COLLEGE *of* ENGINEERING, SCIENCE *and* ENVIRONMENT
SCHOOL *of* INFORMATION *and* PHYSICAL SCIENCES
The UNIVERSITY *of* NEWCASTLE

COMP3330/6380, Semester 1, 2024

Assessment 1 (Group Project): Deep Learning for a Smart Fridge

Assessment Type	Project
Weighting	25% for COMP3330 and 35% for COMP6380
Length	COMP3330 groups: 6-10 pages excluding Appendix COMP6380 groups: 8-14 pages excluding Appendix
Due Date	27 May 2024 (5 pm)
Submission	Online via Canvas / Turnitin

Description

Student groups work to find solutions to deep learning tasks by using Python, PyTorch, and other relevant Python packages. The submission includes:

1. A group report that addresses the questions specified in this document with written text, figures, and tables. The report is to be formatted in Springer LNCS format and exported to `pdf` format. The LNCS conference paper template is available at the following link: `https://www.springer.com/gp/computer-science/lncs/conference-proceedings-guidelines`. The report length in pages should fall in the given range. To save space, figures and/or tables can be placed into an Appendix.
2. A trained PyTorch model for image classification (see Question 1 b)
3. A Python inference script (see Question 1 b)
4. (If necessary) a `README` file explaining how to use your inference script
5. (If necessary) a `requirements.txt` file specifying packages required to run your inference script
6. A document that states the contributions of each group member. If the contributions within the group are very different and/or a conflict arises, the marks will be weighted according to this document. Please start conducting peer assessments early in the project in case any group management issues may arise and request guidance by your lab tutor.
7. All Python code used to produce the results discussed in the report as Supplemental Material. Marks may be deducted for results in the report that cannot be reproduced from submitted code (allowing for variation due to random model initialisation etc.).

It is sufficient if one group member submits. Make sure that all other group member names are listed and each member has signed **(!)** the agreed group report with individual member contribution statements.

The following pages contain the questions to be addressed in the report, and the marking criteria.

Question 1: Image Classification for a Smart Fridge (COMP3330 and COMP6380)

Samsung's smart fridge range uses AI vision and an internal camera. The system can identify up to 33 fresh food items when put in or taken out of the fridge:

`https://www.samsung.com/au/refrigerators/family-hub/`

Your task is to develop a computer vision classifier as part of a new more capable smart fridge system that can identify up to 40 fresh food items. 144 example images that are similar to the secret testimages used for final evaluation of your model are provided in the data set FoodTest1.zip

Example images of 3 of the 40 food item categories are displayed below.

Asparagus (class 0)

Carrotts (class 1)

Oysters (class 2)

a) Develop deep learning models to classify images into the 40 given food item classes that are contained in the provided image data set `FoodTest1.zip`. Experiment with different approaches and models including models that are trained bottom up and others that are obtained using transfer learning. Run experiments with the goal to identify ways to achieve high validation accuracies (e.g., model choice, hyperparameter choice, regularisation, etc.). Determine which model is best suited for a smart fridge taking performance, computing requirements and power consumption into account. For example, a very large model may require a large computer or internet access and would increase production and running costs. The supporting discussion should be documented in your group report, including figures and tables comparing different candidate models, their advantages and disadvantages and the performances that you can achieve.

b) Save your most recommended two models for submission and prepare an inference script. It will need to:

   1. Load your submitted best models
   2. Load images from a folder of `*.jpg` files
   3. Export the model predictions for all images as a file `preds.csv` (first column: image filename, second column: predicted class between 0 and 39)

   We will evaluate your model based on a secret test set. It is similar to and of the same size as your validation set `FoodTest1.zip` and comprises new unseen images of the same 40 categories of food items. The achieved top-1 accuracies of your two models on the secret test set will contribute to your team's mark.
   Note: `FoodTest1.zip` is available on Canvas so you can use it to train and test your inference script. You can either assume that both your script and model file will be placed in the test folder before we run it, or include a `README` file that explains how to use your inference script.
   Important: If your inference script requires specific packages and/or versions of packages, include a `requirements.txt` file specifying these.

Question 2: Smart Fridge System Design (COMP6380 only)

Based on the deep learning study in question 1, propose and discuss a possible design of the AI system for a new smart fridge and take two cases into account:

a) A fridge system that can connect to the internet.

b) A smart fridge system that operates in areas without any internet connection or any external communications.

Provide a literature review and compare and discuss the two use cases.

Marking Criteria

Criterion	Marks	Description/Criteria
Question 1 a)	12	Experimentation with different CNN models (e.g., Yolo, VGG, ResNet, etc.), suitable hyperparameters (e.g., model size, batch size, learning rate, etc.) based on suitable performance metrics (e.g., top-1 accuracy, learning curves, confusion matrices, etc.). This process should be documented, including plots and tables. Overall findings should be discussed and interpreted.
Question 1 b)	6	The submitted inference script should run without errors with the submitted model file on the secret test folder and produce a file `preds.csv`. Marks will depend on the relative performance on the secret test set in terms of top-1 accuracy compared to the other groups.
Question 2) COMP6380 only	10	Proposal and comparison of the two systems makes sense. Explanation of superior performance compared to Samsung's system is plausible. Consideration is given to energy efficiency, computational requirements, maintenance and built costs. Detail and depth of the proposal and the comparative discussion. Literature review is useful and up-to-date.
Report format	2	The report should conform to the Springer LNCS format. Moreover, it should be clearly structured and well organised to be easily readable. The report length in pages (excluding Appendix) should be 6-10 pages for COMP3330 and 8-14 pages for COMP6380. Be aware that any work after the maximum page limit may not be included in marking.
Python code	2	The Python code used to produce the results discussed in the report is to be submitted as supplemental material. The code needs a clear structure and has to be free of errors. Use comments to document what is done and to structure the code. Marks will be deducted for poor documentation, structure, and reproducibility of the results discussed in the report.
Writing and referencing	3	Results and findings should be communicated clearly, accurately, and concisely. This includes correctness of grammar and spelling, and appropriate use of references, direct quotes, paraphrasing, etc. For COMP6380 groups the citations and report presentation are expected to be of high professional standard.