**DL Lab 7 Answers**

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1. **Explain Linear AE and PCA Relationship**

Linear Autoencoders (AEs) without activation functions perform linear transformations. This makes them mathematically equivalent to Principal Component Analysis (PCA). Both reduce dimensionality by finding a lower-dimensional representation of data, but AEs learn through neural network optimization, while PCA uses singular value decomposition (SVD).

**3.**

**Enhanced Image Reconstruction**

The Vanilla CNN AE typically achieves better reconstruction quality due to its ability to capture spatial features.

**Faster Convergence**

The CNN architecture allows for quicker learning, resulting in lower loss values in fewer epochs.

**Greater Robustness**

The CNN's design reduces overfitting, improving the model's performance on unseen data.

**Improved Detail Preservation**

The resulting images from the Vanilla CNN AE show clearer details and fewer artifacts compared to those generated by fully connected AEs.

**6.**

**Enhanced Generalization**: The Image Denoising AE's exposure to noise during training allows it to generalize better to unseen data, leading to improved performance in diverse conditions.

**Improved Reconstruction of Noisy Inputs**: The denoising approach enables the model to effectively reconstruct clean images from noisy inputs, making it more versatile in real-world applications.

**Greater Robustness**: By learning to filter out noise, the Image Denoising AE demonstrates enhanced robustness compared to the Vanilla CNN AE, which may not perform as well in noisy environments.

**7. AE vs. VAE**:

The key difference between AEs and VAEs lies in their structure and purpose. AEs compress data without any probabilistic assumptions, while VAEs introduce randomness by modeling data distribution, making them capable of generating new data.