Istanbul Technical University- Fall 2018
BLG527E Machine Learning
Homework 1

Purpose: Bayes Decision Theory.
Total worth: 5% of your grade.
Handed out: Saturday, Oct 6, 2018.
Due: Wednesday, October 17, 2018 23:00. (through ninova!)
Instructor: Zehra Cataltepe (cataltepe@itu.edu.tr),
Course Assistant: Fulya Celebi Sarioglu (sarioglu16@itu.edu.tr),
Policy: Collaboration in the form of discussions is acceptable, but you should write your own answer/code by yourself. Cheating is highly discouraged for it could mean a zero or negative grade from the homework.
If a question is not clear, please let us know (via email, during office hour or in class).

Submission Instructions: Please submit through the class ninova site.
Please zip and upload all your files using filename studentID_HW1.zip. You must provide all functions you wrote with your zipped file. Functions you do not submit may cause you lose a portion of your grade. You must also include a .docx or pdf file with answers to the questions and how to call your python or matlab functions for each question so that we can run and check the results.

QUESTIONS:

Q1) [Bayesian Decision Theory]

Assume a discriminant function of the form: $g_i(x) = \ln p(x \mid w_i) + \ln P(w_i)$

Assume that $x \in R$, for class 1: $x \sim N(\mu_1, \sigma^2)$ and for class 2: $x \sim N(\mu_1, 2\sigma^2)$.Also assume that $P(w_1) = P(w_2)$.

a) [1 points] For $\boldsymbol{\mu_1 = -5}$, $\boldsymbol{\mu_2 = 10}$, and $\sigma = 4$, plot the pdf's of the two classes inputs and also the separating surface.

b) [1 points] If $P(w_1)$ decreases to 0.1, where would the separating surface be?

c) [2 points] Generate random datasets of size $N1 = N2 = 10$ and $N1 = N2 = 100$ for a) and b), compute the estimates for the mean and plot histograms and the computed separating points on the histograms.

d) [1 points] Assume that there is a third class with class 3: $x \sim N(\mu_3, 3\sigma^2)$ with $\mu_3 = 5$ and the other values as in Q1a), $P(w_1) = P(w_2) = 2P(w_3)$. Compute the decision regions for this case.