

**Machine Learning for Robotics and Computer Vision**  
**Summer term 2013**

**Homework Assignment 1 — April 26, 2013**

**Exercise 1.**

In class, we had an example of a robot that can measure its distance to a wall in front of it. We modeled this using a continuous random variable with a Normal distribution  $\mathcal{N}(x; \mu, \sigma^2)$ .

- a) Write the sensor model  $p(z|x)$  in the full form (not the shorthand notation).
- b) In addition to the distance sensor, the robot has a docking device that can hook up to fixed docking positions on the ground. There are 7 docking positions at equal distances from 1m up to 7m in front of the wall. Now assume the robot does not know how far it is away from the wall, but it travels until it can find a docking station. What is the robot's belief about its current location with respect to the wall if the robot does not use its distance sensor information?
- c) Now the robot uses its sensor to measure the distance and it obtains a value of  $3.6m$ . Assume the sensor noise is  $\sigma = 0.1$ . At which position is the robot most likely and what are the probabilities? How does this change if the sensor noise is  $\sigma = 1.0$ ?
- d) Next, the robot moves from its current docking station towards the wall until it reaches the next docking station. However, this motion towards the wall can fail. In 10% of the cases, the robot actually stays at its position although he got a motion command. In another 10% of the cases, the robot actually moves away from the wall instead of towards it. In case the robot is at the first docking station, the action does not succeed and the robot stays most often at the docking station. At the last station, no backwards movement is possible, because the robot is held back there. Draw the state transition diagram of this motion. What is the posterior of the robot's state? Where is the robot most likely? Explain why the posterior probability is different (higher or lower) compared to the belief before the motion.

## **Exercise 2.**

Try to find (for example by internet search or from the book) at least 5 examples for learning techniques that have not been discussed in class. Describe these techniques briefly and classify them with respect to the hierarchy from the lecture.

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The next exercise class will take place on **May 3rd, 2013**.

For downloads of slides and of homework assignments and for further information on the course see

<http://vision.in.tum.de>

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