Variational Auto-Encoders
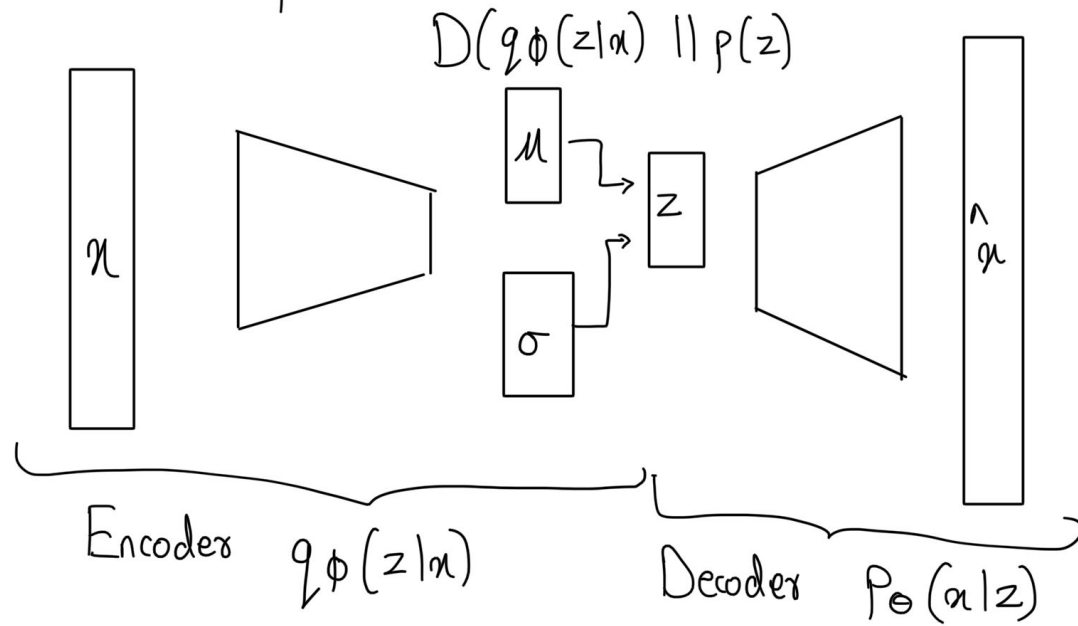
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Variational Auto Encoders (VAEs)

$\longrightarrow$ VAEs are probabilistic twist on auto encoders

$$D(q_\phi(z|x) \| p(z))$$

Encoder $q_\phi(z|x)$

Decoder $P_\theta(x|z)$

$$\mathcal{L}(\phi, \Theta, x) = \text{reconstruction loss} + \text{regularization term}$$

$$D\Big(q_\phi(z|x) \,\|\, p(z)\Big)$$

Inferred latent distribution

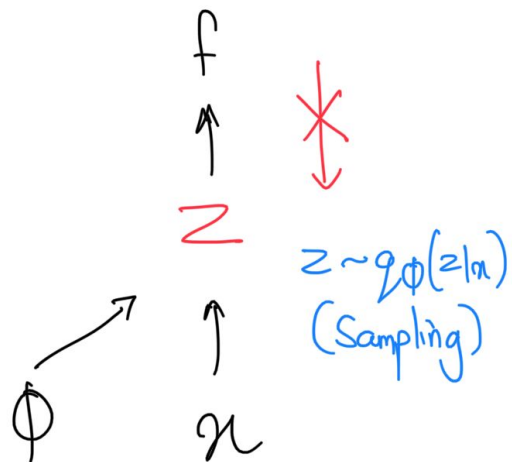Fixed prior on latent distribution

$$= -\frac{1}{2} \sum_{j=0}^{k-1} \left(\sigma_j + \mu_j^2 - 1 - \log \sigma_j\right)$$
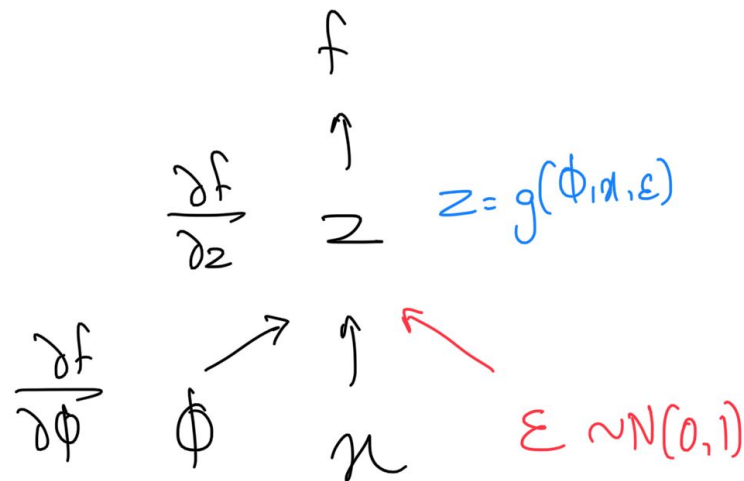
KL-divergence between two gaussians

Backpropagation in VAEs

Normal AEs

f

$\uparrow$

z

$\uparrow$

x

Stocastic node

$z \sim q_\phi(z|x)$
(Sampling)

ϕ

VAEs

f

$\uparrow$

z

$\uparrow$

x

$\frac{\partial f}{\partial z}$

$\frac{\partial f}{\partial \phi}$

$z = g(\phi, x, \varepsilon)$

$\varepsilon \sim N(0,1)$

ϕ

Use cases

- Image Generation using normal distribution
- Image changing latent spaces
- Image Denoising
- Image Resconstruction