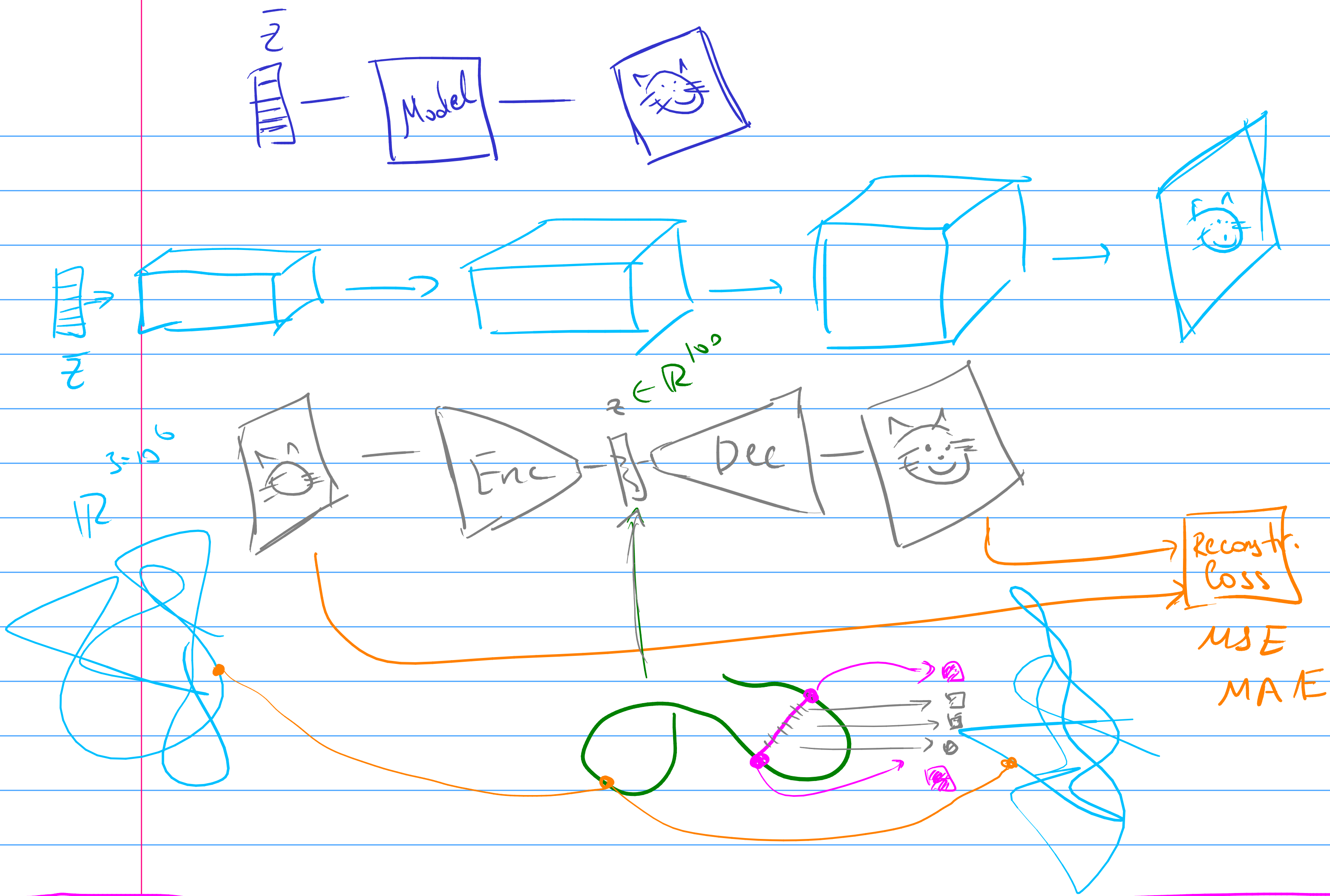
