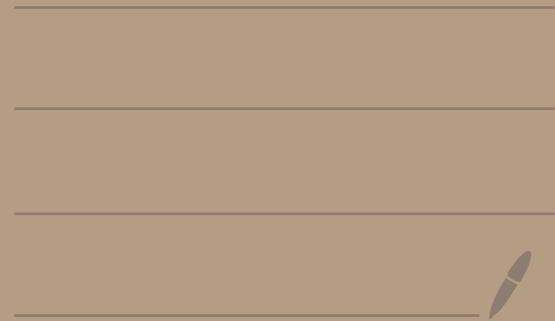
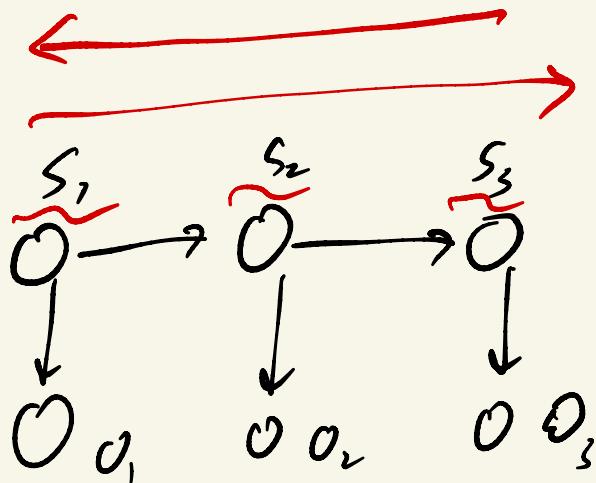


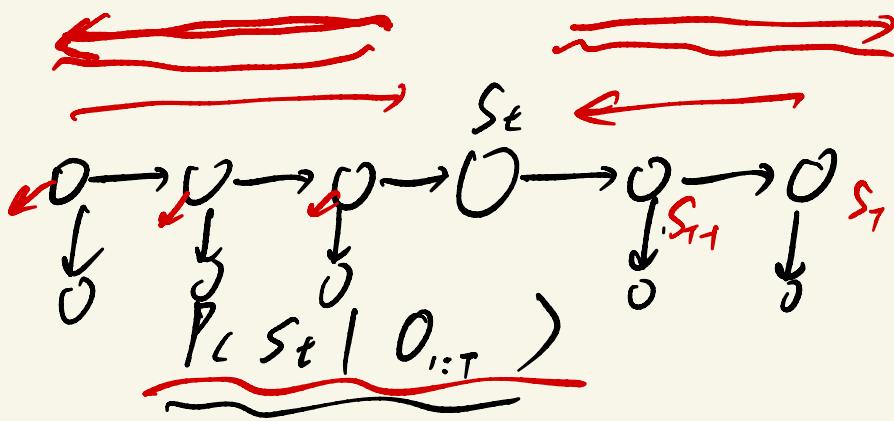
# Lecture 22 GANs and RL

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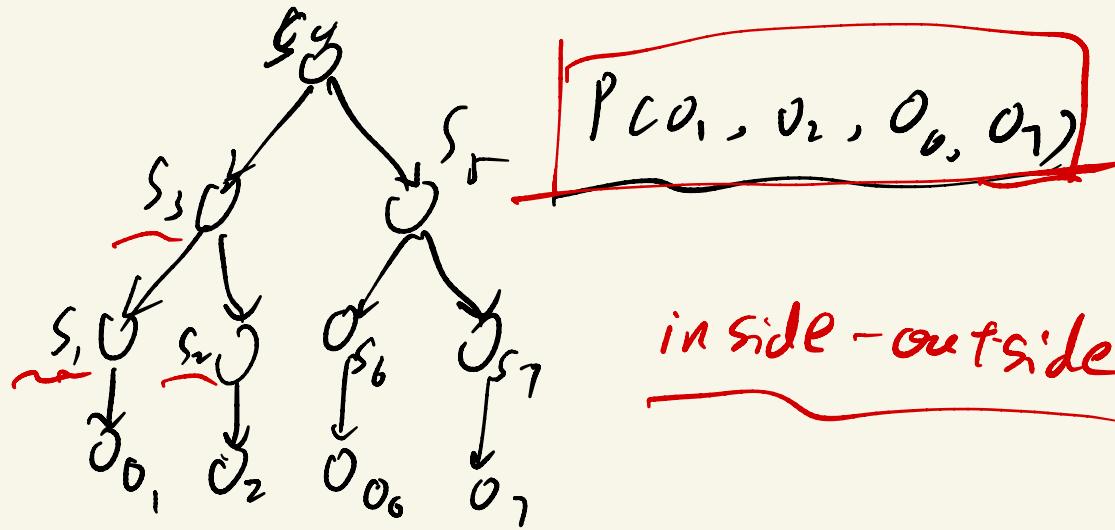




