

Human-Centered Interaction in Robotics

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Homework 03

Ungraded Task (only for self-study)

With the help of a diagram illustrate and explain the processes and pathways in a "conceptually complete" multimodal architecture for socially interactive agents.

Task 1. Bayesian Networks to Infer Appropriate Robot Intent (40%)

In Figure 1, you see a Bayesian Network that could be used to infer the appropriate intent for robot's verbal response based on the recognised user intent, the discourse state, and the learned user preferences.

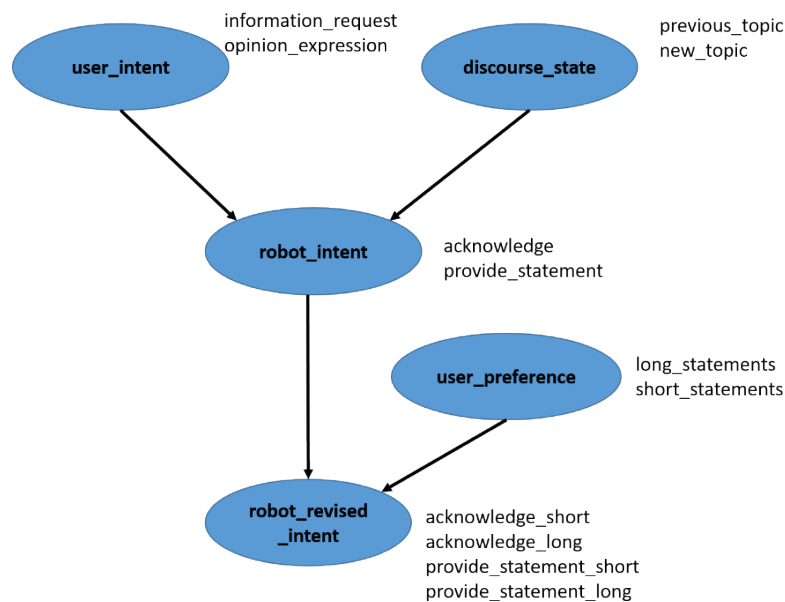


Figure 1: A Bayesian Network modelling the robot's responses based on user input and preferences.

Please complete the following subtasks:

1. Design the Conditional Probability Tables (CPTs) for this network and explain your reasoning behind your choice of values. (15%)
2. Using the *pyAgrum* package (<https://pyagrum.readthedocs.io/en/1.7.1/>), implement this Bayesian Network along with the CPTs that you designed. (15%)
3. Determine the probability of **robot_intent = acknowledge** given the evidence *user_intent = information_request* and *user_preference = long_statements*. (5%)
4. How does the probability change when we add the evidence *discourse_state = new_topic* to the above? Explain your observation. (5%)

Task 2. Create a Chatbot for MAS Admission Assistance (30% + bonus 5%)

In the tutorial, you learned to use the Rasa conversational AI framework to create a chatbot that provides information about weather in different cities.

In this task, you will follow the same procedure to create a chatbot that can answer questions about the MAS admission process. You can use the following website to build the necessary domain knowledge for your chatbot:

<https://www.h-brs.de/en/inf/application-mas-program>

Feel free to also add additional information or advice based on your own experience.

Bonus (5%): Add dynamic content (a new *action.py*) to your chatbot (e.g. getting the lunch menu at the canteen).

Tip: For convenience, you can first test your intents and rules in the Rasa playground and later download the project and run on your local PC.

For instructions on how to use Rasa: See tutorial slides from Session 04 in LEA.

Task 3. Multimodal Machine Learning (30%)

Read the following book chapter:

Tadas Baltrušaitis, Chaitanya Ahuja, and Louis-Philippe Morency. 2018. Challenges and applications in multimodal machine learning. The Handbook of Multimodal-Multisensor Interfaces: Signal Processing, Architectures, and Detection of Emotion and Cognition - Volume 2. Association for Computing Machinery and Morgan & Claypool, 17–48. <https://doi.org/10.1145/3107990.3107993>

Based on the above book chapter, please answer the following:

1. Think of a human-robot interaction scenario. Describe the scenario and argue where single modalities are sufficient and where multiple modalities are needed. (10%)
2. Explain any two challenges in the field of multimodal machine learning with the help of examples. Describe the categories of approaches that have been developed to deal with these challenges. (20%)

Feedback:

Please answer the following:

1. How much time did you spend on doing this sheet per person? Anonymize your answer!
2. Was this sheet too easy / easy / ok / hard / too hard?
3. What additional resources (blogs, papers, books, tutorials, etc.) did you use? Please providelinks or references.
4. Did you face any issues while solving this sheet?

Submission Procedure:

Upload the PDF of your solutions and the relevant source code files in LEA as a single Zip archive. For the naming convention for your submission, please follow the instructions under Course Rules in LEA.

