TU München
Fakultät für Informatik
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Machine Learning for Computer Vision
Winter term 2017

23. Oktober 2017
Topic: **Probabilistic Reasoning**

Exercise 1: Follow the robot

Assume you get your hands on a robot that has various sensors.

a) The robot has a very cheap camera on board, so it's not very accurate at reading colors. After color calibration you know that the camera color model looks as follows:

z \ x	**R**	**G**	**B**
R	0.8	0.1	0.1
G	0.1	0.6	0.2
B	0.1	0.3	0.7

For instance, the probability that the robot reads blue while the true color is green is $p(Z = B|X = G) = 0.3$.
Assume the robot is located in a white room with 5 boxes: 2 red, 2 green and a blue one. The robot moves towards a box and the camera reads green. How likely is it that the box is actually green?

b) The robot also has a proximity sensor and it uses it to measure its distance from a door. The sensor's accuracy can be modeled using a continuous random variable with a Normal distribution with $\sigma_1 = 0.3$ m. Express the sensor model $p(z_t|x_t)$ in the full form (not the shorthand notation).

c) Now the robot moves into a hallway. Initially it knows it is located at the door (x=0). The robot can execute *move* commands but the result of the action is not always perfect. Assume that the robot moves with constant speed v. The motion can also be modeled with a Gaussian with $\sigma_2 = 0.1$ m. Write the motion model $p(x_t|x_{t-1}, u_t)$.

d) **Programming: Bayes Filter**

You let the robot run with a speed of 1 m/s. The robot only runs forward and it updates its belief every second. Assume you get the following sensor measurements in the first 3 seconds: $\{z_1 = 1.2, z_2 = 1.6, z_3 = 2.5\}$. Further assume that the hallway is only 5 meters long. Where does the robot believe it is located with respect to the door after 3 seconds? How certain is it about its location? Try out different standard deviations for the sensor and the motion model. How does the robot's belief change?

Exercise 2: An overview of ML methods

Try to find (for example by internet search or from the book (C.M. Bishop)) 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 categories presented in the lecture.

The next exercise class will take place on **30. Oktober 2017**.

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

`https://vision.in.tum.de/teaching/ws2017/ml4cv`
