AI51
Final Examination F2022

all documents authorized, all electronic devices prohibited.
The evaluation scale is given as an indication (± 1)

1 copy per part

Part 1 (12 points – N. Gaud)

Exercise 1 – AOSE applied to City Parking System : Intelligent parking assistant (IPA) (8 points)

The public parking system developed within the IPA project remodels the public off-street parking system of Gotham City, so that only authorized users can use parking spaces on reservation. An authorized user is a customer registered at the IPA website/apps that has booked a parking stall.

- A parking stall reservation is held for a 'grace period' (e.g. 15 min) after the start of the reserved interval in order to account for customers who does not show up in time. If the customer arrives within the grace period, he/she will be billed for the full reserved period. If the customer does not show up within the grace period, a message (e.g. SMS or email) will inform him/her about the expiration of his/her reservation.
- If the customer arrives any time after the regular grace period, a vacant and unreserved spots will be offered for the remaining period of the original interval of reservation. The customer will be billed from the start to the end of his/her original reservation.
- Customers who fail to clear their parking spot as scheduled will be billed at a higher rate for the overstay duration.
- If a customer arrives and his or her reserved spot is still occupied by a previous customer who failed to depart as scheduled, but there are other available spots, the arriving customer will be offered to park on an available spot. This information will be sent through an SMS.
- Reservation must always be warranted. To fulfil this rule, some special IPA parking spaces are left at the disposal of the IPA (back-up parking spots). The system cannot overbook the parking-space reservations.
- If some customers failed to depart as scheduled, the authorised customer who finds his/her spot occupied will be assigned to one of the backing-up parking spots. This change will be notified with an SMS to the customer.

The IPA features consists of:

1. User computer interaction (apps/website front-end): it enables customer registration, requests for parking-space reservation and general account management, for instance, showing the list of recent user's transactions with the IPA parking system.
2. User management : manages users profiles, information about the registered customers, records of transactions for each customer, such as past reservations, usages, whether the customer showed up late, or failed to show up during their reserved period etc.
3. Parking spot access control (sensors): This system is triggered when a car parks or leaves the parking spot, manages the state of each parking spot: 'available', 'reserved' or 'occupied' and 'out-of-service'.
4. Reservation management: Current parking reservations, guiding the user to his parking place.
5. Transaction management: billing system, it records the customer's transactions with the system, such as extension of the reservation, overstay etc.
6. System administration: the IPA managers should be able to configure the system with parameters such as: † total capacity of the parking spaces; † rates for parking usage as reserved; and † special fees for overstays. This module implements a system for billing reserved occupancy time, extensions and overstays (price settings). Management of malfunctioning and regular maintenance of the IPA parking stalls is implemented in this module.

AI51

Final Examination F2022

all documents authorized, all electronic devices prohibited.
The evaluation scale is given as an indication (± 1)

1 copy per part

Question 1 (5 points)
Using the CRIO language, describe the organizational model of a multiagent-based decentralized Intelligent Parking Assistant (IPA): please provide the different organizations, the roles that make them up and the associated capacities, external resources (e.g. DB, GUI, etc.) if necessary as well as potential links between these organizations (Stereotyped UML Class diagram).

Question 2 (3 points):
Describe an example of instanciation of this tsunami warning system presenting the different software agents required, the roles they play within the different groups instantiating the organizations proposed in the previous question (Cheeseboard diagram – Holarchy description). The consistency of your answer with the one you provided to the previous question is an important point.

Exercise 2 – PEAS (4 points)

Provide the PEAS (Performance, Environment, Actuators, Sensors, Chapter 2 Russel & Norvig) description of the environment of a chess-playing agent (for a timed game), and propose possible architectures to design it.
You must detail the different dimensions of the environment in our analysis, and justify your agent architectures proposals that could be used to design the aforementioned agent.