$$\begin{aligned}
 P(O_1, O_2, O_3) &= \sum_{S_1} \sum_{S_2} \sum_{S_3} P(S_1) P(O_1 | S_1) \\
 &\quad P(S_2 | S_1) \times P(S_3 | S_2) \dots \\
 &= \sum_{S_2} \sum_{S_3} \left( \sum_{S_1} P(S_1) P(O_1 | S_1) \right. \\
 &\quad \left. P(S_2 | S_1) \times \dots \times P(S_3 | S_2) \right)
 \end{aligned}$$



$$\underbrace{s_{t-1}}_{\sim} \rightarrow s_{t-2}$$

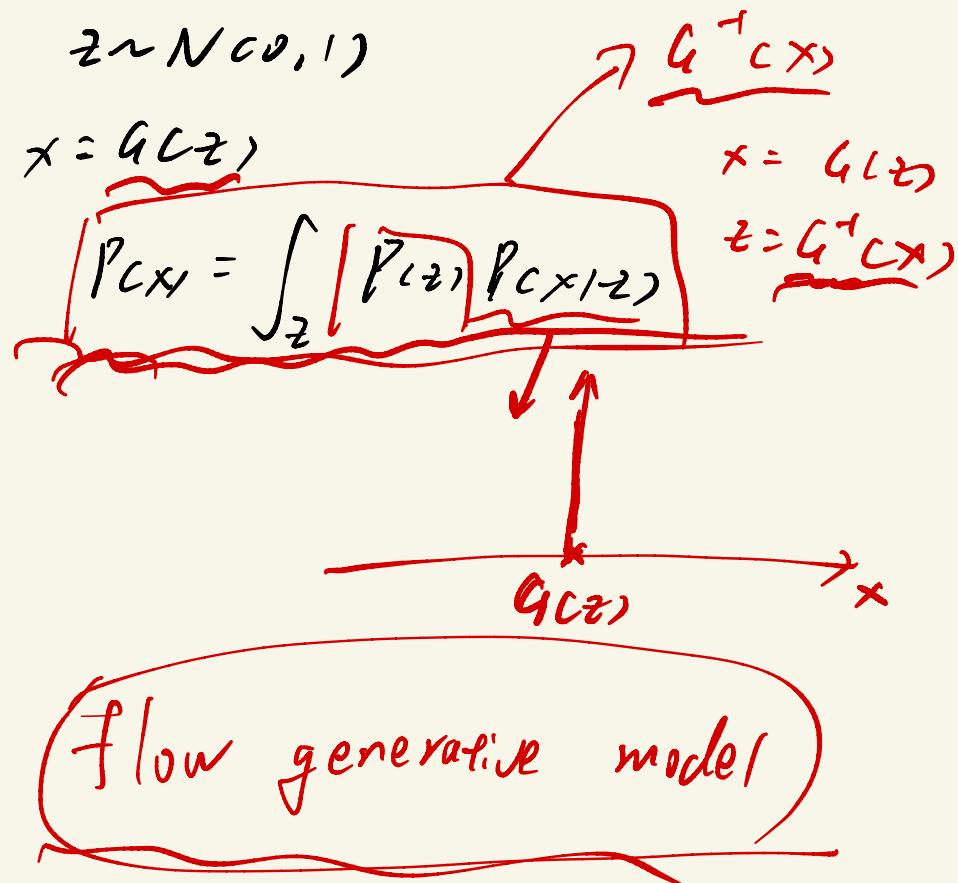


deterministic:  $x = g(z)$

distribution:  $x \sim p(x; g(z))$

$$\text{ELBO} = \underbrace{E_{z \sim q(z|x)}}_{z \sim q(z|x)} \log p(x|z) - \text{KL}(q_{(z|x)} || p_g)$$

$$\log p(x|z) \rightarrow -\infty$$



$\arg \min C(G)$

$$\begin{array}{c} P_g \\ \sim \end{array} \quad \begin{array}{c} KL \geq 0 \\ \sim \end{array}$$

