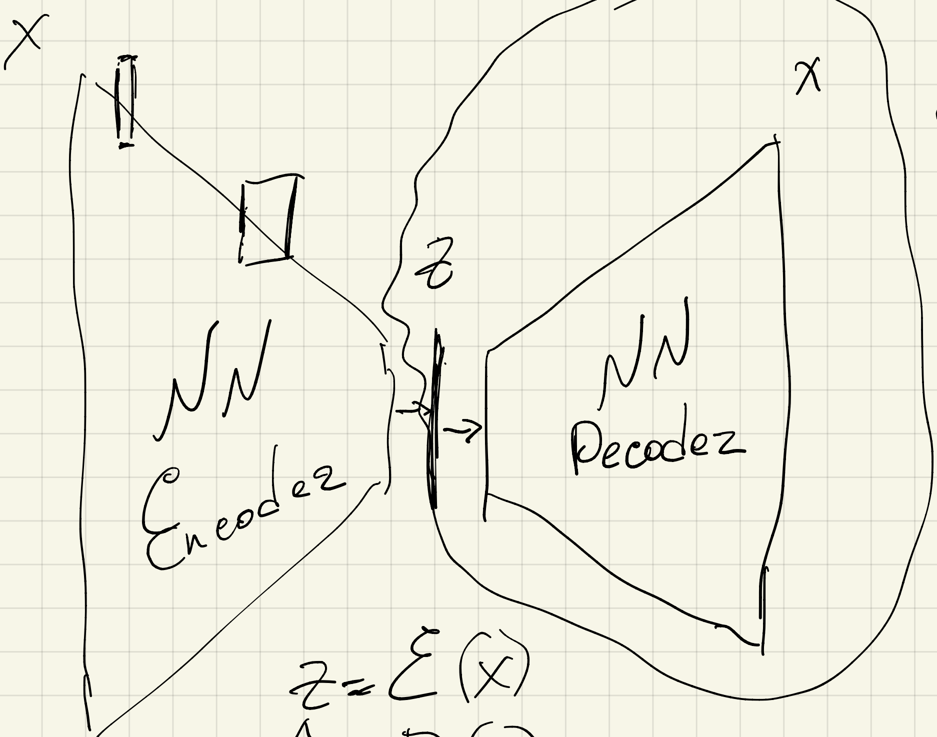
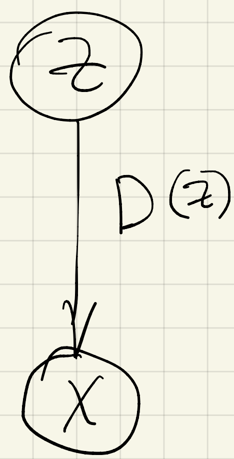


$$\mathcal{L} = MSE(\hat{x}, x)$$

$$\hat{x} = D(\mathcal{E}(x))$$

$$z = \mathcal{E}(x)$$
$$\hat{x} = D(z)$$

$p(z)$
$p(x|z)$

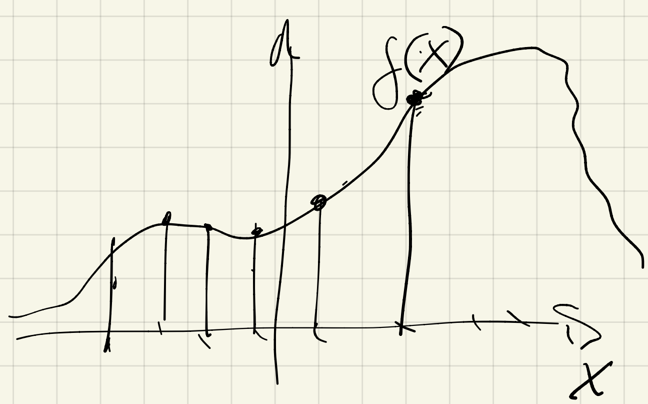


$$p(z|x) = \frac{p(x|z)\,p(z)}{p(x)} = \frac{p(x,z)}{p(x)} = \frac{p(z,x)}{p(x)}$$

$$p(x) = \int_z \underline{p(x|z)}\,\underline{p(z)}\,dz$$

Monte-Carlo

Variational Inference



$$p(z|x) \qquad q(z|x,\theta)$$

$$KL(q(z|x) \| p(z|x)) = -\sum_{z\sim q(z|x)} q(z|x) \log \frac{p(z|x)}{q(z|x)} =$$