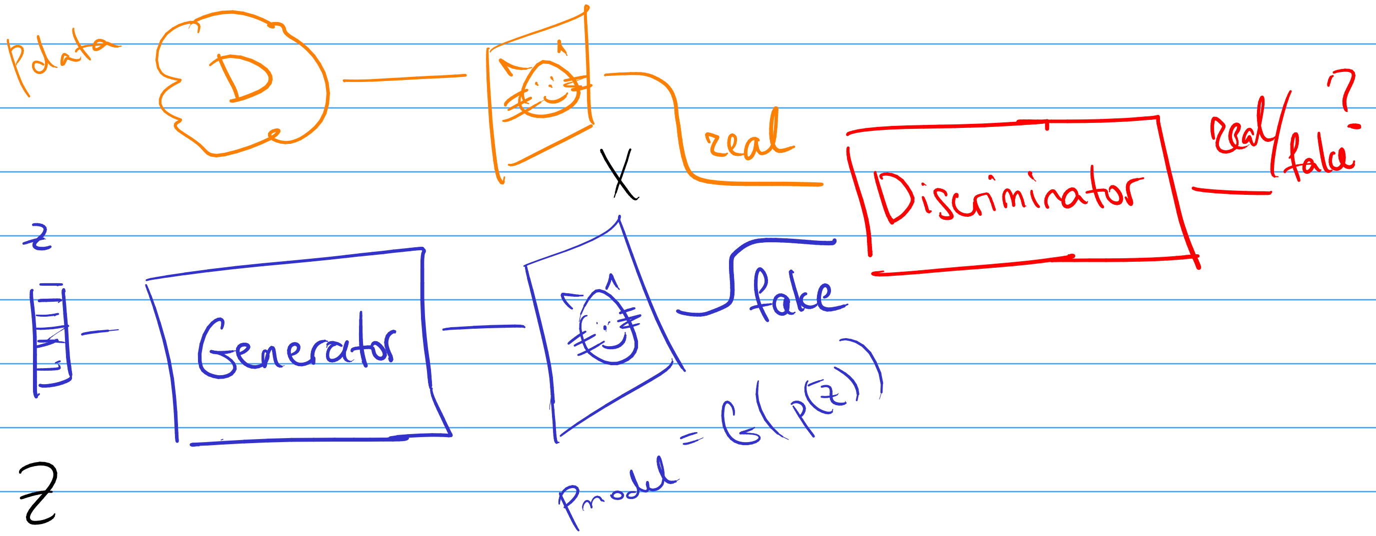




