

Assignment 3

This exercise is part of the course assignment. **Deadline for the assignment 30.11.2022 at 23:59**

The topic of this assignment is image classification with CNN. For this assignment you should return

- The file `main3.m`. The file should contain your name and student number (of both students if you work in pairs).
- Your answers to the questions in the analysis part. At the end of the course, you should return a single pdf containing the answers to all questions of the assignments. The report should contain also your name and student number (of both students if you work in pairs).

NOTE! For this assignment, you are allowed to use Python, if you e.g. have already some machine learning experience from other courses. You can choose whatever framework you prefer, given the simplicity of the network, it is advisable to use keras. Note however that it is your responsibility to re-implement the ready parts (reading data, plotting PR-curve) in python. **It is also your responsibility to ensure code reproducibility**, i.e. make sure others can **easily** run your code without dependency problems.

Coding part (5pt)

In this assignment you will train a CNN to classify images of people as "smile" or "non smile" using the genki 4k dataset, which contains 4000 pictures of people.

- First unzip the dataset `genki4k.tar` (you can use the matlab command `untar` from the matlab command prompt, make sure you are in the correct working directory)
- Open the script `main3.m` and run the first cell, this will load the data and split them into training and test data
- **Preprocessing:** For your neural network all pictures should be RGB and 64×64 , unfortunately they aren't! Convert the `ImageDatastore`-objects to *augmented image datastores* so that all pictures have the correct size and are RGB. **Hint:** read the documentation of the matlab function `augmentedImageDataStore`
- Create a neural network with the following structure

1. Input size $64 \times 64 \times 3$
 2. **Convolutional layer** kernel size: 5×5 , 32 filters, padding: same, use BatchNormalization and ReLu activation
 3. **MaxPooling**: pool size 2 and stride 2
 4. **Convolutional layer** kernel size: 5×5 , 32 filters, padding: same, use BatchNormalization and ReLu activation
 5. **MaxPooling**: pool size 2 and stride 2
 6. **Convolutional layer** kernel size: 5×5 , 32 filters, padding: same, use BatchNormalization and ReLu activation
 7. **MaxPooling**: pool size 2 and stride 2
 8. **Fully connected layer** 128 nodes, ReLu activation
 9. **Fully connected layer** 2 nodes, softmax activation
 10. **classification layer**
- Train your network using 40 epochs (should take about 30-40 minutes) and stochastic gradient descend algorithm (the training options are already setup for you)
 - evaluate your network on the validation data, compute the accuracy and plot the precision recall curve (you can use the code from the previous assignment, either your own or the model solution in the .p-file)
 - Add a dropout layer with dropout probability 0.5 before the last fully connected layer, retrain the network and compute the new accuracy and precision-recall curve

Analysis part (5pt)

Answer the following questions in your report

- What is the dropout layer? What does it do and how does it help the performance? (3pt)
- Include the PR-curves of the network with and without dropout (preferably on the same graph). Report also the accuracies for both networks. In general, what factors determine the final performance of the neural network? What could you do to achieve better accuracies? (2pt)

BONUS PART (5pt)

Modify the network architecture and hyperparameters to achieve a better accuracy. You should achieve at least 85% accuracy to get bonus points. You can also add more preprocessing and/or postprocessing steps. Moreover, you are allowed to use all aces up your sleeve. For this bonus part, you should return a script called `bonus1.m` and your network saved in a file `mdl.mat` (if you have some extra functions in other files, please return also those). You should also write a section in your report where you describe what you have done and motivate your choices. Have fun!