Pattern Recognition
Assignment: 3

Note: Implementation can be done in any programming/ simulation software.
Implement and plot the decision boundary for each of these questions.
Apply the relevant image preprocessing wherever required.

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1. Consider the two- dimensional datapoints from two classes below and each of them come from a Gaussian distribution:
   $p(x \mid \omega_k) \sim N(\mu_k, \Sigma_k)$.
   Data points from class ω_1 and ω_2 are given below.

ω_1	ω_2
(0,0)	(6,9)
(0,1)	(8,9)
(2,2)	(9,8)
(3,1)	(9,9)
(3,2)	(9,10)
(3,3)	(8,11)

   Derive the equation for the decision boundary that separate the two classes and plot the boundary.

2. A Spanish company called Goorrel has launched an application to recognize important emails (ω_1) vs unimportant emails (ω_2). The company is using two secret features such that their training data is well approximated by two Gaussians:

$$p(x \mid \omega_1) \sim N(\mu_1, \Sigma_1)$$
$$p(x \mid \omega_2) \sim N(\mu_2, \Sigma_2)$$

   where $\mu_1 = [0\ 0]^T$, $\mu_2 = [5\ 0]^T$, $\Sigma_1 = I$ and $\Sigma_2 = \begin{bmatrix} 4 & 0 \\ 0 & 4 \end{bmatrix}$; I is the identity matrix.

a. Plot the one sigma ellipse for these two classes in the place : $x = [x_1 x_2]^T$.

b. The company finds that choosing a threshold at $x_1 = 3$ perfectly separates the training samples they have; thus, they propose that this should be the best classifier. Show them an expression, in terms of x, which can improve their classifier with respect to minimizing the Bayes probability of error. Assume that unimportant mails are three times as likely as important emails.

3. Consider the following datasets (circles and triangles) consisting of 10 images each of circles and triangles. Assuming a feature vector of dimension =2, i.e. <color , size>, plot the decision boundary for these two classes. [The images are provided in "shape- dataset" zip folder]

4. A dataset consists of 12 faces and non-faces images each.
   a. Plot all the feature points.
   b. Obtain and plot the decision boundary for these two classes.
   c. Assume that a new image is given. Classify it appropriately.
   [Strictly follow a feature vector of dimension=3]
   [The images are provided in "faceclass- dataset" zip folder]

Due Date : 18/March/2019