Assignment 03: Image Classification with PCA and SVM

Objective:
Use **Principal Component Analysis (PCA)** for feature extraction and **Support Vector Machine (SVM)** for classification of animal images.

Tasks:

1. **Data Preprocessing**:
   - Load the **animal image dataset**.
   - Convert all images to **grayscale**.
   - Resize the images to **64x64**.
   - Flatten the images into **1D vectors** (size: 4096 per image).

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2. **Feature Extraction with PCA**:
   - Use **Principal Component Analysis (PCA)** to reduce the dimensionality of the image data.
   - Select the number of components such that at least **95% variance** is retained.

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3. **Classification with SVM**:
   - Split the dataset into **training** (80%) and **test** (20%) sets.
   - Train a **Support Vector Machine (SVM)** classifier on the PCA-reduced features.
   - Use a **linear kernel** for the SVM.

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4. **Model Evaluation**:
   - Evaluate the SVM classifier on the test set.
   - Report:
     - **Accuracy** of the model.
     - **Confusion Matrix** for the test predictions.
     - **Classification Report** (Precision, Recall, F1-Score).

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5. **Visualization**:
   - Plot the **explained variance ratio** of PCA components.
   - Display a few **test images** with their predicted and true labels.

Bonus Task (Optional):

- Experiment with different SVM kernels (e.g., **RBF**, **Polynomial**) and compare their performance.
- Visualize the first **5 PCA components** as images.

Submission Requirements:

- Submit a **Jupyter Notebook** with:
  - Code for each step.
  - Output metrics and visualizations.
  - A short **conclusion** discussing the impact of PCA on SVM performance.