Gradiance Online Accelerated Learning

MD S Q ZULKAR

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Help

Quiz 12

Number of questions:	3
Positive points per question:	3.0
Negative points per question:	1.0

1. You will be required to run Expectation Maximization for estimating parameters of a Gaussian mixture model in this example. Refer to lecture slides (Lecture E.2) for the exact formulation. You can use python or do the computations by hand. Recall that you need to use the pdf formulation for computing p(x|theta_k)

Consider the following one dimensional data set:

- 2.3
- 3.2
- 3.1
- 1.6
- 1.9
- 11.5
- 10.2
- 12.3
- 8.6
- 10.9

Assume that we are interested in learning a mixture model with two components (k = 2). Let pi_k denote the probability P(z_i = k) for any i. Let (mu_1,sigma_1) be the parameters for the first Gaussian component of the mixture and (mu_2,sigma_2) be the parameters for the second Gaussian component of the mixture.

Given the following initialization: pi_1 = pi_2 = 0.5, mu_1 = 4, mu_2 = 6, and sigma_1 = 1, sigma_2 = 2. Answer the following:

- a) After the third M step, pi_1 > pi_2
- b) After the second M step, sigma_1 = 2.321 sigma_2 = 1.001
- c) After the second M step, sigma_1 = sigma_2 = 2.231
- d) It takes 3 iterations for pi_1 = pi_2

2. You will be required to run Expectation Maximization for estimating parameters of a Gaussian mixture model in this example. Refer to lecture slides (Lecture E.2) for the exact formulation. You can use python or do the computations by hand. Recall that you need to use the pdf formulation for computing p(x|theta_k)

Consider the following one dimensional data set:

- 2.3
- 3.2
- 3.1
- 1.6
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Assume that we are interested in learning a mixture model with two components (k = 2). Let pi_k denote the probability P(z_i = k) for any i. Let (mu_1,sigma_1) be the parameters for the first Gaussian component of the mixture and (mu_2,sigma_2) be the parameters for the second Gaussian component of the mixture.

Given the following initialization: pi_1 = pi_2 = 0.5, mu_1 = mu_2 = 0, and sigma_1 = sigma_2 = 1. Answer the following:

- a) After first M step, mu_1 = 2 mu_2 = 10
- b) After second M step, sigma_1 = 1 sigma_2 = 4
- c) The estimates of pi_1 and pi_2 change after the first M step.
- d) After first M step, sigma_1 = sigma_2 = 18.1324

3. In this problem you will use Principal Components Analysis (PCA) to analyze a simple data set. Do not use a PCA software but only the information provided below. You are free to use a calculator to aid your computations.

Consider the following data set, X:

Name	Feature 1	Feature 2	Feature 3
A	7	4	3
B	4	1	8
C	6	3	5
D	8	6	1
E	8	5	7
F	7	2	9
G	5	3	3
H	9	5	8
I	7	4	5
J	8	2	2

The **covariance matrix** of X (and of centered X) is given by:

2.32	1.61	-0.43
1.61	2.50	-1.28
-0.43	-1.28	7.88

The eigen vectors and the corresponding eigen values of the covariance matrix are given by:

-0.70	0.70	-0.14
0.71	0.66	-0.25
0.08	0.27	0.96

and

0.75
3.68
8.27

respectively.

Apply PCA to the above data set X using only the *top* principal

component to embed data into a 1-D latent space. Answer the following questions about the location of the data points (A,B,C,D) in the latent space (rounded the second decimal):

- a) C: 0.27 D: 0.65
- b) A: -2.15 B: 3.80
- c) E: 0.45, F: -0.80
- d) E: 2.28, F: 0.14

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