2CEIT602: Artificial Intelligence
Practical-2

Aim: Write a python program to solve a Water Jug Problem by using Breadth first search (BFS).

- Program should be written in generalized way to solve by using any capacity of jug.
- Take only two jugs: jug1, jug2
- Don't use any global variable
- Create Class Node, bfs_algo, water_jug with appropriate method and variables.
- Capacity of jug1 and jug2 should have entered by user.
- Don't use any python package throughout program except time.
- Find the minimum number of steps to reach the goal states entered by user.
- Check evaluating criteria Completeness, Optimality, execution time, No. of explored Nodes of BFS algorithm. (Only "time" packages can be used in python if it is necessary to use)

Example:

A Water Jug Problem: You are given two jugs, a 4-gallon one and a 3-gallon one, a pump which has unlimited water which you can use to fill the jug, and the ground on which water may be poured. Neither jug has any measuring markings on it. How can you get exactly 2 gallons of water in the 4-gallon jug?

Let X represents the content of the water in 4-gallon jug.

Let Y represent the content of the water in 3-gallon jug.

Start from initial state: (X=0, Y=0)

Reach any of the Goal states: (X=2, Y=0), (X=2, Y=1), (X=2, Y=2), (X=2, Y=3)

1. Fill 4-gal jug (x,y) $\rightarrow$ $(4,y)$
     $x < 4$

2. Fill 3-gal jug (x,y) $\rightarrow$ $(x,3)$
     $y < 3$

3. Empty 4-gal jug on ground (x,y) $\rightarrow$ $(0,y)$
     $x > 0$

4. Empty 3-gal jug on ground (x,y) $\rightarrow$ $(x,0)$
     $y > 0$

5. Pour water from 3-gal jug to fill 4-gal jug (x,y) $\rightarrow$ $(4, y - (4 - x))$
     $0 < x+y \geq 4$ and $y > 0$

6. Pour water from 4-gal jug to fill 3-gal-jug (x,y) $\rightarrow$ $(x - (3-y), 3)$
     $0 < x+y \geq 3$ and $x > 0$

7. Pour all of water from 3-gal jug into 4-gal jug (x,y) $\rightarrow$ $(x+y, 0)$
     $0 < x+y \leq 4$ and $y \geq 0$

8. Pour all of water from 4-gal jug into 3-gal jug (x,y) $\rightarrow$ $(0, x+y)$
     $0 < x+y \leq 3$ and $x \geq 0$

Output of above example may be look like below:

```
Enter value of maxjug1:4
Enter value of maxjug2:3
Enter value of Goal in jug1:2
BFS Algorithm is running...
Solution can Found by using BFS algorithm:
(0,0)
(0,3)
(3,0)
(3,3)
(4,2)
(0,2)
(2,0)
Path Cost: 7
Execution Time: 8.557319641113281 ms
```