Lab 4 - Classification

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Due Wednesday June 29th before 4:30pm

Hand In Procedure: Labs can be handed alone or in pairs (no more than 2 per lab!). Please prepare a file with a writeup and code (the writeup can be in Hebrew or English). Please make sure the r

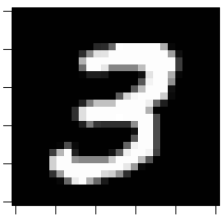
1 Classification Lab

We will try to classify handwritten digits in $28x28$ greyscale values by their digit. The images are from the MNIST dataset; you can (and should) read more about the dataset here: http://yann.lecun.com/exdb/mnist/.

For your convenience, I have supplied a script (written by Prof. David Dalpiaz from UIUC) that downloads the data and prepares it for R. `load_MNIST.R`

Your goal is to build a classifier for telling apart the digit 8 from the digit 3. The data includes all digits, so first separate the required digits from the training set and the test set. Please use only the 4000 images from the training set for fitting.

1. I'd like you to compare two methods, each from a different classifier family (e.g. Classification trees, Bayesian classifiers, linear discriminants, etc). You can use as features the raw pixel values (0 for white to 255 for black). [1] Explain your decisions in specifying the penalty and any hyper-parameters, and in choosing the threshold.
2. Write your own function that calculates (a) the confusion matrix (b) the precision and (c) the recall (assume the class 3 is positive). Calculate the values for both classifiers. Do you observe overfitting of the classifier?
3. Write your own function that draws a response operating curve (ROC). Draw ROCs for both classifiers.
4. For one of your classifiers, display four examples that were classified *incorrectly*. Can you see what made these examples hard for the classifier?
5. Here is an image of a white digit (the digit 3) on a dark background. Do you expect both of your fitted classifiers to work well on this image? Why or why not?



[Hint: Think how would this image be coded into numbers? what would happen if you try to classify using your method?]

[1] Please do not copy online tutorials for MNIST or classifiers that were developed in other courses.