COGNITIVE ROBOTICS (02/09/2018)

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) [1+1+3+3]

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? Which approach does it affect?
b) What is the symbol grounding problem? Which approach does it affect?
c) Describe the deliberative approach, its components, its advantages and its limits. How would you design the architecture for an autonomous car according to the deliberative paradigm?
d) Describe the reactive approach, its components, its advantages and its limits. How would you design the architecture for an autonomous car according to the reactive paradigm?

Exercise 2 (Natural Language Processing) [1+2+1]

With reference to the Part of Speech (POS) tagging problem answer the following questions:

a) What is POS tagging about? Describe it shortly add make an example
b) Describe what is a Hidden Markov Model and how it can be used for POS tagging
c) Could LSTM networks be used for POS tagging? How?

Exercise 3 (Human Robot Interaction)[1+2+2+2]

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 its meaning.
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). Provide a picture of it, describe the intended behavior, and discuss the intended communication.

Exercise 4 (Neural Networks) [1+1+2+2]

The hottest topic in machine learning these days is deep learning, let's spot differences!

a) How does deep learning differ from classical learning with respect to feature representation?
b) Deep learning employs neural networks, but these are not a new method; why were neural networks not obtaining such astonishing results so far?
c) How Convolutional Neural Networks face the issues of image classification? Describe the network architecture the idea behind it and the issues in image classification it solves.
d) How Long-Short Term Memories face the issues of recurrent networks? Describe the network architecture the idea behind it and the issues in image classification it solves.