# AUVE Exam

Only lecture slides and personal notes allowed
The exercise points are given approximately
17th December 2019

## Exercise 1 (3 pts)

Questions:

1. Following Fig. 1, describe the content of the main functional blocks of an Autonomous Vehicle.

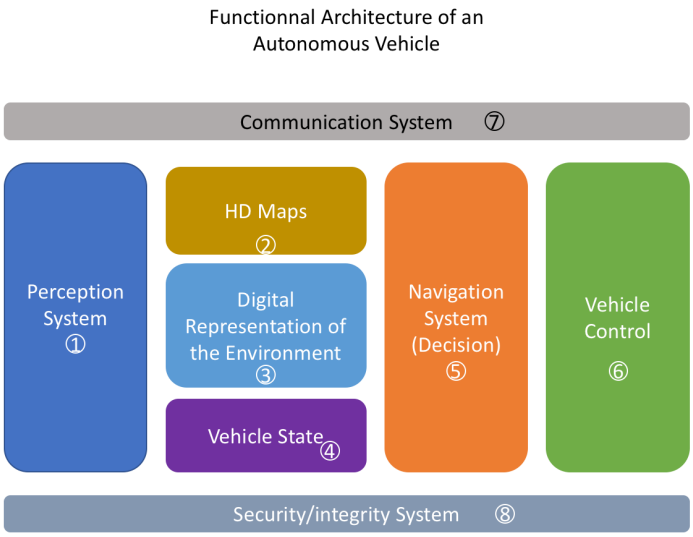


Figure 1: Functional Blocks of an Autonomous Vehicle.

# Exercise 2 (4 pts)

A robot has to build an occupancy grid map (cells $c_0, \ldots, c_n$) of a simple one-dimensional environment using a sequence of measurements from a range sensor (see Fig. 2).

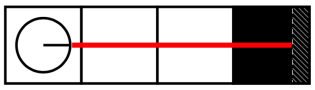

Figure 2: Very simple range sensor.

Assume a very simple sensor model: every grid cell with a distance (based on its coordinate) smaller than the measured distance is assumed to be occupied with probability $p = 0.2$. Every cell behind the measured distance is occupied with probability $p = 0.6$. Every cell located more than 30cm behind the measured distance should not be updated. To calculate the resulting occupancy grid map use the inverse sensor model (based on sensor properties described before) and the log-odds update formula (see below) proposed during the lectures.

$$l(m_i|z_{1:t}, x_{1:t}) = l(m_i|z_t, x_t) + l(m_i|z_{1:t-1}, x_{1:t-1}) - l(m_i)$$

Questions:

1. Sketch the algorithm you will use to compute each cell log-odds value. For that, assign the cell coordinates, which span from 0 to 100cm (both endpoints included) with increments of 20cm, to one array $c$ and the belief values to another array $m$. The measurements and the prior belief are given in the table below.

2. Plot the resulting estimate with the position on the x-axis and the occupancy probability of the y-axis.

| Grid resolution | 20cm |
|---|---|
| Map length (1D only) | 100cm |
| Robot position (static) | $c_0$ |
| Measurements (in cm) | 51, 82, 85 |
| Prior | 0.5 |