**University of Engineering and Technology**

**Computer Programming-2**

**Image Classification of Urdu Alphabets**

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INTRODUCTION:

The Image Classification project aims to classify images of Urdu alphabets into different categories using machine learning techniques. The project utilizes a Random Forest classifier to achieve this task.

Dataset:

The dataset consists of images of Urdu alphabets categorized into four folders: S, R, L, and Z. Each folder contains images corresponding to the respective alphabet. The images are in JPEG format and are preprocessed to grayscale and resized to 128x128 pixels.

Implementation:

The project is implemented in Python using the following libraries:

* OpenCV (cv2) for image loading and preprocessing
* NumPy for array manipulation
* scikit-learn for the Random Forest classifier and evaluation metrics

Project structure:

The project is structured as follows:

* **ImageClassifier Class**: Defines methods for loading images, splitting the dataset into training and testing sets, training the Random Forest model, evaluating model performance, and making predictions on new images.
* **Main Function:** Initializes an instance of the ImageClassifier class, loads images from the specified folders, splits the dataset, trains the model, evaluates model performance, and predicts labels for new images.

Results:

* The Random Forest classifier achieved an accuracy of X% and an F1 score of Y on the test set.
* Performance evaluation involved comparing actual labels with predicted labels using accuracy and F1 score metrics.

Challenges and limitations:

* **Path Handling:** Path to the dataset folders needs to be adjusted based on the system where the code is executed.
* **Data Preprocessing:** The preprocessing steps (grayscale conversion, resizing, flattening) may affect model performance and could be optimized further.
* **Model Selection:** While Random Forest is used in this project, other algorithms could be explored for potentially better performance.

Future improvements:

* **Hyperparameter Tuning:** Experiment with different hyperparameters of the Random Forest classifier to improve model performance.
* **Data Augmentation**: Introduce data augmentation techniques to increase the diversity of the training data.
* **Model Ensembling:** Combine predictions from multiple models to improve classification accuracy

Conclusion:

The Image Classification project demonstrates the application of machine learning techniques to classify Urdu alphabet images. While the Random Forest classifier achieves reasonable performance, there is room for improvement through further optimization and exploration of advanced techniques.