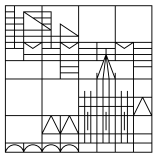
Task Sheet 9

Universität Konstanz



AI for Autonomous Robotics

Deadline 10:00am June 28, 2024

Review on July 2 & 3, 2024

Lecture: *AI for Autonomous Robotics*, Summer Term 2024

Lecturer: Prof. Dr.-Ing. Heiko Hamann

Tutor: Jonas Kuckling & Paolo Leopardi

Task 9.1 Theoretical questions

a) Explain why predictions might be necessary for a robot (*4 points*).

b) Explain the difference between prediction and forecast (*3 points*).

c) Explain in your own words the concept of active inference (*3 points*).

Task 9.2 Prediction and active inference

We want to study the case of a robot trying to predict the world state as in part 7 of the course. Consider a robot moving in a one-dimensional world composed of black and white tiles. The robot should now build a world model and predict the value for the next possible action.

a) Write code (or extend the code from the first exercise) to simulate the robot moving through a one-dimensional tiled world with more than two tiles. At every step, the robot measures the color of the tile (white or black) and updates its internal world model. The robot maintains a world model that predicts the color at a given position through a histogram (one histogram per position). This is different from the first exercise, in which the robot's world model predicted the color after taking an action (one histogram per action). Implement the uncertainty minimizing robot from exercise sheet 1 that always performs the action with the highest certainty for the predicted color. At this point, do not yet use the beta distribution, but rely only on the local samples. What do you observe?

b) Extend your code to include uncertainty, that is the perception of the color is noisy (with 10% probability the wrong color is perceived) and the execution of the action is also noisy (with 10% probability the robot is moving in the other direction than the chosen one). Additionally, implement the cautious and adventurous strategies for the robot to deal with the uncertainty (see slide 22). For computing the mean and variance of the sample, you can assume that the sample follows a binomial distribution (rather than the beta distribution from the lecture). How does this compare against the noise-less version?

c) Also, implement the world model as beta distributions (see slide 9). Compare the two strategies and world models for no noise, 10% noise and 40% noise. What do you observe?

For your submission, please submit the code (and some short documentation on how to execute it), as well as some documentation of your results. The presentation of your results is up to you and can take many forms. For example, you could submit a short PDF file with plots or screenshots from your terminal. Alternatively, you could submit a video of the screen capture, where you explain what is happening. The spirit should be to not just complete the programming task and done - but to play with your little sim a bit. Explore for yourself. Let us know if you found something interesting. Have fun!