VI51: AI for Games and Vir. Env., Intermediate Exam P2016

Duration: 1h30.
No document nor calculator nor smart phone nor touchpad allowed.
English recommended, French accepted.

Part 1: Questions (5 points)

Question 1.1:

Let consider that a simulator is composed of software modules. *What is the Environment module? What is its role in the simulator?*
You could answer to this question by providing and quickly explaining the missions of the Environment in the simulation process.

Question 1.2:

In the definition of the concept of "Agent" given by Ferber, several properties and characteristics are defined for an agent. *Provide at least two of these characteristics.*

Question 1.3:

Let consider two agents, which want to act on the same object at exactly the same time. *What is the module of the simulator, which is managing the simultaneous actions? Brielfy explain the basics of the model for managing the simultaneous actions.*

Part 2: Environment Model (5 points)

The goal of this part is to define a continuous environment that represents a building with multiple levels. It may contain objects (walls, seats, etc.)

Question 2.1:

Write the UML class diagram for the environment and its internal data structure. You should select the best data structure for supporting the continuous space of the environment. You should detail the following elements in the class diagram:

- the different types of environment objects;
- the data structure that contains the environment objects;
- the relationship with the agents.

Part 3: Fleeing Motion Algorithm (5 points)

Let consider the agent A. The goal of this part of the exam is to provide the algorithm for the "fleeing" **steering behaviour** related to A. This behavior permits to A to flee a position in the environment, as fast as possible. The inputs of the algorithm are:

- p_A is the current position of A (position x_A, y_A);
- $\vec{v}_A$ is the current velocity vector of A (not a unit vector, vector with its length in m/s);
- S_A is the maximal speed capability of the agent A (in m/s);
- A_A is the maximal linear acceleration capability of the agent A (in m/s^2);
- T is the point to reach (position x_T, y_T).

The output of the algorithm is the linear motion vector $\vec{m} = (m_x, m_y)$ that has its length in m/s^2.
m/s means "speed in meters per second", and m/s^2 means "acceleration in meters per square second."

Provide "fleeing" steering behaviour algorithm. You could write it with pseudo-code, or the SARL language.

Part 4: Social Force Motion Algorithm (5 points)

Let consider the agent A. The goal of this part of the exam is to provide the algorithm for the '**social-force behaviour** related to A. This behavior permits to A to go toward its target position and avoid collision with environment objects. The inputs of the algorithm are:

- p_A is the current position of A (position x_A, y_A);
- $\vec{v}_A$ is the current velocity vector of A (not a unit vector, vector with its length in m/s);
- S_A is the maximal speed capability of the agent A (in m/s);
- A_A is the maximal linear acceleration capability of the agent A (in m/s^2);
- T is the point to reach (position x_T, y_T).
- O is the set of the obstacles in the field-of-view of the agent A. Each element $i \in O$ is an obstacle with a position $p_i = (x_i, y_i)$.

The output of the algorithm is the linear motion vector $\vec{m} = (m_x, m_y)$ that has its length in m/s^2.

Question 4.1:

Provide the algorithm for computing the general repulsive force $\vec{F}_O$ from the obstacles in O to A. You could write it with pseudo-code, or the SARL language.

Question 4.2:

Provide the algorithm for computing the general attractive force $\vec{F}_T$ from A to T. You could write it with pseudo-code, or the SARL language.

Question 4.3:

Provide the algorithm for computing the linear motion vector $\vec{m}$ from the general repulsive force $\vec{F}_O$ and the general attractive force $\vec{F}_T$. You could write it with pseudo-code, or the SARL language.