CARLETON UNIVERSITY
SCHOOL OF COMPUTER SCIENCE
WINTER 2022

COMP 5107 — Assignment II — Due: February 9, 2022

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:

$$M_1 = [4 \quad 1 \quad 3], \text{ and, } \quad M_2 = [-4 \quad 1 \quad -3].$$

The covariance matrices Σ_1 and Σ_2 are :

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

and

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

(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=4, b=3, c=2 and α=0.1, β=0.2. Show the intermediate covariance matrices in the process.

(c) Generate 200 points of each distribution for the case of a=4, b=3, c=2 and α=0.1, β=0.2. before diagonalization and plot them in the (x_1– x_2) and (x_1– x_3) domains. These points are 200 3-D vectors, but the *projected* points in the (x_1– x_2) and (x_1– x_3) domains must be plotted graphically.

(d) Consider the *same* 200 generated in (b) above for the case of a=4, b=3, c=2 and α=0.1, β=0.2. after diagonalization and plot them in the (x_1– x_2) and (x_1– x_3) domains. Again, remember that these points are 200 3-D vectors, but the points in the (x_1– x_2) and (x_1– x_3) domains must be plotted graphically.