PRACTICE 8

EXERCISE 1: PREDICTION RISK

Knowing that the Gaussian density function is defined as:

$$P(X \mid w_i) = \frac{1}{\sqrt{2\pi\sigma_i^2}} e^{-\frac{(x-\mu_i)^2}{2\sigma_i^2}}$$

We can calculate the decision boundary matching the a posteriori probabilities of both classes: `P(X|w1)*P(w1) = P(X|w2)*P(w2)`, or applying logarithm (e base): `log(P(X|w1)) + log(P(w1)) = log(P(X|w2)) + log(P(w2))`

a) Modify the follow code to find the decisión boundary taking into account the prediction risk:

```
A=s1*s1-s2*s2;
B=2*(m1*s2*s2-m2*s1*s1);
C=2*s1*s1*s2*s2*(log(Pw1)-log(Pw2)-
log(s1)+log(s2))+s1*s1*m2*m2-s2*s2*m1*m1;
x1=(-B+sqrt(B*B-4*A*C))/2/A
x2=(-B-sqrt(B*B-4*A*C))/2/A
```

To solve this problem you must analyze where it comes the formula above, and properly make the necessary terms of cost. Remember that:

$$r_j(x) = \sum_{i=1}^{M} L_{ij} \cdot p(x \mid w_i) \cdot p(w_i)$$

b) If we consider the risk to choose w1 being really w2 like 0.8, and choose w2 being really w1 equal to 2, determine the decision boundary.

EXERCISE 2: MINIMUM DISTANCE CLASSIFICATION

Initialize seeds (rand and randn) random generator numbers to 0, generate two classes of 1000 elements each one using randnorm, the first with mean [0, 0] and covariance matrix C = [1 0.8; 0.8 2] and the second with mean [3, 3] and C = [1 -0.9; -0.9 2] and finally mix the data (use shuffle).

a) Decode a minimum distance classifier with the first 1600 data.

maria.guerrero@uca.es
Departamento Ingeniería Informática

b) Perform the previous point using the Mahalanobis distance, and compare the results.
c) How are the boundaries between the classes? Can you draw them?