GAN Sem sample questions

1. Explain the architecture of Generative Adversarial Networks (GANs), focusing on the roles of the generator and discriminator. How do they interact during training?
2. Discuss the vanishing gradient problem in GANs. Why does it occur, and what strategies can be employed to mitigate it?
3. Compare and contrast GANs with Variational Autoencoders (VAEs). Highlight their differences in terms of architecture, training objectives, and applications.
4. What is mode collapse in GANs? Explain its causes and propose techniques to address this issue effectively.
5. How does the minimax game in GANs ensure that the generator improves over time? Provide a mathematical interpretation.
6. Describe how GANs can be applied in image-to-image translation tasks such as Pix2Pix and CycleGAN. Provide specific examples of practical use cases.
7. Discuss the role of GANs in data augmentation for training other machine learning models. What are the advantages and potential pitfalls?
8. Evaluate the ethical implications of GAN-generated deepfake technology. How can GANs be regulated to mitigate potential misuse?
9. Explore how GANs are utilized in the medical field for tasks such as synthetic data generation and disease diagnosis. Include specific challenges faced in these applications.
10. Analyze the impact of GANs in creative industries, such as art, music, and content generation. How do GANs redefine creativity and originality?
11. Explain how Wasserstein GANs (WGANs) address the challenges of traditional GANs. What are the key modifications in their architecture and loss function?
12. How does the choice of activation functions and normalization techniques affect the performance of GANs? Discuss with examples.
13. Discuss the importance of evaluation metrics in GANs. Compare common metrics such as Inception Score (IS) and Fréchet Inception Distance (FID).
14. Describe how Conditional GANs (cGANs) differ from standard GANs. What additional challenges do they introduce during training?
15. What is progressive growing in GANs, and how does it improve the quality of generated data? Discuss its significance with examples from StyleGAN.
16. a) What is the role of batch normalization in DCGAN? How does it help stabilize GAN training?
    b) Given that a DCGAN uses a convolutional generator with input noise z of dimension 100, calculate the size of the output feature map after passing through three transposed convolution layers with the following kernel sizes and strides:

1. Layer 1: Kernel size = 4×4, stride = 2.
2. Layer 2: Kernel size = 4×4, stride = 2.
3. Layer 3: Kernel size = 3×3, stride = 1.

17. Given critic outputs for real data [0.7,0.9,0.6] and for fake data [0.3,0.2,0.4] calculate the Wasserstein loss.

18. **a)** What is the role of the covariance matrix in the calculation of FID?

b) If the real data has a mean vector $m_r = [0.5, 0.6]$ and covariance matrix $\Sigma_r = \begin{bmatrix} 0.9 & 0.2 \\ 0.2 & 0.8 \end{bmatrix}$, and the generated data has mean $m_g = [0.4, 0.7]$ and covariance matrix $\Sigma_g = \begin{bmatrix} 1.0 & 0.1 \\ 0.1 & 0.7 \end{bmatrix}$, calculate the FID using:

$$FID = ||m_r - m_g||^2 + \text{Tr}(\Sigma_r + \Sigma_g - 2\sqrt{\Sigma_r \Sigma_g}).$$

(*Assume* $\sqrt{\Sigma_r \Sigma_g} = \begin{bmatrix} 0.9 & 0.15 \\ 0.15 & 0.75 \end{bmatrix}$.)

19. **a)** Explain the significance of cycle consistency loss in CycleGANs.

b) If a CycleGAN has forward loss $L_{\text{forward}} = ||G(F(x)) - x||_1 = 2.5$ and backward loss $L_{\text{backward}} = ||F(G(y)) - y||_1 = 3.0$, calculate the total cycle consistency loss.

20. What are Common Challenges in Training GANs, and How Can They Be Addressed?

21. In the context of Generative Adversarial Networks (GANs), discuss the pseudo-code for training a GAN. How does the backpropagation and optimization process for both the Generator and Discriminator work? Include an explanation of why it is important to update the networks alternately and the challenges involved in training GANs.