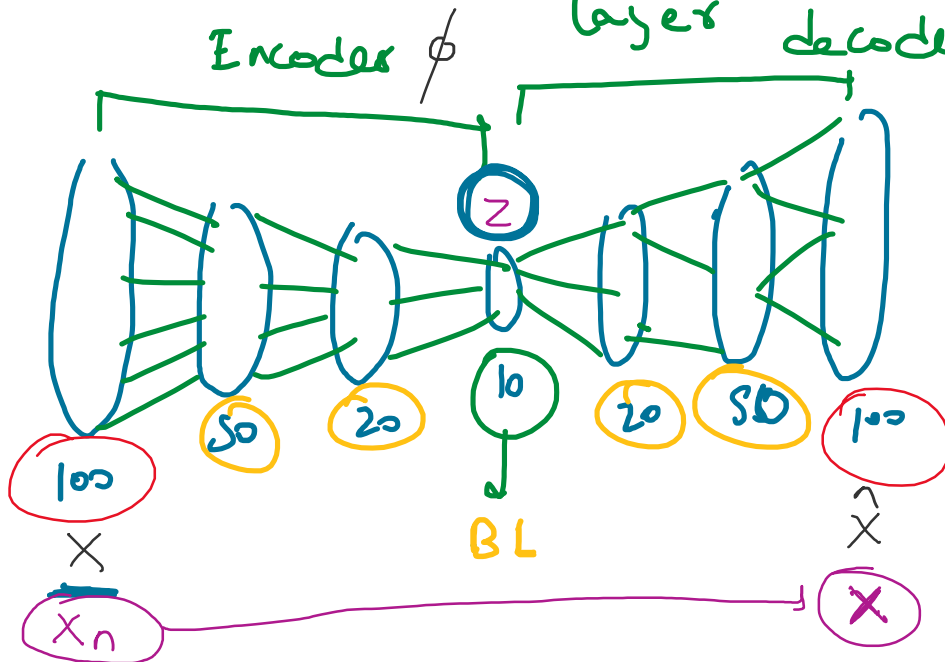
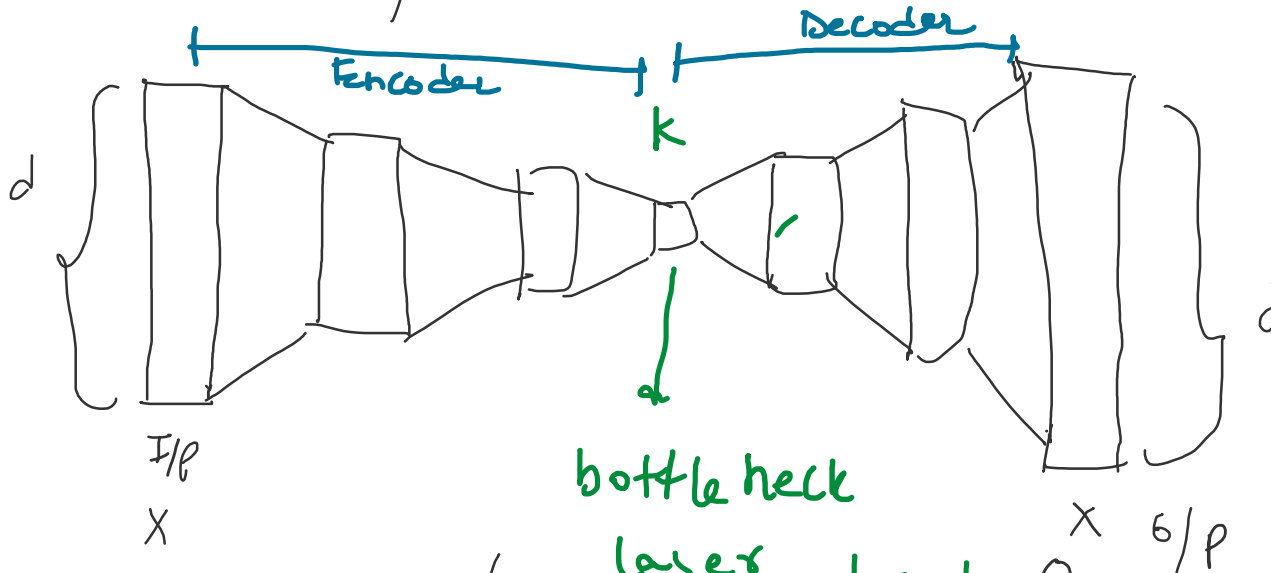


## VAE

02 July 2025 15:03

Variational Auto Encoders

## Auto Encoders / Encoder-Decoder Model



Loss  
MSE

$$\|\hat{x} - x\|_2^2 =$$

$$\sum_{i=1}^n (\hat{x}_i - x_i)^2$$

Text to Image  
Dall-e 3

Auto Encoders :

① Denoising Input :

Diffusion

Variational Auto Encoders

KMean

EM - Algo : Expectation Maximization

E-step : for all  $i$

$$Q_i^{(t)}(z) = P(z | x^{(i)}, \theta)$$

$Q_i \rightarrow$  Expected value  $z$

$P(z | x^{(i)}, \theta)$  is the Posterior (Assume  $N$ )

M-step :

$$\theta^{(t+1)} = \underset{\theta}{\operatorname{argmax}} \sum_{i=1}^n \sum_z Q_i^{(t)}(z^{(i)}) \log p$$

$\mathbb{E}_{z \sim P(z|x, \theta^{(t)})} |$

Variational Inference :

$$\log(p(x)) \geq \text{ELBO}(x; \theta)$$

$$\log(p(x)) = \underbrace{\text{ELBO}(x; \theta)}_{\text{Constant}} + \underbrace{D_{KL}}_{\text{KL Divergence}}$$

Variational Inference :

$$p_{z|x} = \underset{q \in \mathcal{Q}}{\operatorname{argmax}} \text{ELBO}(x)$$

$$Q_i(z) = \mathcal{N}(q(x^{(i)}), \sigma)$$

# Neural Networks

