MACHINE LEARNING
SECOND ASSIGNMENT 2024-2025

Deadline: Monday, 10 March 2025

1 Instructions

Work in groups. The optimal number of students in a group is 3.

The exercise should be implemented in the Python programming language using Keras.

- Code snippets to aid you with your exercise can be found in google drive [Dataset_code].
- Your final report should contain enough details to make your results reproducible.

2 Instalation

- The python installation procedure depends on your operating system. You can find information to help you with your installation online. Make sure you also install the pip tool. If you are using Ubuntu 18.04, python is already installed and pip can be installed with the comand "sudo apt-get install python-pip".
- Once you have installed python and pip, type in your terminal "pip install keras tensorflow matplotlib numpy". You can install any additional library using "pip install (library name) ".
- For gpu, in order to use tensorflow with it run the above command: pip install tensorflow[and-cuda]
- Additional resources to help you get familiar with Python and Keras are uploaded in google drive. [Dataset_code]

3 Exercise

For this exercise, you need to reconstruct the method from this conference paper: "An image representation of skeletal data for action recognition using convolutional neural networks".[conf_paper]. The main purpose of this paper is to recognize human actions using Pseudo-coloured images. A sample code with the architecture of the model and the dataset can be found here: [Dataset_code]

1. Develop a model specifically for the center camera of the PKU Dataset (Folder:ResActionsImagesM). Divide the dataset into training, testing, and validation subsets. Supply a script that outputs the predicted label action id 1,2,3 etc depicted in a pseudo-color image. In [pku_actions_id] there is the identifier along with the corresponding string class. What observations can be made about the model's training process? Is there evidence of underfitting, overfitting, or neither? Provide a detailed explanation. Moreover, construct these two diagrams (Training and validation loss, Training and validation accuracy) similar to the provided examples in the sample code [Example_Code]. This illustration will assist in addressing the question mentioned earlier. Remember to save your models in .h5 format because you will need them for the next steps.

2. If you observe signs of underfitting or overfitting, attempt to remedy the situation with dropout layers or regularizers for layer weights. Consider modifying activation functions, introducing new layers, or removing existing ones to enhance the network. [dropout][regularizers]

3. Once you have trained your model, construct a confusion matrix and calculate the precision, recall and F1 score metrics [conf_matrix] [F1][Recall] [Precision].

4. Now that you have trained a model, try to implement the k-fold cross-validation. cross_validation

5. Make augmentation by rotating the images, zoom on them etc. data_augmentation

6. For the experiments involving a single view as detailed in the paper, aim to carry out steps 1 through 5 with each of the three cameras. Additionally, for the cross-view experiments, try training on (M, L) and testing on R, training on (M, R) and testing on L, and training on (L, R) and testing on M.

7. Now try to implement steps 1 - 5, to the limited dataset located within the folder dataset with the name small_dataset. The first folder contains an example of train val test split, and the second one all the files in case you want to make your own split for the k-fold cross-validation. Are the results satisfactory, or are we encountering issues of underfitting or overfitting?

8. Utilize transfer learning on the small dataset by incorporating the h5 model pre-trained on the pku dataset. Select the optimal model from those you have developed and provide a justification for your choice. Freeze certain layers and train the model with the new dataset. Do the results surpass those from the earlier exercise where the model was trained solely on limited data [transfer_learnings_example_1 transfer_learnings_example_2 transfer_learnings_example_3]

For each query, supply the code, the confusion matrices, and a results table containing all the metrics similar to those in the paper [conf_paper], along with an explanation of the results.