COGNITIVE ROBOTICS (04/07/2017)

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)

Two main paradigms for the design of cognitive systems have been presented during classes, the deliberative approach and the reactive one. Answer the following questions about these two approaches.

a) What is the closed world assumption?
b) Describe the deliberative approach for the development of a cognitive robot, its components, its advantages and its limits. How would you design the architecture for an industrial floor cleaner according to the deliberative paradigm?
c) Describe the reactive approach for the design of a cognitive robot, its components, its advantages and its limits. How would you design the architecture for an industrial floor cleaner according to the reactive paradigm?

Exercise 2 (Natural Language Processing)

Describe the standard processing pipeline of a Natural Language Processing system. Provide a diagram of it describing the information flow, and what kind of models are used. How machine learning could be used in such a pipeline?

Exercise 3 (Human Robot Interaction)

Human robot interaction is about robot being able to interact with humans in the most natural way to convey intentions, emotions, information, etc. With reference to non-verbal interaction between robots and humans, answer the following questions.

a) Why should we care about non-verbal interaction between humans and robots?
b) What is the uncanny valley? Provide its plot and describe it.
c) What kind of sensors could we use to measure distance? What are their main problems?
d) Provide a use case for which a distance measure is used to implement non-verbal interaction between human(s) and machine(s)/robots(s)

Exercise 4 (Neural Networks)

Let assume we want to train a feed forward neural network for classification:

a) Provide a drawing for the network in the case of two classes, define the activation functions, and provide the overall computed function
b) What error function is used for classification 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) The previous network might not work in case we want to classify images, in that case we could use a Convolutional Neural Network. Provide its overall architecture, and describe its components.