$$= -\sum_z q(z|x) \log \frac{p(x|z)\,p(z)}{p(x)\,q(z|x)} =$$

$$= -\sum_z q(z|x) \log \frac{\overbrace{p(x|z)\,p(z)}^{=p(x,z)}}{q(z|x)} + \sum_z q(z|x) \log p(x)$$

$$+ \log p(x)$$

$$KL(q(z|x), p(z|x)) = -\sum_z q(z|x) \log \frac{p(x,z)}{q(z|x)} + \underline{\log p(x)}$$

$$\log p(x) = KL(q,p) + \underbrace{\sum_z q(z|x) \log \frac{p(x,z)}{q(z|x)}}$$

ELBO

VLB - Variational Lower Bound

$$ELBO = \sum_z q(z|x) \log \frac{p(x,z)}{q(z|x)}$$ - subject to <u>maximize</u>

$$ELBO = \sum_z q(z|x) \log \frac{p(x|z)\,p(z)}{q(z|x)} = \sum_z q(z|x) \log p(x|z) +$$

$$+ \sum_z q(z|x) \log \frac{p(z)}{q(z|x)} =$$

$\nearrow max$

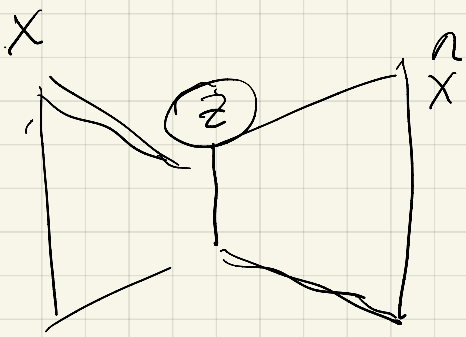
$$\text{ELBO} = \sum_{z} q(z|x) \log p(x|z) - KL\left(q(z|x) \,||\, p(z)\right)$$

