Image Classification

Due 11.59 pm, Sunday 25 August 2024 (Week 4)

General description

This INDIVIDUAL assignment aims to consolidate your practical skills in developing image recognition systems using feature-based classifiers.

In this assignment you will **develop code** to perform classification on a subset of CIFAR-101, and **produce a brief report** describing your investigation of the performance of different features and classifiers.

Important notes

1. This is an individual assignment. You must complete the tasks on your own and submit your own work only.
2. Generative AI tools such as ChatGPT **cannot** be used in this assessment task, and will be considered academic misconduct.
3. Recall that **the University takes academic misconduct very seriously**. Academic misconduct includes working with other students on an individual assignment, plagiarism, copying, and cheating. You should familiarise yourself with your responsibilities in relation to Academic Integrity and if you have any questions, direct them to your subject coordinator. Further information can be found on the website at: https://www.latrobe.edu.au/students/admin/academic-integrity

Submission guidelines

- Submit before 11.59 pm, Friday 25 August 2023.
- You will need to submit two files:
  - Your code as a .ipynb notebook, through the assignment submission area on LMS. Obtain this file from your completed notebook on Google Colab by clicking File >Download > Download .ipynb.
  - Your report as a .pdf document, through Turnitin on LMS.
- Submitting both your code and your report is essential. No marks will be given for the report without the supporting code.
- If you write the report in Microsoft Word, you can include screenshots of code cells and execution results to support your responses and findings. After you finish writing, convert the Word Document to a PDF for submission.

1 The CIFAR-10 dataset: https://www.cs.toronto.edu/~kriz/cifar.html
2 https://scikit-learn.org/stable/modules/generated/sklearn.metrics.ConfusionMatrixDisplay.html#sklearn.metrics.ConfusionMatrixDisplay.from_predictions

Tasks [20 marks]

1. Create a copy of the assignment notebook template, just like you do at the start of each lab. You can find the assignment notebook linked from LMS. Enter your student ID number in the designated location. **[2 mark]**

The student ID number is used as a random seed to generate a unique dataset using a unique combination of three CIFAR-10 classes for each student. You must complete the remaining tasks using your unique three-class dataset.

2. Generate the following *normalised* image features for the images in your dataset:

   a. Colour moment features (mean and standard deviation for each colour channel). **[2 mark]**

   b. Grey-level co-occurrence matrix (GLCM) features (contrast, dissimilarity, homogeneity, ASM, energy, and correlation). **[2 mark]**

3. Split the dataset (features and labels) into training and testing sets. 80% of the data should be for training, and 20% should be for testing. **[2 mark]**

4. Compare the performance of SVM and KNN classifiers. Each classifier must be trained on the training set and evaluated on the testing set. You should prepare a brief report (no longer than 500 words) describing your findings from this task.

   a. Train SVM and KNN classifiers. **[4 marks]**

   b. Compare classifiers using confusion matrices and overall accuracy. **[4 marks]**

You can write the code to calculate the confusion matrix yourself, or you can use ConfusionMatrixDisplay.from_predictions from scikit-learn (the documentation2 includes an example). Make sure that you interpret the results in your report---for example, which class is causing the most prediction errors?

   c. Experiment with using different subsets of features and different free parameters (e.g. "kernel" in SVM and "k" in KNN) to improve your classification results. In your report, list your features/parameters and discuss which ones gave the best results. **[4 marks]**

1 The CIFAR-10 dataset: https://www.cs.toronto.edu/~kriz/cifar.html
2 https://scikit-learn.org/stable/modules/generated/sklearn.metrics.ConfusionMatrixDisplay.html#sklearn.metrics.ConfusionMatrixDisplay.from_predictions