DL lab 7 -Autoencoders (IT21067242 Fernando M.R.R.)

2)

**Linear AE:** When no non-linear activations are used, the AE can only learn linear transformations of the input data. The linear AE tries to minimize reconstruction error between input and output, which is conceptually like PCA.

**PCA:** PCA identifies orthogonal axes of maximum variance and projects data onto these axes, reducing dimensionality while preserving as much variance as possible. Linear AE, when trained, learns a set of weights that perform a similar projection, hence it can be considered a learned version of PCA.

4)

**Reconstruction Accuracy:** The CNN AE uses convolutional layers that are better suited for handling spatial data, like images. These layers capture local patterns (edges, textures) better than dense layers, leading to improved reconstruction quality.

**Test Loss:** You should observe a lower test loss in the CNN AE compared to the dense AE. This improvement occurs because CNNs are more efficient at learning spatial hierarchies, which helps in better image reconstruction.

**Overfitting:** Check whether the CNN AE generalizes better by comparing the training and validation loss curves. A CNN AE is often less prone to overfitting compared to dense AE because of its ability to reduce dimensionality while preserving spatial information.

6)

**Noise Regularization:** Adding noise acts as a regularize, preventing the model from memorizing the training data and improving its ability to generalize to new data.

**Denoising Capability:** The model learns to remove noise, which enhances its feature extraction capabilities.

7)

**Differences Between Autoencoder (AE) and Variational Autoencoder (VAE)**

* **Autoencoder (AE):** A deterministic model where the encoder maps inputs to a latent space, and the decoder reconstructs the input.
* **Variational Autoencoder (VAE):** A probabilistic model where the encoder produces a distribution (mean and variance) over the latent space. The decoder then reconstructs the input by sampling from this distribution, allowing VAE to generate new data and perform better generalization.