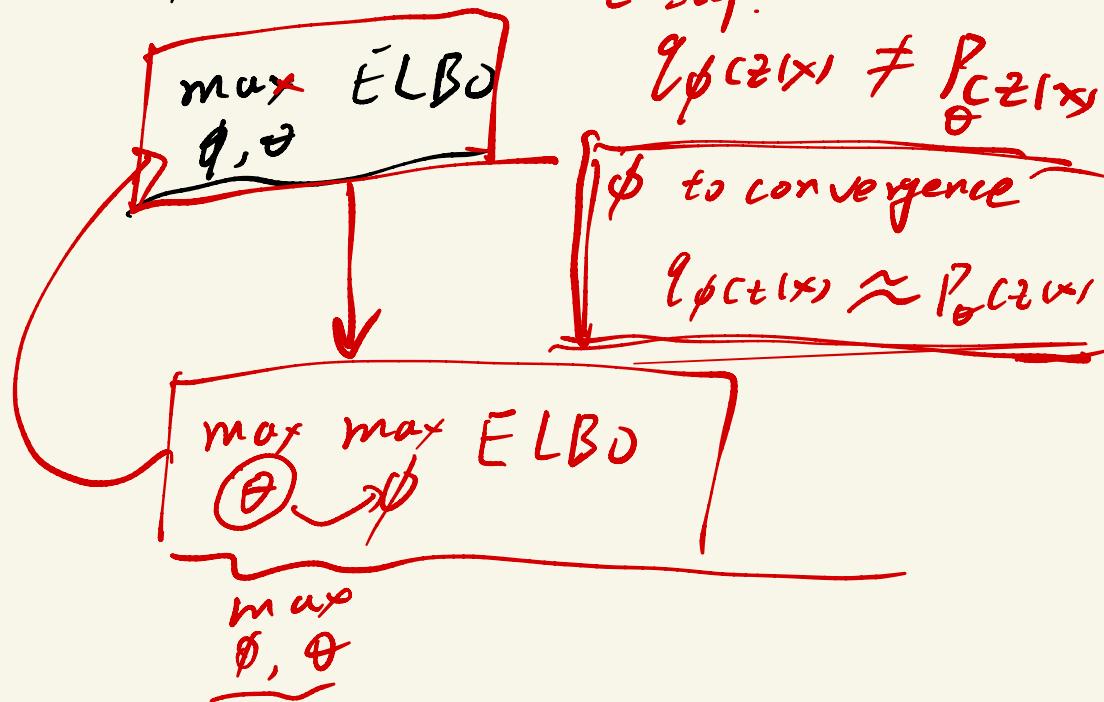
$\sim$   ~~$C(G)$~~

$\boxed{KL = 0}$

$$P_g = P_{\text{data}} \quad KL = 0$$

$$P_{\text{model}} \longrightarrow P_{\text{data}}$$

encoder  $\phi$     decoder  $\theta$



E stop:

$$q_{\phi}(z|x) \neq P_{\theta}(z|x)$$

$\phi$  to convergence

$$q_{\phi}(z|x) \approx P_{\theta}(z|x)$$

$P_g^*$  fixed

$$\text{MLE: } \bar{E}_{x \sim P_{\text{data}}} \log P_g(x)$$

// equivalence

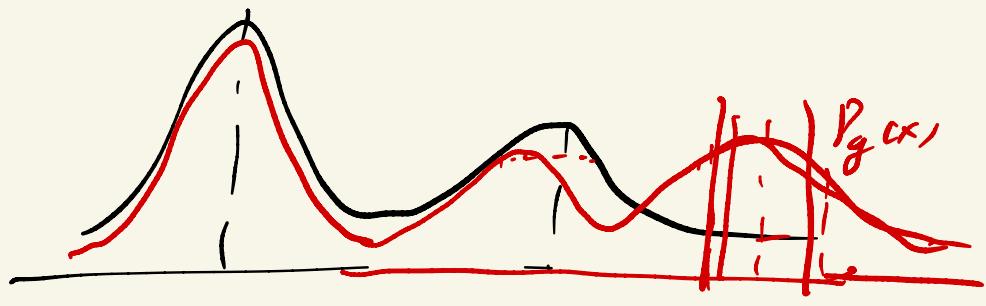
$$\min \underbrace{\text{KL}(P_{\text{data}} \parallel P_g)}_{\text{MLE}}$$

$$= \underbrace{\text{KL}\left(P_g \parallel \frac{P_{\text{data}} + P_g}{2}(\alpha)\right)}$$

$$d(x, y) = \|x - y\|^2 \quad P_g = P_{\text{data}}$$

$$\cos(\vec{x}, \vec{y})$$

$$d(x, y) = d(y, x)$$



$$KL(P||Q) = \underbrace{\int P_{\text{ex}} \log P_{\text{ex}}}_{\cdot} - \int P_{\text{ex}} \log Q_{\text{ex}}$$

