**Demonstration report**

**Data generator**

The first step is loading the data. The dataset is split into 6 batches that are loaded using the following function:

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The images and labels are stored in a pickle file, and the images in the original format have the channels on the first dimension, and we convert them to images with channels on the last dimension.

In order to integrate the data generator with the Keras functionalities, we define the following class:

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And in the constructor, we read the batches:

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Also, we have the option to shuffle the dataset:

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This will be called automatically by Keras after each epoch.

The data is read in batches:

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And the length of the dataset is given by the number of batches:

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**Models**

In order to create the model architectures, we define the following functions for creating dense and convolutional layers:

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In order to create the actual models, we use a functional style of defining them. We define the ANN as:

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The hidden\_layers parameter controls the number of units in each hidden layer. Also, a final dense layer is needed to output the logits for the classes.

In a similar fashion, we define the CNN:

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But here we also use BatchNormalization layers, and in order to get the desired number of outputs we use a pointwise convolution in order to control the number of channels and followed by a GlobalAvgPool in order to get the vector of logits.

**Training**

The next step is the training for which Keras handles most of the job:

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The model is either the ANN or the CNN which are created using the functions described in Models.

We use the following optimizer and callbacks:

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**Evaluation**

In order to perform the evaluation, we first generate a json file containing the ground truth and predicted labels, together with the probabilities for all classes.

This is done on each batch, by loading the corresponding data generator and model as follows:

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After this we compute the results for each image:

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And save them as follows:

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We compute the following metrics: accuracy, precision, recall, f-score and AUC.

In order to compute them, first the confusion matrix must be computed:

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Both pred and gt are lists containing the labels, but the labels can also be seen as indices in the matrix, therefore at each position described by the pair of indexes (pred, gt) we add 1.

Accuracy:

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Precision:

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Recall:

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F-score:

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AUC is a binary metric, therefore in order to compute we implement a one vs all approach by taking each class and considering it positive, and the rest negative. First, we implement binary AUC:

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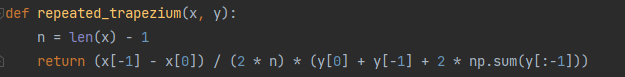
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Then for all classes:

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The actual AUC is an integral and we use the repeated trapezium formula to compute it:



In the end, for all metrics, except for accuracy, we record the values for each class and the mean in a json file.

This is done in a cross-validation manner, by computing them on each batch. Finally, we compute the means and confidence intervals batch wise:

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**Utils**

Useful functions:

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