Assignment 1

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1   Written Questions

1. [20 points]Performance measures for an agent could be designed based on the effects the agent has on the environment or according to the behaviors of the agent. Explain briefly what is the difference, provide an example for each, and explain if one of the two choices is best and why.

   Answer: Taking two examples from the book, in the case of the vacuum cleaner agent, one could define a performance measure by the amount of dirt cleaned up in a single 8 hour shift, awarding more points for more dirt cleaned—a performance measure according to the behaviours of the agent. Alternatively, one could define a performance measure by awarding one point for each clean square at each time step—a performance measure according to the effects the agent has on the environment.

   In the case of a performance measure designed according to the behaviours of the agent, we reward behavior that we think will lead to the desired effects on the environment rather than reward for the desired effects directly. This can allow a rational agent to maximize its performance measure without the desired effects to the environment. For example, as the book points out, a rational vacuum cleaner agent that is maximizing the amount of dirt cleaned in an 8 hour period could maximize its performance measure by cleaning up the dirt, dumping it back on the floor and cleaning it again. For this reason, it is better to define a performance measure based on the desired effects to the environment rather than the behaviors of the agent.

2. [30 points]You are given the following problem: Given a 5-gallon jug filled with water and an empty 2-gallon jug how can you have precisely 1 gallon of water in the 2-gallon jug? Assume you can fill the jugs with water as many times as desired, but you cannot measure how much water is in each jug. When you move water out of a jug you can either fill up the other jug or dump the water.

   You are to formulate the problem using a state-space search representation.

   Describe (precisely):

   (a) what is the initial state

       The initial state is a 5-gallon jug (referred to as "5G" for the remained or the description) filled with water and an empty 2-gallon jug (referred to as "2G" for the remainder of

the description). Note: for the remainder of this description a state will be denoted as $\{Jug1 : NumberofGallons, Jug2 : NumberofGallons\}$. For example, the initial state wwould be $\{5G : 5, 2G : 0\}$.

(b) the goal test

Precisely 1 gallon of water in the 2G.

(c) the actions (called in the textbook successor function)

    i. `pour_into(PouringJug, ReceivingJug)`
      Example:

$$RESULT(\{5G : 5, 2G : 0\}, pour\_into(5G, 2G)) = \{5G : 3, 2G : 2\}$$

    ii. `empty(Jug)`
      Example:

$$RESULT(\{5G : 5, 2G : 0\}, empty(5G)) = \{5G : 0, 2G : 0\}$$

    iii. `fill(Jug)`
      Example:
$$RESULT(\{5G : 5, 2G : 0\}, fill(2G)) = \{5G : 5, 2G : 2\}$$

(d) the path cost

Each step costs 1 so the path cost is the number of steps in the path

(e) the state-space for the problem

The state-space is any state of fullness of the two-gallon and five-gallon jugs reachable by the actions `pour_into(Jug1, Jug2)`, `fill(Jug)`, and `empty(Jug)` performed on the initial state and any resultant states.

(f) is the state-space a tree or a graph?

The sate space if a graph since there are repeated states.

(g) what search algorithm would you use and why?

