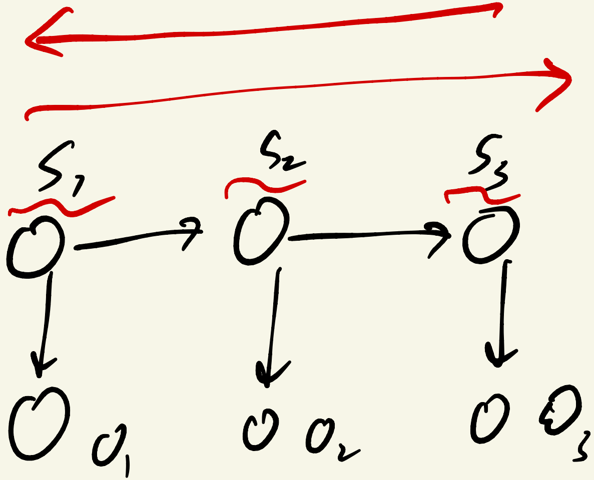
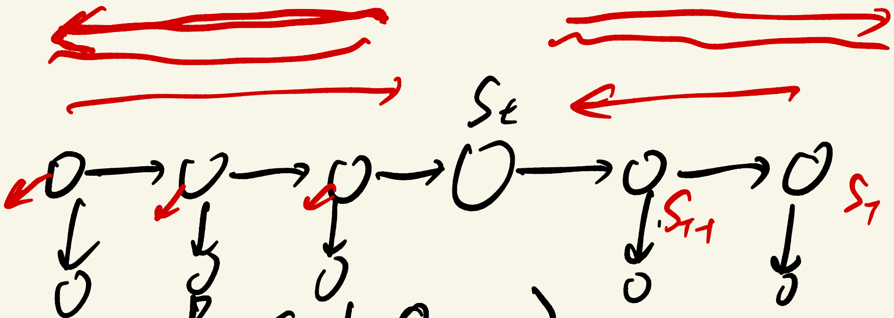
Lecture 22 GANs and RL



$$P(O_1, O_2, O_3) = \sum_{S_1}\sum_{S_2}\sum_{S_3} P(S_1)\,P(O_1|S_1)\,P(S_2|S_1) \times P(S_3|S_2) \cdots$$

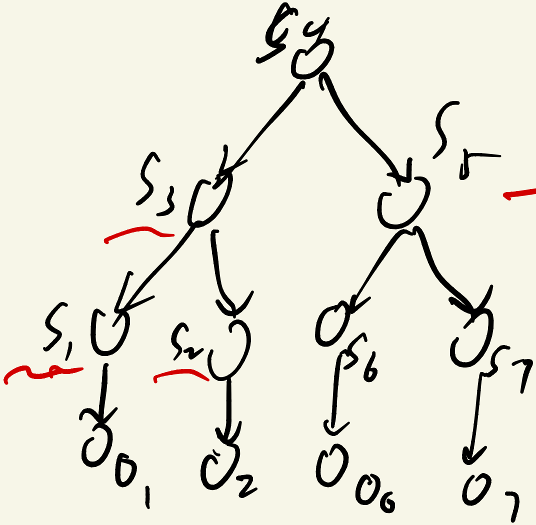
$$= \sum_{S_2}\sum_{S_3} \left(\sum_{S_1} P(S_1)\,P(O_1|S_1)\,P(S_2|S_1) \right) \times (\cdots)$$

$f(S_2)$



$$P(S_t \mid O_{1:T})$$

$$S_{t-1} \to S_{t-2}$$



$$\boxed{P(O_1, O_2, O_6, O_7)}$$

inside-outside

deterministic: $\boxed{x = G(z)}$

distribution: $x = P[x;\ G(z)]$

$$\mathrm{ELBO} = \underbrace{E_{z\sim q(z|x)} \log P(x|z)}_{} - KL(q_{(z|x)} \| P_{(z)})$$

$z \sim q(z|x)$

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

$z \sim N(0,1)$

$x = G(z)$

$$P(x) = \int_z P(z)\, P(x|z)$$

$G^{-1}(x)$

$x = G(z)$

$z = G^{-1}(x)$

flow generative model

$\underbrace{\arg\min_{P_g} C(G)}_{P_g}$

$KL \geq 0$

$\sim$ $\cancel{\ }$ $C(G)$

$\boxed{KL = 0}$

$P_g = P_{data}$ $KL = 0$

$p_{model} \longrightarrow p_{data}$

encoder ϕ $\quad$ θ decoder

E step:

$q_\phi(z|x) \neq p_\theta(z|x)$

$\max\limits_{\phi,\theta}$ ELBO

ϕ to convergence

$q_\phi(z|x) \approx p_\theta(z|x)$

$$\underbrace{\max_{\theta} \max_{\phi} \text{ELBO}}_{\max\limits_{\phi,\theta}}$$

