CS412 Machine Learning

Assignment 4: Neural Networks

Due date: Monday, May 24, 2021, 23:55
Late submission: till Wednesday, May 26, 2021, 23:55
(-10pts penalty for **each** late submission day)

In this assignment, you will classify images by using fully connected neural networks. You are asked to try different hyperparameters such as learning rate, # of epochs, etc. & observe the results. Then you will implement early stopping to avoid overfitting. You will write your findings, results, and interpretations into a report and submit that as well.

Dataset Information:

SVHN dataset:

http://ufldl.stanford.edu/housenumbers/

The dataset (format 2) contains 32x32 RGB centered digit images (from 0 to 9). You can load the SVHN dataset from this drive link.

Implementation:

In this assignment, you are expected to use Google Colab. To start working on your homework, take a copy of this drive folder to your own google drive. You will do your implementations on this file and submit it with the expected outputs. We may just look at your notebook results; so make sure each cell is run and outputs are there.

Instructions:

1) **Preprocessing:** Read the data from linked drive folder. Summarize the dataset, understand the structure. Normalize and visualize images.

2) **Modelling:**

   2.1) **Part 1:** First apply MLP to the SVHN dataset. Try different hyperparameters. Below you can see range of hyperparameters to try. Try **at least 2** different values **for each** hyperparameter stated below (Keep learning rate same and change # of hidden layers, etc.).

e.g: learning rate = [0.1, 0.00001]
# of iterations (epoch) = {10, 50, 100, 200, etc.}
# of hidden layers = {1, 2, 3}
# of neurons = {1024, 512, 128, 64, etc.}
try adding **dropout** to the NN architecture (see Colab for further information)

2.2) **Part 2:** One approach to avoid overfitting is to implement early stopping. With early stopping, model will stop updating weights once performance on validation data no longer improves. In this part you will train a neural network with early stopping approach. Details are available on Colab file.

Note: Don't forget to change Colab's runtime to GPU

3) **Report:** Share your results, which hyperparameters you used, train & test accuracy, etc. Write an at most 1/2-page summary of your approach to this problem at the end of your notebook; this should be like an executive summary. Include problem definition and preprocessing as well. You should write the report under the cell in the Colab notebook.

Topics to discuss:

Explain you results.
How did you choose the best hyperparameters?
What happened when the # of epochs are too large/small, why?
What happened when the learning rate is too large/small, why?
What did you observe when you change the # of hidden layers?
What did you observe when you change the # of neurons?
What is the use of adding dropout?
What is the use of early stopping?

You will get full points from here as long as you have a good (enough) summary of your work, regardless of your best performance or what you have decided to talk about in the last few lines.

You are expected to write this report on your own.

Office Hours:

There will be dense office hours between 18:30 and 21:30 (three hours) on 17,18, 20, 21, 22 & 24th of May. You can join the office hours using this link.

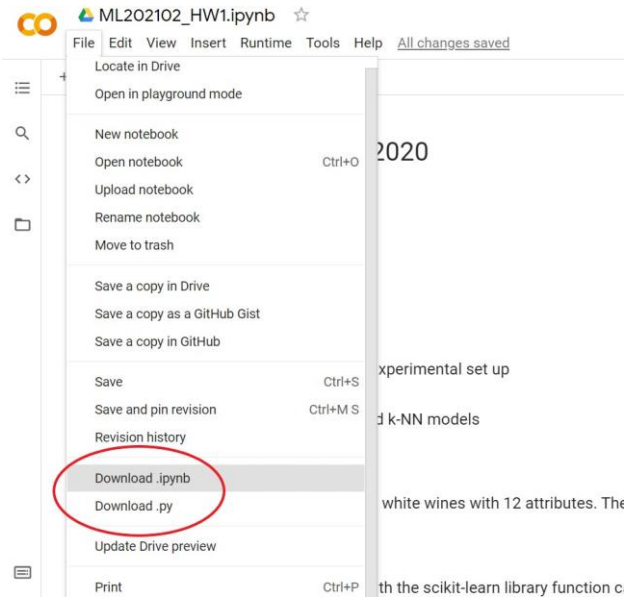
Meeting ID: 640 081 2376

Passcode: cs412

Submission Instructions

- You will submit this homework via SUCourse.
- Please read this document again before submitting it.
- Please submit your **"share link" INLINE in Sucourse submissions.** That is we should be able to click on the link and go there and run (and possibly also modify) your code. For us to be able to modify, in case of errors, etc, you should get your "share link" as **share with anyone in edit mode.**
- Download the **.ipynb and the .html** file and upload both of them to Sucourse.
- Please do your assignment individually, do not copy from a friend or the Internet. Plagiarized assignments will receive -100.

For .ipynb file:



For html file:

Right click on the page