CM20315 – Machine Learning

Coursework 2: Image Classification

Set: 19/02/2024 (week 21) **Due: 15/03/2024 (week 24), 8pm**
Percentage of overall unit mark: 15%
Submission Location: Moodle **Submission Components: Report** **Submission Format: PDF file named with your student number e.g. '119922.pdf'**
Anonymous Marking: N

1 Overview

This coursework assesses two of the three module Learning Outcomes:

2. Demonstrate understanding of a wide range of machine learning techniques, their strengths and their limitations.
3. Write code in a relevant programming language and employ software libraries to solve problems in machine learning.

For this coursework you will be selecting, implementing, and evaluating classification methods for a given scenario and dataset.

1.1 Scenario

A recent citizen science project has been launched which has been asking for the public to send in pictures of the weather to provide real-time updates of the weather in different locations. However, the current process involves manual labelling of the images into two classes, either shine or rain, an example of these images is shown in Figure 1.

Figure 1. Sample images of the 'rain' class (left) and the 'shine' class (right).

1.2 The Task

You have been asked to produce a machine-learning based classification model to replace the manual labelling. To do this you must carry out an experiment comparing at least two classification methods using the sample dataset provided. The deliverable is a report detailed in section 2.

1.3 Dataset

The dataset provided is in the form of two Numpy files:

- features.npy – Contains the flattened images. Each row consists of 45000 columns each representing a pixel value in the original image.
- classes.npy – Contains the respective classifications for the images found in 'features.npy', these are 0 for 'rainy' images and 1 for 'shine' images.

In total there are 248 'shine' images and 299 'rain' images. To load the data you may use the Numpy load function, for example:

```
import numpy as np
inputs = np.load("features.npy")
classes = np.load("classes.npy")
```

To display an image at a given row (i) you can use the following code:

```
import matplotlib.pyplot as plt
inputs = np.load("features.npy")
plt.imshow(np.reshape(inputs[i, :], (100, 150, 3)))
```

2 Deliverable

The deliverable is an individual report with a 3-page maximum detailing your experiment and results – this is a hard limit however your references will not count to this maximum. Appendices are not allowed. Your report must have a minimum font size of 12 and have margins which are 2.54cm (default in Word).

The report must be structured as shown in Table 1.

Section	Content
Introduction	Overview of the problem and the process used.
Method Selection	High-level overview and justification of the methods selected.
Model Training	Explanation of process and data used for training and hyperparameter tuning.
Model Evaluation	Description and justification of the metrics and methods used for evaluating the models.
Results	Overview, interpretation, and analysis of the results from the evaluation.
Conclusions	Final recommendation and supporting statements. Future work ideas.

Table 1. Report contents.

2.1 Mark Scheme

Your report will be assessed using the contributions below, each section will be marked according to the marking grid provided at the end of this document.

Criteria	Percentage of overall deliverable mark
Introduction	5%
Method Selection	10%
Model Training	25%
Model Evaluation	25%
Results	25%
Conclusions	10%
Mark Reductions	**Maximum Penalty -8%**
Incorrect structure	-2%
Poor spelling and grammar	-2%
Incoherent writing style	-2%
Poor presentation	-2%

Table 2. Mark Allocation.

3 Feedback

Formative feedback will be available in the labs.

You will receive **summative feedback** on your work within 3 semester weeks of the submission deadline. The feedback will discuss your performance based on the criteria for marking, including what you did well and how specific components/sections could have been improved.

4 Academic Integrity

Your work will be checked to ensure that you have not plagiarised. For more information about the plagiarism policy at the University see: https://library.bath.ac.uk/referencing/plagiarism

Remember that published work that you refer to in your report should be clearly referenced in your text and listed in a bibliography section given at the end of your report. For more information see, https://library.bath.ac.uk/referencing/new-to-referencing

5 FAQ

5.1 Is the quality of my models marked?

In short, no. We are more interested in whether you can adequately explain and evaluate your models' performances using the metrics and evaluation methods you choose. There are no direct marks available for the quality of the model.

5.2 Why is the page count so small?

When faced with these challenges in the real world it is important that you are able to provide succinct but detailed reports to clients. There is no room for flamboyant language or unnecessary detail, I suggest you are creative in how you use the page limit with figures and tables where necessary, the less figures you need to use, the more space you have but sometimes a picture can paint a thousand words.

5.3 Do we have to write the algorithms ourselves?

No! The point of this exercise is to allow you the freedom to select and implement necessary methods from Python libraries, whilst you may wish to write the algorithms yourself this would have not fluency on your mark. Consider the task, the short time frame and remember this is primarily about your knowledge of evaluating and interpreting machine learning models using appropriate techniques, not how well you can program in Python.

5.4 How many methods do we need to evaluate?

To make a comparison you'll need at least 2 and there is no upper limit. However, think carefully again about the space given to report your results and the time you need to perform the evaluation.

5.5 Can we use methods that haven't been taught?

If you wish to use classification methods or validation metrics which you have found independently or used last semester you may use these if you make the adequate justifications in the report. This will not attract more marks.

Marking Rubric

Section	%	Mark				
		0-40	40-49	50-59	60-69	70+
Introduction	5%	No introduction or limited, non-contextual introduction to the study.	Limited introduction covering the context provided.	Limited introduction covering the context and some of the process.	Good introduction outlining the context, objective and process in moderate detail.	Excellent introduction detailing the scenario, objective and the process in a succinct manner.
Method Selection	10%	No description of the methods or methods selected are inappropriate.	At least one appropriate method selected and described in adequate detail.	At least two appropriate methods selected and described in fair detail with limited justifications.	At least two appropriate methods selected and described with fair justifications.	Excellent description of at least two appropriate methods with good justifications.
Model Training	25%	No training process defined or limited, and vague detail given.	Limited description of the training process.	Good overview of the training process with appropriate choices regarding data.	Good overview and justifications given for data selected and hyperparameters.	Excellent overview of data, process and justifications for training and hyperparameter tuning.
Model Evaluation	25%	No evaluation process described, or process described is inappropriate.	Limited process described with vague reference to relevant metrics.	Limited process and data descriptions with some appropriate metrics selected.	Good overview of evaluation process and data with a good number of relevant metrics.	Excellent overview of the evaluation process and data with suitable and justified metrics.
Results	25%	No results presented or results presented with no context or explanation.	Limited presentation of results with little analysis and interpretation.	Overview of the results with some limited analysis and interpretation.	Good overview of the results with good analysis and interpretation in context of the problem.	Excellent analysis and presentation of the results with good contextualisation and interpretation.
Conclusions	10%	No conclusions drawn.	Limited conclusions drawn from results with a lack of supporting evidence.	Limited but contextualised conclusions drawn with links back to results.	Contextualised conclusions drawn from results with supporting evidence.	Contextualised conclusions with clear links to results leading to potential future work.
Comments						