AUTONOMOUS AGENTS AND MULTI-AGENT SYSTEMS (AASMA)

2018/2019

LAB 1 – INTRODUCTION TO MULTI-AGENT SYSTEMS

1. OBJECTIVES

- Basic concepts of autonomous agents.
- Specification and discussion of the *Loading Docks* scenario.

2. LOADING DOCKS

Loading Dock is a frequently used scenario in the field of Multi-Agent Systems. In this scenario, autonomous robots are used to store boxes in corresponding shelves in a warehouse. Boxes are loaded into a central ramp and should be stored according to their color (e.g. blue boxes in blue shelves). Every object in the environment has a regular form and are mapped into grid units. Figure 1 illustrates the initial situation of Loading Docks.

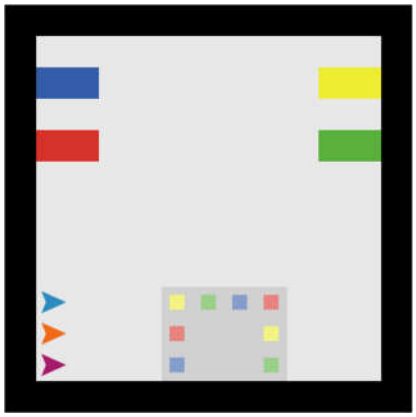

FIGURE 1: THE LOADING DOCKS INITIAL SETTING

2.1 ENTITIES

This scenario has four types of entities:

1. **Robot**: autonomous agent, it can grab a single box at a time, carry and store boxes in a shelf. Additionally, the robot can move one cell forward (if it is free) and rotate in 90º steps (left and right). The robot sensors are limited as it can only sense its current cell and the cell in front of it. It can also sense whether it is carrying a box or not. Further, it can recognize the color of the box it carries.
2. **Ramp:** static object (unable to change its position) that holds boxes. Robots cannot move through the ramp. It initially holds 8 boxes of four different colors. There is only one ramp in the store.
3. **Shelf:** static object characterized by a color where boxes can be stored. The environment has 4 shelves with 4 different colors (red, blue, green and yellow). Each shelf contains two holding compartments; thus, it can hold up to two boxes. It should be noted that, the boxes must store in a shelf with the same color (e.g. red boxes must be stored on the red shelf).
4. **Box:** it is a static object that can be carried by the robots. It is characterized by a color.

2.2 Dynamics

- A robot can move one cell at a time in the direction it is facing or change its direction 90º left or right. It cannot move to an occupied cell or go outside the warehouse's limits.
- A robot not carrying a box can grab a box if the box is standing in the cell in front of him. A robot can carry one box at a time and can only drop it in the corresponding shelf. Robots cannot exchange boxes. To store the box in the shelf, the agent needs to be facing an empty shelf of the corresponding color. A robot can only drop a box in the cell ahead, so it should take the right orientation before dropping it.
- Robots' goal is to store all boxes in the corresponding shelves and then return to their initial position. They can only carry one box at a time, cannot exchange boxes or drop them in the warehouse's floor.

3. Exercises

After careful reading of the description of the Loading Docks scenario, discuss the following questions:

3.1 How do you characterize the environment?

3.2 How do you characterize the agent assuming that it doesn't have internal state?

3.3 What are the agents' sensors and effectors to be able to solve this problem?

3.4 What rules should a reactive agent have in order to solve the problem?

3.5 What are the problems of the this solution?

3.6 How can you improve the reactive solution given to 3.4 when considering an internal state?

4. Homework

- Install NetLogo 6.0 (the most recent version): http://www.netlogoweb.org
- Read the NetLogo manual obtainable form: https://ccl.northwestern.edu/netlogo/docs/
- Do the three tutorials introduced in: https://ccl.northwestern.edu/netlogo/docs/tutorial1.html
- [*optional*] Read the following article on agent-based programming languages: https://www.academia.edu/3497795/A_Survey_of_Programming_Languages_and_Platforms_for_Multi-Agent_Systems
- [*optional*] Read JADE (Java Agent DEvelopment) white paper http://jade.tilab.com/papers/2003/WhitePaperJADEEXP.pdf