Machine Learning for Robotics and Computer Vision
Winter term 2013

Homework Assignment 6
Topic: Kullback Leibler Divergence
Tutorial January 24th, 2013

Exercise 1: Kullback Leibler Divergence 1

Verify that the log normal distribution of the observed data $\ln p(X)$ can be decomposed into two terms

$$\ln p(X) = L(q) + KL(q||p)$$

where

$$L(q) = \int q(Z) \ln \left(\frac{p(X, Z)}{q(Z)} \right) dZ$$

$$KL(q||p) = - \int q(Z) \ln \left(\frac{p(Z|X)}{q(Z)} \right) dZ$$

Exercise 2: Kullback Leibler Divergence 2

Consider a factorized variational distribution

$$q(Z) = \prod_{i=1}^{M} q_i(Z_i)$$

By using the technique of Lagrange multipliers, verify that minimization of the Kullback Leibler divergence $KL(p||q)$ with respect to one of the factors $q_i(Z_i)$, keeping all other factors fixed, leads to:

$$q_j^*(Z_j) = \int p(Z) \prod_{i \neq j} dZ_i = p(Z_j)$$

For downloads of slides and of homework assignments and for further information on the course see
http://vision.in.tum.de/teaching/ws2013/ml_ws13