**Introduction**

- Implicit probabilistic models:
  
  \[ z \sim \mathcal{N}(0, I) \]
  
  \[ y = T_\theta(z) \]

- Challenge: Likelihood function cannot be expressed analytically or computed numerically.

- Question: How to train such models?

- Existing Approach: Generative adversarial nets (GANs)

- Consequence: Unable to learn the data distribution.

**Implicit Maximum Likelihood Estimation**

- Can we maximize likelihood without computing likelihood?

  - Key Idea:

    1. Select the nearest sample to each data point (NOT the nearest data point to each sample).
    
    \[ x_1, \ldots, x_n: \text{data points} \quad \hat{x}_1^\theta, \ldots, \hat{x}_m^\theta: \text{i.i.d. samples} \]
    
    \[ \hat{\theta}_{\text{IMLE}} := \arg \min_\theta \mathbb{E}_{\hat{x}_1^\theta, \ldots, \hat{x}_m^\theta} \left[ \sum_{i=1}^n \min_{j \in [m]} \| x_i^\theta - \hat{x}_j^\theta \|_2^2 \right] \]

    - Why? Maximize likelihood \( \iff \) High density at each data point \( \iff \) Samples likely to be near data points (Proof is in the paper)

    - Difference from a GAN with a 1-nearest neighbour discriminator:

      1. Push samples towards region containing real data.
      
      2. Every sample has a nearby data point, but some data points may not have a nearby sample.

**Advantages**

- **No More Mode Collapse/Dropping**

  - Why is this important? This allows control over recall.
  
  - Otherwise better sample quality (precision) does not necessarily mean better modelling.
    
    - Wouldn’t be able to tell apart the following cases:

- Overcomes all three problems of GANs:

**Application: Multimodal Prediction**

- Conditional setting:
  
  \[ z \sim \mathcal{N}(0, I) \quad y = T_\theta(x, z) \]

- Different samples for the same input image:

  - **Multimodal Super-Resolution**

- **Multimodal Image Synthesis from Semantic Layout**

**References**


---

**Poster Presentations.com**

Poster Presentations.com can also delete them by going to VIEW > MASTER. On the Mac choose the poster type that best suits your needs and can also create your own color theme. You can easily change the color theme of your poster by going to VIEW > SLIDE MASTER. After you finish working on the master be sure to go to VIEW > NORMAL to continue working on your poster.