AUTONOMOUS AGENTS AND MULTI-AGENT SYSTEMS (AASMA)

2018/2019

LAB 3 – DELIBERATIVE AGENTS IN THE LOADING DOCKS SCENARIO

1. GOALS

To develop deliberative behavior in the *Loading Docks* scenario and to allow agent communication.

2. THE DELIBERATIVE AGENT

The following pseudo-code recovers the deliberation procedure of a deliberative agent (BDI)

```
B <- B0 /*initial beliefs*/
I <- I0 /*initial intentions*/
while true do
    P <- get-perceptions
    B <- beliefs-revision-function(B,P)
    D <- option(B,I)
    I <- filter(B,D,I)
    plan <- build-plan(B,I,Ac)
    while (not (empty(plan) or succeeded(I,B) or impossible(I,B))) do
        instruction <- head(plan)
        execute(instruction)
        plan <- tail(plan)
        P <- get-perceptions
        B <- beliefs-revision-function(B,P)
        if reconsider(B,I):
             D <- option(B,I)
             I <- filter(B,D,I)
        if not(sound(plan,I,B)): plan <- build-plan(B,I,Ac)
    end-while
end-while
```

The ***beliefs*** of an agent in the *Loading Docks* include all the information captured by its perceptions.

Desires include all the possible options for the agent to take regarding its perceptions.

In the *Loading Docks* environment, three possible desires occur independently.

- *Grab*: the agent wants to grab a box
- *Drop*: the agent wants to drop the box
- *Initial-position*: the agent believes all boxes had been delivered and want to return to its initial-position

The ***intention*** will reflect the chosen desire to perform. There is a single intention for each desire.

3. PROVIDED FILE (NETLOGO AND JAVA)

- **`robot-loop`** (NetLogo) and **`agentDecision`** (Java) procedures contain the BDI approach presented in *Section 2*. The implementation of *deliberation* and *planning* procedures are missing, which causes the agents to initially behave using a reactive approach.

- *Beliefs*: the agents' internal state contains a map of the warehouse where the information about the ramp and shelves is updated during their navigation in the warehouse.
- *Desires*: agents can have one or more desires at a time: **"grab"**, **"drop"** or **"initial-position".**
- *Intentions*: they are based on desires and determine the agent's behavior. Intentions are represented as a tuple **<desire, position, heading>**. Illustrating, the chosen desire of grabbing a box will generate an intention with the position and heading required to grab a specific box.
- *Plans*: they contain the set of instructions to achieve the current intention. There are different plan instructions provided NetLogo file and Java file.
- *Communications*: the following procedures allow communication between the agents:
    - **`send-message`** (NetLogo) **`sendMessage`** (Java)
    - **`receive-message`** (NetLogo) **`receiveMessage`** (Java)
- *Supplementary* procedures: besides the introduced procedures to create, access and modify the provided internal abstract types, there are other useful procedures. Illustrating, in NetLogo:
    - **`build-path-plan`** (NetLogo) **`buildPathPlan`** (Java)
    - **`adjacent-pos-of-occupied-ramp, adjacent-pos-of-free-shelf`** (NetLogo)

4. Exercises

4.1 Agent behavior

In the previous class, the reactive agent architecture revealed to be insufficient for agents to efficiently deliver boxes and return to their initial positions. In this class, the agents can keep record of warehouse map and communicate, therefore, more efficient solutions might be created.

Elaborate this solution and assume the agents know the total number of boxes in the world.

4.2 BDI Agent

Implement deliberative behavior based on beliefs, desires and intentions (BDI). Implement the procedures **BDI-options**, **BDI-filter** and **build-plan-for-intention** in *NetLogo* (or **deliberate** and **buildPlan** in *Java*) for updating agent's current desire, converting into an intention, and building a plan accordingly.

4.3 Commitment

Implement persistent intentions, in a way that after an intention has failed, the agents try to find an alternative. For instance, during the executions of two plans, if two agents have collided, they should find another way to achieve the same intention.

4.4 Communication

Implement two major forms of communication. First, communication that allows the agents to return to their initial positions after all boxes had been delivered. Second, communication that allows the agents to exchange relevant information regarding the world in order to improve their behavior.

4.5 Behavior comparison

Quantitatively assess the impact of deliberative behavior and communication in the behavior of the agents.

4.6 Problems

Identify some problems of the developed deliberative agents and discuss possible improvements.