Image Classification using CIFAR-10 and CIFAR-100 datasets

Module:	Smart Technologies	**Assignment:**	CA1
Due:	17-12-2023 23:55	**Credit:**	50%

Objectives:

To practice the following:

- Obtain and load data from relevant sources
- To prepare the data for building a model which can classify between 24 different classes
- To explore and summarise the data
- To build a convolutional neural network model which can take in images and classify them between twenty four different classes
- To assess the accuracy of your model and minimise overfitting
- To work in groups of two and use a source code repository (Git) to track the development of your solution

Deliverables

This project consists of two deliverables.

1. **Deliverable 1** is the code used to download, explore, and prepare the data, build, test and assess the model.
2. **Deliverable 2** is a report detailing the data, the model and the model accuracy. For details on writing a report see Improving Your Technical Writing Skills

The Data

The CIFAR-10 and CIFAR-100 datasets can be downloaded from https://cs.toronto.edu/~kriz/cifar.html. The CIFAR-10 dataset consists of 60000 32x32 colour images in 10 classes with 6000 images per class, There are 50000 training images and 10000 test images. The 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. You will only need the data for automobile, bird, cat, deer, dog, horse, and truck from this dataset.

The CIFAR-100 dataset is just like the CIFAR-10, except it has 100 classes containing 600 images each. There are 500 training images and 100 testing images per class. The 100 classes in the CIFAR-100 are grouped into 20 superclasses. Each image comes with a "fine" label (the class to which it belongs) and a "coarse" label (the superclass to which it belongs). You will only need the data for cattle, fox, baby, boy, girl, man, woman, rabbit, squirrel, trees (superclass), bicycle, bus, motorcycle, pickup truck, train, lawn-mower and tractor from this dataset.

Your objective is to build a model that can classify between automobile, bird, cat, deer, dog, horse, truck, cattle, fox, baby, boy, girl, man, woman, rabbit, squirrel, trees, bicycle, bus, motorcycle, pickup truck, train, lawn-mower and tractor as accurately as possible.

Data Pre-Processing
The data is not perfectly set up for your purposes in building a model to classify objects. You will need to load in the data from CIFAR-10 and CIRFAR-100, extract the relevant data from each dataset and combine them together. You may also need to preprocess the data to scale, grayscale, adjust lighting, and scale down variability.

(30 marks)

Data Exploration
Having pre-processed the data you should investigate the images that you have for each class. What size are the images? What classes do the images represent? You can also present any work you have done before processing to investigate the data such as counting how many labels each image has.

(10 marks)

Building the model
Build an appropriate model to classify between the 24 different classes. Consider **overfitting** and **underfitting** when building the model. Comment on these issues and how you have addressed them in the report.

(30 marks)

Testing the model
Use the test data to measure the accuracy of the model. This should be an iterative process where you tweak the hyperparameters to improve the accuracy of the model between test runs. Document your results and the hyperparameters changed between each run and how the accuracy has improved.

(20 marks)

Code Repository Requirements:

You are required to use version control to track the development of this project. You should read this article https://chris.beams.io/posts/git-commit/ and adhere to the seven rules detailed when writing commit messages. You should also commit regularly throughout the development of the project and add me as a collaborator on the project. You do not need to push the images and labels up to git and should adjust the .gitignore so that you don't as these files are big and you will overrun your allocated space.

(10 marks)

Submission Requirements:

1. Source code, and other items must be submitted in the relevant sub-folders inside a single ZIP file through Moodle.
2. Each student may be required to attend an **interview** after the deadline date. Each student may be questioned on the functionality of the code.
3. The assignment must be entirely the work of each student. Student are not permitted to share any pseudocode or source code from their solution with any other individual in the class. Students may not distribute the source code of their solution to any student in any format (i.e. electronic, verbal, or hardcopy transmission).
4. Plagiarised assignments will receive a mark of zero. This also applies to the individual allowing their work to be plagiarised.

5. Any plagiarism will be reported to the Head of Department and a report will be added to your permanent academic record.
6. Late assignments will only be accepted if accompanied by the appropriate medical note. This documentation must be received within 10 working days of the project deadline. The penalty for late submission is as follows:
   - Marked out of 80% if up to 24 hours late.
   - Marked out of 60% if 24-48 hours late.
   - Marked out of 40% if 48-72 hours late.
   - Marked out of 20% if 72-96 hours late.
   - Marked out of 0%, if over 96 hours late.