Q.1

Ans:-

We know that the restricted Boltzmann joint probability distribution:

$$P(v, h) = \frac{1}{Z} e^{-E(v,h)}$$

& Energy function for an RBM:

$$E(v,h) = -b^T v - c^T h - v^T W h$$

Partition Function (Z):

$$Z = \sum_v \sum_h e^{-E(v,h)}$$

The partition fnxn Z implies that the normalized joint probability distribution $p(v)$ is ~~~~ intractable.

Although we know that $P(v)$ is intractable, the bipartite graph structure of RBM has ~~that~~ a quality that visible & hidden units are conditionally independent to each other.

So, to solve further:
we have

$$P(h|v) = \frac{P(h,v)}{P(v)} = \frac{1}{P(v)} \frac{1}{Z} \exp\{b^T v + c^T h + v^T W h\}$$

then $$= \frac{1}{Z'} \exp\{c^T h + v^T W h\}$$

$$= \frac{1}{Z'} \exp\{\textstyle\sum_j c_j h_j + \sum_j v^T W_{:j} h_j\}$$

$$= \frac{1}{Z'} \text{Multiply}_j \exp\{c_j h_j + v^T W_{:j} h_j\}$$

~~so~~ For $P(h_j = 1, v)$
we have,

$$\frac{\hat{P}(h_j = 1, v)}{\hat{P}(h_j = 0, v) + \hat{P}(h_j = 1, v)} = \frac{\exp\{c_j + v^T W_{:j}\}}{\exp\{0\} + \exp\{c_j + v^T W_{:j}\}}$$

then
$$P(v/h) = \frac{1}{Z'} \Pi_k \exp\{b_k + h^T W_k\}$$

4 As a result:

$$P(v_k = 1|h) = \sigma(b_k + h^T W_k)$$

Thus we ~~say~~ solve for (RBM) in $P(v_k = 1|h)$.

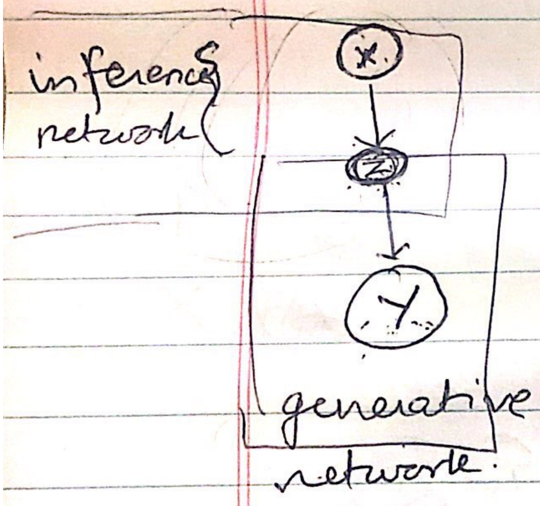
VAE

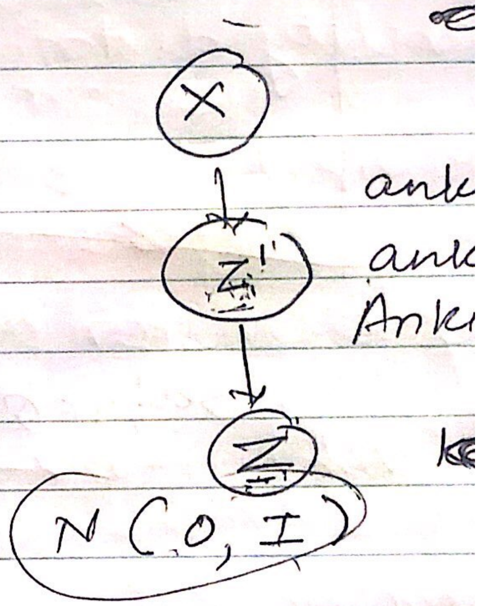
X : data.

