

# DD2434/FDD3434 Machine Learning, Advanced Course

## Module 6 Exercise

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## 6 Variational Autoencoder – Exercises

### 6.1 Reparameterization

Let's assume you want the latent variable in VAE to follow the Gamma distribution. You can use the Weibull distribution instead, it is an approximation to the Gamma distribution and easy to reparametrize. Using inverse transform method, show how to reparametrize the Weibull distribution.

### 6.2 Lower Bound

Let's assume that we want to use the following lower bound:

$$\mathcal{L}_k(x) = \mathbb{E}_{z_1, z_2, \dots, z_k \sim q(z|x)} \left[ \log \frac{1}{k} \sum_{i=1}^k \frac{p(x, z_i)}{q(z_i|x)} \right]$$

1- Show that this is a valid lower bound:

$$\log p(x) \geq \mathcal{L}_k(x)$$

2- Show that  $\mathcal{L}_k \geq \mathcal{L}_m$  for  $k \geq m$ .

3- Show that  $\log p(x) = \lim_{k \rightarrow \infty} \mathcal{L}_k$ , assuming  $p(x, z)/q(z|x)$  is bounded.