

Multi Agent Systems

Assignment 1

The main learning goals of this assignment are getting used to the NetLogo environment, constructing a simple agent-system, and running simulations with it. We strongly recommend you to make Assignment 1.1 *individually*. The other sub-assignments can be made in groups.

1.1 Experimenting with NetLogo

Install NetLogo and explore the software environment by making tutorial 1-3 from <https://ccl.northwestern.edu/netlogo/docs/>. Tutorial #1 and #2 present some basic concepts and example models from the available library. In tutorial #3, you will construct your first multi-agent system. You do not have to hand in the results of this sub-assignment.

1.2 A Smart Vacuum Cleaner

In the remainder of this assignment you will implement a “Practical Reasoning Agent”, as introduced in Chapter 4 of the book. This agent will be a smart vacuum cleaner that navigates through a grid world and cleans all the dirt found in the grid. Each square of the grid is a place that may contain dirt or not. For each new simulation, the cells with dirt should be randomly defined. At the end of the simulation the robot must have cleaned all the dirt.

This situation is similar to the 'Cleaning Robot' described in Chapter 3, but with some important differences. First, the agent does not necessarily have to move in angles of 90 degrees. So it may move in any arbitrary angle. Second, the behaviour of the agent will be based on the *BDI framework*, i.e., it will generate actions on the basis of its beliefs, desires, and intentions.

In particular, the agent will have the *desire* to clean all the dirt in the environment. To perform this general task, the agent may have some *beliefs* about where all the pieces of dirt are (in terms of their Cartesian coordinates). In addition, the agent will have *intentions* which will guide its actions. For instance, if the agent believes that a piece of dirt is located at (-3,5), and the agent has the desire to clean all the dirt, then it may

generate the intention to actually go to location $(-3,5)^*$. Next, as soon as the agent has arrived at that location, it will generate the intention to clean the dirt. To make this assignment, you should follow the template that you can find in the file *assignment1_template.nlogo*.

The first challenge is to implement the smart vacuum cleaner in such a way that it shows the following behaviour. At time point 0, the agent will have *complete information* about where all the pieces of dirt are located. This information should be added to the *belief base*, which can be represented as a list of Cartesian coordinates. Additionally, it will start with the *desire* to clean all the dirt; this desire should persist until the entire environment has been cleaned. During the simulation, the agent may derive *intentions* (e.g., to go to a location or to clean a location). To navigate through the environment, it should use the following simple strategy: “always clean the location that corresponds to the *first* belief in your list of beliefs, and remove the belief from the list”. All beliefs, desires and intentions should be updated dynamically. Further recommendations about how to develop your agent can be found in the NetLogo template. The locations of all the pieces of dirt should be determined randomly.

NetLogo Tips:

- In this assignment, the agent will only have 1 desire and 1 intention at a time, whereas it may have multiple beliefs at a time (which can be represented as a list);
- Use the command **facexy x y** to turn your agent towards a given position **(x,y)**;
- Use the command **round n** to set a given decimal number **n** to the closest integer number;
- Leave the checkboxes *World wraps horizontally* and *World wraps vertically* unchecked in the Settings menu at the interface.

1.3 An Even Smarter Vacuum Cleaner

We will now extend the scenario in two ways: first, instead of always cleaning the piece of dirt that corresponds to the first belief from the belief base, your agent will now always clean the *nearest* piece of dirt. Your solution here may differ from the previous one in only one line of code. In particular, you will need to calculate the distance between two given points in the Cartesian coordinate system.

In addition, your smart vacuum cleaner will now carry a *bag* in which the pieces of dirt are collected. Of course, this bag will have a maximum capacity (e.g., 5 pieces of dirt). So, as soon as the bag is full, the agent will have to go to a *garbage can* to empty the bag

* The actions of the agent should depend *directly* on its intentions, which means that it will *only* perform an action if it has a specific intention to do that.

there. Again, the locations of all the pieces of dirt should be random, as well as the position of the garbage can.

NetLogo Tips:

- The command **sort-by** could be used to update the order of a given list based on some condition.
- You should create a new slider for the maximum capacity of the bag;
- You will need at least 2 additional intentions, namely to go to the garbage can and to empty the bag;
- It might be convenient to implement the garbage can as an agent.

What to hand in?

You have to develop two separate NetLogo models, which correspond to Assignment 1.2 and Assignment 1.3. Please include the two NetLogo models within one .zip-file, and submit this file (as a group) via Blackboard.