Human-Centered Interaction in Robotics

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Due Date: 26th June 2024, 23:59

Homework 04

Note: Please do not use AI tools such as ChatGPT to answer theoretical questions.

Task 1. Multimodal Machine Learning (25%)

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. (15%)

Task 2. Human-Centered Reinforcement Learning (25%)

1. Name at least two characteristics of each of the three algorithms: TAMER, SABL and COACH. (15%)
2. For each of the three algorithms, give an example of a human-robot interaction scenario where you would apply this algorithm. (10%)

Task 3. TAMER for Mountain Car Problem (50%)

Here is a sample code for using TAMER to train a car to climb a mountain:
https://github.com/RitwikC07/Hill_climb_TAMER

    a. Modify the code base so that the program can take human evaluative feedback via keyboard with keys 'W' or 'w' for reward (+1), 'A' or 'a' for punishment (-1), while the agent is training. (5%)

    b. Train the mountain car to reach the goal state when credit assignment is set to 'False' and share a screenshot of how far your car reached. (15%)

    c. Explain the strategy you used for giving rewards and punishments while training the mountain car. (5%)

    d. Repeat steps 'b' and 'c' with credit assignment now set to 'True'. (20%)

    e. Compare your results and reason about the role of credit assignment. (5%)

    f. Please submit the modified source code and your results as a .zip file.

Please refer to the following paper for the task:
Knox, W. & Stone, Peter. (2009). Interactively shaping agents via human reinforcement: the TAMER framework. 9-16. 10.1145/1597735.1597738.

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 provide links 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.