

Machine Learning for Computer Vision Winter term 2016

November 18, 2016

K-Means, Expectation-Maximization, Mixture Models

Exercise 1: Expectation-Maximization for GMM

In the standard EM algorithm, we first define the responsibilities γ as

$$\gamma_{nk} = p(z_{nk} = 1 | x_n) = \frac{\pi_k \mathcal{N}(x_n | \mu_k, \Sigma_k)}{\sum_{j=1}^K \pi_j \mathcal{N}(x_n | \mu_j, \Sigma_j)}, z_{nk} \in \{0, 1\}, \sum_{k=1}^K z_{nk} = 1$$

- a) Find the optimal means, covariances and mixing coefficients that *maximize the data likelihood*. How can you interpret the results?
- b) Define the complete-data-log-likelihood. What is the difference to the standard log-likelihood?

Exercise 2: K-Means Compression and EM for GMM (Programming)

Implement following exercises in your preferred programming language. Download the *clustering.zip* found on the website and extract its contents.

- a) Implement K-Means and use it to compress the *mona-lisa.jpg* image, by using only 2, 3, ..., 10 colors.
- b) Implement the Expectation-Maximization algorithm (EM) for Gaussian Mixture Models (GMM) to cluster the *old faithful* dataset.

The next exercise class will take place on **November 25th, 2016**.

For downloads of slides and of homework assignments and for further information on the course see

<https://vision.in.tum.de/teaching/ws2016/mlcv16>
