COMP61342/41342: Cognitive Robotics and Computer Vision Assignment

Submission deadline: **Friday 9th May 2025, 18:00** (Blackboard)

Aim and Deliverable

The aim of this coursework is to develop skills on the design, execution and evaluation of computer vision algorithms. It also aims at discussing the role of the computer vision and deep learning approaches within the context of the state of the art in robotics.

You will choose a benchmark vision dataset and apply traditional computer vision methods for object recognition (such as Local Features), and a deep learning CNN model to this dataset. Each method will require the systematic exploration and evaluation of the role of specific algorithm settings and hyperparameters. This will also allow you to compare the overall performance of the two approaches to object recognition and analyse the pros and cons of each with respect to the problem and dataset. You will 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 choose a robotics vision dataset (e.g. iCub World[1], RGB-D Object Dataset[2]).

The deliverable to submit is a **report** (max 7 pages including figures/tables and references but excluding appendix for the code) to describe and discuss the computer simulations done and the computer vision and robotics research.

Marking Criteria (out of 50)

1. CNN for vision: Clarity of the methods, 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) **[8]**
2. CNN for vision: Description, interpretation, and assessment of the results on the hyperparameter testing simulations, including appropriate figures and tables to support the results (marks given for the clarity of the reporting of the simulations done and the results presented via text/tables/charts; Depth of the interpretation and assessment of the quality of the results; Discussion of alternative/future simulations to complement the results obtained); **[8]**
3. Object recognition (classification) using Local Features and CV algorithms: describe methods and parameters and justify your choices **[8]**
4. Object Recognition using Local Features and CV algorithms: Results **[8]**
5. Explanation and comparison of the object recognition results between the two approaches (deep learning *vs.* traditional CV algorithms) **[3]**

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

6. State of the art: Contextualisation and state of the art in computer vision for robotics (marks given for clarity/completeness of the overview of the state of the art, with spectrum of deep learning methods considered in robotics; critical analysis of the deep learning role in robotics; quality of the references cited) **[10]**
7. Marks for exceptional performance in the complexity of the work and report **[5]**

Due Date: 18.00 on Friday **9th May 2025**, uploaded to Blackboard **as _one_ PDF** file (your code for parts 3 and 4 should appear at the end of your report, as an appendix).