# RBE 500 — Foundations of Robotics

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Spring 2022

**Problem Set 4**

Due: April 22, 2022 at 11:59 pm

Please note: This PSET is an individual assignment, NOT a group assignment. Therefore, collaboration with other students while implementing the solution is prohibited.

## Problem 1 (10 points)

Implement Bayes filter (available in the Lecture 11 slides and the Probabilistic Robotics book script that is provided in Canvas as an additional resource) to iteratively calculate the belief regarding the "door state" in the "Robot-Door" problem explained in Slides 34-40. Assume you do not have any prior information about the state of the door.

Test your code with the following consecutive action-measurement pairs.

You can implement your code in a language of your choice (MATLAB, Python, C++, etc). Submit your code together with a short report presenting your test results.

**Note**: Calculate the effect of these iterations in a `while` or `for` loop. First, write a general implementation of the Bayes Filter that would work for any [action, measurement] pair of this problem. Then place this function in a `for` or `while` loop, which will utilize a given array of action and measurement pairs. So, your code should work for any series of [action, measurement] pairs, NOT only for iterations below.

- Iteration 1: action: `do_nothing`, measurement: `closed`
- Iteration 2: action: `do_nothing`, measurement: `closed`
- Iteration 3: action: `open`, measurement: `closed`
- Iteration 4: action: `do_nothing`, measurement: `closed`
- Iteration 5: action: `open`, measurement: `open`
- Iteration 6: action: `do_nothing`, measurement: `open`

Include your code in your PDF submission. Do not upload your code to Gradescope.

## Problem 2 (10 points)

A target is moving in a 1D plane. The reference position is known and fixed at the origin, thus the target's position at time step $k$ is $x_k$. We have no information on the target's trajectory and thus we model the motion as a random walk with variance of 4 $m^2$.

Based on previous measurements, we have an initial guess of the target position as $\mu_0 = 20\ m$ with variance $\sigma_0^2 = 9\ m^2$. We then receive measurement from each of the next two time steps $z_1 = 22\ m$ and $z_2 = 23\ m$. Each with variance 1 $m^2$.

Use a Kalman filter to estimate the state of the target at time step 2 ($\mu_2$ and $\sigma_2^2$).

*Note:* This problem can be solved either manually or by writing a Python or MATLAB script. If writing a code, include your code in your PDF submission.