

LR Discriminative  
 NB Generative

$$p(y|\bar{x})$$

$$p(\bar{x}, y) = p(\bar{x})p(y|\bar{x})$$



Explicit density models

Approximate density models

$$p(\bar{x}) \approx q(\bar{x}) = \prod \dots$$

$$KL(q||p) \rightarrow \min_q$$

Transforms

Tractable density models

$$p(\bar{x})$$

$$NB: p(\bar{x}, y) = p(y) \prod_{i=1}^n p(x_i|y)$$

Autoregressive models:

$$p(x_1 \dots x_n) = p(x_1) p(x_2|x_1) p(x_3|x_1, x_2) \dots p(x_n|x_1 \dots x_{n-1})$$

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RNN:



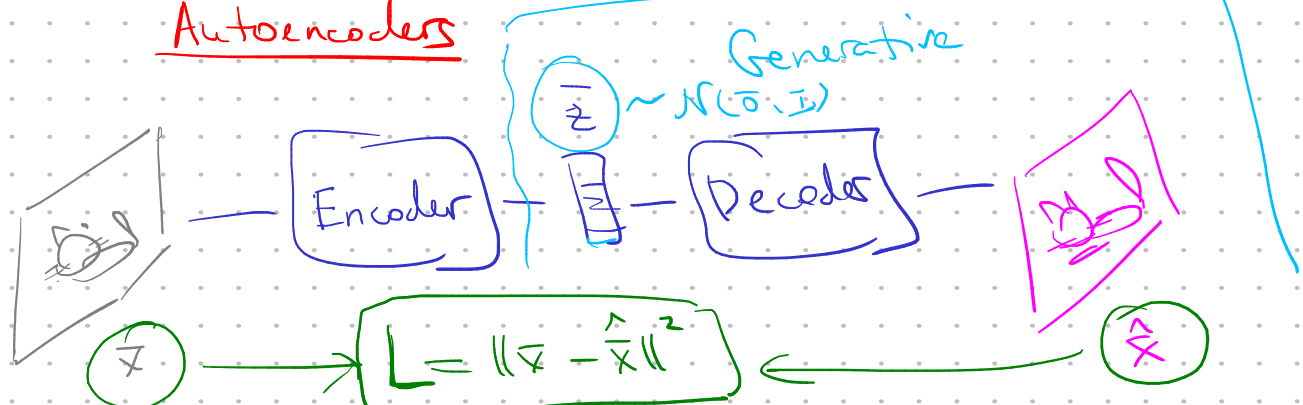
$$p(\bar{x}_t | \bar{x}_1, \dots, \bar{x}_{t-1}, h_0) = p(\bar{x}_t | \bar{x}_{t-1}, h_{t-1})$$

$$h_{t-1} = f(\bar{x}_{t-1}, h_{t-2})$$

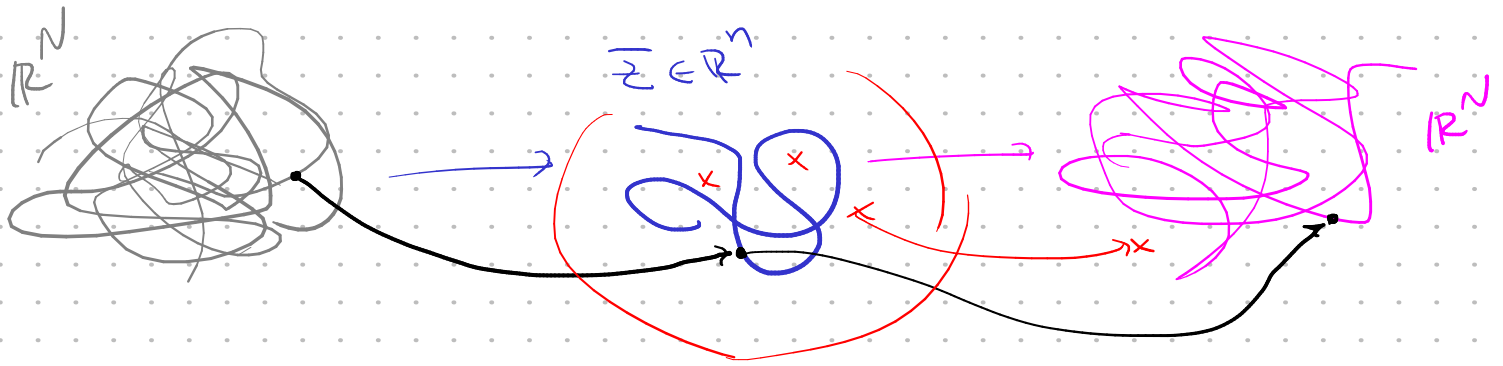
Flow-based models:

$$p(\bar{x}) = (f_d \circ f_{d-1} \circ \dots \circ f_2 \circ f_1 \circ p_0)(\bar{x})$$