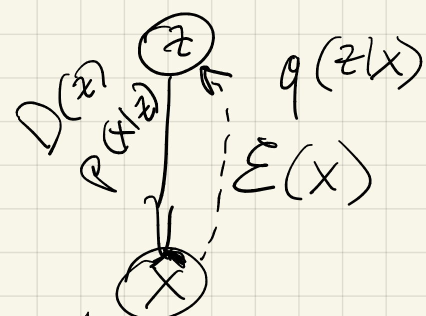
VLB

L

$$\int_z \log p(\ldots) \; q(z|x) \, dz$$

$$\mathbb{E}_{z \sim q(z|x)} \log p(x|z) \quad \nearrow max$$

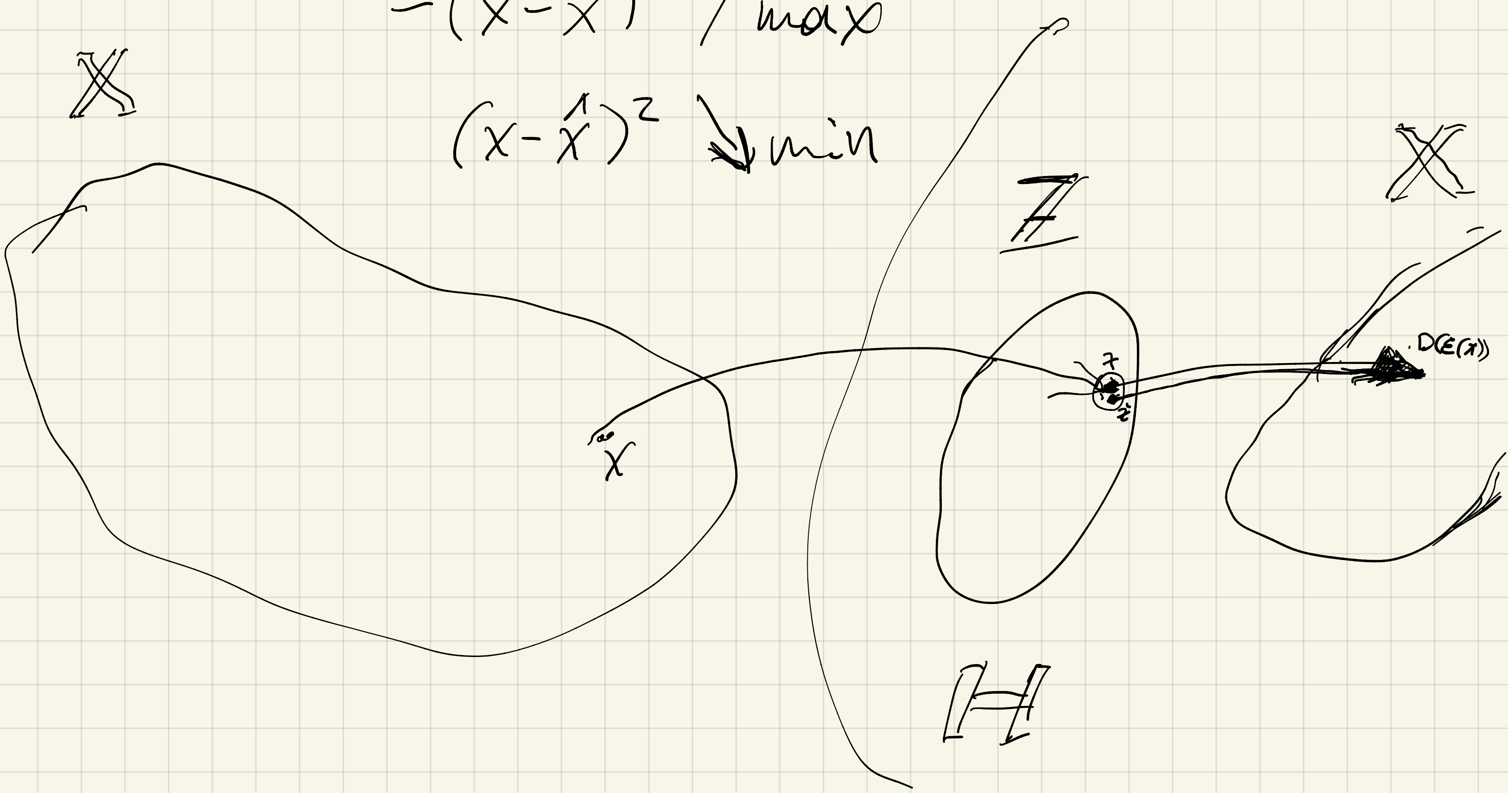


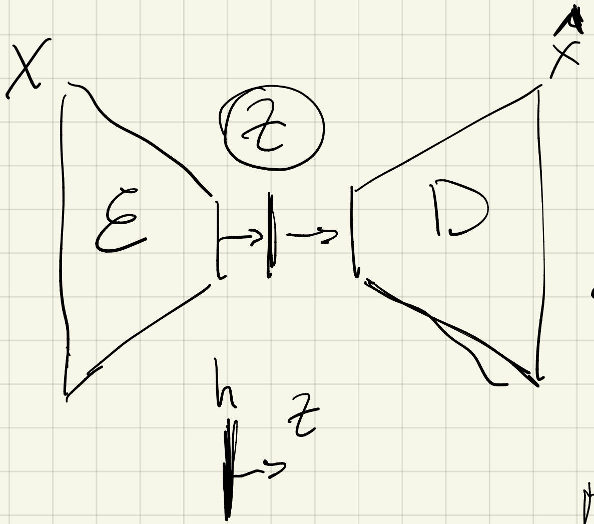


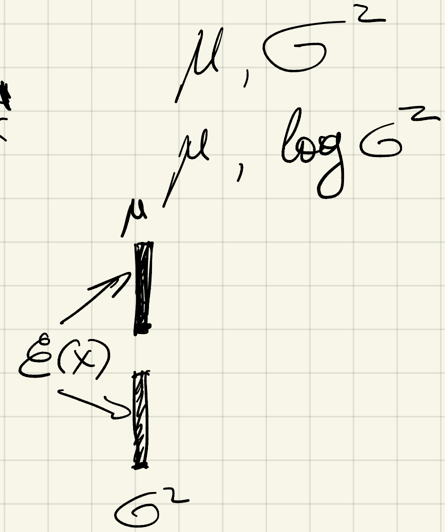
$$p(x|z) \quad \underline{p(x|\hat{x})} = \mathcal{N} \quad e^{-(x-\hat{x})^2} \quad \nearrow max$$

