CSE 465- COMPUTER ASSIGNMENT 1
(DUE DATE: MARCH 20'17)

1. Write a Matlab/Python function to calculate the discriminant function of the following form

$$g_i(x) = -\frac{1}{2}(x-\mu_i)^t\Sigma_i^{-1}(x-\mu_i) - \frac{d}{2}\ln\frac{\pi}{2} - \frac{1}{2}\ln|\Sigma_i| + \ln P(\omega_i)$$

   for a given mean vector and a covariance matrix.

2. Write a function to calculate the Mahalanobis distance between an arbitrary point x and the mean, μ_i, of a Gaussian distribution with covariance matrix Σ_i.

3. Use the data set shown in the table below and assume each category has Gaussian distribution.

	ω_1			ω_2			ω_3		
sample	x_1	x_2	x_3	x_1	x_2	x_3	x_1	x_2	x_3
1	−5.01	−8.12	−3.68	−0.91	−0.18	−0.05	5.35	2.26	8.13
2	−5.43	−3.48	−3.54	1.30	−2.06	−3.53	5.12	3.22	−2.66
3	1.08	−5.52	1.66	−7.75	−4.54	−0.95	−1.34	−5.31	−9.87
4	0.86	−3.78	−4.11	−5.47	0.50	3.92	4.48	3.42	5.19
5	−2.67	0.63	7.39	6.14	5.72	−4.85	7.11	2.39	9.21
6	4.94	3.29	2.08	3.60	1.26	4.36	7.17	4.33	−0.98
7	−2.51	2.09	−2.59	5.37	−4.63	−3.65	5.75	3.97	6.65
8	−2.25	−2.13	−6.94	7.18	1.46	−6.66	0.77	0.27	2.41
9	5.56	2.86	−2.26	−7.39	1.17	6.30	0.90	−0.43	−8.71
10	1.03	−3.33	4.33	−7.50	−6.32	−0.31	3.52	−0.36	6.43

   to compute the mean and covariance matrix for each category. Assume the prior probabilities are

$$P(\omega_1) = 0.8, P(\omega_2) = P(\omega_3) = 0.1.$$

   Then use your procedures developed in the previous parts (1) and (2) and the minimal error classifier (MAP) to classify the following test data points: $p_1 = (1,2,1), p + 2(5,3,1), p_3 = (0,0,0)$, and $p_4 = (1,0,0)$.

4. Draw the decision boundaries between the three classes.

5. Repeat parts (3) and (4) using Maximum Likelihood (ML) classifier.

Here is the table data in text format:

```
x1 = [[-5.01,-5.43,1.08,0.86,-2.67,4.94,-2.51,-2.25,5.56,1.03],
[-8.12,-3.48,-5.52,-3.78,0.63,3.29,2.09,-2.13,2.86,-3.33],
[-3.68,-3.54,1.66,-4.11,7.39,2.08,-2.59,-6.94,-2.26,4.33]];

x2 = [[-0.91,1.30,-7.75,-5.47,6.14,3.60,5.37,7.18,-7.39,-7.50],
[-0.18,-2.06,-4.54,0.50,5.72,1.26,-4.63,1.46,1.17,-6.32],
[-0.05,-3.53,-0.95,3.92,-4.85,4.36,-3.65,-6.66,6.30,-0.31]];

x3 = [[5.35,5.12,-1.34,4.48,7.11,7.17,5.75,0.77,0.90,3.52],
[2.26,3.22,-5.31,3.42,2.39,4.33,3.97,0.27,-0.43,-0.36],
[8.13,-2.66,-9.87,5.19,9.21,-0.98,6.65,2.41,-8.71,6.43]]
```
