CECS 551
Assignment 7
Total: 45 Points

General Instruction

- Submit uncompressed file(s) in the Dropbox folder via Canvas (Not email).

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1. Find the CIFAR-100 (not CIFAR-10) data set at *here*.
   - Training and Testing Images: Observe that there are 500 training images and 100 testing images for each class in the CIFAR-100 dataset.
   - Classes and Superclasses: This dataset is unique as it contains 100 different classes. These classes are further categorized into 20 superclasses.
   - Labeling: Each image in the dataset is associated with two types of labels:
     - A "fine" label that specifies the class of the image.
     - A "coarse" label that indicates the superclass to which the image belongs.
2. Design covolutional neural networks to classify CIFAR-100 images using `keras` library.
   (a) (5 points) Dataset Division: Divide the training dataset into two parts: a sub-training set and a validation set. Allocate randomly $\frac{1}{5}$ of the training dataset to serve as the validation set.
   (b) Label Prediction Requirement: Ensure that your model is designed to predict the "fine" label (class) rather than the "coarse" label (superclass). Important: Your model must predict the "fine" label to be considered for grading; predicting the "coarse" label will result in a score of zero.
   (c) Model Experimentation: Experiment with various combinations of activation functions, optimizers, hyper-parameters, and architectures within your model.
   (d) (10 points) Model Selection: Using the sub-training and validation sets, identify the three most effective models.
   (e) Full Training: Re-train these top three models using the entire training dataset.
   (f) (5 points) Accuracy Testing: Calculate and compare the test accuracy of each of these three models using the test dataset.
   (g) (5 points) Benchmarking: Compare your model's performance against others by checking its ranking on the CIFAR-100 image classification leaderboard, available *here*. Note: Since some high-ranked models on the leaderboard may have used extra training data, for a fair comparison, consider comparing your models against those which did not use additional training data.
   (h) (20 points) Reporting: Write a comprehensive report detailing the activation functions, optimizers, hyper-parameters, and architectures used in your three best models. Include their test accuracies, benchmarking result, and the total number of parameters for each model.

3. Please submit the following as part of your homework assignment:

   - IPYNB File: A `.ipynb` file should contain your source code, along with detailed comments explaining the steps you took in:
     - Dividing the dataset
     - Selecting the model
     - Testing for accuracy
   - PDF File: A `.pdf` file that includes a comprehensive report of your work.