Assignment for unit 2: Computer Vision

In this practical exercise you will solve several computer vision problems using deep models.

The goals of these assignments are:

- Develop proficiency in using Keras for training and testing neural nets (NNs).
- Optimize the parameters and architectures of a dense feed-forward neural network (ffNN), and a convolutional neural net (CNN) for image classification.
- Build a traffic sign detection algorithm.

Practical Assignment

1. Week February, 20th to 26th.

   Follow the instructions in your class slides to set up your working environment.

   This week we will implement solutions that optimize the parameters and arquitecture of a ffNN for solving two image image classification problems: traffic sign and Cifar 100.

   Download from Moodle the Jupyter notebook `Assignment_2_1.ipynb`. There you will find code to download the data sets and train both models.

   You must modify the code to improve the ffNN models provided. To this end you must decide on:

   - Number of layers and number of units in each layer.
   - Optimization parameters and algorithms to train the net.
   - When to stop training according to the evolution of training during the optimization.
   - Regularization.

   Note that at this point you are not allowed to use Convolutional layers or any pre-trained models.

   You must produce a few **slides in PDF** format to make a 5 minutes presentation describing your network architectures, plots of the evolution of losses and classification performances on training and validation data sets, the final performance on the test data sets. Describe also the process that you have followed to reach your solution.

   During the course of this assignment you must introduce your intermediate test results in the wiki contest page “The ffNN challenge 2020” located in the Moodle page.

   Submit your pdf slides and Pyton code to “The ffNN assignment 2020” delivery area before the deadline.

   We will select one or two groups to present their results on Thursday, 27th. Please check your mail at 12:00 am that day to see if you received our invitation. You must acknowledge it as soon as possible.

   At the begining of the next class, on Tuesday 25th, we will devote some time to answer your questions. Of course, you can also email us or post a question in the News forum.

   Deadline: Wednesday, February 26th, 23:55.

2. Weeks February, 28th to March 9th.

   During this period we will improve our previous net using convolutional layers.

   Download from Moodle the Jupyter notebook `Assignment_2_2.ipynb`. Improve the performance of your net compared to that of the previous week. Again, you must decide

on:

- Architecture of your net
- Optimization parameters and algorithms to train the net.
- Performance improvement (regularization, data augmentation, etc.)
- Etc...

You must produce a few **slides in PDF** format to make a 5 minutes presentation describing your network architectures, plots of the evolution of losses and classification performances on training and validation data sets, the final performance on the test data sets. Describe also the process that you have followed to reach your solution.

During the course of this assignment you must introduce your intermediate test results in the wiki contest page "The CNN challenge 2020" located in the Moodle page.

Submit your pdf slides and Pyton code to "The CNN assignment 2020" delivery area before the deadline.

We will select one group to present their results on Tuesday, March 10th. Please check your mail at 12:00 am that day to see if you received our invitation. You must acknowledge it as soon as possible.

At the beginning of the next class, on Thursday, March 4th, we will devote some time to answer your questions. Of course, you can also email us or post a question in the News forum.

Deadline: Monday, March 9th, 23:55.

3. Week March, 10th to 18th.

During this week we will use our previous results to build a traffic sign detection system. You can find in Moodle the slides with the instruction given in class to complete this assignment as well as two Jupyter notebooks, `Assignment_2_3_tf2.ipynb` and `Assignment_2_3_tf1.ipynb` with partial implementations.

During the course of this assignment you must introduce your intermediate test results in the wiki contest page "The traffic sign detection challenge 2020".

Please try to introduce some results before the marked deadline. We also encourage you to include your firnal results before the final report delivery deadline.

4. Weeks March, 19th to April 3rd.

Write the **final report** of your project. You can also improve any of your previous results with new ideas.

It should include, at least, the following sections:

1. Introduction.
   Brief presentation of the report: deep learning, ffNN, CNN, ..., traffic sign and cifar100 data sets, goals of the work, description of the document.
2. ffNN results
3. CNN results

   In each of the previous sections explain the process followed to reach your final model, intermediate results, final results, plots of the learning process, execution time, etc. Compare and **discuss** your solutions, ffNN vs. CNN, improvements obtained with different regularization, optimization algorithms, etc.

   Do not forget to clearly display your final best train/validation/test loss and accuracy, as well as processing time.

   The explanation and discussion of your result is as important as the final numbers.
4. Traffic sign detection

   Explain your solution to the detection problem. How you have tried to improve the

accuracy and efficiency of the final solution. Clearly display the timming and mAP of your final result and discuss it. Include possible future ways to improve it.

5. Personal comment and suggestions for next year

   Here include personal reflections on this practical exercise and the course. Also your experience with Keras, Tensor Flow, Google Colab, Google Cloud computing environment, problems/improvements related to our instructions, etc...).

6. Conclusions

   Final comments and conclusion.

Submit your pdf report and Python code (all three final Jupyter notebooks) to the "**Computer vision final report**" delivery area before the deadline.

Deadline: Friday April 3rd 2020.