

# COGNITIVE ROBOTICS (21/06/2018)

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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+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) How the symbol grounding problem could be solved/faced?
- d) Describe the deliberative approach, its components, its advantages and its limits. How would you design the architecture for an autonomous vacuum cleaner according to the deliberative paradigm?
- e) Describe the reactive approach, its components, its advantages and its limits. How would you design the architecture for an autonomous vacuum cleaner according to the reactive paradigm?

## **Exercise 2 (ROS and Gazebo) [2+2+1]**

Answer the following questions:

- a) What is ROS? What it is used for?
- b) What are the communication paradigms provided by ROS for the development of robots?
- c) Does it make sense to teach ROS in a Cognitive Robotics class? Why?

## **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) Let's design a novel interaction experience between the user and its sofa (yes the sofa!). Provide a picture of it, describe the intended behavior, and discuss the intended communication. Which sensors would be used and to do what?

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

With reference to the lectures on Feed Forward Neural Networks answer the following:

- a) Describe the perceptron model, draw it, and provide its output formula and its training algorithm.
- b) Describe the backpropagation algorithm and discuss the difference w.r.t. the perceptron learning algorithm. Derive the backpropagation formula for the output layer in a FFNN with SSE loss function.
- c) How do neural networks fit in the classic sense-plan-act cycle?
- d) What is the issue of vanishing gradient in neural networks training?