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Homework 3

1. **Solution to problem 1**

   (a) After running the algorithm for 2500 times, the upper bound and training error are plotted as below.

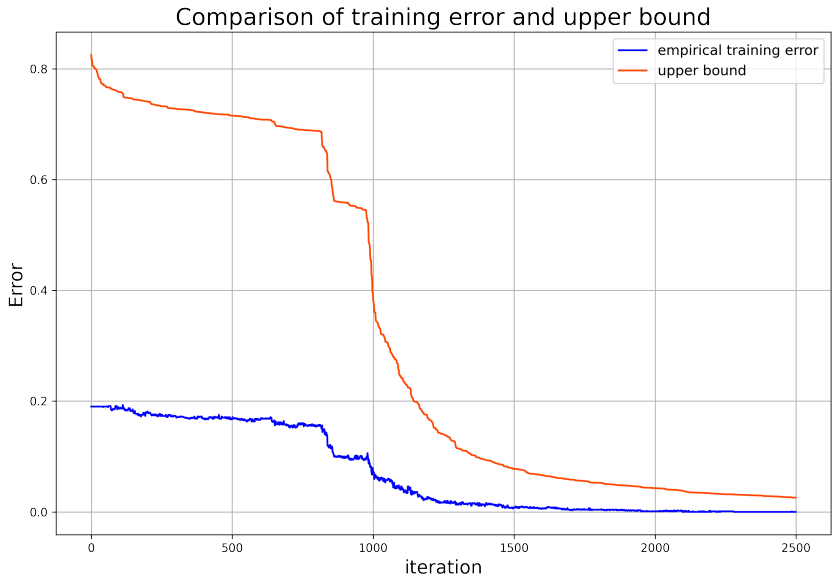

Figure 1: error

   (b) The stem plot of 999 weight is shown as below.

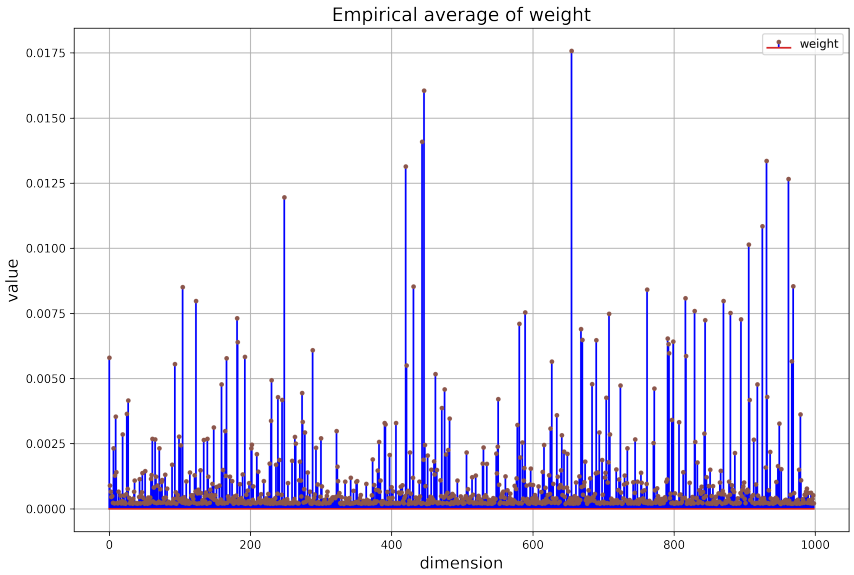

Figure 2: stem plot of weight

(c) The trend of α_t and ϵ_t are shown as below separately.

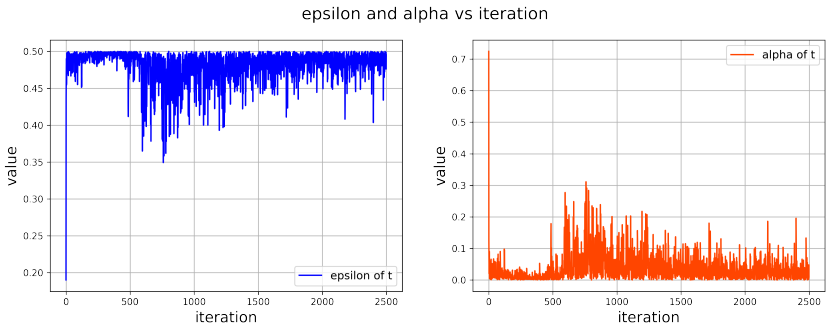

Figure 3: trend of α_t and ϵ_t

2. **Solution to problem 2**

(a) The value of the K-means objective function per iteration for 20 iterations is plotted as below. Random initialization leads to different start value but all converges to the robust one.