$G: Z \to X$

$D: X \to [0,1]$

max

$$L_D = \mathbb{E}_{\bar{x}\sim p_{data}}\left[\log D(\bar{x})\right] + \mathbb{E}_{\bar{x}\sim p_g}\left[\log\left(1-D(\bar{x})\right)\right]$$

$$V(D,G) = \mathbb{E}_{\bar{x}\sim p_{data}}\left[\log D(\bar{x})\right] + \mathbb{E}_{\bar{z}\sim p_{\bar{z}}}\left[\log\left(1-D(G(\bar{z}))\right)\right]$$

$$L_G = \mathbb{E}_{\bar z \sim p_{\bar z}}\left[\log\left(1 - D(G(\bar z))\right)\right] \longrightarrow \min$$

$$\boxed{\min_G \max_D V(D, G)}$$

1) $G = \text{fix}$ $D = ?$

$$L_D = \int \underbrace{\left(p_{data}(\bar x)\log \underline{D(\bar x)} + p_g(\bar x)\log\left(1 - \underline{D(\bar x)}\right)\right)}_{\xrightarrow{D(\bar x)} \max} d\bar x$$

$$p_{data}(\bar x) \log a + p_g(\bar x)\log(1-a) \rightarrow \max$$

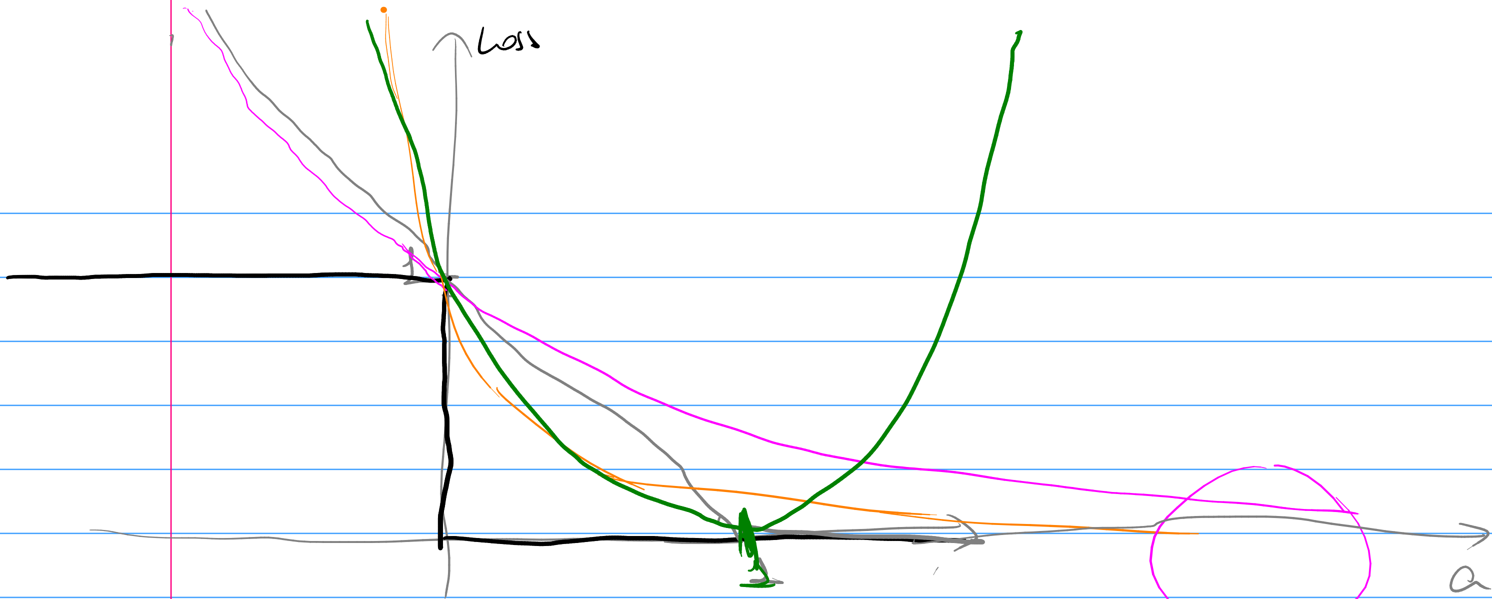
$$\boxed{\underline{D^*(\bar x)} = \frac{p_{data}(\bar x)}{p_{data}(\bar x) + p_g(\bar x)}}$$

2) $$L_G = \int \left(p_d \log \frac{p_d}{(p_d + p_g)/2} + p_g \log \frac{p_g}{(p_d+p_g)/2}\right) d\bar x - 2\log 2 \longrightarrow \min$$

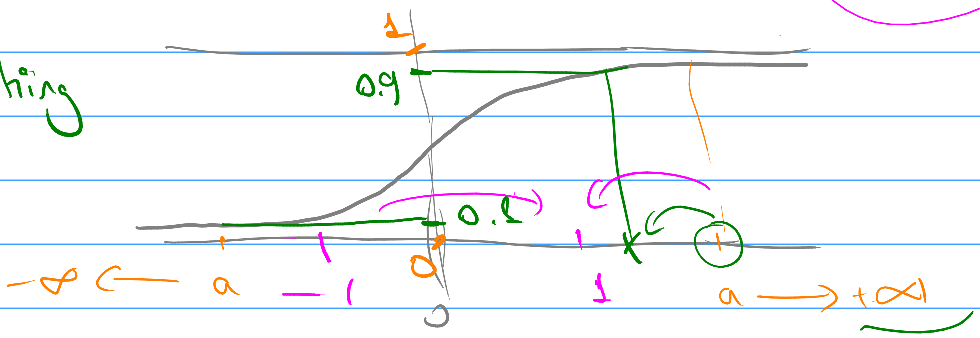
$$KL(p \| q) = \int p \log \frac{p}{q} d\bar x$$

$$L_G = KL\left(p_{data} \middle\| \frac{p_{data} + p_g}{2}\right) + KL\left(p_g \middle\| \frac{p_{data}+p_g}{2}\right) =$$