$$-(x-\hat{x})^2 \nearrow max$$

$$(x-\hat{x})^2 \searrow min$$







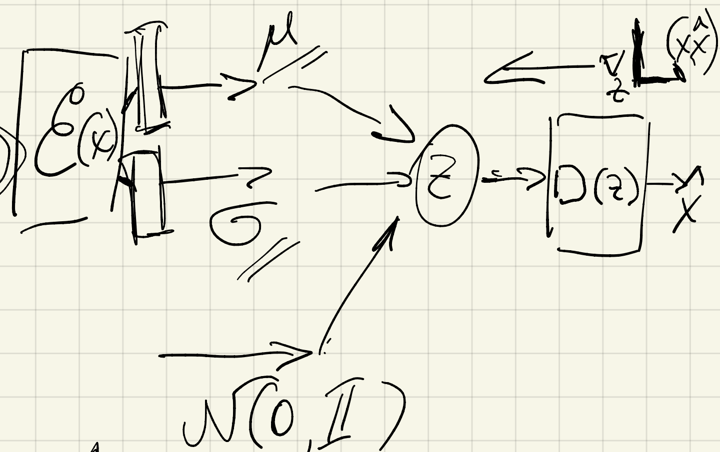
Variational
Autoencoder
VAE

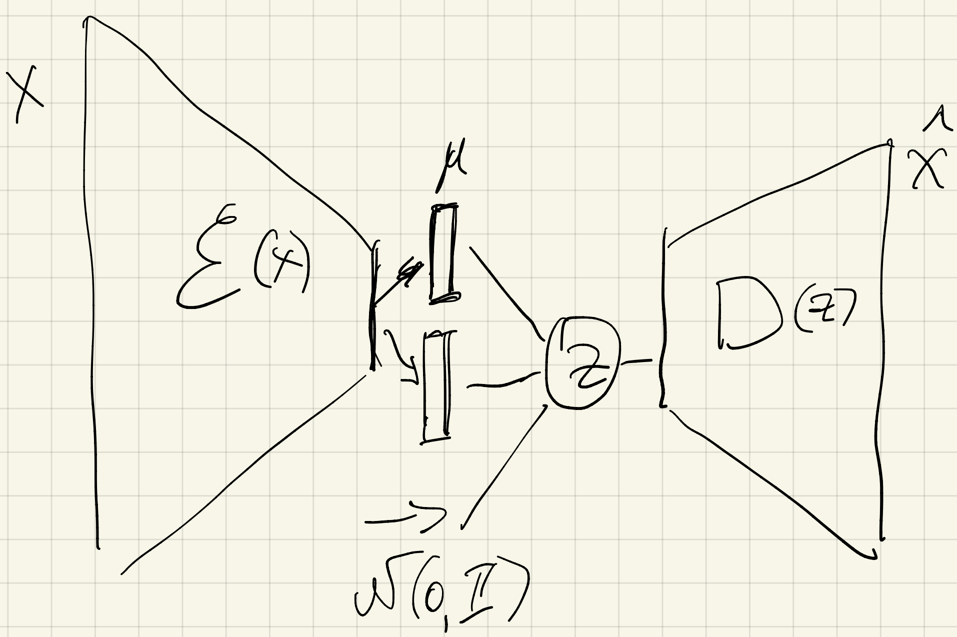
$$KL\left(q(z|x)\,||\,p(z)\right)$$

$$p(z) = \mathcal{N}(\mu, \Sigma^2)$$

$$z = \mu + \varepsilon \cdot \sigma$$

$$\varepsilon \sim \mathcal{N}(0, \mathbb{I})$$





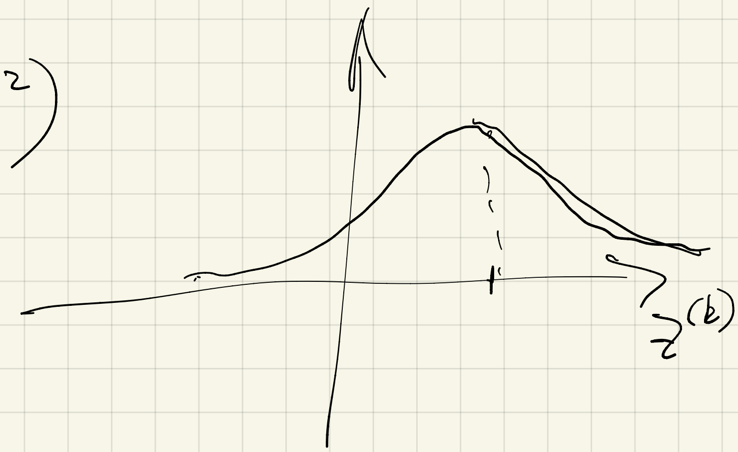
$$\mu, \log\sigma^2 = \mathcal{E}(X)$$

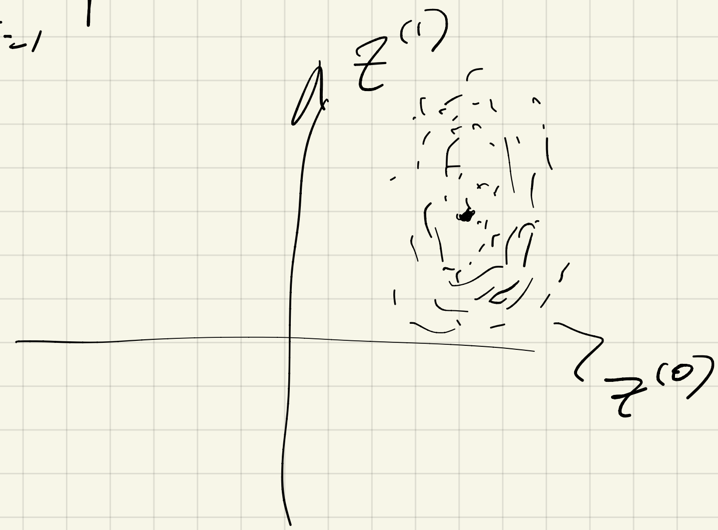
$$KL = \frac{1}{2}\left[\left(\sum_{i=1}^{\cancel{z}} \mu^2 + \sum_{i=1}^{\cancel{z}} \sigma_i^2\right) - \sum_{i=1}^{z} \left(\log \sigma_i^2 + 1\right)\right]$$

