Challenge 4

In this challenge, you are provided with a dataset of real and forged handwritten signatures of different users, and you're asked to train a Siamese Neural Network to detect real signatures from forged ones. The provided dataset consists of two main categories: one for training and the other one for testing. Each category contains multiple real and forged signature images for each individual. Training dataset includes signatures of 64 unique persons, while testing dataset includes signatures of 21 unique persons. The training set has 887 real signatures and 762 forged signatures in total, while the test dataset has 252 real signatures and 248 forged signatures overall.

Prepare a report and submit a PDF file by Tuesday (**11/03/2020 before 6 pm**) considering the below details:

1. Many machine learning tasks require either pre-processing or post-processing of instances. For this task, you need to scale all images into a desired dimension so that all images are of similar length and width.
2. The first requirement to train a Siamese network is to prepare adequate pairs of similar (real) and dissimilar (forged) inputs (i.e., signatures). Thus, you need to create as many pairs of real and forged signatures for both training as testing phases. To do so, you need to consider all combinations of real signature images for each individual as pairs of similar signatures. Dissimilar pairs are created by considering all combinations of signature images where on image in the pair is a real signature and the other one is a forged signature.
3. Once step 2 is done, report the exact numbers of similar and dissimilar pairs for both training and testing phases precisely.
4. Construct a Siamese network with your desired library (e.g., Keras or Pytorch), where each sub-network is a Convolutional Neural Network with the following details:
    a. The kernel size should be 3*3.
    b. The striding length is 1.
    c. Use "same padding" of size 1 to pad all input images and prevent data loss.
    d. Use ReLU as activation function in both sub-networks.

    e. Apply “Average Pooling” of size 2*2 to all images to reduce their spatial size.
5. Evaluate the above model using only the training set with 5-fold cross-validation. Also, report the mean, median and standard deviation of prediction errors (Note: Use 20 epochs and a batch size of 30 to train each sub-network).
6. Train your network again on the training set and apply the trained network on the test set.
7. Report and discuss the accuracy of this network on the test dataset.