Autoencoder with SVHN Dataset

Follow the instructions below carefully.

1. Dataset

- Use the **SVHN (Street View House Numbers)** dataset.
- Dataset link: `https://www.kaggle.com/datasets/stanfordu/street-view-house-numbers`
- Do **not** use the labels; the task is unsupervised.

2. Model Architecture

You must implement a **convolutional autoencoder** consisting of:

Encoder

- Images must be used in RGB format as input.
- Produces a low-dimensional **latent representation**.

Decoder

- Reconstructs the image from the latent representation.
- Output size must be $32 \times 32 \times 3$.

3. Training

- Input = image, Target = same image.
- Loss function: Mean Squared Error (MSE).
- Train the model for at least **20 epochs**.

4. Required Experiments

4.1 Reconstruction Results

- Display at least 10 original images.
- Display their corresponding reconstructed images.
- Show original and reconstructed images side by side.

4.2 Latent Representation

- Create a separate encoder model.
- Extract latent vectors for sample images.
- Report the shape of the latent representation.
- Print one example latent vector.

4.3 Size Experiment

- Train the autoencoder using at least two different latent sizes (e.g., 64 and 16).
- Compare reconstruction quality for different latent sizes.
- Print example latent vectors for each latent size and report their shapes.
- Comment briefly on how reducing the latent dimension affects the representation.
- Demonstrate that the latent representation preserves sufficient information by showing successful image reconstruction.

5. Written Explanation (Markdown Cells)

In the notebook, briefly explain:

- What a latent representation is.
- How dimensionality reduction affects reconstruction quality.
- The role of autoencoders in representation learning.

6. Submission

- Submit a **Jupyter Notebook (.ipynb)**.
- The notebook must include code, outputs, and explanations.
- The notebook must run end-to-end without errors.