1. GAN

1.

As we take derivative to D and set it to zero:

2. If we take into the minimax, it becomes:

Since , and

, and

, where ,

, and

.

Thus,

,

which is the minimization of the JS-divergence.

3. If there’s a time that D can perfectly classifies generated samples from real data, D(G(z)) will become 1 and log(D(G(z))) will become negative infinity, which leads vanishes.

4. Since , and , we need to calculate for and , which is and . The results are , . As we take this into the original formula , and

, we can get

and .

For EM distance, we can use formula: , and thus we need to calculate . Since for uniform distribution , , , and .

Thus, we can plug these values into the original equation. We can get that

.

2. Diffusion Model

1. , where indicates the expectation is of the distribution of .

2. No, because the direct calculation involves the integration overall possible paths from to , and this is practically infeasible since the amount of calculation.

3. Since , where , we can expand it recursively:

Hence, as mean and variance are and correspondingly, .

4. From , which is a gaussian distribution, and , , and

, we can get: the mean of is of the form . Now, we can substitute and

into the formula.

Hence, .

5. Since ,

, in which

. And then we take gradient of x:

, and

. Finally, we can get:

.

3. Unsupervised learning / contrastive learnings:

1. True.

2. False. The mask-out rate between MAE and BERT are different. MAE is used for computer vision, so it’s mask-out rate should be much higher than that of BERT, which focuses on NLP tasks.

3. True.

4. False. CLIP is designed for classifying images with textual descriptions without extra finetuning on images. We can input datasets of images, texts and potential classes, and CLIP can find the relativeness of the images and texts through the similarities between those inputs.

4. Coding: GAN:

6.

epoch 70:

A number and a black background

Description automatically generated with medium confidence

epoch 80:

A number and a number on a black background

Description automatically generated with medium confidence

Epoch 90:

A number and a number on a black background

Description automatically generated with medium confidence

5. Coding: Diffusion Model:

4.

A graph showing a number of blue dots

Description automatically generated