VAE:  $KL(P_{\text{data}} || P_g) = \boxed{\int P_{\text{data}} \log P_{\text{data}}^{cx}}$

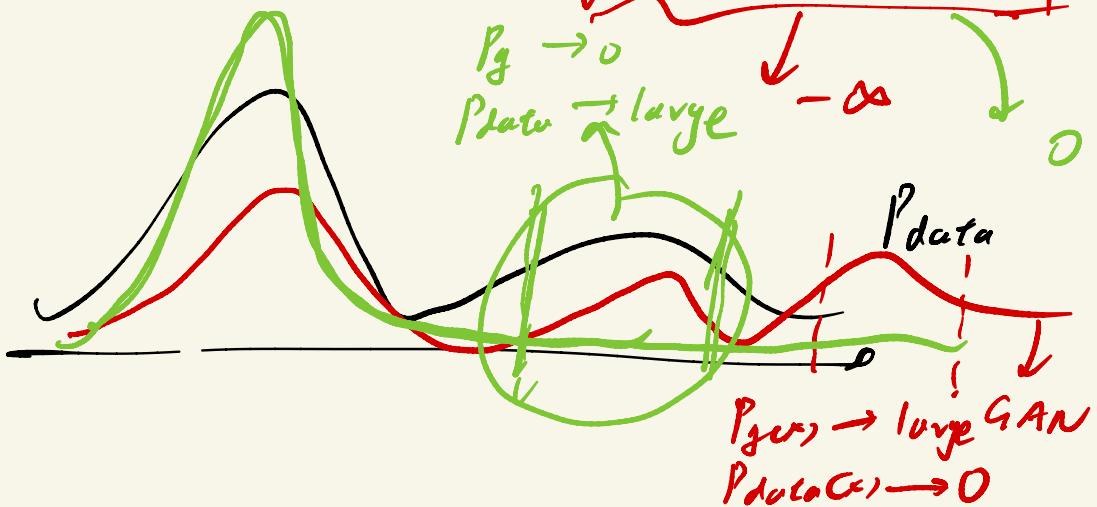
$\begin{aligned} & - \int P_{\text{data}}^{cx} \log P_g^{cx} \rightarrow \infty \\ & 0 \quad \log P_g^{cx} \rightarrow -\infty \end{aligned}$

CAN:

$$\int P_g^{cx} \log$$

$$KL(P_g \parallel P_{data}) = \int P_{g(x)} \log P_{g(x)}$$

$$- \int P_{g(x)} \log P_{data(x)}$$

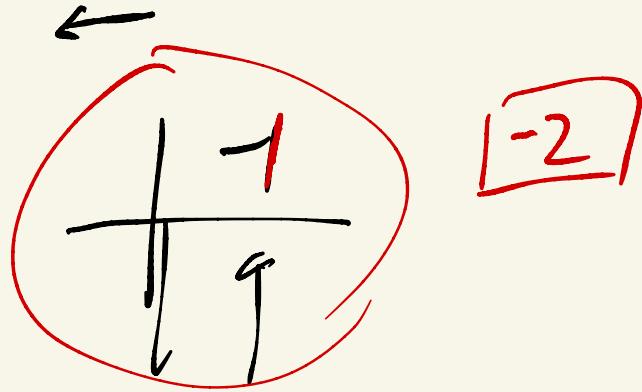


$$KL(P_g \parallel P_{\text{data}}) + KL(P_{\text{data}} \parallel P_g)$$

A hand-drawn diagram consisting of two terms separated by a plus sign, enclosed in a single horizontal bracket. The first term is  $KL(P_g \parallel P_{\text{data}})$ , and the second term is  $KL(P_{\text{data}} \parallel P_g)$ . Above the first term, the letters "JSD" are written inside a rectangular box, with a curved line above it connecting to the top of the bracket. Below the second term, the word "symmetric" is written, with a curved line below it connecting to the bottom of the bracket.

$$\overbrace{\quad \quad \quad \quad \quad}^{\text{JSD}} \left( KL(P_{\text{data}} \parallel P_g) \right)$$

symmetric



$$r_0 + r_1 + r_2 + r_3 + \dots$$

$r \rightarrow \text{reward}$

$$\tilde{r}_0 + \left[ \tilde{r}_1 + \gamma^2 \tilde{r}_2 + \dots \right]$$

$$R_{CS} + \gamma \sum_{S, ES} P_{CS, | S, \pi(S)} V^\pi(S,)$$

$$V^\pi(S) \downarrow$$

| $S|$