Swinburne University of Technology
Department of Computer Science and Software Engineering

COS80027 Machine learning

Semester 1 2024 – Final Project
Due: 23:59, Sunday 2 June 2024
Interview: 4 June 2024 (Exam Period)

Format

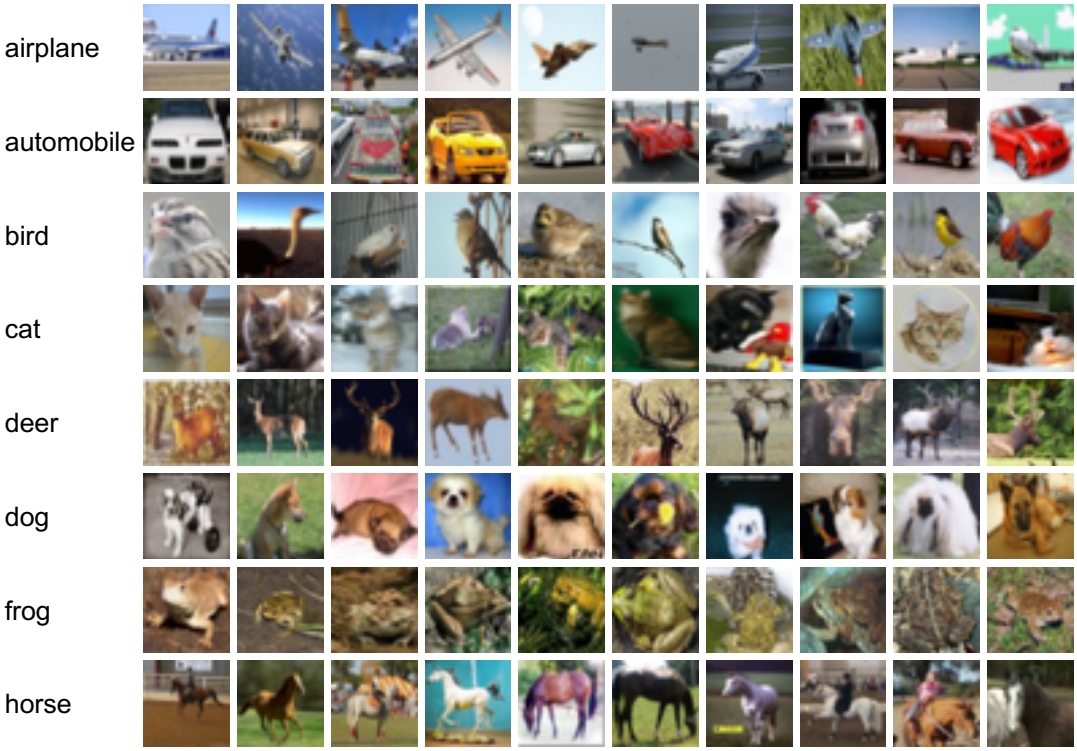
You will perform a Deep learning vs Machine learning task in teams. Each team contains 3 - 7 members. You are free to choose your teammates. **Please notify your lecturer or convenor by email asap, if you don't have a team yet**.
The estimated time needed to complete this project is 4 working days for a team of 3 members.

Project Overview

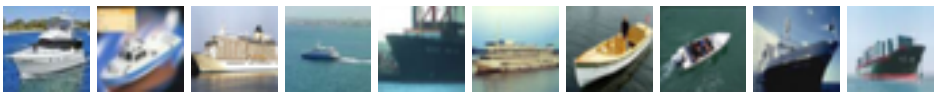
Option1: You are provided with a CIFAR10 dataset consists of 60000 32x32 colour images in 10 classes, with 6000 images per class. There are 50000 training images and 10000 test images. Your goal is to develop two models, a deep learning and a machine learning model which take the images and output the classes. You need to compare and discuss the results of two models in the end.

Option2: Alternatively, you may choose to work on your own project which must be Face or Action Classification. In this case, please note that you should find an appropriate dataset yourselves, while the number of classes in your dataset must be at least 10 and you have to follow all the instructions and submission criteria will be similar.

Data source
The CIFAR10 dataset is divided into five training batches and one test batch, each with 10000 images. The test batch contains exactly 1000 randomly-selected images from each class. The training batches contain the remaining images in random order, but some training batches may contain more images from one class than another. Between them, the training batches contain exactly 5000 images from each class. Here are the classes in the dataset, as well as 10 random images from each:



ship



truck

The classes are completely mutually exclusive. There is no overlap between automobiles and trucks. "Automobile" includes sedans, SUVs, things of that sort. "Truck" includes only big trucks. Neither includes pickup trucks.

Tasks

Your team will need to accomplish the following tasks. You should apply the suitable techniques covered in the lectures and tutorials. However, you are free to use any DL architecture (as long as it's mentioned in the lectures) and any framework that you prefer.

Task1: Deep Learning

1. Perform data pre-processing if it's required.
2. Formulate the problem as a Deep learning task. Choose a DL framework that you are comfortable using it, e.g. fastai, TensorFlow, etc.
3. Perform data partitioning. You may use the standard data splits that CIFAR10 provided or you may use your own data splits. If you decide to use your own, you must clearly explain it. The training data will be used for **model development**, with the test data for **performance evaluation**.
4. Select one DL architecture (mentioned in the lectures) that you think is the most suitable one for this project.
5. Train your DL model on CIFAR10 dataset for classifying 10 different object categories.
6. You may use Pre-trained models for finetuning the last layer on your dataset, rather than training from scratch, but you are not allowed to use any pre-trained model that might already trained on the CIFAR10 dataset. You should clearly state which pre-trained model you used, in your code comments and presentation.
7. Perform **performance assessment**
    - Apply your DL model on the test data to get the prediction.
    - C*alculate the accuracy and the confusion matrix.*
    - Plot the Training loss.
    - Show predicted classes for some samples of test data.

