COGNITIVE ROBOTICS (10/07/2018)

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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) [2+1+3+1]

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 is planning? Formalize a planning problem and its components.
b) How planning could be use in a hybrid architecture including deliberative and reactive components?
c) Using PPDL , define the planning problem of a sailor moving a wolf, a goat, and a cabbage across a river (you might need to use conditional effects in actions …):
- The boat is tiny and can only carry one passenger at a time
- If the sailor leaves the wolf and the goat alone together, the wolf will eat the goat.
- If the sailor leaves the goat and the cabbage alone together, the goat will eat the cabbage.
d) Is the previous problem solvable using pure STRIPS definitions instead of ADL? Explain why.

Exercise 2 (ROS and friends) [4]

Describe and design a simple robot using ROS nodes and topics (what it does, which sensors uses, what information it exchange).

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

Design a desktop robotic lamp which interacts with a student preparing his/her Cognitive Robotics exam.
a) Provide a sketch of the robot identifying actuators and relevant moving parts
b) What kind of sensors/actuators might be needed to interact with the person? Describe where to put them and explain why!
c) What kind of emotional interaction could it show/trigger? Why?
d) What channels could be exploited to induce such an interaction?

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

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) Can ReLu activation function be used for classification? Why?