CARLETON UNIVERSITY
SCHOOL OF COMPUTER SCIENCE
WINTER 2020

COMP 5107 Assignment II Due: February 6, 2020

Consider a two-class problem in which the class conditional distributions are both normally distributed in 3-dimensions with means M_1 and M_2, where:

$$M_1 = [2 \quad 4 \quad 6], \text{ and, } M_2 = [2 \quad -4 \quad -6].$$

The covariance matrices Σ_1 and Σ_2 are :

$$\Sigma_1 = \begin{bmatrix} a^2 & \alpha ab & \alpha ac \\ \alpha ab & b^2 & \beta bc \\ \alpha ac & \beta bc & c^2 \end{bmatrix}$$

and

$$\Sigma_2 = \begin{bmatrix} c^2 & \beta bc & \beta ac \\ \beta bc & b^2 & \alpha ab \\ \beta ac & \alpha ab & a^2 \end{bmatrix}$$

(a) Write a program to generate Gaussian random **vectors** assuming that you only have access to a function which generates *Uniform* random variables.

(b) Using the strategy taught in class, write a program to simultaneously diagonalize both the distributions. Print out the diagonalizing matrices for a few cases, and in particular, for the case of $a=3$, $b=4$, $c=6$ and $\alpha=0.2$, $\beta=0.1$. Show the intermediate covariance matrices in the process.

(c) Generate 200 points of each distribution for the case of $a=3$, $b=4$, $c=6$ and $\alpha=0.2$, $\beta=0.1$. before diagonalization and plot them in the $(x_1–x_2)$ and $(x_2–x_3)$ domains. These points are 200 3-D vectors, but the *projected* points in the $(x_1–x_2)$ and $(x_2–x_3)$ domains must be plotted graphically.

(d) Consider the *same* 200 generated in (b) above for the case of $a=3$, $b=4$, $c=6$ and $\alpha=0.2$, $\beta=0.1$. after diagonalization and plot them in the $(x_1–x_2)$ and $(x_2–x_3)$ domains. Again remember that these points are 200 3-D vectors, but the points in the $(x_1–x_2)$ and $(x_2–x_3)$ domains must be plotted graphically.