COMP34212: Coursework on Deep Learning and Robotics

34212-Lab-S-Report

Angelo Cangelosi
<angelo.cangelosi@manchester.ac.uk>

Release: February 2024

Submission deadline: 18 April 2024, 18:00 (BlackBoard)

Aim and Deliverable

The aim of this coursework is (i) to analyse the role of the deep learning approach within the context of the state of the art in robotics, and (ii) to develop skills on the design, execution and evaluation of deep neural networks experiments for a vision recognition task. The assignment will in particular address the learning outcome LO1 on the analysis of the methods and software technologies for robotics, and LO3 on applying different machine learning methods for intelligent behaviour.

The first task is to do a brief literature review of deep learning models in robotics. You can give a summary discussion of various applications of DNN to different robotics domains/applications. Alternatively, you can focus on one robotic application, and discuss the different DNN models used for this application. In either case, the report should show a good understanding of the key works in the topic chosen.

The second task is to extend the deep learning laboratory exercises (e.g. Multi-Layer Perceptron (MLP) and/or Convolutional Neural Network (CNN) exercises for image datasets) and carry out and analyse new training simulations. This will allow you to evaluate the role of different hyperparameter values and explain and interpret the general pattern of results to optimise the training for robotics (vision) applications. You should also contextualise your work within the state of the art, with a discussion of the role of deep learning and its pros and cons for robotics research and applications.

You can use the standard object recognition datasets (e.g. CIFAR, COCO) or robotics vision datasets (e.g. iCub World[1], RGB-D Object Dataset[2]). You are also allowed to use other deep learning models beyond those presented in the lab.

The deliverable to submit is a **report** (**max 5 pages** including figures/tables and references) to describe and discuss the training simulations done and their context within robotics research and applications. The report must also include on online link to the Code/Notebook within the report, or ad the code as appendix (the Code Appendix is in addition to the 5 pages of the core report). Do not use AI/LLM models to generate your report. Demonstrate a credible analysis and discussion of

[1] https://robotology.github.io/iCubWorld/
[2] https://rgbd-dataset.cs.washington.edu/index.html

your own simulation setup and results, not of generic CNN simulations. And demonstrate a credible, personalised analysis of the literature backed by cited references.

Marking Criteria (out of 30)

1. Contextualisation and state of the art in robotics and deep learning, with proper use of citations backing your academic brief review and statements (marks given for clarity/completeness of the overview of the state of the art, with spectrum of deep learning methods considered in robotics; credible personalised critical analysis of the deep learning role in robotics; quality and use of the references cited) **[10]**
2. ~~A clear introductory to the DNN classification problem and the methodology used~~, with ~~explanation and justification of the dataset, the network topology and the hyperparameters chosen~~; Add Link to the code/notebook you used or add the code in appendix. **[3]**
3. Complexity of the network(s), hyperparameters and dataset (marks given for complexity and appropriateness of the network topology; ~~hyperparameter exploration approach, data processing and~~ coding requirements) **[4]**
4. Description, interpretation~~, and assessment of the results on the hyperparameter testing simulations;~~ include appropriate figures and tables to support the results; depth of the interpretation and assessment of the quality of the results (the text must clearly and credibly explain the data in the charts/tables); Discussion of alternative/future simulations to complement the results obtained) **[13]**
5. 10% Marks lost if report longer than the required maximum of 5 pages: 10% Marks lost if code/notebook (link to external repository or as appendix) is not included.

Due Date: **18 April 2024**, **h18.00,** pdf on Blackboard. Use standard file name: *34212-Lab-S-Report*