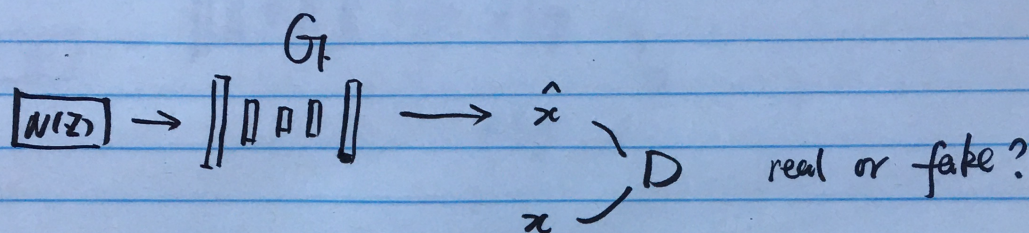


① Generative Adversarial Networks (GANs)



$$x \sim p_{\text{data}}$$

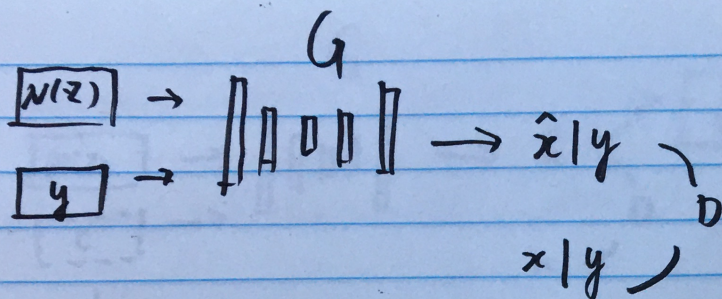
$$z \sim \mathcal{N}(0, 1)$$

$$G^*, D^* = \arg \min_G \max_D \mathbb{E}_{x \sim p_{\text{data}}(x)} [\log D(x)] \\ + \mathbb{E}_{z \sim p_z(z)} [\log (1 - D(G(z)))]$$

② Conditional Generative Networks (cGANs)

Both G and D are conditioned on auxiliary information (such as class label) y .

$$G^*, D^* = \arg \min_G \max_D \mathbb{E}_{x \sim p_{\text{data}}(x)} [\log D(x|y)] \\ + \mathbb{E}_{z \sim p_z(z)} [\log (1 - D(G(z|y)))]$$



③ InfoGAN

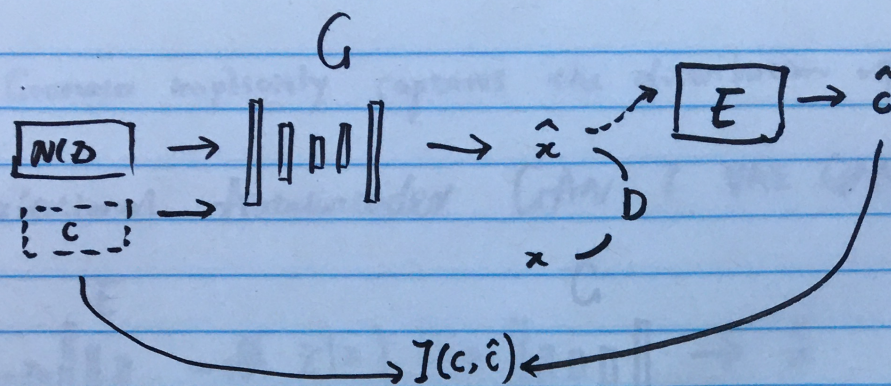
Generator takes input (1) incompressible noise z and (2) structured latent variables c

$$p(c_1, c_2, \dots, c_L) = \prod_{i=1}^L p(c_i)$$

$$G(z) \rightarrow G(z, c)$$

$I(c; G(z, c))$ should be high, so that c is not ignored.

$$G^*, D^* = \arg \min_G \max_D \mathbb{E}_{x \sim p_{\text{data}}(x)} [\log D(x)] + \mathbb{E}_{z \sim p_z(z)} [\log (1 - D(G(z, c)))] - \lambda I(c; G(z, c))$$

