly 0 gallon of water into the 3-gallons jug

|  |  |  |  |
| --- | --- | --- | --- |
| state | Jug1 | Jug2 | rules |
| Initial state | 0 | 0 | - |
| 1 | 0 | 3 | 2 |
| 2 | 3 | 0 | 8 |
| 3 | 3 | 3 | 2 |
| 4 | 4 | 2 | 6 |
| 5 | 0 | 2 | 3 |
| Final state | **2** | 0 | 8 |

Solution-2: exactly 2 gallon of water into the 4-gallons jug and any amount of water into the 3-gallons jug

|  |  |  |  |
| --- | --- | --- | --- |
| state | Jug1 | Jug2 | rules |
| Initial state | 0 | 0 | - |
|  | 4 | 0 | 1 |
|  | 1 | 3 | 5 |
|  | 1 | 0 | 4 |
|  | 0 | 1 | 7 |
|  | 4 | 1 | 1 |
| Final state | **2** | 3 | 5 |

Rules:

|  |  |  |  |
| --- | --- | --- | --- |
| Rule | jug | Task | State/logic |
| 1 | (j1,j2) | Fill the 4-gallon jug | if(r==1):  j1=x; |
| 2 | (j1,j2) | Fill the 3-gallon jug | elif(r==2):  j2=y |
| 3 | (j1,j2) | Empty the 4-gallon jug on the ground | elif(r==3):  j1=0; |
| 4 | (j1,j2) | Empty the 3-gallon jug on the ground | elif(r==4):  j2=0; |
| 5 | (j1,j2) | Pour water from the 4-gallon jug into the 3-gallon jug **until the 3-gallon jug is full** | elif(r==5):  t=y-j2;  **j2=y;**  j1-=t  if j1<0  j1=0 |
| 6 | (j1,j2) | Pour water from the 3-gallon jug into the 4-gallon jug **until the 4-gallon jug is full** | elif(r==6):  t=x-j1;  **j1=x**  j2-=t;  if j2<0:  j2=0; |
| 7 | (j1,j2) | Pour all water from the 4-gallon jug into the 3-gallon jug **until the 4-gallon jug becomes empty** | elif(r==7):  j2+=j1  **j1=0;**  if j2>y  j2=y |
| 8 | (j1,j2) | Pour water from the 3-gallon jug  into the 4-gallon jug **until the 3-gallon jug becomes empty** | elif(r==8):  j1+=j2  **j2=0;**  if j1>x  j1=x |