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COS711 Assignment 3

Deep Learning

Due date: 15 November 2021, at 23:30

1 General instructions

For this assignment, you will use a deep learning technique of your choice to solve a real life problem. You will work on a problem hosted at `https://zindi.africa`, an African data science and machine learning competition platform.

You have to submit a pdf document, containing a technical report wherein you describe what you have done, present and discuss your findings. Guidelines for writing your report are provided in this specification document. The report will be checked for plagiarism using the Turnitin system, and should be submitted through the ClickUp system. You are advised but not required to typeset your report in LaTeX.

2 Deep Learning

Deep learning is a term used to refer to a modern branch on neural network models focused on learning hierarchical representations of the data rather than modelling a single highly complex non-linear transformation from the inputs to the outputs. Deep learning architectures such as convolutional neural networks (CNNs) and long short-term memory networks (LSTMs) have achieved impressive results in image processing and natural language processing tasks. For this assignment, you will apply deep learning techniques of your choice to a real-life problem.

2.1 Makerere Passion Fruit Disease Detection

For this assignment, you will need to create a deep learning solution to predict makerere passion fruit disease. This is an image recognition problem, thus convolutional neural networks would be the best fit. Full details of the problem, as well as the dataset, are available here:
`https://zindi.africa/competitions/makerere-passion-fruit-disease-detection-challenge`

2.1.1 Problem description

> *"Passion fruit pests and diseases in Uganda lead to reduced yields and decreased investment in farming over time. Most Ugandan farmers (including passion fruit farmers) are smallholder farmers from low-income households, and do not have sufficient information and means to combat these challenges. Without the required knowledge about the health of their crops, farmers cannot intervene promptly to avoid devastating losses.*

The Marconi Society Machine Learning Laboratory at Makerere University is addressing the lack of a reliable, timely diagnostic platform for passion fruit diseases by developing a low-cost hand-held diagnostic device (based on the Raspberry Pi) making use of state-of-the-art machine learning techniques.

In this challenge, you will classify the disease status of a plant given an image of a passion fruit. If successful, this model will be deployed as part of a device to aid smallholder farmers in making a prompt diagnosis in their passion fruit crops."

2.1.2 Your task

Your task is to apply a deep learning technique of your choice to create a disease detection model. You may apply more than one technique. Each applied technique must be optimised for the problem, i.e. at least **three** relevant hyperparameters have to be tuned. Since this is an image recognition technique, some marks will be awarded for data augmentation.

2.1.3 Notes

- You may use any programming language and platform.
- You may use a neural network library/framework.
- The data may require cleaning and augmentation. Marks will be awarded for the analysis of the dataset.
- Zindi is a lively community, and you are encouraged to browse the related forums for ideas on how to get started. However, no plagiarism will be tolerated. You must propose your own solution to the given problem, not simply borrow somebody else's.
- You must substantiate the various hyperparameter choices that you make. Choice of deep learning techniques must also be substantiated and informed by the given dataset.
- For competition purposes, the test set given on Zindi does not come with labels. Therefore, you must split the given training set into training/generalisation to test your model.
- Consider using google colab for the purpose of running your experiments on high-performance hardware: `https://colab.research.google.com/`
- This is a live data science competition. If you get a working solution up and running, you stand a chance to win a monetary prize. Details can be found on the Zindi website.
- Additional marks can be obtained if you make it to the top 10 contenders on the Zindi leaderboard. If you decide to submit your solution to Zindi, please report on your score.

3 Marking and general guidelines

For this assignment you have to submit (1) a research report where you discuss your findings. Your reports must follow the IEEE conference format (`https://www.ieee.org/conferences/publishing/templates.html`). (2) A link to an open github repository where your code is stored. Note that uploading your code to github is compulsory. Please include the link in the title of your report next to your name (it can serve as a contact address or affiliation). You may use the Latex or the Word template, however it will serve as good academic writing practice to utilise LaTeX. There is also a strict page limit of **8 pages** for this assignment. Given the imposed two column format it would require a substantial amount of writing to exceed this limit.

This is not a course in technical and report writing; however, you should at least attempt to follow some accepted document writing techniques and make your report as readable as possible.

You are more likely to obtain a higher mark if your report generates a good impression with the marker and is void of general errors like spelling and grammar mistakes.

A typical report would consist of the following sections:

1. **Abstract**

   The abstract should briefly summarise the purpose and findings of the report.

2. **Introduction**

   The introduction sets the stage for the remainder of your report. You usually have very general statements here. The introduction prepares the reader for what to expect from reading your report. In general, the introduction should either contain or be a summary of your ENTIRE report. Keep the introduction concise, try to limit it to 1 page maximum.

3. **Background**

   A very high level discussion on the problem domain and the algorithms and/or approaches that you have used. Do not be too specific on the algorithms and approaches. This section is typically where the "base cases" of concepts that appear throughout the remainder of your report are discussed. It is also an ideal place to refer a reader to other sources containing relevant information on the topic which is outside the scope of your assignment. Remember to discuss very generally. After reading this section the marker should be able to determine whether or not you know what you're talking about. Try to limit this section to 1 page maximum.

4. **Experimental Set-Up**

   In this section you discuss how you approached, implemented and solved the problem. Mention the values set for the algorithm's control parameters, how many simulations you have run and what the characteristics for candidate solutions to your problems are. After reading this section (in addition to the background) the reader should be able to replicate your experiments to obtain similar results to those obtained by you. This is also the section where your discussion specialises on the concepts mentioned in the background section. Be very specific in your discussions in this section.

5. **Research Results**

   This is the section where you report your results obtained from running the experiments as discussed in the experimental set-up section. You have to give, at least, the averages and the standard deviations for all the experiments/simulations. Training, generalisation, and classification errors (if applicable) have to be reported. Thoroughly discuss the results that you've obtained and reason about why you obtained the results that you have. Answer questions like "are these results to be expected?" and "why these results occurred?" and "would different circumstances lead to different results?"

6. **Conclusion(s)**

   Very general conclusions about the assignment that you have done. This section "answers" the questions and issues that you've raised and investigated. This section is, in general, a summary of what you have done, what the results were and finally what you concluded from these results. This is the final section in your document so be sure that all the issues raised up until now are answered here. This is also the perfect section to discuss what you have learnt in doing this assignment.

Please **do not** include any code or pseudocode in the report, unless you are proposing a novel algorithm. Research reports must focus on the scientific contributions. We just assume that you can code – you do not have to prove it anymore!

3.1 Marking

The following general breakdown will be used during the assessment of this assignment:

Category	**Mark Allocation**
Report Structure	5 marks
Background	5 marks
Experimental Setup	15 marks
Data Preparation	15 marks
Deep Learning Hyperparameter Tuning	25 marks
Deep Learning Classification Model	25 marks
Conclusions	5 marks
References	5 marks
Extra marks (eg. additional DL model, top-10 on Zindi)	10 marks*
TOTAL	100 marks*

*The total can go up to 110 if you decide to put in the extra effort.

Submit only the PDF report. No additional files of any sort should be submitted. Upload the PDF file to the appropriate assignment upload on ClickUp. Multiple uploads are allowed, but only the last one will be marked. The deadline is **15 November 2021, at 23h30** .