Lecture 9 – Unsupervised Learning & GANs

Provide short answers (max. 25 words each) to the following questions.

- What is the key characteristic of Unsupervised Learning?
- Give two common applications of Unsupervised Learning.
- What is the typical role of latent variables in Unsupervised Learning?
- Name three classical Unsupervised Learning methods.
- What is the main goal of generative models in Unsupervised Learning?
- List three types of generative models.
- What does “efficient sampling” mean for generative models?
- What does “coverage” mean in generative models?
- What is a well-behaved latent space?
- What is a disentangled latent space?
- What is test likelihood used for?
- What is the Inception Score?
- What two criteria define a good Inception Score?
- What is the main goal of GANs?
- What are the two components of a GAN?
- What does the Generator do in a GAN?
- What does the Discriminator do in a GAN?
- What loss function is commonly used for the Discriminator?
- What is mode collapse?
- What is mode dropping?
- What metric improves GAN training stability?
- What is a Conditional GAN?
- What is the goal of InfoGAN?
- What does Pix2Pix do?
- What is CycleGAN used for?
- What is StyleGAN’s main innovation?
- Give one technique to improve GAN image quality.

Multiple-choice questions

What is the key characteristic of Unsupervised Learning?

A) Requires labeled data
B) Learns from unlabeled data
C) Uses reinforcement signals
D) Predicts future states

Which of the following is NOT an Unsupervised Learning application?

A) Clustering
B) Dimensionality reduction
C) Image classification with labels
D) Data compression

What is the typical role of latent variables in Unsupervised Learning?

A) Increase data dimensionality
B) Represent compressed data features
C) Predict labels
D) Remove noise completely

Which of the following is a classical unsupervised method?

A) Logistic regression
B) K-means clustering
C) Decision trees
D) Gradient boosting

Which of these is a generative model?

A) Random Forest
B) SVM
C) GAN
D) Linear Regression

What does “efficient sampling” mean for generative models?

A) Sampling requires large computation
B) Sampling is fast and parallelizable
C) Sampling is probabilistic only
D) Sampling ignores latent space

What does “coverage” refer to in generative models?

A) Generated samples represent all modes of the training distribution
B) Generated samples are identical to training data
C) Generated samples ignore diversity
D) Generated samples are deterministic

What is a well-behaved latent space?

A) Random changes in latent variables produce random outputs
B) Smooth changes in latent variables produce smooth changes in outputs
C) Latent space is discrete only
D) Latent space ignores data structure

What is a disentangled latent space?

A) Latent dimensions control multiple properties simultaneously
B) Each latent dimension controls an interpretable property
C) Latent space is random
D) Latent space is fixed

Which property is desirable for Probabilistic Generative Models?

A) Efficient likelihood computation
B) Ignoring likelihood
C) Removing latent variables
D) Using deterministic outputs only

What does test likelihood measure?

A) Probability of generated samples being real
B) Latent space smoothness
C) Diversity of generated samples
D) Fit of model to unseen data

What is the Inception Score used for?

A) Evaluate image generation quality
B) Evaluate clustering quality
C) Measure latent space disentanglement
D) Compute GAN loss

Which condition improves Inception Score?

A) Generated images are class-specific and diverse
B) Generated images belong to multiple classes
C) Generated images are identical
D) Generated images ignore class labels

What is the main goal of GANs?

A) Predict labels
B) Compress data
C) Generate samples indistinguishable from real data
D) Remove noise

What are the two components of a GAN?

A) Encoder and Decoder
B) Generator and Discriminator
C) Predictor and Classifier

D) Transformer and Attention

What does the Generator do?

A) Classifies real vs fake
B) Normalizes data
C) Computes loss
D) Produces synthetic samples from latent variables

What does the Discriminator do?

A) Generates samples
B) Compresses latent space
C) Distinguishes real from fake samples
D) Performs clustering

Which loss function is commonly used for the Discriminator?

A) Mean squared error
B) Cross-entropy
C) Hinge loss
D) KL divergence

What is mode collapse?

A) Generator produces diverse samples
B) Generator outputs very few distinct samples
C) Discriminator fails completely
D) Latent space expands

What is mode dropping?

A) Generator ignores parts of the data distribution
B) Generator covers all modes
C) Discriminator ignores real samples
D) Latent space becomes random

Which metric improves GAN stability?

A) KL divergence
B) Euclidean distance
C) Wasserstein distance
D) Cosine similarity

Which technique enforces Lipschitz constraint in WGANs?

A) Dropout
B) Batch normalization

C) Weight clipping
D) Data augmentation

What is a Conditional GAN?

A) GAN that uses additional attributes for generation
B) GAN without latent variables
C) GAN that ignores discriminator
D) GAN for clustering

What is InfoGAN's main goal?

A) Remove latent space
B) Learn interpretable and disentangled representations
C) Increase batch size
D) Reduce diversity

What does Pix2Pix do?

A) Text-to-image generation
B) Image-to-image translation using paired data
C) Style transfer without pairs
D) Latent space interpolation

What is CycleGAN used for?

A) Paired image translation
B) Text generation
C) Unpaired image-to-image translation
D) Audio synthesis

What is StyleGAN's main innovation?

A) Removes latent space
B) Ignores image resolution
C) Uses only convolution
D) Separates style and noise for fine control