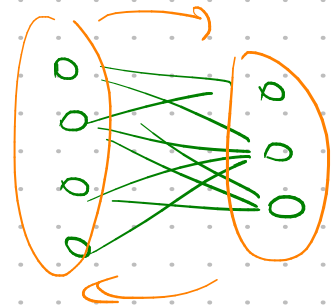
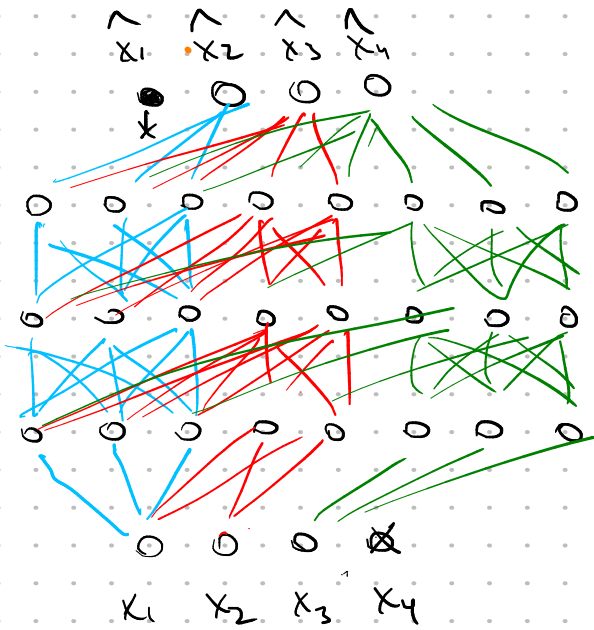
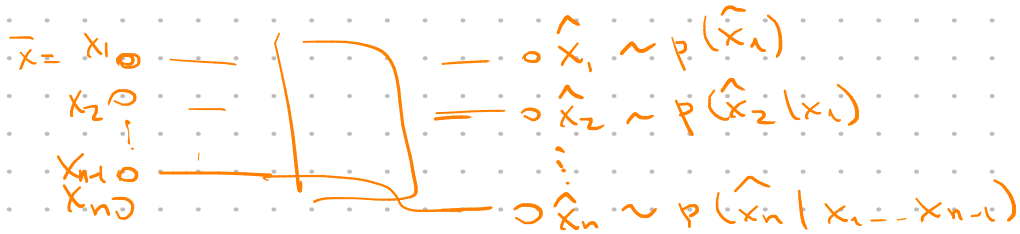
Autoencoders



VAE  
 Variational autoencoders



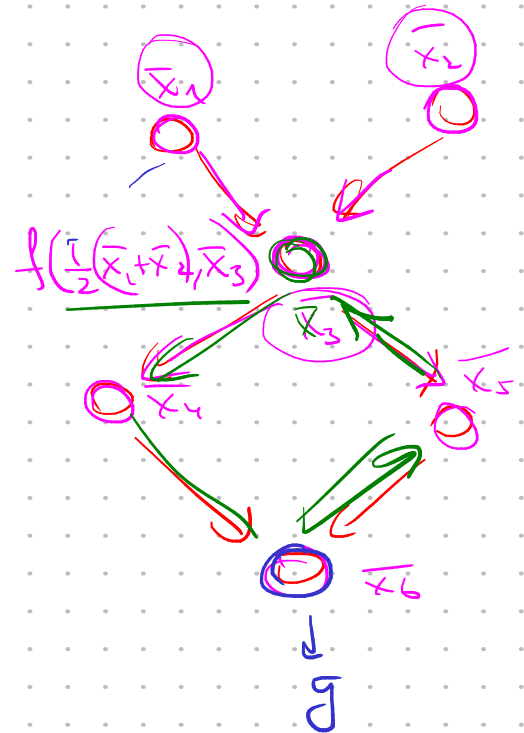
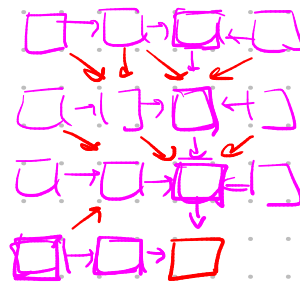
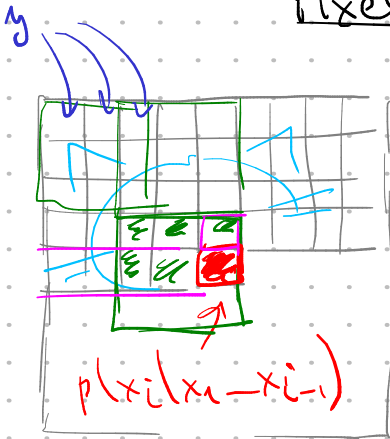
MAD E - masked autoencoder



