5. Mixture Model - Unobserved Case: EM Algorithm

The EM Algorithm

counts.

For each point, I can say how likely that this point actually

belongs to this cluster.

This will be a soft equivalent of this measure.

Here, I just say, is point i assigned to cluster j?

Now we say, how likely is it that the point

i comes from the cluster j?

So it's going to be 0 and 1.

It could be some other number.

But what it actually means is that instead of using delta,

I can use here the probability.

The point is assigned.

So as previously, when I did all this computation,

instead of taking this indicator function 0 and 1s.

0:00 / 0:00 1.50x

Video

Download video file

Transcripts

Download SubRip (.srt) file

Download Text (.txt) file

Gaussian Mixture Model: An Example Update - E-Step

5/5 points (graded)

Assume that the initial means and variances of two clusters in a GMM are as follows: $\mu^{(1)} = -3$, $\mu^{(2)} = 2$, $\sigma_1^2 = \sigma_2^2 = 4$. Let $p_1 = p_2 = 0.5$.

Let $x^{(1)} = 0.2$, $x^{(2)} = -0.9$, $x^{(3)} = -1$, $x^{(4)} = 1.2$, $x^{(5)} = 1.8$ be five points that we wish to cluster.

In this problem and in the next, we compute the updated parameters corresponding to cluster 1. You may use any computational tool at your disposal.

Compute the following posterior probabilities (provide at least five decimal digits):

$p(1 \mid 1) =$

0.29421497 ✔ **Answer:** 0.29421

$p(1 \mid 2) =$

0.62245933 ✔ **Answer:** 0.62246

$p(1 \mid 3) =$

0.65135486 ✔ **Answer:** 0.65135

$p(1 \mid 4) =$

0.10669059 ✔ **Answer:** 0.10669

$p(1 \mid 5) =$

0.05340333

✔ **Answer:** 0.053403

Solution:

Using the formula of the E-step

$$p(j \mid i) = \frac{p_j \mathcal{N}(x^{(i)}; \mu^{(j)}, \sigma_j^2)}{p(x^{(i)} | \theta)},$$

we can obtain that

$$\begin{aligned} p(1 \mid 1) &= 0.29421 \\ p(1 \mid 2) &= 0.62246 \\ p(1 \mid 3) &= 0.65135 \\ p(1 \mid 4) &= 0.10669 \\ p(1 \mid 5) &= 0.053403. \end{aligned}$$

Submit

You have used 1 of 3 attempts

Answers are displayed within the problem

Gaussian Mixture Model: An Example Update - M-Step

3/3 points (graded)

Compute the updated parameters corresponding to cluster 1 (provide at least five decimal digits):

$\hat{p}_1 =$

0.34562462 **Answer:** 0.34562

$\hat{\mu}_1 =$

-0.53732895 **Answer:** -0.53733

$\hat{\sigma}_1^2 =$

0.57578591 **Answer:** 0.57579

Solution:

Using the formulae corresponding to the M-step,

$$\hat{n}_1 = \sum_{i=1}^{5} p(1|i) = 1.7281$$

$$\hat{p}_1 = \frac{\hat{n}_1}{n} = \frac{\hat{n}_1}{5} = 0.34562$$

$$\hat{\mu}_1 = \frac{1}{\hat{n}_1} \sum_{i=1}^{5} p(1|i)\, x^{(i)} = -0.53733$$

$$\hat{\sigma}_1^2 = \frac{1}{\hat{n}_1} \sum_{i=1}^{5} p(1|i)\, (x^{(i)} - \hat{\mu}^{(1)})^2 = 0.57579.$$

Submit You have used 1 of 3 attempts

Answers are displayed within the problem

Gaussian Mixture Model and the EM Algorithm

1/1 point (graded)

Which of the following statements are true? Assume that we have a Gaussian mixture model with known (or estimated) parameters (means and variances of the Gaussians and the mixture weights).

- [x] A Gaussian mixture model can provide information about how likely it is that a given point belongs to each cluster. ✔
- [ ] The EM algorithm converges to the same estimate of the parameters irrespective of the initialized values.
- [x] An iteration of the EM algorithm is computationally more expensive when compared to an iteration of the K-means algorithm for the same number of clusters. ✔

✔

Solution:

The first and third statements are true. The first statement is true because the estimated posterior probabilities tell us how likely it is that a given point belongs to each cluster. The third statement is true because each iteration of the EM algorithm involves two steps that are each more computationally expensive than the updates involved in an iteration of the K-means algorithm.

The second statement is not true. As explained in the video, the EM algorithm is guaranteed (under some conditions) to only converge locally.

Submit You have used 1 of 2 attempts

Answers are displayed within the problem

Mixture Models and Digit Classification

3/3 points (graded)

Assume that we have 100,000 black-and-white images of size 26×26 pixels that are the result of scans of hand-written digits between 0 and 9.

We can apply mixture models to effectively train a classifier based on clustering using the EM algorithm applied to the dataset.

Identify the following parameters (according to notation developed in the lecture, assuming that we use all the data for training):

$K =$

10

Answer: 10

$n =$

100000

Answer: 100000

$d =$

676

Answer: 676

Solution:

We are classifying $n = 100,000$ vectors each of length $d = 676$ into $K = 10$ clusters (one cluster for each digit).

Submit

You have used 1 of 2 attempts

Answers are displayed within the problem

Discussion

Hide Discussion

Topic: Unit 4 Unsupervised Learning (2 weeks) :Lecture 16. Mixture Models; EM algorithm / 5. Mixture Model - Unobserved Case: EM Algorithm

Add a Post

All Posts

[Staff] Answer for the last question

question posted 4 days ago by weliu

When I submit my answer, the grader report "There was a problem with the staff answer to this problem." Please help check if the answer set up correctly?

This post is visible to everyone.

Add a Response

4 responses

GiaCatNguyen
4 days ago

I'm seeing the same issue.

I'm also seeing the same problem

posted 3 days ago by MarkBowles

Same issue

posted 3 days ago by maciejosinski

Same issue

posted 3 days ago by **ieyasu2014**

Same

posted 3 days ago by **nktoan**

+1

posted 3 days ago by **BrendanWood**

+1

posted 2 days ago by **sandipan_dey**

+1

posted 2 days ago by **RommelAlbertoRodriguezPerez**

+1

posted a day ago by **robweatherston18**

+1

posted about 13 hours ago by **nbourbon**

Add a comment

HumphreyP
2 days ago

+1

$+\sqrt{4}-1^2$

posted 2 days ago by **SniperWolf787**

e^0, lol

posted a day ago by **Cool7** (Community TA)

$+\ 0^0$

posted about 23 hours ago by **michael_x**

@ michael_x i thought 0^0 is undefined.

posted about 9 hours ago by **sandipan_dey**

@sandipan_dey : I forgot the detailed discussion about this. Maybe some people say it's undefined. A subtle case anyway

posted about 3 hours ago by **michael_x**

Add a comment

Preview

Submit

LarryRiedel
about 11 hours ago

isn't the $+$ button so people can vote up a question without replying "+1"? :-)

yes, but we are all mathematicians and not GUI users :-) just the e^0, $\sqrt(4) - 1^2$ justfifies it:-)

posted about 11 hours ago by **nr7116**

Add a comment

disguiser
about 11 hours ago

Still not fixed. Staff, please take a look.

Add a comment

Showing all responses

Add a response:

Preview

Submit