Homework 5

Due 12/07/2012 5 PM

The aim of this homework is to test your understanding of the course. Hence, the problems span across multiple concepts learned in the course. Think at a high-level and try to answer these questions. Remember, like in many real-world problems, there may not be an unique answer for many of these questions. As you had learned in the course, there could be multiple representations for the same problem and these all could yield the same final answer – although the computational efficiency can be different.

Finally, the solutions **must** be submitted through Sakai. They could be typed in word or pdf (latex). Alternatively, you could write the solution, scan it and upload the solutions. I will not check my email and so this must be submitted through Sakai.

1. (15 Points) Consider the grid world shown in the figure below. In this domain, the agent is in a gridworld where each grid cell has 4 doors that the agent has to open to navigate to the adjacent cell. The goals of the agent are to Gather a resource or to Attack an enemy. To gather a resource, the agent has to collect the resource and deposit it at the corresponding location. Similarly, to destroy an enemy, the agent has to kill the dragon and destroy the castle. There are different kinds of resources, namely food and gold. Each resource can be stored only in a storage of its own type (i.e, food is stored in granary and gold is stored in bank). There are 2 locations for each of the resources and its storage. Similarly there are 2 kinds of enemy red and blue. The agent has to kill the dragon of a particular kind and destroy the castle of the same kind. The episode ends when the agent meets the goal of either gathering a resource and storing it or killing a dragon and destroying the castle. The actions that the agent can perform are to move in 4 directions, open the 4 doors, pick up, put down and attack. The door closes after one time-step so that at any time only one door is open.
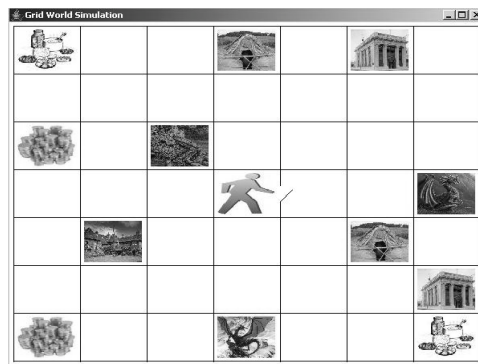

Figure 1: Grid world

Answer **all** the questions below.

Write the PEAS description for this agent. Now can you explain how a simple reflex agent (without the notion of state) operate in this case? How will a reflex agent with state operate? Can you design a goal-based agent for this case? Finally, how about an utility based agent? Which agent will perform the best in this situation?

2. (10 points) Now, let us consider the search through the space of solutions. Assume that the agent *always* starts in the center square. Now assume that the agent has to collect food and store it in the nearest granary. Also, assume a step-cost of -1 per action. So the agent will want to achieve the goal as soon as possible. Show how a BFS and DFS tree might look for this search (note that depending on how you expand, you might get different trees). Design an admissible heuristic for this problem and show how a A^* trace would work for this case.

3. (5 points) Finally, let us represent the above knowledge in first-order logic. Consider the following statements:

- Only one door can be open at anytime.
- The agent can walk through only an open door.
- The direction of walking is the same as the direction of door open.
- A resource can be stored only in a storage of the same type. Note that you can store **only if** you have the resource in hand.
- There are two types of resources, gold and food.
- There are two gold locations and two storage locations for gold (i.e., 2 banks). Let us simply call them as $G1$, $G2$, $B1$ and $B2$.
- There are two food locations and two storage locations for food (i.e., 2 granary). Let us simply call them as $F1$, $F2$, $S1$, $S2$.

Write the above sentences in clausal form. Now use GMP to prove than once the agent has gold from G1 in hand, it should store it either in $B1$ or $B2$.