$$\boxed{= JSD(p_{data} \| p_g) \xrightarrow[G]{} \min}$$



Label smoothing



Adversarial loss functions

LSGAN

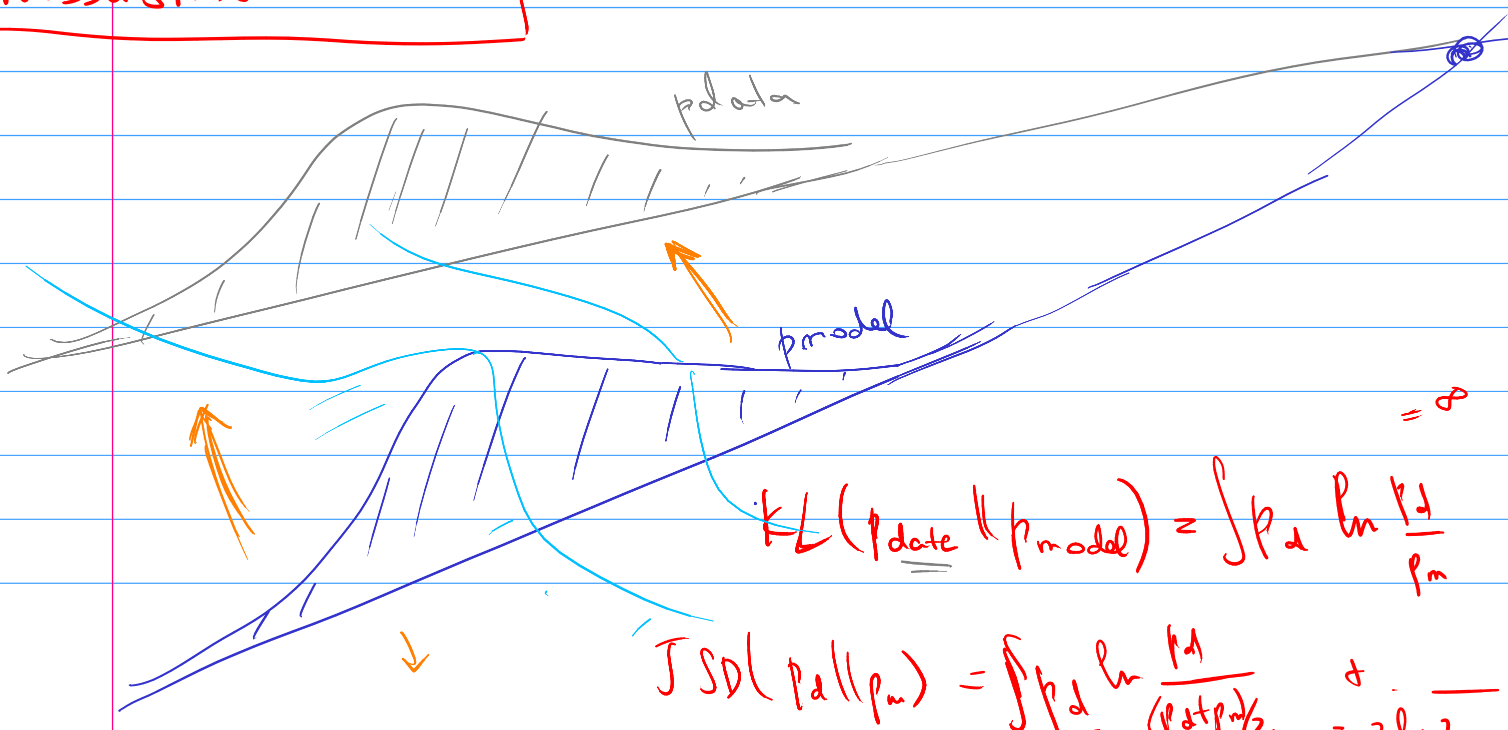
$$L_D = \mathbb{E}_{\bar{x}\sim p_{data}}\left[(D(\bar{x})-b)^2\right] + \mathbb{E}_{\bar{x}\sim p_g}\left[(D(\bar{x})-a)^2\right]$$

$$\boxed{L_G = \mathbb{E}_{\bar{z}\sim p_{\bar{z}}}\left[(D(G(\bar{z}))-c)^2\right]}$$

$a = 0, -1$

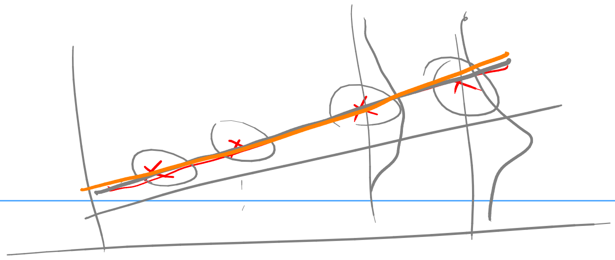
$b = c = 1$

Wasserhtein GANs



$$KL(p_{data} \| p_{model}) = \int p_d \ln \frac{p_d}{p_m} = \infty$$

$$JSD(p_d \| p_m) = \int p_d \ln \frac{p_d}{(p_d+p_m)/2} + \ldots = 2\ln 2$$



$$p(y|\bar{w},\bar{x}) = \mathcal{N}(y|\bar{w}^T\bar{x}, \sigma^2)$$

$$y(\bar{x}) = \bar{w}_*^T\bar{x} + \cancel{\mathcal{N}(0,\sigma^2)}$$