Instructions for Running the Code

1. Environment

- The project was on **Kaggle Notebooks**.
- Kaggle provides the required environment by default, including:
    - Python 3.9+
    - PyTorch and Torchvision
    - NumPy, Matplotlib, and Scikit-learn
- No additional installation is required if run on Kaggle.

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2. Dataset

By default, the notebook loads images from the following directory:

```
/kaggle/input/human-bone-fractures-image-dataset/Human Bone Fractures Multi-modal Image Dataset (HBFMID)/Bone Fractures Detection/train/images
```

- If the dataset is not available, the notebook automatically falls back to the **MNIST** dataset.
- To use a custom dataset:
    1. Upload the dataset to **Kaggle Datasets** from the link attached below or from the given folder

Dataset Link →
https://www.kaggle.com/datasets/jockeroika/human-bone-fractures-image-dataset

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3. Running the Notebook

1. Open the Kaggle notebook:
2. In **Notebook Settings**, enable GPU T4 x 2 for faster training (`Setting > Accelerator > GPU T4 x 2`)

3. Run all cells sequentially (`Cell > Run All`).
    - Imports
    - Access Dataset
    - DataLoader
    - VAE Setup
    - Stochastic PG-ECA Setup
    - Evaluation Metrics for Clustering, Generation and Reconstruction
    - Main Method for Training, evaluation and visualization

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4. Outputs

- **Training logs**: Reconstruction and KL losses per epoch.
- **Clustering metrics**: Silhouette Score
- **Generative metrics**: Frechet Inception Distance (FID), Inception Score (IS).
- **Visual outputs**:
    - Reconstructed and generated images by VAE and Stochastic PG-ECA
    - t-SNE and embedding plots for clustering by VAE and Stochastic PG-ECA
