Assessment 3: Project Report - Capstone Research

Overview

During this assessment, you will produce a written report on a computer vision data science project utilising AWS as the primary data repository and computational resource.

Learning outcomes

1. Analyse real world computer vision tasks using machine learning techniques learnt in this subject
2. Engage AWS cloud computing services
3. Develop and deploy neural network models on AWS
4. Tune hyperparameters for neural network models using AWS
5. Construct a written communication and interpretation of machine learning methodologies
6. Demonstrate and apply advanced theoretical and technical knowledge of data science to research problem.

Format

You will need to submit the following:

- A PDF file clearly shows the assignment question, the associated answers, relevant Python outputs, analyses and discussions
- Appendices include screen-shot images of AWS console detailing the development, training and deploying the CNN model
- Jupyternotebook
- The task cover sheet
- The assignment **should not exceed 12-A4 pages**. Appendices do not form part of the page limit.

You have up to three attempts to submit your assessment, and only the last submission will be graded.

A word on plagiarism

Plagiarism is the act of using another's words, works or ideas from any source as one's own.

Plagiarism has no place in a University. Student work containing plagiarised material will be subject to formal university processes.

Computer vision

Computer vision is an expanding field in data science, being led by business applications. Computer vision applications range from analysing static photographs (drone images, satellite imagery, static albums), interactive image albums and content (such as Facebook, Instagram and Twitter), to live steaming of video (cctv, drone/satellite video).

Assessment Tasks

The purposes of the assignment are to i) develop a research proposal relating to image classification/detection using your own dataset; and ii) implement basic neural networks to address the research questions.

Note: *Please note that a dataset **must NOT** be covered in practical sessions (e.g. MNIST or CIFAR-10/100, dogsvscats). Model Deployment in this report must be conducted using AWS SageMaker.*

The report must cover the following aspects.

1. **Research proposal (4 marks)**
    a) Describe the primary objectives/questions from a research.
    b) Discuss some literature relating to the proposal research.
2. **Data (3 marks)**
    a) Document any data cleaning/formatting tasks required for the image classification task.
3. **Modelling (10 marks)**
    a) Propose a baseline CNN to address the research proposal. Explain the structure of the benchmark model in detail. At least, consider the following criteria when designing and training the baseline model:
        - Early stopping
        - Drop-out
        - Using batches to train the baseline model
        - Considering at least 2 optimisers and different learning rates when selecting the baseline model
        - Considering different hidden layers

    b) Provide evidence of completed training on AWS. Script mode training is required.
4. **Model Evaluation and Deployment using AWS-SageMaker (6 marks)**
    a) Evaluate and Discuss the performance of the model for the training and test data. Provide relevant graphs, metric measures and evidence of an endpoint on AWS.
    b) Evaluate and Discuss the degree to which the model meets your research objectives.
5. **Discuss the use of AWS SageMaker (2 marks)**

At least discuss the following aspects:

a) Notebook instance type

b) Cost and computation time

6. **Transfer-learning and Model comparison (5 marks)**

   a) Use one of the pretrained CNN structures via Keras Application API https://keras.io/api/applications/ to do transfer learning to address objectives of your research. Compare the results obtained from transfer learning and those obtained from the benchmark models. Discuss the results. Script mode training is required.

Data Source

Some data source you might find helpful

- https://data.mendeley.com/research-data/?type=IMAGE
- https://www.kaggle.com/datasets

Marking Criteria and Rubric: MA3832 Assessment 4

Criteria	High Distinction	Pass	Fail
Review the article	Demonstrate excellent understanding on the selected article. Provides detailed, accurate descriptions of CNN structure presented in a paper. Demonstrate excellent understanding on contributions and limitations of a paper.	Demonstrate good understanding on the selected article. Provides adequate descriptions of CNN structure presented in a paper. Demonstrate general understanding on contributions and limitations of a paper.	Does not meet pass criteria – See commentary for specific details**.**
Project proposal design. Logically arrange, present and communicate the information of analysis and comparison	Project plan is coherently and logically structured. Its impact is clear and well-defined. Communication is clear, concise, accurate and uses appropriate terminology and references to relevant theoretical frameworks.	Project plan is structured so that with some inferences, a logically structure incorporating adequate detail that can be deduced. Some inaccurate statements and limited justifications. Communication is adequate with some ambiguous and inferred elements. Some replications and not all internal and external sources are appropriately referenced.	Does not meet pass criteria – See commentary for specific details**.**

Data considerations for machine learning analysis	Provides a detailed, accurate description of the data used in the project.	Provides adequate description of the data used in the project. Some elements of the method are inferred or partially detailed.	Does not meet pass criteria – See commentary for specific details
Model and Model Evaluation	Provides a detailed, accurate and description of the proposed model. The model is clearly visualised, and the visualisation is clearly and concisely described. Hyperparameter tuning is clearly and concisely described with overt justifications link to model theory and supporting literature. Model development draws upon unit knowledge and demonstrated wider readings	Provides an adequate description of the proposed model where some elements are inferred or ambiguous. The model is visualised, but the visualisation is not completely described, or elements are inferred or ambiguous. Hyperparameter tuning described with some inferred or ambiguous links to model theory or supporting literature. Model development draws upon unit knowledge and limited wider readings	Does not meet pass criteria – See commentary for specific details

	with clear overt links to external sources. Model overfitting and regularisation elements are clearly and concisely justified with links to model theory. Provide detailed explanation on performance of the model	with some links to external sources. Model overfitting and regularisation elements are described with limited links to model theory. Some elements are inferred or ambiguous. Provide some explanation on performance of the model	
Model comparison	Provides a detailed comparison and discussion regarding performance of the proposed model and the model proposed in the reviewed in Part 1.	Provide limited comparison and discussion regarding performance of the proposed model and the model proposed in the reviewed in Part 1.	
Application on AWS	Provide evidence suggesting all models considered in the analysis are successfully trained and deployed. Model deployment, monitoring and maintenance is clearly and concisely described using AWS SageMaker services.	Provide some evidence suggesting all models considered in the analysis are successfully trained and deployed. Model deployment, monitoring and maintenance is clearly and concisely described using AWS SageMaker services.	Does not meet pass criteria – See commentary for specific details