24/11/23

Deep Learning

- Recap GAN
- Learnings in this course
- Recap: GAN problem, solution, optimal or equilibrium state

- $V(G,D) = E_{x \sim p_{data}}[\log D(x)] + E_{z \sim p_z}[\log(1 - D(\underbrace{G(z)}_{\text{generator}}))]$

$$= E_{x \sim p_{data}}[\log D(x)] + E_{x \sim p_g}[\log(1 - D(x))]$$

- G is a model with params θ_g
  D is a model with params θ_D
- $G^*, D^* = \arg \min_G \max_D V(G,D)$
- Algorithm to learn θ_D & θ_g
  - Alternate between updating θ_D & θ_g. sample $z \sim p_z$, $x \sim p_{data}$

θ_D update → Fix G and update θ_D for k iterations - Stochastic gradient ascent

θ_g update Fix D and update θ_g → SG descent - sample $z \sim p_z$

- $D^*(x) = \dfrac{p_{data}(x)}{p_{data}(x) + p_g(x)}$

- $C(G) = -\log 4 + 2 \cdot \underbrace{JS(p_{data} \| p_g)}$

$\Rightarrow C(G^*) = -\log 4$, and this is achieved when $p_g = p_{data}$ (dist)

- Comments on gen. models:
  - GANs are difficult to train
  - Nevertheless, GANs are extremely popular and have several variants
    - example Conditional GAN. → in addition to z, we give a conditioning input y : $p_g(x \mid z, y)$.
  - The stability of GAN training has been significantly improved - e.g. WGAN
  - Diffusion models are easier to train than GANs
  - VAEs continue to be popular but not as much as GANs or D.M.
  - Read the current literature on Gen AI.