

# Fall 2018: CSI5139Q

## Assignment 1

Due: Friday, October 12th, 2018, 11:00pm in Virtual Campus  
University of Ottawa - Université d'Ottawa

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## 1 Image Labelling - Linear Classification

This assignment will give you a chance to familiarize yourself with Jupyter, scikit-learn and other ML tools. You will use the CMU Image dataset which can be downloaded from the UCI Machine learning repository at <http://archive.ics.uci.edu/ml/datasets/cmu+face+images>. You are looking for an archive called `faces.tar.gz`. This archive contains black and white images of 20 different peoples in four different poses but with different expressions and with and without sunglasses. Furthermore, each image is already stored in three different resolutions.

In this assignment, you will train binary and multiclass linear classifier available from scikit-learn.

### 1.1 Getting Started [3]

You should use the python image library (PIL), or rather its active fork `pillow`. You will find a `pgm image loader` and test code attached to this assignment. Note that the labels for the images are encoded in the file names. (Some images have the ending bad, i.e., they cannot be used.)

- The person in the image is encoded with a `user id` at the start of the filename. It is also the directory name.
- The head pose is the next word in the file name. The choices are: `straight`, `left`, `right`, and `up`.
- The facial expression is the next word in the file name. The choices are: `neutral`, `happy`, `sad`, and `angry`.
- The `sunglass state` of the person is encoded next. The choices are: `open` and `sunglasses`.
- Finally, the size of the image is indicated with a number. Full resolution is  $128 \times 120$  and  $\frac{1}{2}$  and  $\frac{1}{4}$  in each dimension of the full resolution are provided. This is encoded with no number, 2 and 4, respectively.

You will need to load all images and organize them suitably into three different design matrices `A1`, `A2` and `A4` and corresponding matrices target labels `Y1`, `Y2` and `Y4`. Each of these dataset split into corresponding 80/20 splits for training and testing. By corresponding, I mean that `A1train[i,:]`, `A2train[i,:]` and `A4train[i,:]` all refer to the same image except for resolution. (Note you have to settle on a strategy for dealing with bad images).

## 1.2 Binary Classifier [3]

Use A4 to train a logistic regression classifier for the class sunglasses vs. open. Find and print the confusion matrix, the accuracy, the recall and the precision of your classifier based on the training data, as well as on the testing data. Print the ROC curve.

## 1.3 Multiclass Classifier [2]

Use A4 again to train a logistic regression classifier but this time to classify into multiple classes for the pose: left, right, straight and up. Find and print the confusion matrix and the accuracy. Discuss briefly how the classifier perform on this task, e.g., are there easier or more difficult classes, do certain classes tend to be confused etc.

## 1.4 Expression Classification [2 + Bonus]

Train a multi-class classifier of your choice to distinguish faces by their expression. You are allowed to use any resolution training data and you are challenged to get *good* results. Find and print the confusion matrix and the accuracy again as a foundation for your discussion. Discuss how this task is similar and different than the task in Section 1.3. Make sure you use markup in your Jupyter notebook to clearly identify the steps in your approach.

# 2 Submission

You will need to submit your solution in a Jupyter file. Make you have run all the cells. All text must be embedded in the Jupyter file, I will not look at separately submitted text files. If your Jupyter file needs a local python file to run, please submit it as well. Assignment submission is only though Virtual Campus by the deadline. No late submissions are allowed, you can submit multiple times but only your last submission is kept and marked.