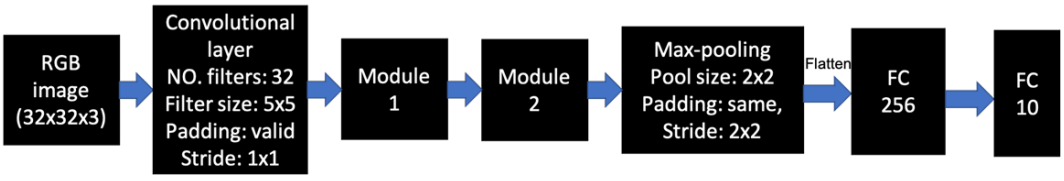
The University of Melbourne
School of Computing and Information Systems
COMP90086 Computer Vision, 2021 Semester 2

Assignment 2: Convolutional neural network for image classification

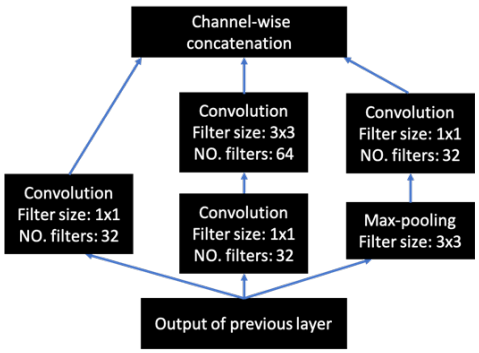
Due:	7pm, 10 Sept 2021
Submission:	Source code (in Jupyter Notebook) and written responses (as .pdf)
Marks:	The assignment will be marked out of 6 points, and will contribute 6% of your total mark.

1. Network parameters [1.5 pt]

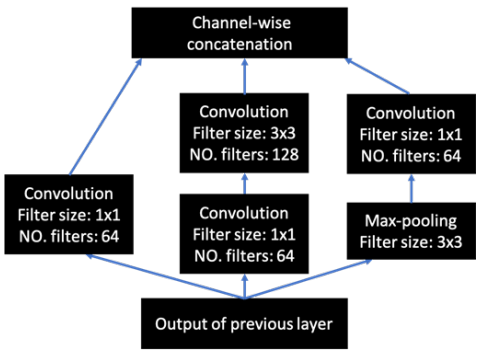
Below is the architecture of a network. "FC 256" denotes a fully connected layer with 256 units. "FC 10" denotes a fully connected layer with 10 units. In all layers of Module 1 and Module 2, the padding is set to "same" and strides are set to 1×1. The activation functions of all hidden layers are ReLU. The activation function of the last FC layer is Softmax. Compute the number (NO.) of parameters and NO. multiplications in each layer of the network (ignore the bias) given the single input. **Show your working in the writing report.**
Note: the NO.parameters and multiplications in each layer of the module 1 and 2 should be separately given.



Network diagram



Module 1

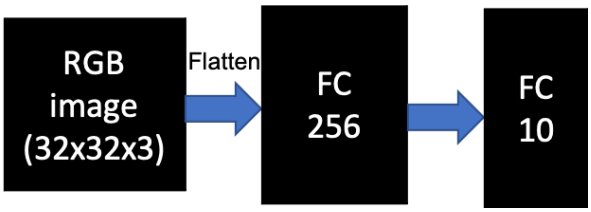


Module 2

2. Classification on the CIFAR-10 subset [4.5 pts]

1. (1.5 pts) Implement the CNN shown in Q1 in the provided Jupyter notebook and use it to classify the provided dataset. Plot the training accuracy and testing accuracy under different epochs. Use "adam" as the optimization algorithm (set learning rate to 0.001, and leave other hyperparameters of Adam fixed at the default for the library you choose to use). Set batch size to 32 and epoch to 20. In your written report, present the recognition results (show the plot of the training accuracy and testing accuracy under different epochs) and explain why the testing accuracy of this network is poor.

2. (1 pt) Based on the given dataset (subset of CIFAR-10 with the provided 250/200 train/test split), you consider using the following multi-layer perceptron (MLP) to conduct classification on the raw images with the same training settings, i.e., same optimisation algorithm, batch size and epoch as the above CNN model. Implement the model and use it to classify the given dataset. Plot the training accuracy and testing accuracy under different epochs. In your written report, present the recognition results (show the plot of the training accuracy and testing accuracy under different epochs) and explain why the testing accuracy of the MPL is poor.



MLP

3. (2 pts) Assume that you don't have other extra CIFAR-10 image data except the given subset. You now consider how to improve the testing accuracy of the above MLP model without modifying the model, i.e., without changing the model architecture, hyperparameters, or training settings in any way. One strategy is to use features of the images as the input of the MLP to improve the performance. How will you extract the features from the raw images? Implement the feature extraction and classification on the given dataset, and plot the training accuracy and testing accuracy under different epochs. In your written report, present the recognition results (i.e., show the plot of the training accuracy and testing accuracy under different epochs), explain how you extract the features to conduct classification and why this method can improve the testing accuracy of the MLP.

Submission

You should make two submissions on the LMS: your code and a short written report with answers to the above two questions. Please note both questions require written response. In Q1, show the formulas for each computation. In Q2, the explanations to each sub question should be less than five sentences.

Submission will be made via the Canvas LMS. Please submit your code and written report separately under the **Assignment 2: Code** and the **Assignment 2: Report** links on Canvas.

- Your **code** submission should include the Jupyter Notebook (please use the provided template) with your code.

- Your written **report** should be a .pdf with your answers to each of the questions. The report should address the questions posed in this assignment and include any images, diagrams, or tables required by the question.

Evaluation

Your submission will be marked on the correctness of your code/method, including the quality and efficiency of your code. You should use built-in Python functions where appropriate and use descriptive variable names. Your written report should clearly include all of the specific outputs required by the question (e.g., images, diagrams, tables, or responses to sub-questions).

Late submission

The submission mechanism will stay open for one week after the submission deadline. Late submissions will be penalised at 10% of the total possible mark per 24-hour period after the original deadline. Submissions will be closed 7 days (168 hours) after the published assignment deadline, and no further submissions will be accepted after this point.

Updates to the assignment specifications

If any changes or clarifications are made to the project specification, these will be posted on the LMS.

Academic misconduct

You are welcome — indeed encouraged — to collaborate with your peers in terms of the conceptualisation and framing of the problem. For example, we encourage you to discuss what the assignment specification is asking you to do, or what you would need to implement to be able to respond to a question.

However, sharing materials — for example, showing other students your code or colluding in writing responses to questions — or plagiarising existing code or material will be considered cheating. Your submission must be your own original, individual work. We will invoke University's Academic Misconduct policy (`http://academichonesty.unimelb.edu.au/policy.html`) where inappropriate levels of plagiarism or collusion are deemed to have taken place.