AI51
Final Examination F2022

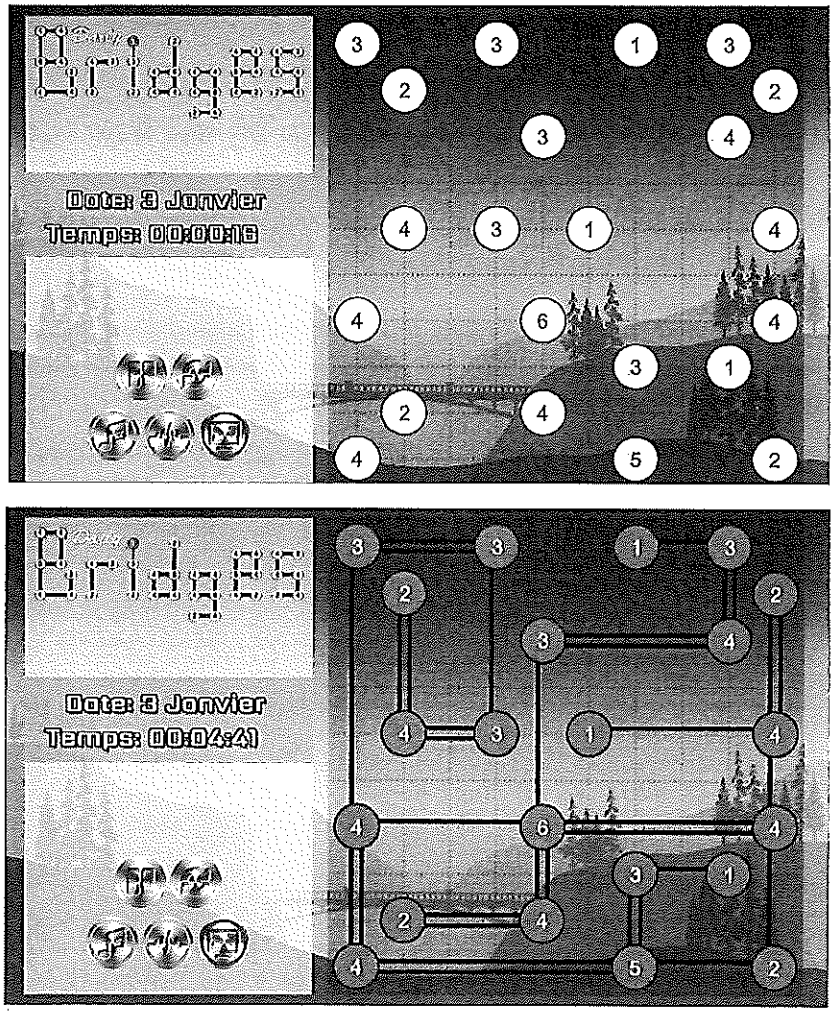
all documents authorized, all electronic devices prohibited.
The evaluation scale is given as an indication (± 1)

1 copy per part

Part 2 (4 points – F. Gechter) – Reactive Multiagent Systems

Bridges is a mind game also known as Hashiwokakero or Hashi. The goal is to connect every island, such that any island can be reached from any other. Each island contains a number that shows you how many bridges must leave that island. Up to two bridges can connect islands together. Bridges can only go horizontally or vertically and may not cross each other.

The two following figures are showing the initial configuration and the solution obtained respecting all the rules of the game.



Question 1 (1 points): Among the algorithms seen during the lectures about Reactive MAS, which one seems to be the most suitable to this game? Why?

Question 2 (3 points): Apply this algorithm to the game explaining what are the agents, what are their behavior and how they will interact so as to collectively find the solution.

AI51

Final Examination F2022

all documents authorized, all electronic devices prohibited.
The evaluation scale is given as an indication (± 1)

1 copy per part

Part 3 (4 points – S. Galland) – Agent-based Simulation.

Question 1 (1 points) :

In a multiagent system, cite two different principles of communication for enabling agents to exchange any information. These principles of communication should be based on different communication paradigms.

Question 2 (1 points) :

In agent-based simulation, what is the "environment" concept and what is the "agent environment" concept?

Question 3 (2 points) :

In the context of agent-based simulation, explain a method for synchronizing the agents in order to ensure that the agents are perceiving, deciding and acting at the same simulated time even if they are supposed to be executed in parallel from a theoretic point of view.