COGNITIVE ROBOTICS (19/01/2018)

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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

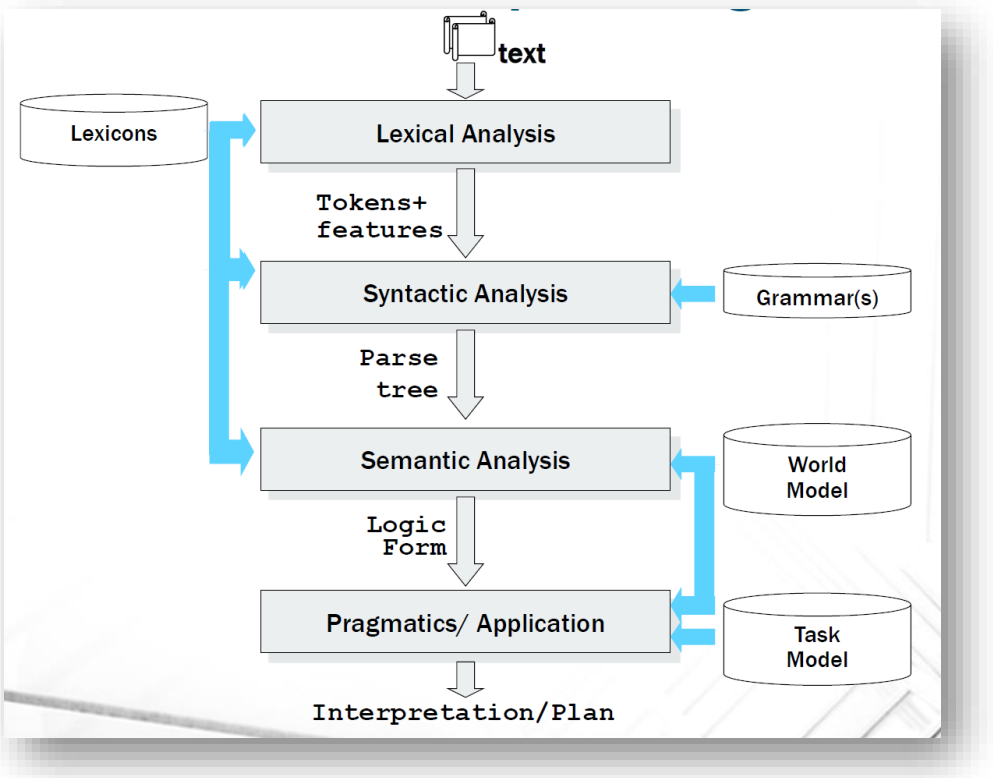
Exercise 1 (Cognitive Architectures) (2+2+1+2 points)

Two main paradigms for the design of cognitive systems have been presented during classes, the oldest one being the deliberative approach. Answer the following questions about it.

a) What is planning? How it is related to the deliberative approach? Formalize a planning problem and its components.
b) Using PPDL, define the planning problem of dressing up for a formal dinner, e.g., trousers, tie/necklace, shirt, jacket. You just need a minimal set of actions, but some cloths should be put in the right order. Is there more than a single plan?
c) What is the closed world assumption?
d) What is the Symbol Grounding problem? How can it be faced?

Exercise 2 (Natural Language Processing) (1+1+1+1 points)

Consider the standard Natural Language Processing pipeline reported in the following schema. Describe each of the grey blocks in terms of input, output, purpose, and provide a simple example of its use.



Exercise 3 (Human Robot Interaction) (2+3+1 points)

You are designing an interactive restaurant table to make "more interesting" the ordering experience of visitors, and, at the same time, to save on dishes delivery time.

a) What kind of sensors and actuators might be needed for the interaction? For each of them describe its purpose. Provide also a sketch of the table with the sensors and discuss their placement. Consider you might be more attendant and you want the table to interact with them also **during** the dinner
b) Not to be predictable, i.e., boring, the table should have different patterns of behaviors and generate different reactions. Provide 3 of such patterns, describe which reactions they are supposed to induce, and how sensors are used in each of those.
c) Discuss the role of time in human robot interaction in general.

Exercise 4 (Neural Networks) (1+2+2+2+1 points)

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.
e) How does deep learning differ from classical learning with respect to feature representation?