EEEM071 Advanced Topics in Computer Vision and Deep Learning
Coursework Assignment (2024)
Vehicle Re-identification

NAME:

URN:

Learning objectives and outcomes:

1. Objectives:
    a. Learn and become familiar with the process of sequential hyperparameter tuning of an entire deep learning pipeline
    b. Develop intuition via experimentation on how to use such model design and parameter tuning to improve the performance of a pipeline.
    c. Interpret experimental results of deep learning experiments and their implications.
2. Outcomes:
    a. You will be able to navigate moderately complex deep learning codebases and modify according to requirements.
    b. You will be able to empirically suggest reasonable values for hyperparameters and then choose the ones enabling the best performance.
    c. You will learn to understand the implications of changing the backbone architecture of a pipeline.
    d. You will be able to reason why data augmentation works.
    e. You will learn to understand the implications and importance of selecting the best learning rate and batch size.
    f. You will understand how to report experimental results professionally. This includes using tables, plots, and diagrams to communicate ideas and results.

Baseline: The default settings already provided for you in the code base.

Hyperparameters: The parameters that are not learnable, and you can set before starting the training.

Important instructions:

1. Regarding the format and way for answering each question, please see the examples in ***Figure I*** below.
    a. Please ensure your answers are on the spot as exemplified.
    b. Please do NOT go highly redundant and give what is not required. The word limit is up to *200 words per Section (excluding tables, plots, graphs)*. Penalties will be applied for unnecessarily long reports (*up to 50% penalty*).

2. Regarding log files:
    - **a.** Please submit your own log files from your codebase. ***Need to submit the log file for each experiment based question*.**
    - b. All log files are automatically watermarked and are unique to each run. Do not change the log file structure.
    - c. All log files should be named based on the section number and the question number. (***log_{Section_num}_{Question_num}***.txt)

        For example, a log file generated for an experiment corresponding to question 2 in section 1, should be named as "log_1_2.txt".

3. Regarding *presentation and clarity* of your answers:
    - a. In addition to the scientific content, you will also be assessed on the presentation and clarity of the writing.
    - b. This accounts for 10 marks. Following criteria to be taken into consideration:
        - i. Figures should be well presented. The axis and the markings should be easily readable. [2 marks]
        - ii. The writing should be clear, grammatically correct, and the ideas come across easily to the reader. [6 marks]
        - iii. It is important to use tables if you are discussing results across different values of hyperparameters. [2 marks]

4. Model performance metrics: while there are different metrics there, suggest using mAP as the major one for selecting the best performance models.

NOTE: Please read all questions carefully before attempting to answer. The below four sections account for 90 marks and (as mentioned above) 10 marks are allotted for presentation and clarity of the overall report.

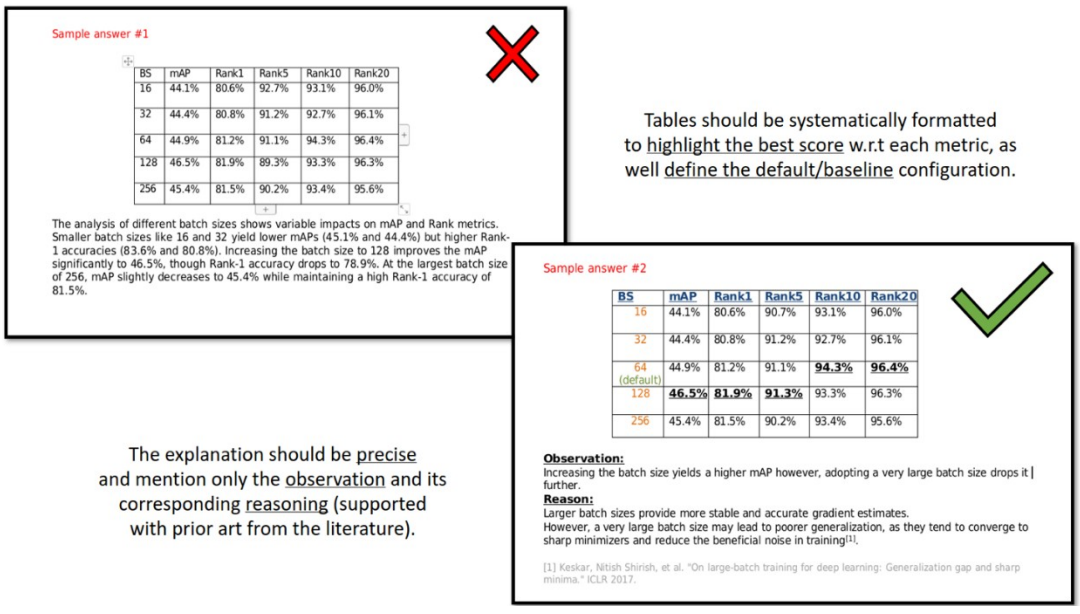

Figure I: Example answers.

Section 1 – Familiarity with the code provided. [30 marks]

1. Run the code using the default settings. Discuss the training and evaluation process (*mention the loss functions used*) followed by implications of the observed performance using an appropriate metric. **[10 marks]**

2. Apply another CNN variant (that is not provided in the default settings). Critically discuss and contrast the results with what observed in question 1 above. Need to get the new arch explicitly reflected in your shell script command if you are using an arch from the codebase. [**10 marks]**

3. Apply one more neural network architecture not from the same family as the above questions Sec 1.1 and 1.2 (e.g., if some ResNet is used for question 1.1 or 1.2 above, do not use any ResNet variant here). Critically discuss and contrast the results with what observed questions 1 and 2 above. Need to get the new arch explicitly reflected in your shell script command if you choose an arch from the codebase. [**10 marks]**

Section 2 – Dataset preparation and Augmentation experiment (*Start from the default data augmentations setting with random, horizontal flip and Random2DTranslation*). **[25 marks]**

1. Further append on top three extra data augmentation techniques in isolation one by one (for example, Default + "crop", Default + "horizontal flip", and Default + "blurring"). Discuss the results in comparison *when this selected augmentation is not employed*, i.e., the default configuration in the provided code. **[20 marks]**

2. Combine augmentation techniques employed in question 1 above to find the best recipe in terms of performance. Highlight any improvement or drop in overall score. **[5 marks]**

Section 3 – Exploration of Hyperparameters (*Start from the default learning rate and batch size*)**. [25 marks]**

1. Exploration of Learning Rate (LR). **[10 marks]**
    a. Experiment with 4 values of LR (in addition to the default value).
    b. Discuss the effects observed on overall performance.

2. Exploration Batch sizes. **[10 marks]**
    a. Fixing the best LR value from the experiments in question 1 above, experiment with 4 different values of the BS (in addition to the default value).
    b. Discuss the effects observed on overall performance.

3. Exploration of the optimizer. **[5 marks]**
    a. Fixing the best Learning Rate value and best Bath Size value from the experiments in questions 1 and 2 above, respectively, experiment with changing the optimizer to SGD. (use PyTorch's internal class)
    b. Discuss the effects observed on overall performance.

Section 4 – Summary on overall hyper-parameter tuning, only need to fill up the table below, no more text. **[10 marks]**

Section	Hyper-parameter	Best configuration (obtained)	mAP	Rank-1
1	Architecture			
2	Data augmentation			
3.1	Learning rate			
3.2	Batch size			
3.3	Optimizer			