Graph NN

Pixel CNN

Pixel RNN

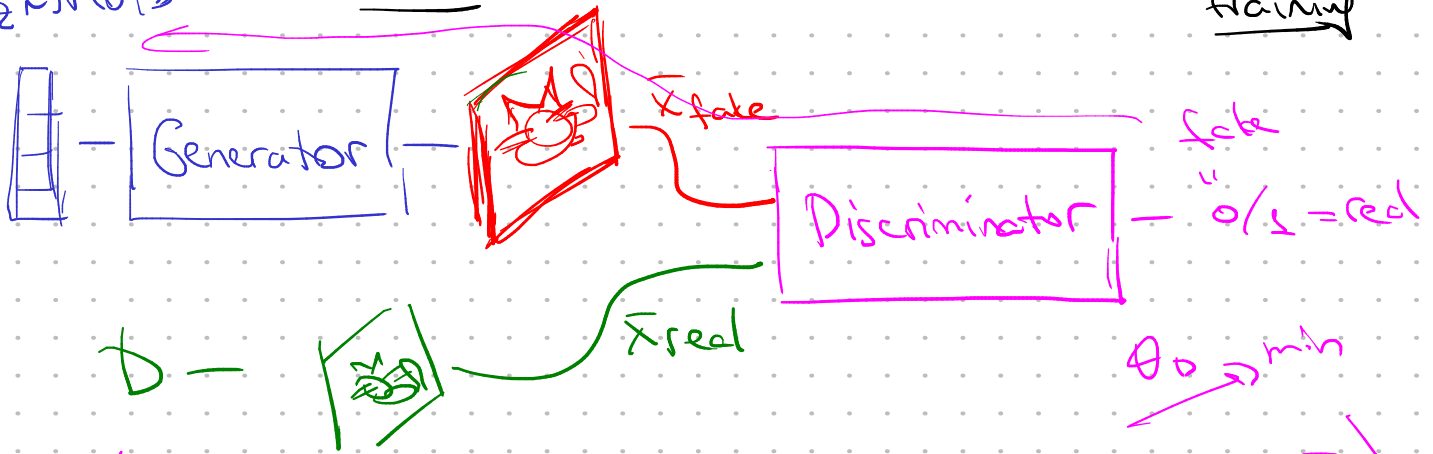


$$\bar{z} \sim \mathcal{N}(\bar{0}, \bar{I})$$

GAN

$$D = \{x_n\}_{n=1}^N$$

Adversarial training



$$L_D = - \left( \mathbb{E}_{x_{real} \sim p} [\log D(x)] + \mathbb{E}_{x_{fake} \sim p_G(x)} [\log (1 - D(x))] \right)$$

$$L_G = \mathbb{E}_{\bar{z} \sim p(\bar{z})} [\log (1 - D(G(\bar{z})))] \xrightarrow{\bar{\theta}_G} \min L(\theta_D, \theta_G)$$

$$\min_{\bar{\theta}_G} \max_{\bar{\theta}_D} L(\bar{\theta}_D, \bar{\theta}_G)$$

- fix  $\bar{\theta}_G$ , train  $\bar{\theta}_D$

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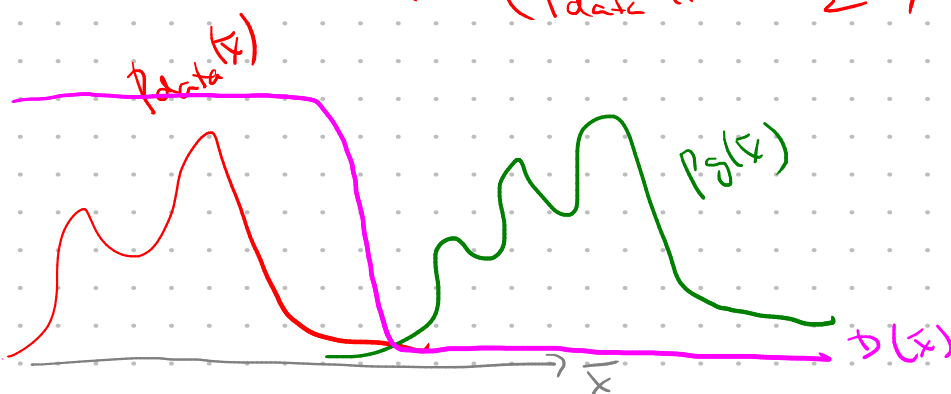
fix G:

$$D_G^*(x) = \frac{p_{data}(x)}{p_G(x) + p_{data}(x)}$$

$$\Rightarrow G^* : p_{data} = p_G$$

$$\min_{\bar{\theta}_G} L(\bar{\theta}_D^*, \bar{\theta}_G) = \text{JS D}(p_{data}, p_G) =$$

$$= \frac{1}{2} \text{KL} \left( p_{data} \parallel \frac{p_G + p_{data}}{2} \right) + \frac{1}{2} \text{KL} \left( p_G \parallel \frac{p_G + p_{data}}{2} \right)$$



# Self-adversarial training

