

# Multi Agent Systems

## Assignment 3

In this assignment you will implement a “Practical Reasoning Agent”, as introduced in Chapter 4 of the book. This agent will be based on the BDI framework, i.e., it will generate behaviour on the basis of its beliefs, desires, intentions.

Using NetLogo, you will implement an agent representing a smart vacuum cleaner, as in Assignment 2. However, this time the agent will reason with 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 (each of them with respective 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 *assignment3\_template.nlogo*.

### IMPORTANT:

- In contrast to Assignment 2, this time the agent does not necessarily have to move in angles of 90 degrees. So it may move in any arbitrary angle.
- 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.

### 3.1 A Smart Vacuum Cleaner [3 points]

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.

### 3.2 An Even Smarter Vacuum Cleaner [2 points]

Now you will develop another smart vacuum cleaner that is similar to the previous one, but with a slight (but important) difference: your agent will always clean the *nearest* piece of dirt (instead of the one corresponding to the first belief from the belief base). 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.

NetLogo Tip:

- The command `sort-by` could be used to update the order of a given list based on some condition.

### 3.3 A More Realistic Example: Limited Carrying Capacity [5 points]

We will now make this scenario a bit more realistic: now your smart vacuum cleaner will 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 there. Remember: as in the previous assignment, your agent will always clean the nearest piece of dirt. Again, the locations of all the pieces of dirt should be random, as well as the position of the garbage can.

NetLogo Tip:

- 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 three separate NetLogo models, which correspond to the following assignments:

- Assignment 3.1 [3 points]
- Assignment 3.2 [2 points]
- Assignment 3.3 [5 points]

Please include the three NetLogo models within one .zip-file, and submit this file (as a group) via Blackboard.