Task 2: Machine Learning

1. Perform data pre-processing if it's required.
2. Formulate the problem as a machine learning task.
3. Select **one** learning algorithms based on the lectures and identify the corresponding hyperparameters to be optimised.
4. Use the same data partitioning as the previous task.
5. Perform **model development**
    - Choose an appropriate feature engineering method for image classification task and extract your features. You need to investigate popular feature extraction methods for image classification task and apply one of them.
    - Train your model based on training data and hyperparameter tuning.
6. Perform **performance assessment**
    - Apply your ML model on the test data to get the prediction.
    - C*alculate the accuracy and the confusion matrix.*
7. (optional) Conduct other analysis to be decided by the team members. For example:
    - Identify the best feature extraction method by comparing at least 2 of popular ones.

Task 3: Model comparisons

- Compare the results of Task1 and Task2 and discuss the differences, advantages and disadvantages.

Submission Requirements

The final project is due at:

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Assignments submitted after this time are subjected to late submission penalties. For detailed information, please refer to the relevant section in the Unit Outline under the menu "Syllabus" in Canvas. You need to prepare the following two files:

1. A notebook file named **development_DL.ipynb** and **development_ML.ipynb** which contain all your code and code-level comments for Tasks 1 and 2.
   Note: Please make sure to clean the code before making submission to remove all unnecessary code. A report file named **appendix.pdf** which consists of supplementary materials to your work. For example, output (e.g. scatter plot) that is too large to be displayed properly in the notebook.

To submit, you **must** archive all of the above files into **ONE** single **.zip** file, name it as per your team leader's surname (e.g., John_Smith.zip), and then submit it in Canvas under:

Assignments/Final Project

Please do NOT submit other unnecessary files.

The estimated time needed to complete this project is 4 working days for a team of 3 members. Hence extension is already incorporated into the due date.

Assessment Criteria

Your work will be assessed based on the submitted code (65 points) and a presentation (35 points).

Code (65 points)

Corresponding to the tasks, each team should submit two Notebooks with the following sections. At the beginning of the first Notebook, you should have the team members' name and their contributions clearly stated (include a **self-assessment of factor** between 0 to 1 by referring to the individual contribution factor below.)

Individual Contribution Factor				
1.00 Very Good Crucial code included in the project	0.80 Good Contributed idea and substantial code and code testing and debugging	0.50 Good Attempt Contributed idea, partial code, and code testing and debugging	0.30 Needs Improvement Contributed ideas but no code	0.0 Needs Improvement No contribution

The code is assessed as follows:

Task1:

1. Specify the learning type of the problem, architecture and framework. (5 points)
2. Code for model development (13 points)
   - Uploading the suitable pre-trained model
   - Finetuning a new model on the CIFAR10 dataset
   - Use appropriate personalised training parameters
   -
3. Perform performance assessment (12 points)
   - Code for the accuracy and the confusion matrix.
   - Code for plotting the trend of training error during epochs.
   - Show predicted classes for some samples of test data.

Task 2:

1. Specify the learning type of the problem. Select **one** learning algorithms and one hyperparameter to be optimised. (5 points)
2. Perform **model development** (15 points)
   - Extract features using an appropriate feature engineering method for image classification task
   - Train your model based on training data and hyperparameter tuning.
3. Code for assessing the validation performance for each learning algorithm (10 points).
   - Apply your ML model on the test data to get the prediction.
   - Ca*lculate the accuracy and the confusion matrix.*
4. (optional) Conduct other analysis to be decided by the team members. (5 points)

Task 3:

Use appropriate figures/plots to compare two models and highlight the differences. (5 points)

Individual marks will be calculated as

- 60% from the team, based on the overall quality
- 40% from individuals, based on the individual contribution

Calculation is

60% of total marks from Tasks 1 to 3
\+ 40% of total marks from Tasks 1 to 3 x Individual Contribution Factor
Individual points for code

Presentation (35 points)
Each team will give a presentation of 10 minutes to showcase the methods they use and report the main findings. There is a 3-minute session for questions and answers. Individual marks will be calculated as

- 60% from the team, based on the presentation quality and the team questions
- 40% from individuals, based on the individual questions

Criteria	Ratings				Pts
Demonstrate knowledge of content (Team)	16.0 to > 12.0 pts Very Good Demonstrate knowledge	12.0 to > 7.5 pts Good Can improve by providing relevant example	7.5 to > 3.0 pts Good Attempt Reads text the slide	3.0 to 0.0 pts Needs Improvement No attempt or minimal contribution	16
Answers to questions are direct to the point and addressed the intended concern. (Team)	5.0 to > 4.0 pts Very Good Answered the question	4.0 to > 2.5 pts Good Can improve by relating to specific instances	2.5 to > 1.0 pts Good Attempt Can improve by being clear in the answers, and not repeat the text in the slides	1.0 to 0.0 pts Needs Improvement Unable to answer the question or no answer	4
Answers to questions are direct to the point and addressed the intended concern. (Individual)	14.0 to > 11.0 pts Very Good Answered the question	11.0 to > 6.0 pts Good Can improve by relating to specific instances	6.0 to > 2.5 pts Good Attempt Can improve by being clear in the answers, and not repeat the text in the slides	1.0 to 0.0 pts Needs Improvement Unable to answer the question or no answer	15