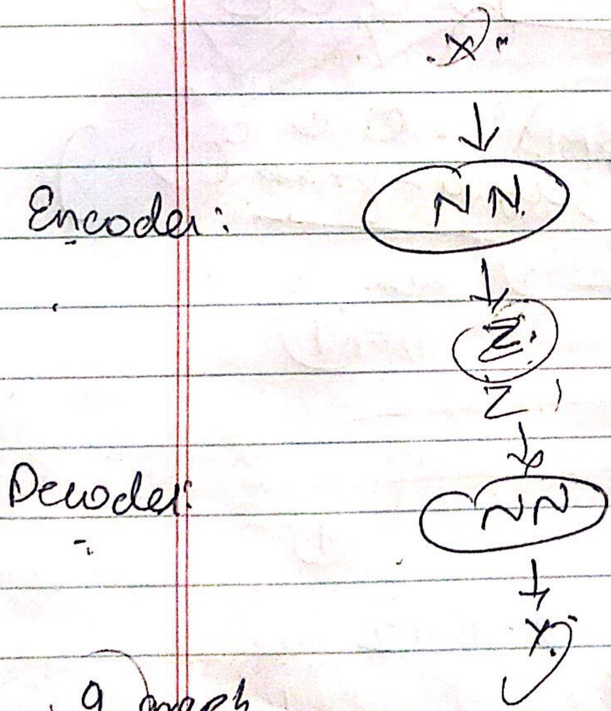
Z : latent variable

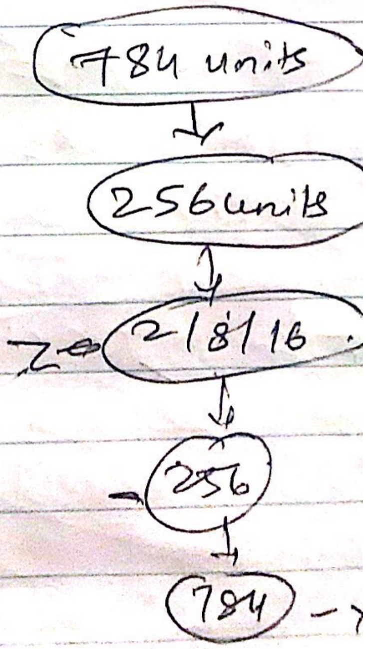
$P(Z|X) \approx \boxed{P(Z) \sim}$

Y : reconstruction of data



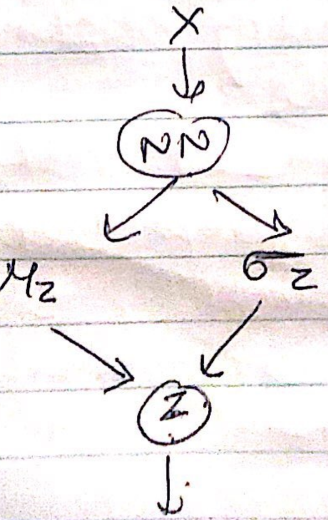




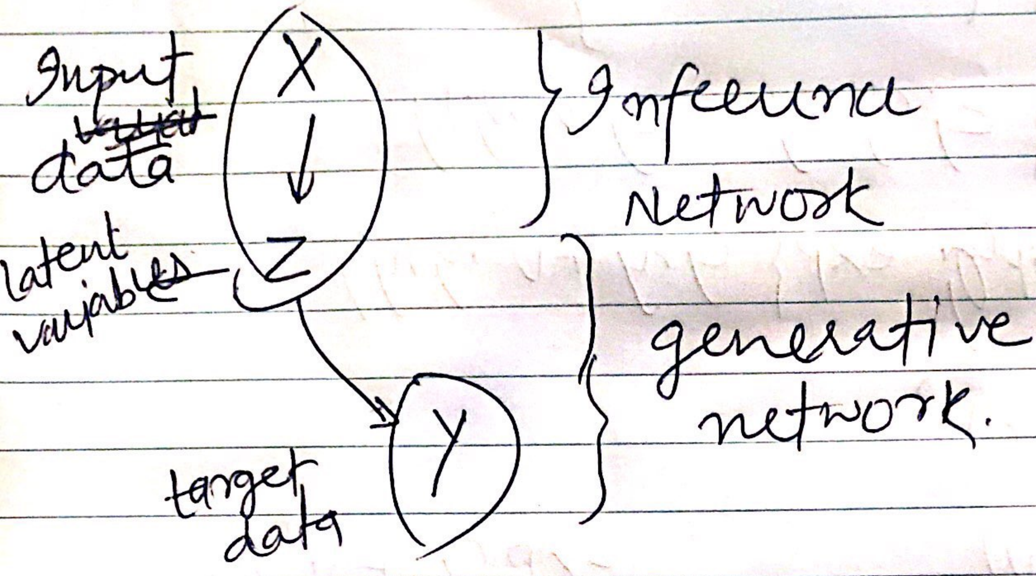


q-graph

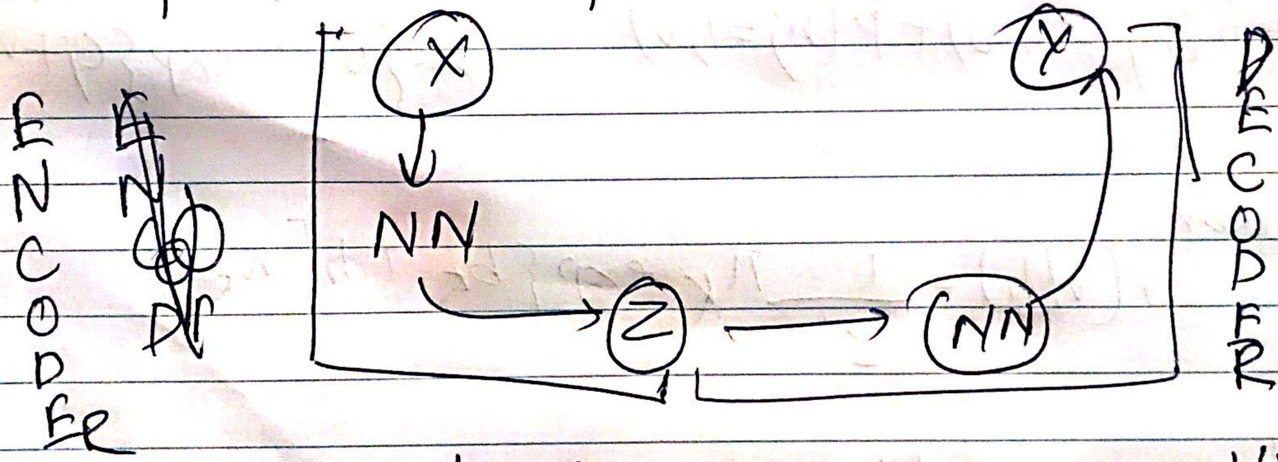
p-graph



Q.2
f:- For VAE, encoder, decoder we have



We feed the Input data to a NN



~~so~~ We have; z = z_mean + sqrt(var) * eps
loss = mse_loss + KL_loss