Lecture 30 Auto Encoder

revision of previous lecture
strides, pooling, auto encoder basic
encoder
decoder
latent-space

Types of Auto Encoder

① Vanilla Autoencoder

Type of artificial neural network used to learn efficient codings of input data in an unsupervised manner. (unlabeled)

reconstruction loss

loss function measures the difference b/w input reconstructed output. (MSE)

input ← - - $x \approx x'$ - - → Re-construction

[illegible] (Fully connected) [illegible]

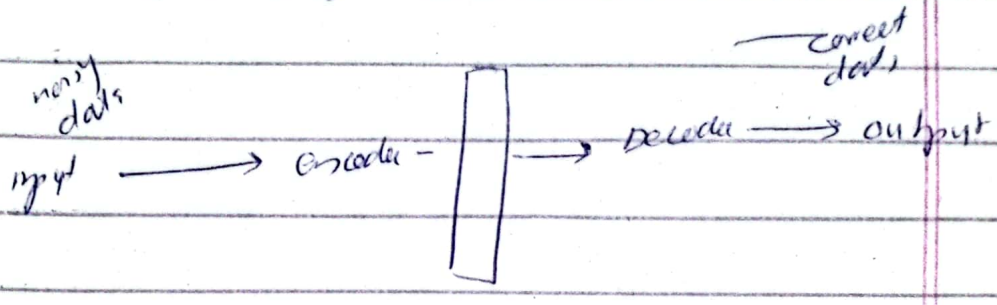
Application :- ① image compression ② anomaly detection (unusual)

③ data denoising ④ dimensionality reduction

② Denoising auto-encoder

removes noise from data by learning robust representation.

during training, the input data is corrupted with noise, but target remains original, uncorrupted data.



input corruption

(random noise is added to input)

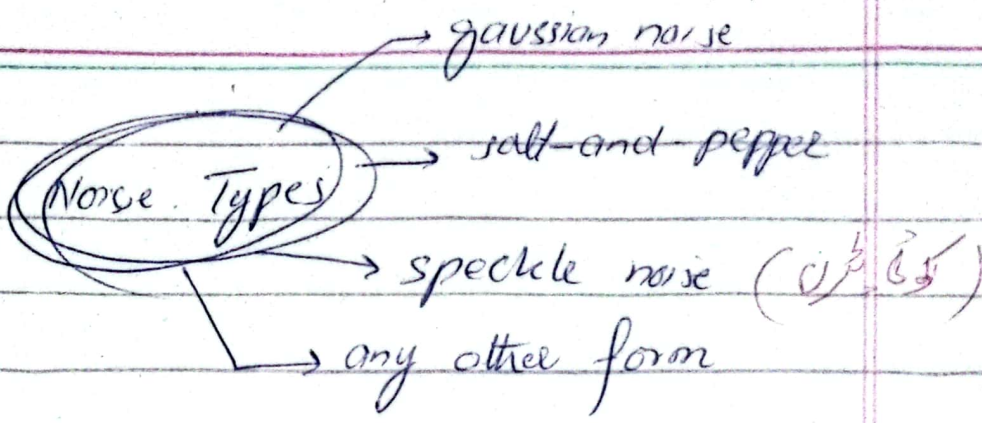
Reconstructor

The autoencoder is trained to re-construct the original, noise-free data from corrupted world.

measures the difference b/w original (clean) input & reconstruct output

Purpose	Advantage
To learn denoise data	• improved feature learning • robustness to noisy data • better generalization

Application
1. image denoising
2. audio denoising
3. Pre-processing for training task



③ Convolutional Auto Encoder (CAE)

Convolutional Autoencoder (CAE) type of autoencoder that uses convolutional layers to learn efficient encoding of image data.

encoder :- use convolutional layers to extract Hierarchical features

Latent space :- encoded representation with reduced dimension, capturing the essential features.

Decoder :- uses transposed convolutional layer (upsampling) to reconstruct the input image from latent space.

⇒ By increasing the number of image we can increase the size of image.

Perform	Advantages
1) image compression	1) exploit spatial hierarchies (local + high)
2) denoising	2) reduce no of parameters
3) feature extraction	3) Improve generalization

Training,

network to trained to " minimize the reconstruction error, using MSE (Mean Squared Error) as loss function.

Applications

③ Anomaly detection → ① image denoising

④ Pre processing for → ② image compression

vision tasks

pooling

- max pooling or average pooling are often used in encoder to reduce spatial dimension

upsampling

used in decoder to restore original dimension

Regularization :

Techniques like drop out & weight decay can be used to prevent over-fitting

Hyper-parameters

include the number of convolutional layers, filter, size, learning rate

Effectiveness depends on

↳ ① architecture

② Type of convolutional layers

③ Tuning of hyper-parameters

basic model of Gen AI

④ Variational Auto Encoder (VAE)

major issue with regular auto-encoder is that latent space that inputs are converted to are discrete.

(output) کے لیے (input) جس سے (encoder) بنایا ہے وہ

ہوتی ہے

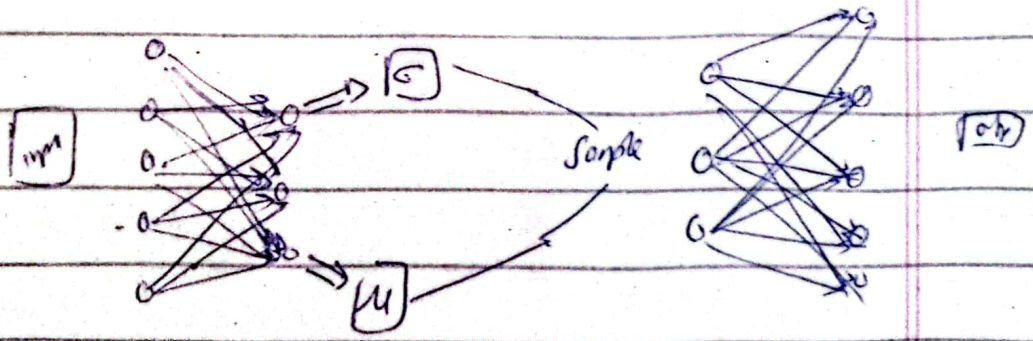
• اس میں ہم آؤٹ پٹ کو (input) کی طرح بنانے کی

کوشش کرتے ہیں کہ (features) کو دیکھ

کر نئی مدد سے (new images) بنا سکیں۔

- mean → average
- variance → range

Generative part of auto encoder works by randomly picking samples from latent space



encoder does not generate a vector size of n but generate two vector miles

vector mean μ

Standard deviation σ

Practical Applications

1. Data Generator (creating new data samples)
2. Representation learning (learning compact, meaningful representations)
3. Anomaly Detection (identifying unusual data points)