Brandy Griffin

Department of Science, Technology, Engineering & Math, Houston

ITAI 1378 Computer Vision

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Professor Patricia McManus

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**Image Classification with CIFAR-10 Dataset and Scikit-Learn**

**Installing and Importing Libraries**

For this assignment students had to open a notebook within Jupyter. The objection was to download the following file located in Module 5 for this week and run commands. I have attached the file down below: assignment <https://eagleonline.hccs.edu/courses/266737/files/66961867/download?download_frd=1>

After downloading the above file students had to ensure that the proper dataset is downloaded plus libraries were installed. You can install the libraries individually or all at once. To make sure all libraries were installed correctly and the same time I used the following command. This command uploads numpy, matplotlib, tensorflow and scikit-learn.

!pip install numpy matplotlib tensorflow scikit**-**learn

This command was already prewritten within the first cell. All I had to do was run the cell by pressing the play icon. After running the cell this command imported multiple libraries. After the libraries were installed, I had to import them into my notebook. Once that step is completed, now we’re able to use the functionalities in the codes. All libraries use short names to make code clear to read. Then I used the following code below for the above step

# Importing necessary libraries

While installing all libraries at once is more convenient and efficient in terms of time and dependency management, doing so may complicate debugging if issues arise, making it beneficial to weigh these factors based on your specific needs.

**Loading and Preprocessing the CIFAR-10 Dataset**

The next step is CIFAR-10 dataset was already available in the keras library. This will assist in loading the dataset and preprocess it by converting images into grayscale and flattening them.

Using the codes

# Load CIFAR-10 dataset

# To minimize computational demands lets work with three classes of your choice

# CIFAR-10 classes

class\_names = ['airplane', 'automobile', 'bird', 'cat', 'deer',

'dog', 'frog', 'horse', 'ship', 'truck']

# Choose a subset of classes

['cat', 'dog', 'ship']

# Filter data for the chosen classes

# Convert images to grayscale

# Normalize the images

# Flatten the images

# Display a sample image

The above code gives commands that will focus on just three classes such as cat, dog, and ship which filter out only the images and labels for these classes. After that, the command converted the images to grayscale using a formula based on the RGB channels and normalized the pixel values again. Finally, it displayed a sample grayscale image and printed the sizes of the training and testing sets. This gives us a good overview of the data prepared for training the model.

**Training a Machine Learning Model**

**What is SVM (Support Vector Machine)?**

Support Vector Machine (SVM) is a supervised learning algorithm used mainly for classification. Its goal is to find the optimal hyperplane that separates data points into different classes in an N-dimensional space. Key components include the hyperplane which is the decision boundary, support vectors the closest points to the hyperplane that influence its position, and the margin the distance between the hyperplane and the nearest points. SVM maximizes this margin to improve classification accuracy and model robustness.

**Why Use SVM?**

SVM is a valuable machine learning algorithm because it performs well in high-dimensional spaces, making it suitable for complex datasets. It is memory efficient, using only a subset of training points to support vectors, which reduces computational load. Additionally, SVM’s versatility with kernel functions, such as linear, polynomial, and radial basis function (RBF), allows it to handle both linearly and non-linearly separable data, making it adaptable to a wide range of problems. These qualities make SVM an effective and flexible choice for many machine learning tasks.

**What does SVC (kernel=’linear’) mean?**

SVC (Support Vector Classification) is a classification implementation of SVM where the kernel parameter defines the decision boundary. When using SVC (kernel=’linear’), the algorithm assumes the data is linearly separable and applies a straight hyperplane to divide it. For non-linear data, other kernels like polynomial or radial basis function (RBF) transform the data into higher-dimensional spaces to achieve separation. These options make SVM flexible and adaptable for various data types.

**Training the SVM Model**

To train the model on the extracted features Support Vector Machine was used. The

Commands use for this one were

# Train an SVM classifier

# Predict on the test set

# Evaluate the model

# Lets see some images of the datasset in the different stages

# Function to display images

# Display original color images

# Display gray/scale images

# Display normalized images

The final output was a cool grid with 5 columns and 3 rows, showing original color images of cats and ships. Images went from grayscale to bright colors showing how the transformation worked. It organized the images by recession and classification, making it easy to see the differences between the two subjects.

**Conclusion**

In conclusion, I got to see how Jupyter works by learning how to install libraries and work with the CIFAR-10 dataset, focusing on three classes such as a cat, dog, and ship. I went through the steps of converting images to grayscale, normalizing, and flattening them, which set me up to train a Support Vector Machine (SVM) model. Using SVM and SVC with a linear kernel showed me how classification works in complex data. Plus, displaying images during the process gave me a clear view of how the data changed, helping me to understand each command is important for dataset

**References**

“CIFAR-10 Dataset Instructions.” *Bing Videos*, www.bing.com/videos/riverview/relatedvideo?q=CIFAR-10+dataset+instructions&mid=5006F76C8BE1616552BB5006F76C8BE1616552BB&FORM=VIRE. Accessed [09/26/2024].