

## Weekly Exercises 10

Room: 02.09.023

Wednesday, 24.07.2019, 12:15 - 14:00

### EM algorithm and GMM (Due: 22.07) (6 Points)

**NOTE:** There will be a Q&A session next Wednesday. If time permits, a Q&A session will also take place after the guest lecture next Monday.

**Exercise 1** (6 Points). (M-step for GMM) Following the example of learning GMM with EM in the lecture slides, show that the parameters  $\pi_k, \mu_k, \Sigma_k$  will be updated in the M-step as follows:

$$\pi_k^{t+1} = \frac{1}{|\mathcal{S}|} \sum_{x \in \mathcal{S}} q^t(z = k|x) \quad (1)$$

$$\mu_k^{t+1} = \frac{\sum_{x \in \mathcal{S}} (q^t(z = k|x) \cdot x)}{\sum_{x \in \mathcal{S}} q^t(z = k|x)} \quad (2)$$

$$\Sigma_k^{t+1} = \frac{\sum_{x \in \mathcal{S}} (q^t(z = k|x)(x - \mu_k^{t+1})(x - \mu_k^{t+1})^\top)}{\sum_{x \in \mathcal{S}} q^t(z = k|x)} \quad (3)$$

### Programming (Due:29.07) (12 Points)

In this programming exercise, you are asked to design unary energies based on coarse density estimation using GMM model trained via EM. You are also asked to use graphcut library to perform MAP inference with the energies you have designed. See the ipython file for more details.