

## DIKU RoboRally 2017

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This is the exam assignment on the REX course and the purpose is for you to demonstrate your knowledge of the different aspects of and methods for robotics that you have learnt during this course. The assignment is formed as a game including an informal competition among the participating groups - from now on referred to as *racing teams*.

The exam consists of a group demonstration of your solution to this assignment followed by an individual oral examination without preparation time. Your group must hand in your solution which includes your code and a short description of your solution. The short description must be uploaded no later than Tuesday 7/11 2017 and your code must be uploaded no later than just before your demonstration. The oral exam (15 minutes including grading) will be based on your solution of the assignment as well as the curriculum of the course (as given by the lecture plan and indicated reading material). No aids are allowed during the oral exam. The group demonstration takes place on Wednesday 8/11 2017 from 8:00 to 11:20. The oral exams are distributed on Wednesday 8/11 2017 in the afternoon (from 12:00 to 16:00) and Friday 10/11 2017 from 8:00 to 16:00. The schedule of the individual examination will be posted in Absalon.

### The rules of the game

Your task is to write a program that turns your robot into a rally racing machine. The robot should be able to complete a race track as fast as possible without bumping into obstacles, but using no more than 15 minutes to complete the track. The race track consists of 4 unique landmarks positioned in a square (see drawing in figure 1). Each landmark consists of a colored checkerboard pattern, and color and orientation (horizontal or vertical) of the pattern uniquely identifies the landmark (see table 1 for a definition of each landmark). In the race track there will be randomly positioned obstacles in the form of cardboard boxes with a square of a green A4 paper on each side.

Your robot will start in the vicinity of landmark L1 and you may assume that it faces the landmark. You may not assume anything about the distance to or position around the landmark. Your robot must visit the landmarks in the order L1, L2, L3, and finally L4. Your robot must only visit a landmark once. A landmark is visited, if the robot (or parts of it) is within 40cm distance to the landmark (measured to the checkerboard paper). Your robot has completed the race track when it reaches landmark L4 and the time it took is recorded. The racing team completing the track using the shortest amount of time (including penalty minutes) is declared the winner of the race.

The obstacles will be placed at random inside the race track square. On race day the referees will place the obstacles on the race track. Therefore, you cannot assume anything about the location, orientation and number of these obstacles, except that they will be fully or partially inside the race track square.

Your team has in total 20 minutes to setup and race, and when the 20 minutes are over your robot will be removed from the race track. As soon as your robot moves by itself the clock starts counting down on your 15 minutes race time. It is therefore important that your racing team is ready to go when it is your time to race.

If your robot fails to complete the race track within 15 minutes, the robots current position is recorded. If no race team completes the track, the team that comes closest to the final landmark L4 is declared the winner of the race. A verdict will be reached by the referees based on how many landmarks have been visited by each team.

The race schedule will be posted on Absalon in the morning of the race. All teams are expected to be present during all races. The race day will end with the announcement of the champions of DIKU RoboRally 2017.

**Penalties:** Penalties will be given by tough, but fair, referees and will be added to the time it takes your robot to complete the race track:

- If your robot bump into a landmark or obstacle your racing team will receive a penalty of 2 minutes for each collision.
- If your robot misses a landmark (the robot does not come within 40cm distance to the landmark), your racing team will receive a penalty of 14 minutes for each missed landmark.
- If your robot visits the landmarks in a different order than L1, L2, L3, and L4 or revisits a landmark, your racing team will receive a penalty of 14 minutes.

#### **Suggestions on how to solve the exercise**

You need to come up with a strategy for completing the race track as fast as possible avoiding getting penalty minutes. You may use any part of your solutions to the previous exercises as you see fit. You can reuse your solution to the self localization exercise and extend it to include four landmarks and use this to localize your robot on the race track. To avoid obstacles you can use either your obstacle avoidance solution or your solutions to find a green target and measure distance and bearing to this (this could allow you to see the target from a distance and plan ahead), or you can combine all of these solutions.

Landmark	Unique code
L1	Vertical red
L2	Vertical green
L3	Horizontal green
L4	Horizontal red

Table 1: Definition of each landmarks unique code.

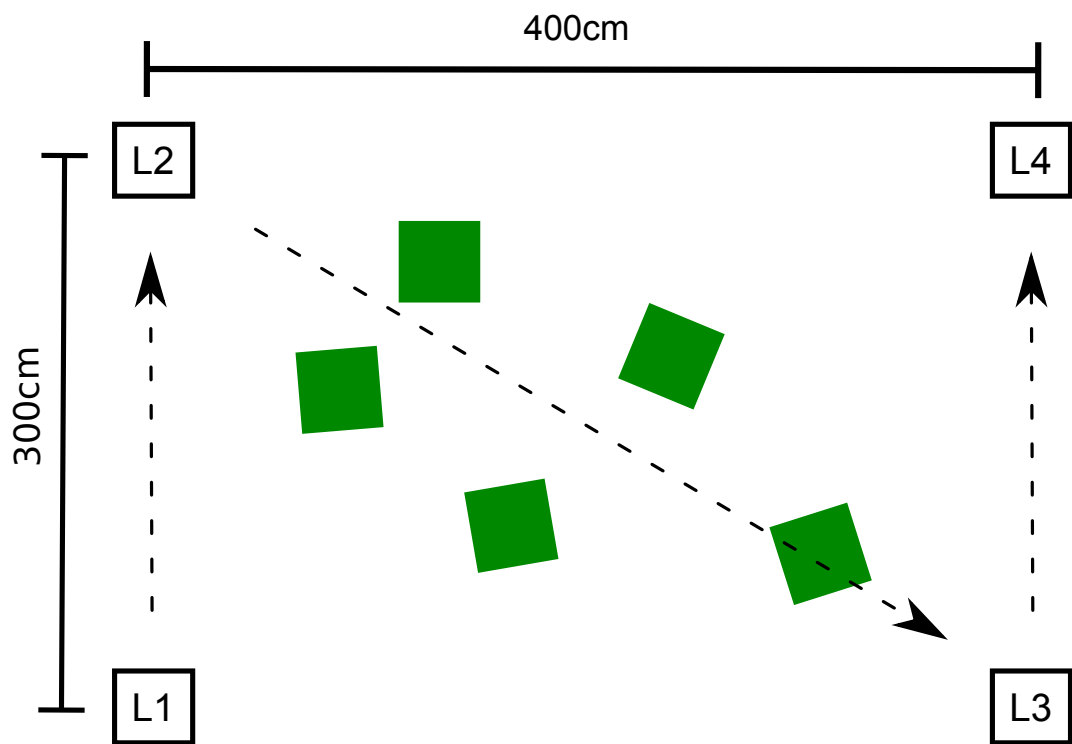


Figure 1: Definition of the race track. The four landmarks are indicated with the black boxes. An example of obstacle positions are shown with the green boxes. Dashed arrows indicate the driving direction, and finally the two bars indicate the dimensions of the race track square.