Individual Assignment: Bayes Filter

Start Assignment

Due Sunday by 11:59pm **Points** 12 **Submitting** a file upload **Attempts** 0
Allowed Attempts 1

Assignment Overview

Consider a household robot equipped with a camera. It operates in an apartment with two rooms: a living room and a bedroom. The robot runs an artificial neural network that can recognize a living room in the camera image. Further, the robot can perform a switch-room action, i.e., it moves to the living room if it is in the bedroom, and vice versa. Neither the recognition nor the motion controller is perfect.

From previous experience, you know that the robot succeeds in moving from the living room to the bedroom with a probability of 0.7, and with a probability of 0.8 in the other direction:

$$p(x_{t+1} = \text{bedroom} \mid x_t = \text{living room}, u_{t+1} = \text{switch-room}) = 0.7$$

$$p(x_{t+1} = \text{living room} \mid x_t = \text{bedroom}, u_{t+1} = \text{switch-room}) = 0.8$$

The probability that the neural network indicates that the robot is in the living room although it is in the bedroom is given by $p(z = \text{living room} \mid x = \text{bedroom}) = 0.3$, and the probability that the network correctly detects the living room is given by
$p(z = \text{living room} \mid x = \text{living room}) = 0.9$.

Unfortunately, you have no knowledge about the current location of the robot.
However, after performing the switch-room action, the neural network indicates that the robot is not in the living room. After performing the switch-room action for the second time, the network again indicates not seeing a living room.

A. Use the Bayes filter algorithm to compute the probability that the robot is in the bedroom after performing the two actions. Use an appropriate prior distribution and justify your choice.
B. Which prior minimizes that probability? Briefly explain your answer.

Guidelines

Please submit your answers as a .pdf until Sunday, Dec 04, 23:59 CET. We recommend writing your solution in Latex, Microsoft Word, etc. Handwritten solutions are also accepted, though please make sure that they are readable.

Technical Support

For technical support please get in contact with stars@utn.de (mailto:stars@utn.de) .

Need help using Canvas Discussions? If so, please review the following page: **Canvas Resources for Students - Discussions (https://design.instructure.com/courses/178/pages/discussions?module_item_id=676) .**

M3 Bayes Filter Individual			
Criteria	**Ratings**		**Pts**
first step integration Correct execution of the Bayes filter for the first action and measurement.	**6 to >0.0 pts** **Full Marks**	**0 pts** **No Marks**	6 pts
second step integration Correct execution of the Bayes filter for the second action and measurement.	**3 to >0.0 pts** **Full Marks**	**0 pts** **No Marks**	3 pts
proper prior part A Find and justify a proper prior in part A	**2 to >0.0 pts** **Full Marks**	**0 pts** **No Marks**	2 pts
proper prior part B Find and justify a proper prior in part B	**1 pts** **Full Marks**	**0 pts** **No Marks**	1 pts
			Total Points: 12