CS-661 AI Assignment 4

In the lecture the *water jug* problem was introduced. The agent is given two jugs, one holds 4 quarts and one 3 quarts. The agent can:

- fill either jug from a water supply,

- dump either jug into the drain, or

- pour from one jug into the other until either:

  - the jug being filled is full, or
  - the jug being emptied is empty.

The agent's goal is to have two quarts of water in the 4-quart jug.

Use the notation (x, y) for the state wherein there are x quarts of water in the 4-quart jug and y quarts in the 3-quart jug. In this notation $(0, 0)$ is the initial state, and $(2, 0)$ is the goal state. Use the extended notation $(x, y|\text{conditions})$ when we have partial information, e.g. $(x, y|x \leq 4, y \leq 3)$ is the most general state.

1. How many basic operations are there? Invent notations for each basic operation. For example, filling the 4-quart jug could be $F4 \equiv (x, y|x < 4) \Longrightarrow (4, y)$. Define each operation *exactly* (be careful with the inequalities).

2. Using the notation just invented, write out the shortest solution showing the states at each step.

3. Expand the initial state showing all states generated. What states are **not** generated?

4. Expand all the first level states (breadth first).

5. Depict (by rough drawing) breadth first and depth first search for the jug problem. Which will reach the solution first?

6. Can you find a useful heuristic for the water jug problem?