



Machine Learning
Exam #1
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1 Introduction

We've sourced a diverse set of images from the internet, providing a broad perspective on human knowledge. These images have been annotated and classified by individuals, resulting in a dataset comprising 33,737 images spread across 10 distinct classes. The potential of deep learning in automatically categorizing such images is vast, offering significant advantages over manual classification.

This exam requires you to implement a Multi-Layer Perceptron (MLP) network to classify these images into different class types: "Class1" to "Class10". The images have been processed to deter manual labeling. If a model can successfully identify the 10 classes with more than 10% accuracy (which is what you could achieve by flipping a coin), you could help people to have a better classification.

The format will be a competition between you and the rest of your classmates. You will be given a training set and then asked to submit your code together with your trained MLP, so that we can test it on our private held-out set. You will be given a unique private nickname to check your results in the public leaderboard, and you may submit your work once per day until the competition ends. The dailyboard (which shows your score for last submission) and the leaderboard (which shows everyonens best score so far) will be updated every afternoon on Blackboard, and when the competition ends, the reports of winners will be published.

In the script, we have included several metrics for you in the sample code. Try out the different metrics and decide how well these metrics represent the performance of the model.

2 Dataset and Sample code

- Download the exam dataset and sample code from the following link <https://storage.googleapis.com/exam-deep-learning/Exam1-v4.zip>
- You can use this link and use `wget` command to download your data into your cloud. For example
 - `wget https://storage.googleapis.com/exam-deep-learning/Exam1-v4.zip`
 - `wget -O Exam1-v4.zip https://gwu.box.com/shared/static/glvigdqvvcezh07sgmytir1kg25fotbb.zip`
- unzip it and you should have Exam1 folder that includes **Code, Data and excel** directories.
 - `unzip Exam1-v4.zip`
- Please check the sample `train_example.py` in the code folder, use that as base code. This is just to get you started and give you an example of how you complete the `test_to_do.py`. You will get a sample directory as follows

1. **Code** : the example code
 2. **Data** : images example
 3. **Excel** : excel example
- The datasets consist of an Excel file and the images to be tested. The name of the images are listed in the spreadsheet classified with “train” and “test” labels. Use the “train” to create your model and “test” to tested. A very important note, the “test” images should be used as they are label do not change this parameter since these exact images will be used to compare the validity of the models. Only the valid models using this exact information will be given a score in the leaderboard.
 - Note: Use pandas to read the dataset and work on DataFrames.

3 Rules of Competition

Please read these rules **carefully** and if you have any questions please send an email to me directly.

- You can **only** use MLP for training. This means only Fully Connected layers. **No Convolutional** Layers nor feedbacks are allowed (**LSTM** or any **RNN** architecture). No pre-trained models are allowed such as (resnet, densenet, ...)
- You can use other operations in-between layers, like Dropout, Batch Normalization or other types of layer input/output manipulation.
- You can only use the data you are given. Using additional data from any other sources is not allowed.
- You can do any kind of pre-processing with the training data, which you should split into at least training and testing. You may use whichever library you want for this purpose.
- You can only use Tensorflow for training the model.
- Every student will have a nickname for the competition. You are not allowed to share your nickname with anyone or reveal other students' nicknames. If we find out you will get **zero** grade for the Exam.
- You are not allowed to copy code or ideas from any students in the class. If we find out you will get **zero** grade for the Exam.
- You are allowed to search in the internet and find out ideas. You can use any external GitHub but you need to **cite** it. If we found any violation of this rule you get a reduce grade.

4 Daily Deliverables

1. A single script named `test_<nickname>.py`. You should receive your nicknames by email, if you do not, please contact us. (e.g. `test_katrina.py`)
2. A single model `model_<nickname>.keras`.
3. A file text `summary_<nickname>.txt`, which contains `model.summary()`.
4. An Excel file `results_<nickname>.xlsx`, with the following format
 - “id” : image name
 - “target”: original classification
 - “split” : test images, this images are given in the original Excel.
 - “results” : the results of the prediction
5. The names should be as listed above.
6. You need to submit item 1 through item 4 every single night to Blackboard (in electronic reserve section - there is a submission link for each day) if you want to test your trained model for that day. The results of daily submissions will be posted the next day in Daily Board excel sheet in the electronic reserve section of BB.
7. **Very Important Note:** DO NOT ZIP YOUR FILES IF YOU DO THEN YOU DON'T GET A GRADE FOR THAT DAY. PLEASE UPLOAD THEM SEPARATELY AS THEY ARE.
8. **Note:** You **just** have **one** submission per day. In case of ensembling you need to write your predict function in a way that it loads multiple models and does the ensemble and then predict. Makes sure all of your models named properly (i.e, `model_<nickname>1.hdf5`, `model_<nickname>2.hdf5`, etc.) and you need to put all of your models in **ONE SUBMISSION**. In other words, one submission per a day means you just get one score per a day for your trained model.If you do not submit your models for one day or so you do not get penalized.

5 Clarifications regarding `test_<nickname>.py`

- The python script must begin with the necessary imports, followed by one or more lines of `os.system("sudo pip install <whatever additional package you used>")`. Please make sure this way of installation works on the ubuntu image. If not, write whatever command line commands you need using `os.system`.
- The rest of the code must consist of a single function called `test` with the following features:
- The path argument will be used as follows:
 - a-1)** The test should be run in the terminal with two arguments `--path --split`.

a-2) `python3 test_Nickname.py --path 'path to your exam directory' --split test`

a-3) Example: `python3 test_adam.py --path /home/ubuntu/Exam1 --split test`

a-4)) The excel file will be obtained from `path + os.path.sep + "excel"`, where the excel file with the name of ids and the targets are recorded.

- The “split” arguments can receive two values : “test” and “validate.” The “validate” will use data that we have in store to calculate the metrics for the leader board.
- The test script must read the images from the path given in the previous argument.
- The test script may have any transformation needed to make your model works correctly.
- The script must generate a excel file with results of your prediction in the format already mentioned in section 4 of this document.
- The script must save the results into an .xlsx file. The format is explained in section 4 of this document. Remember to use exactly the same format.
- The test script will be using the models “.keras” in the local directory.
- Test the file in your Linux instance. Only send test files that run without errors.
- Note that the process to get the leader board results will be fully automated, so if Python throws an error, your model will be skipped and you will see a score of 0 and the corresponding error message instead of your model’s score. You can contact me anytime to fix this if you think your code has no bugs.

6 Final Deliverables - Last day of Exam

1. Create a folder named `Final_Scripts`. Put the following into it.
 - A final script named `train_<nickname>.py` that shows everything you did to get your best model.
 - A final test file like the one you submitted during the competition.
 - Your best model.
2. Create a folder named `All_Submissions`. Put the following into it.
 - All daily train, test scripts and models for each day. For example, for day 1, you need to have a subfolder in the `All_Submissions` folder named as `day1` with all the scripts and models of day1 in it. Do the same for the rest of the days.
3. Create a folder named `Exam_report`. Put the following into it.
 - An exam report named `report_<nickname>.pdf` that explains what you did and why (like changes that made your score higher, creative ideas, etc). Please submit in .pdf format.

- Your report should not be very lengthy or very short. It needs to show your work It can have the followings (network architecture, table, block diagram, what changes you did, preprocessing, new ideas, tricks, snippet of your code ...)

Your `train_<nickname>.py` scripts and your `report_<nickname>.pdf` report will only be graded after the competition ends, so you don't need to submit them until then.

There is a link final submission for exam1 in electronic reserve section of BB. Please submit your final submissions to this link.