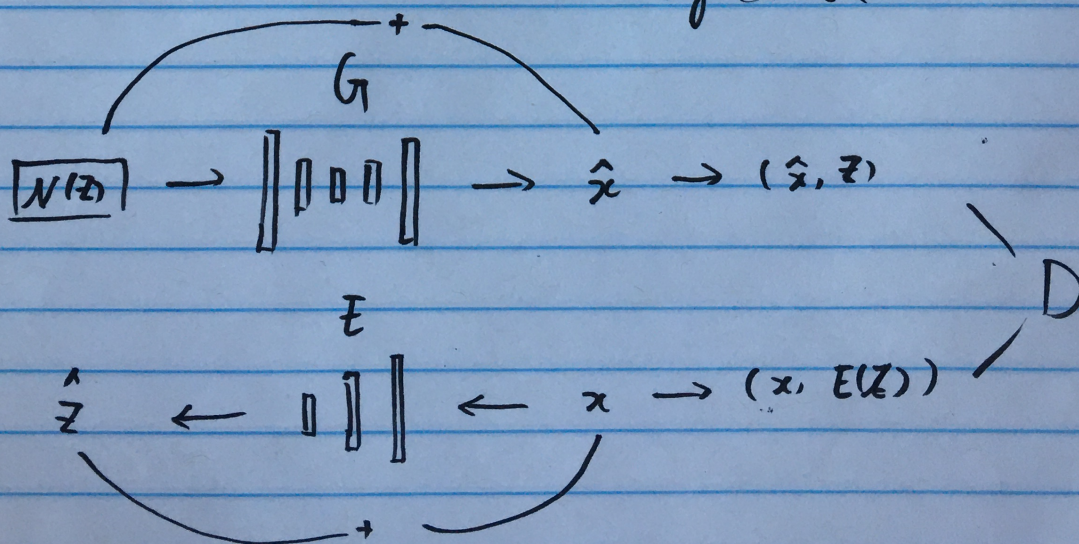


④ BiGAN

$$p^*, (E^*) \quad G^* = \arg \min_{G, E} \max_D \mathbb{E}_{x \sim p_{\text{data}}(x)} [\mathbb{E}_{z \sim p_E(\cdot|x)} [\log D(x, z)]]$$

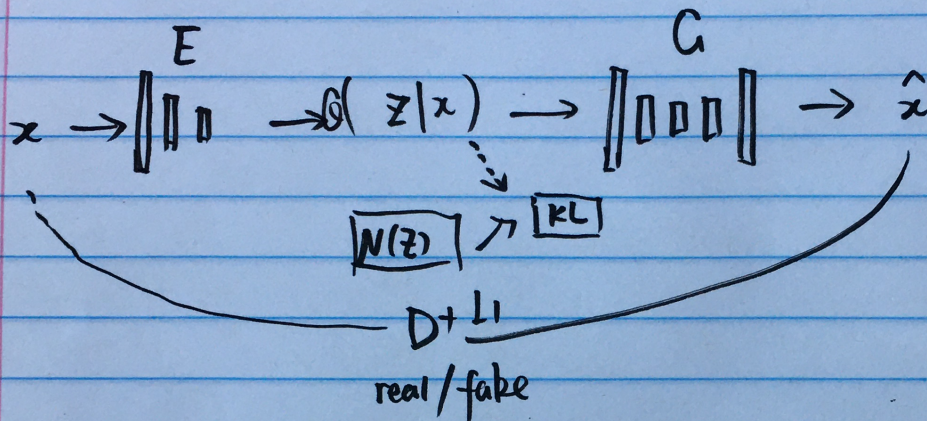
$$+ \mathbb{E}_{z \sim p_z(z)} [\mathbb{E}_{x \sim p_G(\cdot|z)} [\log (1 - D(x, z))]]$$

$\log D(x, E(x))$
 $\uparrow$
 $\log (1 - D(G(z), z))$



Generator implicitly captures the distribution of data.

⑤ Variational Autoencoder GAN (VAE GANs)



$$L = L_{KL} + L_{GAN} + L_{reconstruction}$$