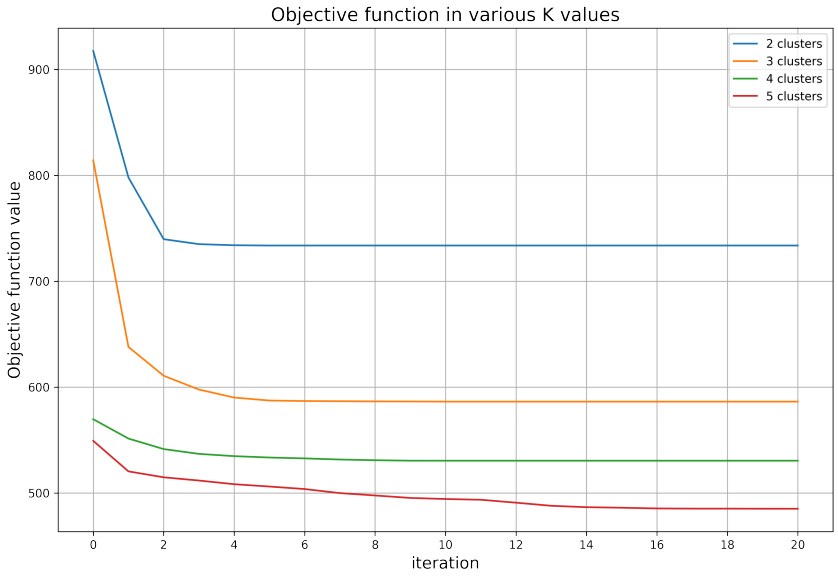

Figure 4: Objective function in various K values

(b) The scatter-plot of 3 clusters and 5 clusters is shown as below.

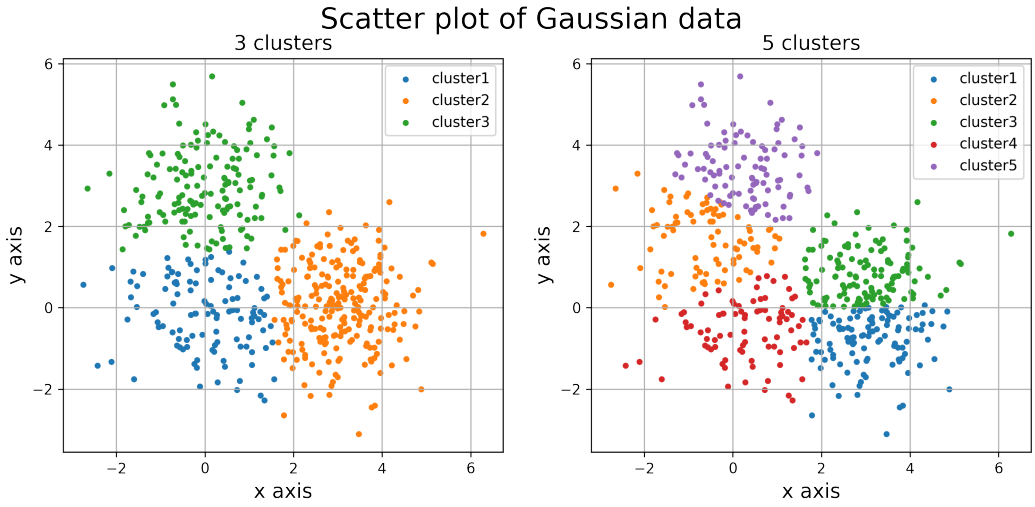

Figure 5: Scatter plot of Gaussian data

3. **Solution to problem 3**

(a) After running the EM algorithm for 10 times. Two plots corresponding to class 0 and 1 are shown as below.

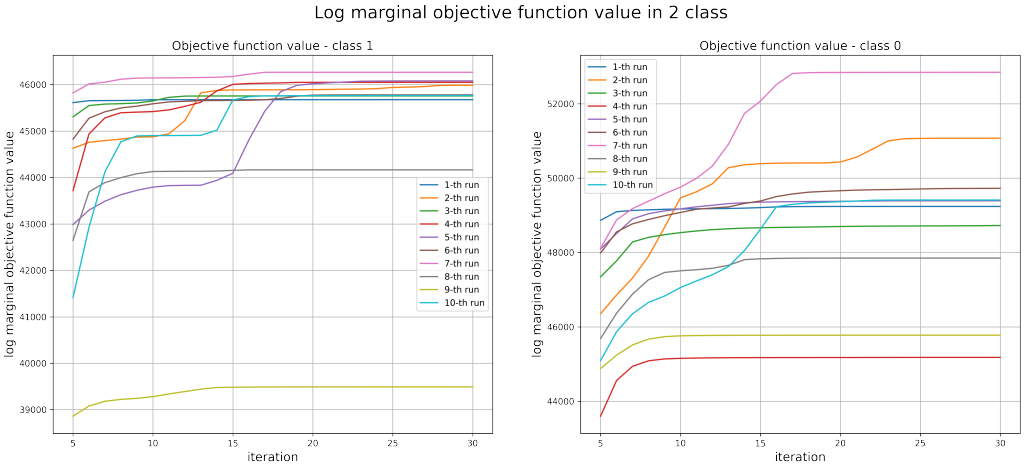

Figure 6: Log marginal objective function value in 2 class

(b) In this part, I show confusion matrix and their accuracy with k = 1, 2, 3, 4 respectively.

Table 1: Bayes classifier with k = 1

		predict	
		$y' = 0$	$y' = 1$
actual	$y = 0$	180	98
	$y = 1$	6	176
Accuracy = 77%			

Table 2: Bayes classifier with k = 2

		predict	
		$y' = 0$	$y' = 1$
actual	$y = 0$	191	87
	$y = 1$	8	174
Accuracy = 79%			

Table 3: Bayes classifier with k = 3

		predict	
		$y' = 0$	$y' = 1$
actual	$y = 0$	196	82
	$y = 1$	11	171
Accuracy = 80%			

Table 4: Bayes classifier with k = 4

		predict	
		$y' = 0$	$y' = 1$
actual	$y = 0$	209	69
	$y = 1$	10	172
Accuracy = 83%			