COMP417, Fall 2019 Quiz 4

First Name:

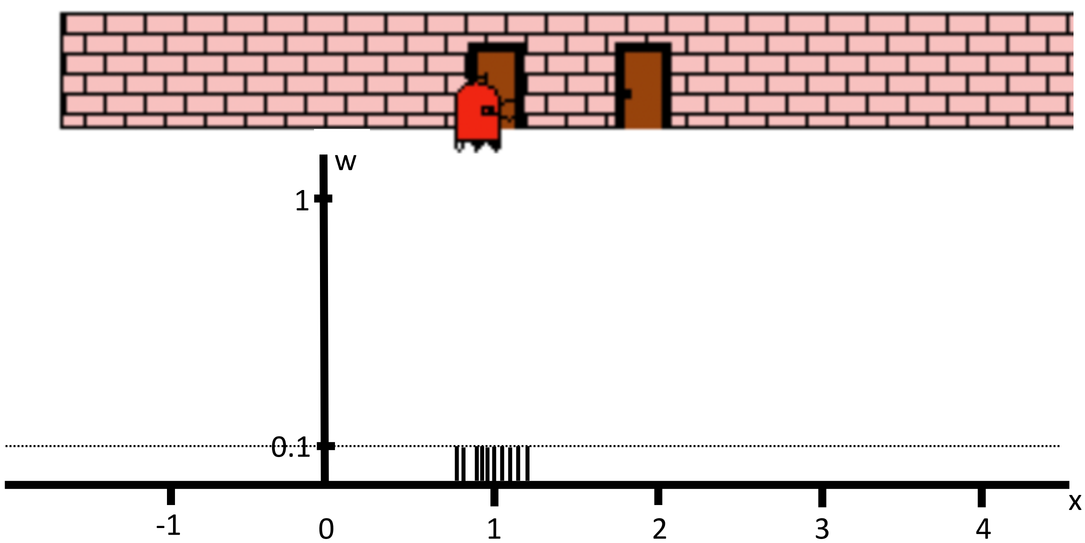
Last Name:

Student #:

Q1: A 1D robot walks through the "2 door" environment, shown below. The motion model is $x_t = x_{t-1} + u_{t-1} + \epsilon$ with $\epsilon \sim \mathcal{N}(0, 0.1^2)$. Measurement model is:

$$p(z_t|x_t) = \begin{cases} p(z == 1) = 0.9 \; and \; p(z == 0) = 0.1, if \; x_t \; is \; in \; front \; of a \; door \\ p(z == 1) = 0.1 \; and \; p(z == 0) = 0.9, if \; x_t \; is \; in \; front \; of a \; wall \end{cases}.$$

The robot is using a particle filter with N=10 particles. Its initial belief is $\mathcal{N}(1, 0.1^2)$. represented by 10 vertical lines, shown below, where the horizontal position (x-axis) is the sampled state and the height (w-axis) is the particle weight (all are equal at this stage). Draw a statistically likely set of particles representing the result of applying one step of the particle filter with control $u_0 = 1$ and observation $z_1 = 0$. Do not apply resampling.



Q2: Circle the best control combination for achieving the target without oscillation.

P-only PI D-only ID I-only PD

Q3: The block-on ice with force limitation has $\ddot{x} = u$ s.t. $|u| < 1$, with state space $\boldsymbol{x} = \begin{bmatrix} x \\ \dot{x} \end{bmatrix}$, goal state $\boldsymbol{x_g} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$, and cost $g(\boldsymbol{x}, u) = 0 \; if \; goal, else \; 1$. Fill in u*, the optimal action, for states:

a) $\boldsymbol{x_a} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$: $u^*(\boldsymbol{x_a}) =$

b) $\boldsymbol{x_b} = \begin{bmatrix} -0.2 \\ 0 \end{bmatrix}$: $u^*(\boldsymbol{x_b}) =$

c) $\boldsymbol{x_c} = \begin{bmatrix} 0 \\ 3.14 \end{bmatrix}$: $u^*(\boldsymbol{x_c}) =$