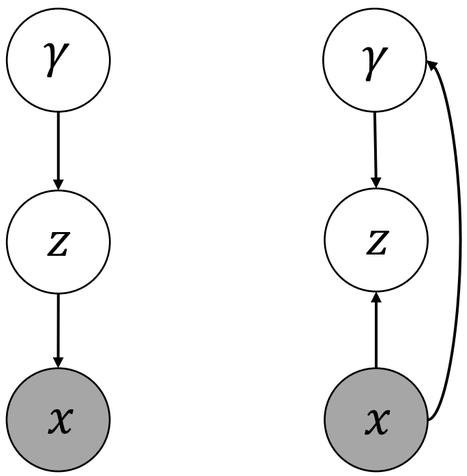
Hierarchical Sparse Variational Autoencoder (HSVAE)



(a) (b)

Figure: Graphical model of HSVAE: (a) generative mode: $p_\theta(x, z, \gamma)$, where θ is the parameter of the decoder; (b) inference model: $q_\phi(z, \gamma|x)$, where ϕ is the parameter of the variational distribution.

ELBO:

reconstruction loss — regularize informativeness of z

$$\mathbb{E}_{q_\phi(z,\gamma|x)}[\log p_\theta(x|z)] - \psi\mathbb{E}_{q_\phi(\gamma|x)}[\mathbb{D}_{KL}\big(q_\phi(z|\gamma, x), p_\theta(z|\gamma)\big)]-$$
$$-\lambda\mathbb{D}_{KL}\big(q_\phi(\gamma|x)||p_\theta(\gamma)\big),$$

regularize sparsity level

where $\psi, \lambda \in \mathbb{R}$.

Spike-and-Slab Distribution:

$$p(z) = \prod_i^{\mathrm{D}} (1 - \gamma_i)\,\mathcal{N}(z_i; 0, 1) + \gamma_i\,\mathcal{N}(z_i; 0, \sigma \to 0),$$

where i denotes the i'th dimension of z and D is the total number of dimensions of z.