I would use a uniform-cost search because the search space is small, and it will always find an optimal solution.
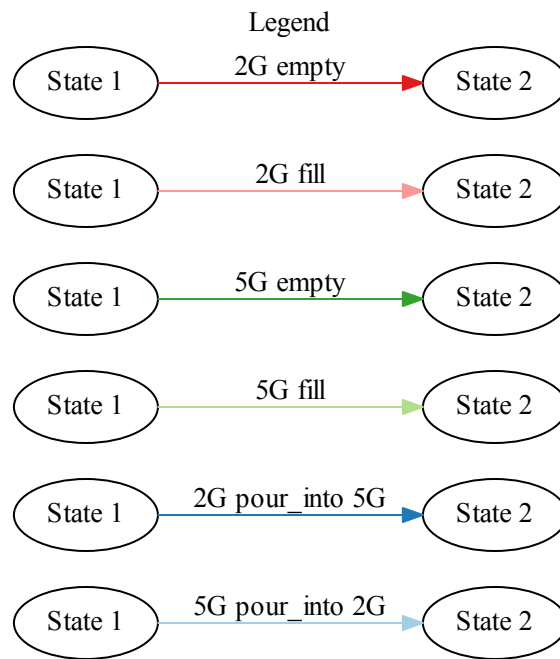
(h) show graphically the search space explored and the solution (there might be more than one solution)
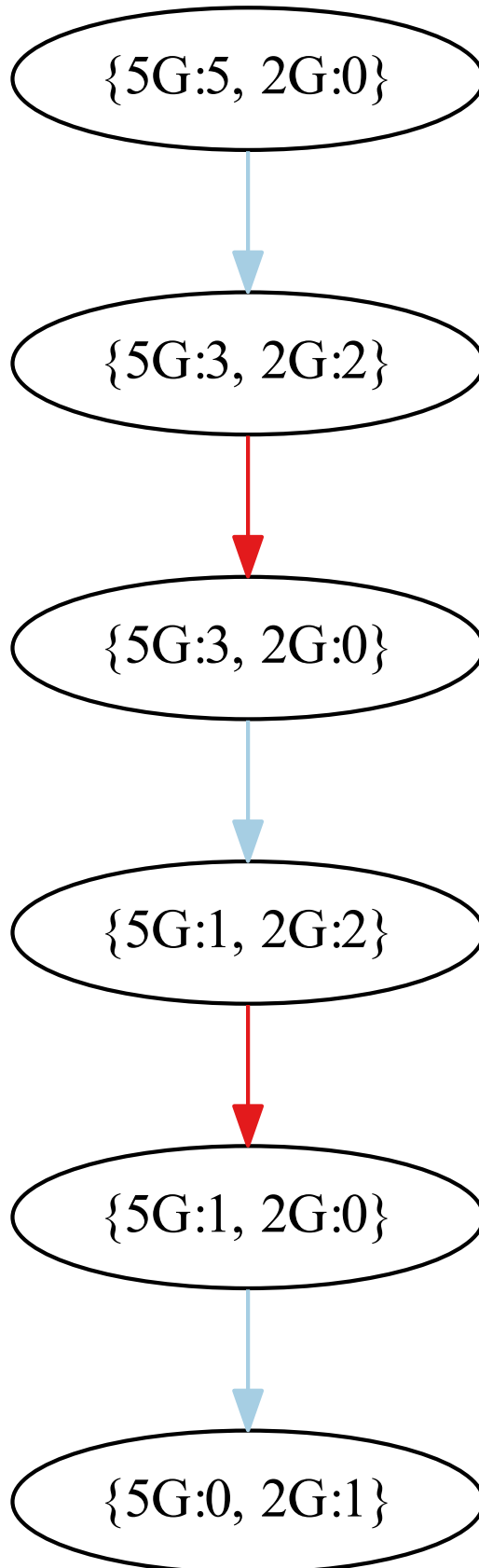
Next two pages show