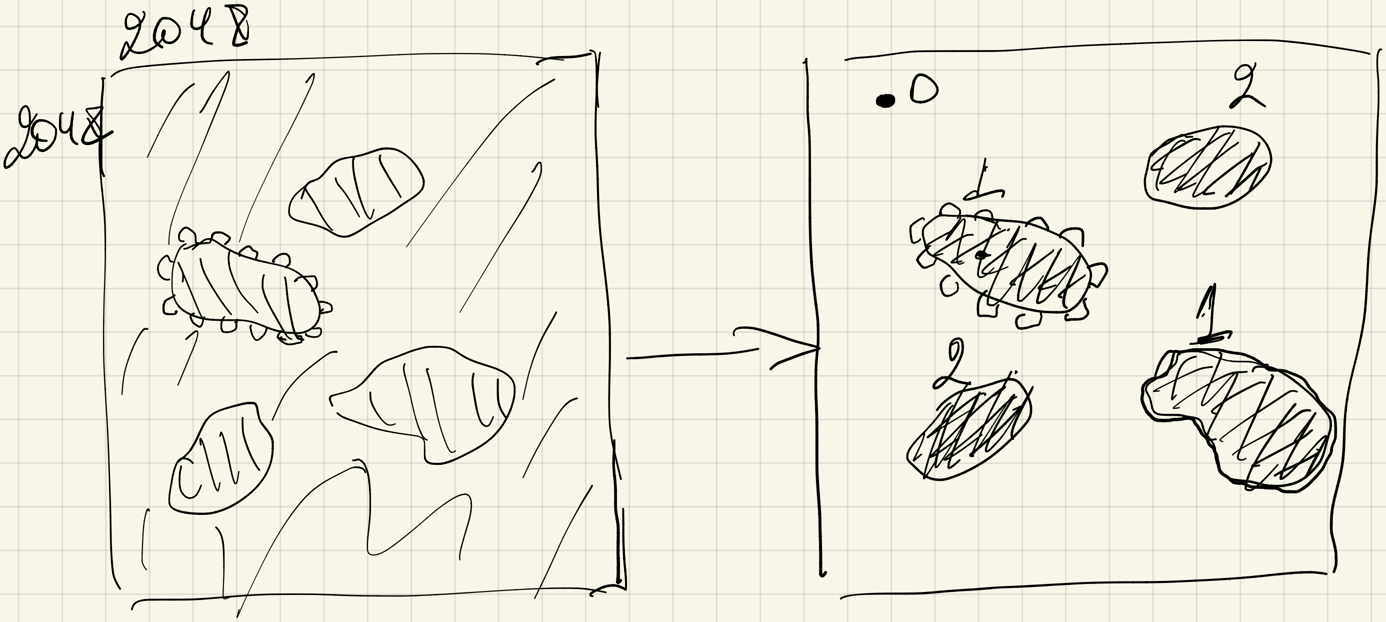
$$-ELBO = L(\hat{x}, x) + KL$$

$$(z_i | x_i) \sim \mathcal{N}(\mu, \sigma^2)$$

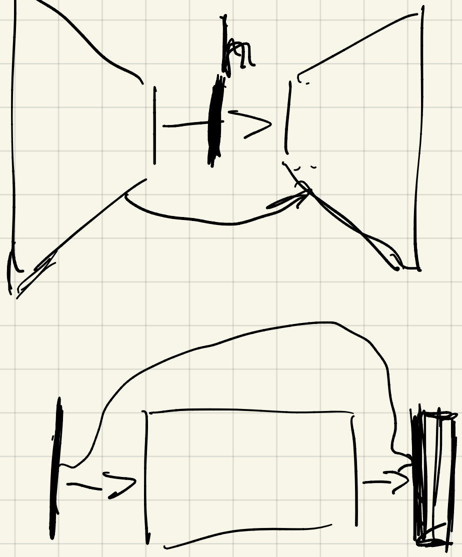
$$\prod_{i=1}^{n} p(z_i | x_i)$$



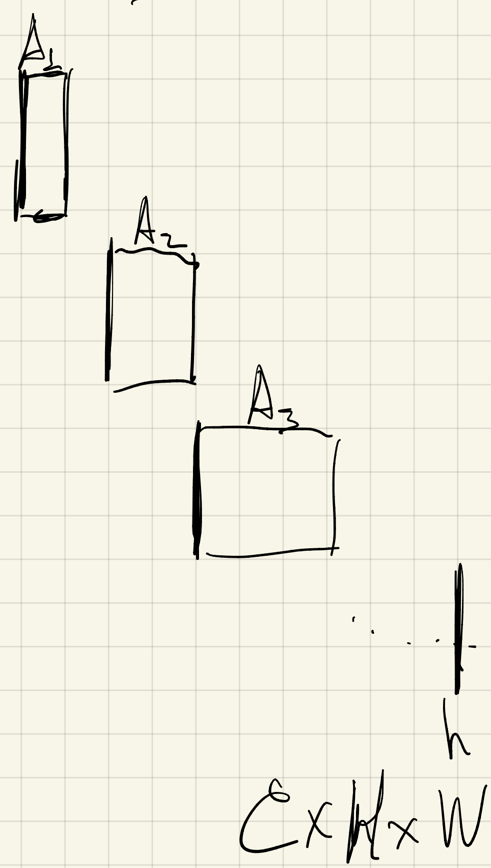




