COGNITIVE ROBOTICS (30/08/2018)

Prof. Matteo Matteucci

The exam will be graded IFF the following recommendations have been taken into account:
- Write clearly so that the teacher can easily understand your answers
- Write your name, surname, and student id on each sheet you deliver for evaluation
- For each exercise/question report clearly the number and sub-number (if present)
- You are not allowed to use any programmable device (e.g., smartphone, calculator, etc.)
- You can use pen or pencil, paper will be provided, you cannot use notes or books

Exercise 1 (Cognitive Architectures) [2+2+2+2]

Two main paradigms for the design of cognitive systems have been presented during classes, with hybrid approached, among the two resulting in being the most common ones. Answer the following:
a) What are the limits of the deliberative approach the hybrid one aims to overcome?
b) What are the limits of the reactive approach the hybrid one aims to overcome?
c) What is planning? Formalize a planning problem and its components.
d) How planning could be use in a hybrid architecture including deliberative and reactive components?

Exercise 2 (ROS and friends) [1+2+2]

ROS is a middleware used to develop the software system of a robot.
a) Why do we need a middleware such as ROS for that?
b) What are nodes and topics?
c) What are messages and services?

Exercise 3 (Human Robot Interaction) [2+2+2]

A new vacuum cleaner is going to be launched on the market, the main innovation is that it naturally interacts with the house owner! You are hired to design such interaction:
a) What are the reasons the vacuum cleaner should interact with the owner? Should this interaction be verbal or non verbal? Why?
b) Describe a possible verbal interaction between the robot and the owner. What kind of sensors and actuators you will punt on the vacuum cleaner to implement such a verbal interaction? What are the possible issues which could arise when vacuum cleaning?
c) Describe a possible non verbal interaction between the robot and the owner. What kind of sensors and actuators you will punt on the vacuum cleaner to implement such a non verbal interaction? What are the possible issues which could arise when vacuum cleaning?

Exercise 4 (Neural Networks) [2+2+2+2]

Let assume we want to train a feed forward neural network for regression:
a) Provide a drawing for the network in the case of a single hidden layer with J neurons. Define the activation functions, and provide the overall computed function
b) What error function is used for regression and why? Provide its derivation.
c) How neural networks are trained? What are the possible issues of such a procedure and how they could be avoided?
d) What is ReLU and why we could want to use it? Can ReLu activation function be used in all the nodes in the proposed network? Why?