P_g^* fixed

MLE: $E_{x \sim P_{data}} \log P_g(x)$

// equivalent

$\min \underbrace{KL(P_{data} \,\|\, P_g)}$ MLE

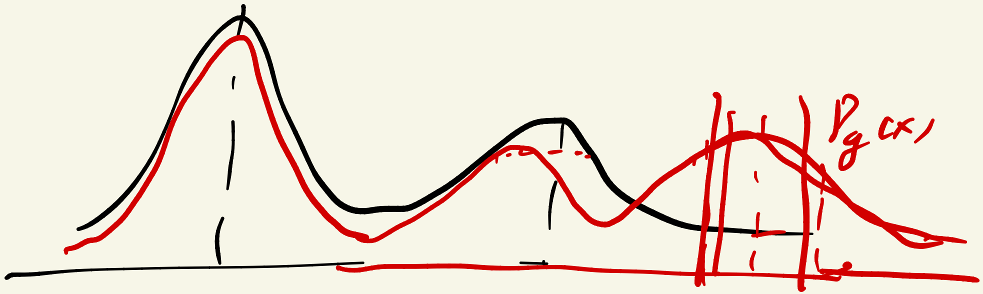
$KL\left(P_g \,\Big\|\, \frac{P_{data} + P_g^*(x)}{2}\right)$

$d(x,y) = ||x-y||^2$

$P_g = P_{data}$

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

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



$$KL(P\|q) = \underbrace{\int P(x)\log P(x)} - \int P(x)\log q(x)$$

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

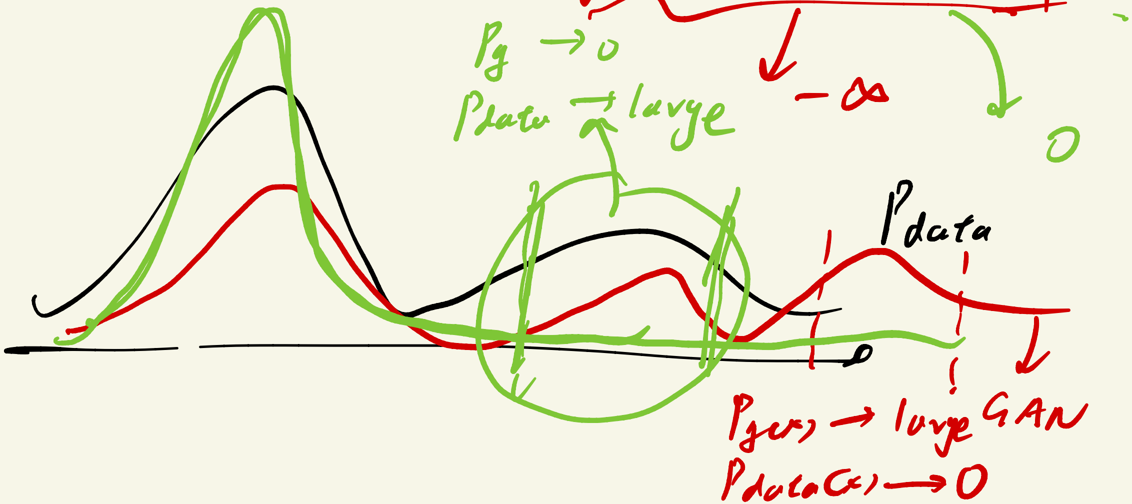
$$\underbrace{-\int P_{data}(x)\log P_g(x)}_{0} \to \infty$$

$\log P_g(x) \to -\infty$

GAN:

$\int P_g(x)\,lo$

$$KL(P_g \| P_{data}) = \int P_g(x) \log P_g(x) \boxed{- \int P_g(x) \log P_{data}(x)}$$

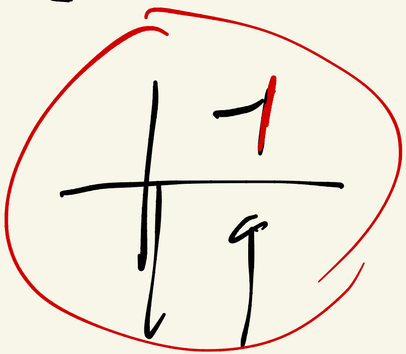


$KL(P_g \| P_{data}) + KL(P_{data} \| P_g)$

$\boxed{JSD}(P_{data} \| P_g)$

symmetric

←



$\boxed{-2}$

$$r_0 + r_1 + r_2 + r_3 \cdots$$

$r \rightarrow$ reward

$$r_0 + \underbrace{\left[\gamma r_1 + \gamma^2 r_2 + \cdots\right]}$$

$$R(s) + \gamma \cdot \sum_{s_1 \in S} P(s_1 \mid s, \pi(s))\, V^{\pi}(s_1)$$

$$V^{\pi}(s)$$

$$|s|$$