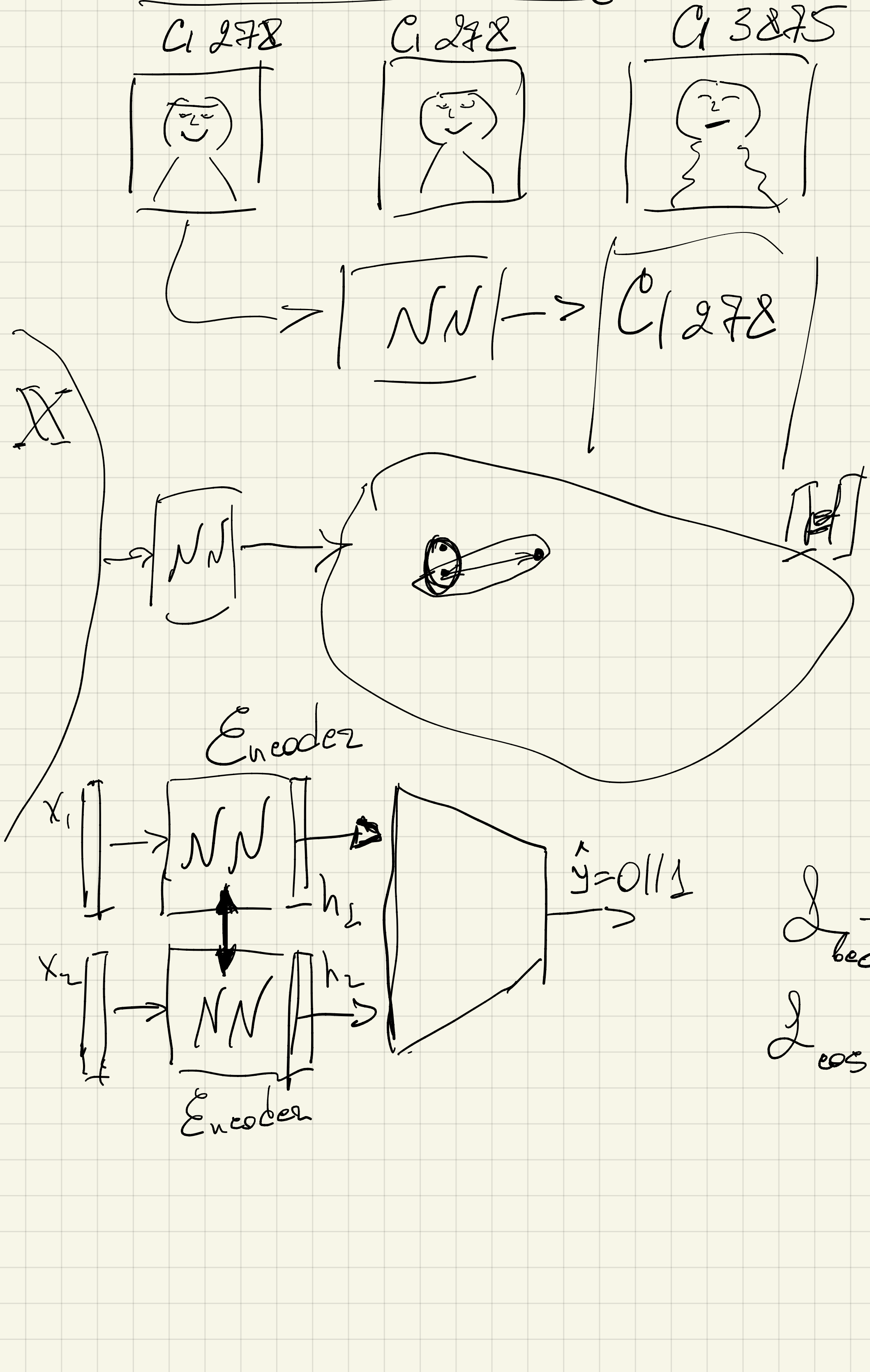
AE



MCE

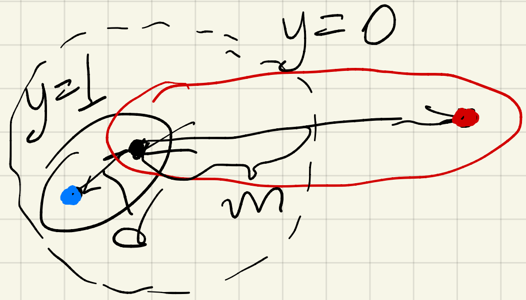


Metric Learning



$$\mathcal{L}_{bce} = BCE(\hat{y})$$

$$\mathcal{L}_{cos} = \frac{h_1 \cdot h_2}{\|h_1\| \, \|h_2\|}$$

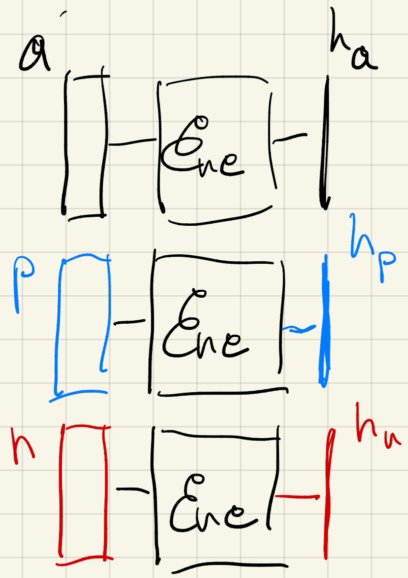


• – ancor

• – positive

• – negative

$$\mathcal{L}(d, y) = \frac{1}{2} \cdot y \cdot d^2 + (1-y)\frac{1}{2}\left(\max(0, m-d)\right)^2$$



$$\mathcal{L}_{triplet} = \max(d_p^2 - d_n^2 + m, 0)$$

$$d_p = \|h_p - h_a\|$$

$$d_n = \|h_n - h_a\|$$