Problem 4

4. (1)

3/3 points (graded)
Mark the following statements as true or false.

The EM algorithm monotonically increases the likelihood of the data with each iteration. In other words, the likelihood after iteration $i+1$ is greater than or equal to the likelihood after iteration i, for all i.

- (●) True
- ( ) False

✔

Depending on the initialization, the likelihood of the data the algorithm converges to may be different.

- (●) True
- ( ) False

✔

We are estimating a mixture model with K components. During random initialization, p_1 was assigned to be zero. p_1 could become non-zero as the algorithm iterates.

- ( ) True
- (●) False

✔

Solution:

The M-step chooses the parameter values that maximize the likelihood. Therefore, the previous iteration cannot have parameters of a greater likelihood than the current iteration.

The initial values provide a "starting point" for the algorithm, different initializations lead to different results.

The expected value after the E-step will be zero, therefore p_1 is recomputed in the M-step to be a sum of zeros.

Submit You have used 1 of 3 attempts

ℹ Answers are displayed within the problem

4. (2)

1/1 point (graded)
Consider a 1-dim Gaussian mixture model with two components. We set the mixture with $\mu_1 = 1$, $\mu_2 = 1$, $\sigma_1 = 0.5$,$\sigma_2 = 0.5$. The mixing proportions are set differently for the two components: $p_1 = 0.01$ and $p_2 = 0.99$. Is it the case that $\mu_1 = \mu_2$ and $\sigma_1 = \sigma_2$ after running the EM algorithm regardless of the data?

Yes

No

✔

Will $p_1 = 0.01$ and $p_2 = 0.99$ also hold at convergence? (There is no answer box for this question.)

Solution: Yes

Initially, it will be 99 times more likely that the points come from cluster 2 as opposed to cluster 1. However, the μ and σ that maximize the probability of the clusters generating the given points are the same.

$p\left(cluster1|examplei\right) = \frac{0.01x}{0.01x+0.99x}$ $p\left(cluster2|examplei\right) = \frac{0.99x}{0.01x+0.99x}$ Since all $p\left(cluster1|examplei\right) * 0.99 = p\left(clusterz|examplei\right)$ for all $i, p_1 * 99 = p_2$. This holds by induction.

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Answers are displayed within the problem

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Topic: Final exam (1 week):Final Exam / Problem 4

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