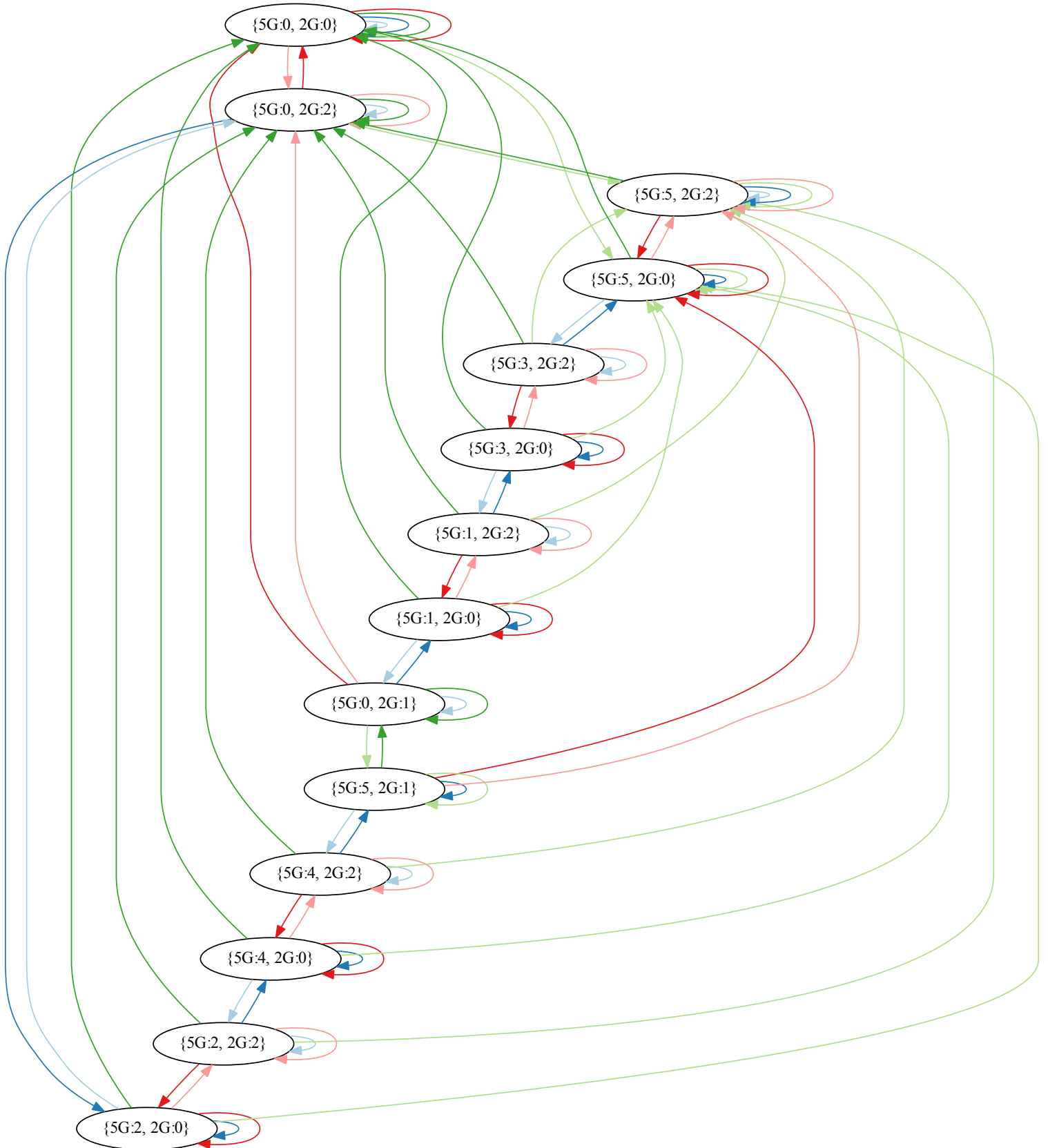   i. The search space explored
    ii. The optimal soluion

The color of the arrows indicate the action according to the following legend

Legend

State 1 — 2G empty → State 2

State 1 — 2G fill → State 2

State 1 — 5G empty → State 2

State 1 — 5G fill → State 2

State 1 — 2G pour_into 5G → State 2

State 1 — 5G pour_into 2G → State 2

Optimal Solution

```
{5G:5, 2G:0}
      │
      ▼
{5G:3, 2G:2}
      │
      ▼
{5G:3, 2G:0}
      │
      ▼
{5G:1, 2G:2}
      │
      ▼
{5G:1, 2G:0}
      │
      ▼
{5G:0, 2G:1}
```

State Space for Jug Problem

3. [20 points]There has been a lot of discussion recently in the news and on the web on the dangers of AI, started by Stephen Hawking and Elon Musk
.

   (a) Search for a few on line writings on the controversy and summarize (in 1/2 to 1 page) the main arguments made.

   (b) Read the white paper by Eric Horvitz outlining the project One Hundred Year Study on Artificial Intelligence. Can you think of some additional topics not listed there? or could you add more questions to one of the topics listed? Summarize your thoughts (in a few paragraphs).

2 Lisp