An Example of a State-Space Search

The Problem: You are given two jugs, a 4-gallon one and a 3-gallon one. Neither has any measuring markers on it. There is a pump that can be used to fill the jugs with water. How can you get exactly 2 gallons of water into the 4-gallon jug?

We need to define a representation of a state. For example, let the ordered pair (X, Y) where $0 \le X \le 4$ represents the water in the 4-gallon jug and $0 \le Y \le 3$ represents the water in the 3-gallon jug. Using this representation, the start state is (0, 0), and the goal state is (2, n).

Next, we need to define a set of operators that map from one state to another. For example,

RULE	INPUT	OUTPUT	INTERPRETATION
1.	(x,y) if x < 4	→ (4,y)	Fill the 4-gallon jug
2.	(x,y) if y < 3	→ (x,3)	Fill the 3-gal jug
3.	(x,y) if x > 0	→ (0,y)	Empty the 4-gallon jug on the ground
4.	(x,y) if y > 0	→ (x,0)	Empty the 3-gallon jug on the ground
5.	(x,y) if x+y ≥ 4 and y > 0	→ (4, y-(4-x))	Pour water from the 3-gal jug into the 4-gal jug until it is full
6.	(x,y) if x+y ≥ 3 and x > 0	→ (x-(3-y), 3)	Pour water from the 4-gal jug into the 3-gal jug until it is full
7.	(x,y) if x+y ≤ 4 and y > 0	→ (x+y, 0)	Pour all the water from the 3-gal jug into the 4-gal jug
8.	(x,y) if x+y ≤ 3 and x > 0	→ (0, x+y)	Pour all the water from the 4-gal jug into the 3-gal jug on the ground

A sample solution might be.

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Start State       (0,0)
      [R2]  →     (0,3)
      [R7]  →     (3,0)
      [R2]  →     (3,3)
      [R5]  →     (4,2)
      [R3]  →     (0,2)
      [R7]  →     (2,0) Goal State
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