Assignment 9

Due on 2020-11-18, 23:59 IST

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Instructions: In the following questions, one or more choices may be correct. Select all that apply.

1) Consider the operation of a Bayesian filter algorithm as described in the class. The robot consists of the state of the door as 'open' or 'shut'. The robot has a single sensor that can sense the state of the door as 'open' or 'shut'. The robot also has an actuator that can push open the door if appropriate. The robot can also choose to do nothing which does not cause any change in state. Given the information below, compute the belief state after the following sequence of actions and observations:

- \( t_1 = \text{do-nothing}, \ t_2 = \text{shut} \)

Initial Belief: \( \text{bel}(x_0 = \text{open}) = 0.5, \ \text{bel}(x_0 = \text{shut}) = 0.5 \)

Sensor Model:
- \( p(z_2 = \text{open}|x_2 = \text{open}) = 0.8 \)
- \( p(z_2 = \text{shut}|x_2 = \text{open}) = 0.2 \)
- \( p(z_2 = \text{open}|x_2 = \text{shut}) = 0.1 \)
- \( p(z_2 = \text{shut}|x_2 = \text{shut}) = 0.9 \)

Transition Model:
- \( p(x_2 = \text{open}|x_1 = \text{open}, u_1 = \text{push-open}, x_{t-1} = \text{open}) = 1.0 \)
- \( p(x_2 = \text{shut}|x_1 = \text{open}, u_1 = \text{push-open}, x_{t-1} = \text{open}) = 0.0 \)
- \( p(x_2 = \text{open}|x_1 = \text{shut}, u_1 = \text{push-open}, x_{t-1} = \text{shut}) = 0.7 \)
- \( p(x_2 = \text{shut}|x_1 = \text{shut}, u_1 = \text{push-open}, x_{t-1} = \text{shut}) = 0.3 \)

Which of the following are true?

1. \( \text{bel}(x_1 = \text{open}) = 0.79, \ \text{bel}(x_1 = \text{shut}) = 0.21 \)
2. \( \text{bel}(x_1 = \text{open}) = 0.37, \ \text{bel}(x_1 = \text{shut}) = 0.63 \)
3. \( \text{bel}(x_1 = \text{open}) = 0.54, \ \text{bel}(x_1 = \text{shut}) = 0.46 \)
4. \( \text{bel}(x_1 = \text{open}) = 0.64, \ \text{bel}(x_1 = \text{shut}) = 0.36 \)
5. \( \text{bel}(x_1 = \text{open}) = 0.18, \ \text{bel}(x_1 = \text{shut}) = 0.82 \)
6. \( \text{bel}(x_1 = \text{open}) = 0.73, \ \text{bel}(x_1 = \text{shut}) = 0.27 \)
7. \( \text{bel}(x_1 = \text{open}) = 0.27, \ \text{bel}(x_1 = \text{shut}) = 0.73 \)
8. \( \text{bel}(x_1 = \text{open}) = 0.64, \ \text{bel}(x_1 = \text{shut}) = 0.36 \)
9. \( \text{bel}(x_1 = \text{open}) = 0.18, \ \text{bel}(x_1 = \text{shut}) = 0.82 \)

2) In the previous question, suppose that the robot subsequently pushes the door open and observes that it is open (that is, \( u_2 = \text{push-open, } x_2 = \text{open} \)). Use the belief state that you computed after \( t_2 \) to compute the belief state after \( t_3 \) is observed. (Assume that the robot sensor model and the dynamics of the environment are unchanged.)

Which of the following are true?

1. \( \text{bel}(x_3 = \text{open}) = 0.86, \ \text{bel}(x_3 = \text{shut}) = 0.14 \)
2. \( \text{bel}(x_3 = \text{open}) = 0.49, \ \text{bel}(x_3 = \text{shut}) = 0.51 \)
3. \( \text{bel}(x_3 = \text{open}) = 0.96, \ \text{bel}(x_3 = \text{shut}) = 0.04 \)
4. \( \text{bel}(x_3 = \text{open}) = 0.29, \ \text{bel}(x_3 = \text{shut}) = 0.71 \)
5. \( \text{bel}(x_3 = \text{shut}) = 0.56, \ \text{bel}(x_3 = \text{open}) = 0.44 \)
6. \( \text{bel}(x_3 = \text{shut}) = 0.49, \ \text{bel}(x_3 = \text{open}) = 0.51 \)
7. \( \text{bel}(x_3 = \text{shut}) = 0.96, \ \text{bel}(x_3 = \text{open}) = 0.04 \)
8. \( \text{bel}(x_3 = \text{shut}) = 0.29, \ \text{bel}(x_3 = \text{open}) = 0.71 \)

3) Since the Bayes Filter algorithm uses the entire history of observations and actions, it does not assume Markov dynamics for the system.

Which of the following are true?

1. True
2. False

4) Which of the following are valid state variables for a Markov model?

1. The total distance travelled since the robot was turned on.
2. The robot is on the straight path.
3. The on-board battery level.
4. The number of times the robot turned left so far

Which of the following are true?

1. True
2. False

5) Given a noise-free measurement model, is it possible for the robot to know exactly where it is in the state space at every instant?

Which of the following are true?

1. True
2. False