

## EECS545 Lecture 18 Quiz Solutions

1. The purpose of the generator  $G$  in GAN is to (check all that apply)
- (a) Maximize classification error for discriminator
  - (b) Minimize classification error for discriminator
  - (c) Minimize  $\log(1 - D(G(z)))$ .
  - (d) Maximize  $\log(D(G(z)))$  as an approximate objective

**Solution:** (a), (c), (d) Note the GAN objective is:

$$\min_{\theta_g} \max_{\theta_d} [\mathbb{E}_{x \sim p_{\text{data}}} \log D_{\theta_d}(x) + \mathbb{E}_{z \sim p(z)} \log(1 - D_{\theta_d}(G_{\theta_g}(z)))]$$

where the term on the right is the term with the generated output for fake data.

2. Ideally, in GAN, when both generator and discriminator have enough capacity and training both of them converges after some iterations, which of the following statements are true? (Check all that apply.)
- (a) The discriminator can perfectly distinguish the samples from real data and the generated samples
  - (b) The generator can generate samples with the same distribution as the real data samples
  - (c) Both the generator and discriminator cannot be improved more
  - (d) The discriminator is unable to differentiate the real data samples and generated samples

**Solution:** (b), (c), (d)

3. Which of the following statements is true for a (vanilla) variational auto-encoder? (Check all that apply.)
- (a) VAE can be used for both continuous latent variables and discrete latent variables
  - (b) VAE efficiently approximates the maximum likelihood estimation for parameters in the network of encoder and decoder
  - (c) Training of VAE is more difficult than GAN
  - (d) VAE can be used to infer the latent variable  $z$  for input image  $x$  as latent representation, while GAN cannot be used to infer the latent representation.

**Solution:** (b), (d)

4. Will  $\log(1 - D(G(z)))$  saturate early in learning if  $G$  is poor?

- (a) Yes, as discriminator can reject generated samples with high confidence
- (b) No, as discriminator can reject generated samples with high confidence
- (c) Yes, as discriminator will have very low confidence
- (d) No, as discriminator will have very low confidence

**Solution:** (a)

5. What are the differences between VAEs and diffusion models?

- (a) VAEs are inspired by non-equilibrium thermodynamics, while diffusion models rely on a surrogate loss
- (b) VAEs have access to a low-dimensional latent space, while diffusion models do not
- (c) VAEs can generate images in a single pass, while diffusion models have to generate through several passes
- (d) VAEs are approximate density models, while diffusion models are not

**Solution:** (b) and (c)