

# Machine Learning Lab 3

## KNN and Cross Validation

In this lab, you will still implement instance based learning technique (KNN) instead of use functions from `sklearn` library to solve the problem of handwritten digit recognition and practice cross validation performance measurement. As for the dataset, we still use the subset of MNIST which we used in our previous labs. You should finish the following tasks.

1. Implement your own function called `myknn` that takes four input arguments. One is the input sample to be classified. The second and third arguments are the feature vector (`x_small`) and the labels (`y_small`). The last argument is the hyper parameter  $k$ . The output is the label predicted for the input sample:

```
def myknn(sample, tr_feats, tr_label, k):
```

2. Implement cross validation on the training data for selecting the best  $k$  for the problem. You should use 5 fold cross validation and **error rate** to evaluate the models and try possible  $k$  from **1 to 9**. Plot a figure to show the error rates vs  $k$  (x-axis is  $k$  and y-axis is error rate). You can use `plot` function from `matplotlib.pyplot`.
3. After selecting the model with the best  $k$ , you will classify the **test images** and calculate F1-Scores **for each digit**. Also, compute the confusion matrix to check which pair(s) of digits are most likely to be confused with each other by your KNN classifier.
4. Use `KNeighborsClassifier` from `sklearn.neighbors` and `cross_val_score` from `sklearn.model_selection`. To perform the above tasks instead of your own functions.

You can see more details about how to use these methods from [https://scikit-learn.org/stable/auto\\_examples/neighbors/plot\\_classification.html#sphx-glr-auto-examples-neighbors-plot-classification-py](https://scikit-learn.org/stable/auto_examples/neighbors/plot_classification.html#sphx-glr-auto-examples-neighbors-plot-classification-py) and [https://scikit-learn.org/stable/modules/cross\\_validation.html](https://scikit-learn.org/stable/modules/cross_validation.html)