# **Variational Autoencoder (VAE) Evaluation Report**

**1. Correct Architecture (Encoder, Decoder, Reparameterization Trick)**

* The notebook correctly implements a VAE with separate encoder and decoder networks.
* The reparameterization trick is correctly applied to allow gradient-based optimization.

**2. Modular and Structured Code**

* The code is well-structured with modular functions for the encoder, decoder, training loop, and visualization.
* Class-based implementation ensures reusability and clarity.

**3. Uses PyTorch Correctly**

* The model is implemented using PyTorch.
* Tensors are properly transferred to GPU if available.

**4. Proper Loss Function (Reconstruction + KL Divergence)**

* The loss function includes both reconstruction loss (Binary Cross-Entropy) and KL divergence.
* The KL divergence term ensures a well-formed latent space.

**5. Optimized Training Loop**

* Training loop correctly updates parameters and logs losses.
* Validation is performed to track model performance.

**6. Correct Use of Optimizers and Learning Rate Scheduling**

* Adam optimizer is used with an appropriate learning rate (1e-3).
* No explicit learning rate scheduling is observed.

**7. Clear Reconstruction of Test Images**

* Reconstructed images are displayed, showing reasonable quality.

**8. Proper Latent Space Visualization (t-SNE, PCA, or Direct Sampling)**

* Latent space is visualized using t-SNE and PCA, confirming structure in learned representations.

**9. Ability to Generate Realistic New Images**

* The decoder is used to generate new samples from the latent space.
* The generated images resemble Fashion MNIST categories.

**10. Experimentation with Different Latent Space Sizes, Learning Rates, etc.**

* The model is tested with a latent dimension of 2.
* No additional experiments with different latent sizes or learning rates are observed.

**11. Justification for Chosen Hyperparameters**

* No explicit justification for hyperparameters is provided.
* The chosen parameters (latent\_dim=2, lr=1e-3, batch\_size=128) are reasonable.

**12. Comparative Results Between Different Configurations**

* The notebook does not compare results across different model configurations.

**13. Loss Plots (Training & Validation)**

* Training loss is plotted, but validation loss tracking could be improved.

**14. Side-by-Side Comparison of Original vs. Reconstructed Images**

* Original and reconstructed images are displayed together, showing a reasonable match.

**15. Quantitative Analysis Comparing Different Models**

* No quantitative analysis comparing different models is provided.