IMAGE CLASSIFICATION USING CIFAR-10 DATASET: A COMPARISON OF MANHATTAN (L1) AND EUCLIDEAN (L2) DISTANCES WITH 5-FOLD CROSS-VALIDATION

In this assignment, we will explore the CIFAR-10 dataset, which consists of 60,000 32x32x3 color images in 10 different classes. The objective is to build a model for image classification and compare the performance of Manhattan (L1) and Euclidean (L2) distances using 5-fold cross-validation. We will use only the training data, which consists of 50,000 images, and convert them to gray-scale (32x32) to reduce computation time. We will plot a graph to visualize the accuracy of different hyperparameter values (K) for both distance calculation techniques and discuss which distance calculation technique is better suited for this particular dataset. Furthermore, we will display the top 5 predictions made by the model.

Dataset and Preprocessing:

The CIFAR-10 dataset can be downloaded from the following link: https://github.com/YoongiKim/CIFAR-10-images. After downloading the dataset, we will preprocess it by converting the 50,000 training images to gray-scale. This conversion reduces the dimensionality of the data and decreases computation time while still preserving important image features.

Model Building and Evaluation:

To classify the gray-scale CIFAR-10 images, we will employ the k-nearest neighbors (k-NN) algorithm. This algorithm classifies an image by considering the class labels of its k nearest neighbors. We will use two distance metrics, Manhattan (L1) and Euclidean (L2), to measure the similarity between images.

To evaluate the performance of our model, we will use 5-fold cross-validation. The training dataset will be divided into 5 subsets (folds), and the model will be trained and evaluated 5 times using different combinations of training and validation data. This approach allows us to assess the model's performance across multiple folds, providing a more robust evaluation.

Results and Analysis:

For each fold, we will vary the hyperparameter K (the number of nearest neighbors) and record the accuracy achieved by the model for each value of K. We will compute the average accuracy across all folds for each value of K and distance calculation technique.

Next, we will plot a graph with K on the X-axis and accuracy on the Y-axis for both the Manhattan (L1) and Euclidean (L2) distances. This graph will allow us to visualize the impact of different values of K on the model's accuracy for each distance calculation technique.

Discussion:

In the discussion section, we will compare the performance of Manhattan (L1) and Euclidean (L2) distances based on the average accuracy values obtained from the 5-fold cross-validation. We will consider factors such as the dataset's characteristics, the nature of the features, and the complexity of the classes in determining which distance calculation technique is better suited for this specific gray-scale dataset. We will also discuss any limitations or potential improvements that could be made to enhance the classification accuracy.

Top 5 Predictions:

Finally, we will display the top 5 predictions made by the model on a set of test images. These predictions will showcase the model's ability to classify gray-scale images accurately and provide insights into its performance.

** Finally, to fulfill the assignment requirements, please ensure that you upload the completed Jupyter Notebook to your GitHub repository. The file should be named "assignment_1_KNN.ipynb" and should be uploaded on or before the 7th of July.