

THIRD ASSIGNMENT

Solving Image Classification Problems with Convolutional Neural Networks

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PROJECT GOAL: This project consists of two goals: (1) compare the performance of multiple CNN pre-trained models studied in class and (2) propose a new model that can improve the performance of the best pre-trained model. For the first step, select **two of the pre-trained models studied in class** (and listed below) and compare their performance with the current dataset (details later) without changing any aspect of these networks:

1. AlexNet
2. VGGNet
3. GoogleNet
4. ResNet
5. SENet

In your report, briefly describe (1) how these models work, (2) why did you select these models and (3) compare their classification performance (using the usual classification metrics, such as accuracy, recall, precision, etc).

OBS_1: CNN pretrained methods might take a long time to retrain and test, so please try to use cloud-based systems and start your experiments as soon as possible.

OBS_2: there are multiple versions of some of these models (like VGG16 or VGG19). Please give preference to the smaller models (i.e., models with less layers) to make experiments faster.

In the second step, based on the best network from the previous analysis, **you'll have to propose a new CNN** to improve the performance of this best network. You can do this in two ways:

1. Adjusting the current pre-trained model by adding extra layers on top of the model. These layers can be convolutional layers, pooling layer, etc.
2. Creating a new CNN with similar architecture to the pre-trained model (or incorporating some features of different pre-trained models).

Similar to the previous step, you have **to clearly explain the adjustments you've made in the model and why you've made those adjustments based on your AI knowledge or research** (include references if necessary). Compare the results of this newly created model with the results from step 1.

Any python library (scikit-learn, keras, pytorch, tensorflow, matplotlib, seaborn, etc) and IDE (Jupyter Notebook, Google Collab, Spyder, etc) can be used in this project, however the essential steps your code should include are:

- Data Cleaning and analysis
- Loading and adjusting the pre-trained models
- Training and testing different models
- Plot the results comparing different networks

Please include comments describing each of these key steps in your code.

DATASET: The dataset used in this project is the Chest X-ray dataset: <https://www.kaggle.com/datasets/prashant268/chest-xray-covid19-pneumonia>

This database contains X-ray images from healthy patients and patients with either covid-19 or pneumonia. This consists, therefore, of a multiclass classification problem. All images are in grayscale and of the same size.

REQUIREMENTS: This assignment should be completed in pairs and consists of two deliverables:

- The python code: one or more files in any preferable IDE, such as Jupyter Notebook or Google Collab (40%) together with a README.txt file explaining how to run your code (specially if you have more than one file).
- A short report of maximum of four pages (not considering references, in case you want to include) (60%). **Please include a cover page with the name and ID of the team members** and details of the assignment (the cover does not count as a page). This report should contain:
 - a. An introduction Section explaining the development process (20%):
 - i. The libraries used
 - ii. Description of the data cleaning and analysis process
 - iii. Details of the pre-trained models selected (together with an explanation on how they work and why they were selected)
 - iv. Any training and testing process (data split ratio, if cross-validation was used, the loss function used, etc).
 - b. An evaluation section describing your results (60%):
 - i. Comparative analysis of the performance of the pre-trained models tested, with your conclusions on these results.
 - ii. Detailed description of the new network proposed, including the reasons for developing the network as it is, if more than one network was developed, the training and testing process, etc
 - iii. Your conclusions on the new network results (comparison of this network with the previous ones) based on your AI knowledge.
 - iv. Any future work necessary to improve the current model.
 - c. Final conclusions (20%)
 - i. The challenges of the project
 - ii. The project task allocation (what each member did)

OBS_2: BOTH MEMBERS NEED TO SUBMIT ON CANVAS A ZIP FOLDER (PLEASE DON'T SUBMIT .RAR FOLDERS, ONLY .ZIP FOLDERS) CONTAINING THE CODE AND THE REPORT.

DEADLINE: WEDNESDAY, 11TH OF MAY 2022 AT 17:00

GUIDANCE: Please consult the following materials for further guidance on implementing Neural Networks in python:

1. Practical Machine Learning for Computer Vision - <https://www.oreilly.com/library/view/practical-machine-learning/9781098102357/>
2. Hands-on Machine Learning with scikit-learn, keras and tensorflow (book) - <https://www.oreilly.com/library/view/hands-on-machine-learning/9781492032632/> - Especially Chapter 14

Good luck to everyone,

Best Regards,

Pamela Bezerra