ROBOTICS (27/06/2016)

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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 (Algorithm)
Let's consider how trajectory planning works, in particular:
a) Describe what is trajectory planning all about
b) Describe how graph-based search planning works
c) Describe the A* algorithm for graph-based search
d) How can motion primitives improve on basic graph-based planning?

Exercise 2 (Numerical Exercise)
Consider a differential robot base with a 50cm wheel base:
a) Provide the direct kinematics formulas for a differential drive robot
b) Assuming the robot starts in (0,0,0) compute the robot pose at times A, B and C according to the following actuations (numbers are strange, but computation should be easy)
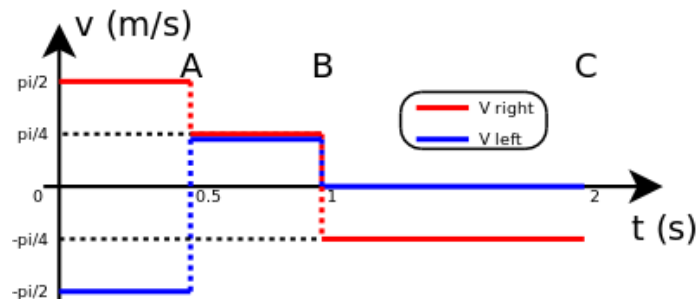
Exercise 3 (Theory)
Let's consider the Simultaneous Localization and Mapping problem; answer the following questions
a) How Simultaneous Localization and Mapping (SLAM) differs from Localization?
b) How Simultaneous Localization and Mapping (SLAM) differs from Mapping?
c) Describe what is the difference between online and offline SLAM
d) Provide the derivation of the recursive Bayes Filter for online SLAM

Exercise 4 (ROS)
Describe in details the roles of the ROS Master in a ROS architecture (what it is, what it does).

Exercise 5 (Other)
What is the C-Space? Why and how it is used? Provide also a simple example to clarify your answer.