Albert-Ludwigs-Universität Freiburg | Institut für Informatik
Lecture: Introduction to Mobile Robotics
Summer term 2012 | Prof. Dr. W. Burgard

Presence-Exercise

Topic: Bayes Filter with Motion and Sensor Models

Exercise 1:

A robot moves along the middle of a corridor with a given accurate map, as depicted in the figure (see next page). At some of the given locations x_i it takes measurements z_k of the distance to one side, using one laser beam. Every measurement is corrupted only with additive Gaussian noise $\mathcal{N}(\mu, \sigma)$ with $\mu = 0m$ and $\sigma = 1m$. The scanner range is assumed to be unlimited. The measured distances are $z_1 = 1m$, $z_2 = 2m$, $z_3 = 5.4m$, $z_4 = 8.6m$, $z_5 = 9m$. The mapping between z_k and x_i is unknown.

1. For each measurement, determine the most likely robot pose by calculating the probabilities for each position given the measurement using Bayes' rule. Assume an equally distributed *prior*. Remember that the probabilities should be scaled such that $\sum_{i=1}^{4} P(x_i|z) = 1$.

2. The robot believes that taking measurements at the positions x_2 and x_3 is in general four times as likely as doing so at x_1 and x_4. Use this prior information to recalculate the probabilities of (2.1) .

3. Given the uniform prior, the robot measures $z_6 = 5.5m$. Then it moves to the right, according to the following probability table:

x_{t-1}	x_1	x_2	x_3	x_4
$P(x_t = x_1 \| u, x_{t-1})$	0.2	0.05	0	0
$P(x_t = x_2 \| u, x_{t-1})$	0.8	0.15	0.05	0
$P(x_t = x_3 \| u, x_{t-1})$	0	0.8	0.15	0.05
$P(x_t = x_4 \| u, x_{t-1})$	0	0	0.8	0.95

   Then it measures $z_7 = 5.5m$. What is the most likely pose of the robot?

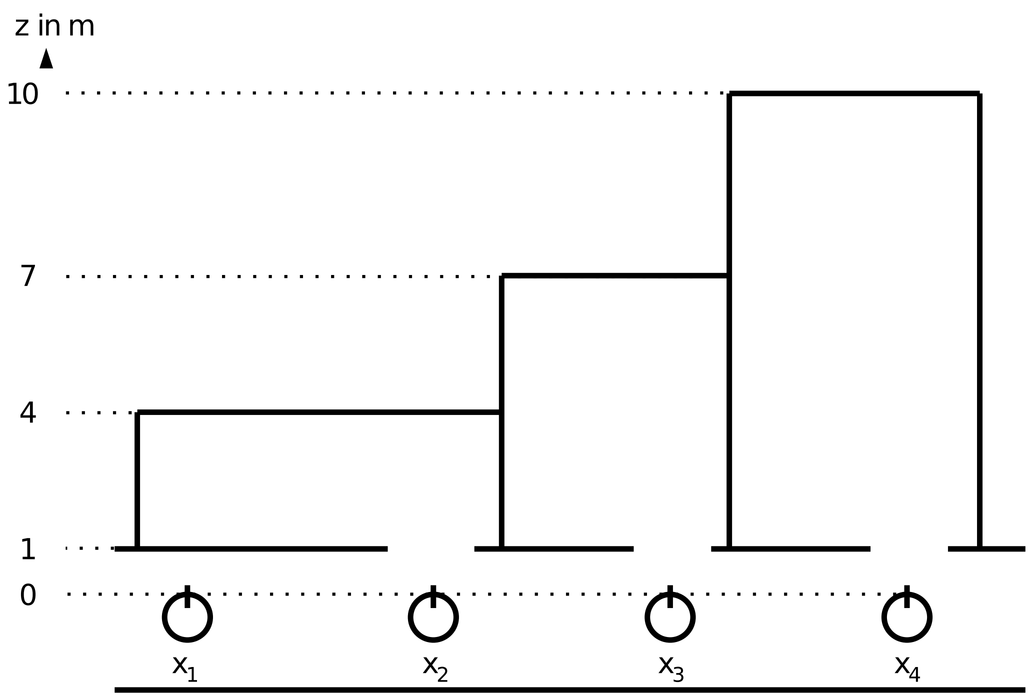

Figure 1: Map