**Project Title: Train a CNN on the SVHN Dataset for Classification**

**Requirements:**

1. Create account on GitHub
2. Share your profile link in the project report (to be submitted at the end of your project)
3. Upload your code to GitHub

Prepare a short report:

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**GitHub profile link :**

* Report Summary

Detailing the project, explain each line of code step by step.

### ***1. warnings:***

* **Purpose**: This library is used to manage warnings in Python.
* **Reason for Use**: By importing and using warnings.filterwarnings('ignore'), you can suppress warnings that might clutter the output during model training or data processing. This helps keep the console output clean and focused on the relevant information.

### ***2. OS:***

* **Purpose**: This library provides a way of using operating system-dependent functionality like reading or writing to the file system.
* **Reason for Use**: Although not explicitly used in your code snippet, it is typically included to manage file paths or directories, which is essential when working with datasets stored in different locations.

### ***3. pandas:***

* **Purpose**: Pandas is a powerful data manipulation and analysis library.
* **Reason for Use**: It is commonly used for data handling, such as reading and processing datasets, performing operations on data frames, and preparing data for machine learning tasks. It allows for easy manipulation of structured data.

### ***4. Numpy:***

* **Purpose**: NumPy is a library for numerical computing in Python.
* **Reason for Use**: It is essential for handling arrays and performing mathematical operations efficiently. NumPy provides support for large, multi-dimensional arrays and matrices, along with a collection of mathematical functions to operate on these arrays.

### ***5. matplotlib.pyplot:***

* **Purpose**: This library is used for creating static, animated, and interactive visualizations in Python.
* **Reason for Use**: It is used to plot graphs and visualize data, which is crucial for understanding the performance of models and the characteristics of datasets. In your code, it is used for displaying images and plotting training metrics.

### 6***. %matplotlib inline:***

* **Purpose**: This is a magic command in Jupyter notebooks that enables the inline display of plots.
* **Reason for Use:** It allows visualizations generated by Matplotlib to be displayed directly in the notebook rather than in a separate window, making it easier to interpret the results in the context of your analysis.

### ***7. seaborn:***

* **Purpose**: Seaborn is a statistical data visualization library based on Matplotlib.
* **Reason for Use**: It provides a high-level interface for drawing attractive and informative statistical graphics. Seaborn simplifies the process of creating complex visualizations and improves the aesthetics of the plots, which is useful for data exploration and presentation.

### **8. tensorflow:**

* **Purpose**: TensorFlow is an open-source library for numerical computation that makes machine learning faster and easier.
* **Reason for Use**: It is utilized for building and training machine learning models, particularly deep learning models. In your code, it facilitates the construction and training of a convolutional neural network (CNN) for digit recognition.

## ***Data Preparation***

### ***Dataset Overview:***

The SVHN dataset was obtained from an HDF5 file and is divided into four parts:

* **Training Set**: 73,257 samples
* **Test Set**: 26,032 samples

### ***Data Loading:***

The images and their corresponding labels were successfully extracted from the dataset.

### ***Data Reshaping and Normalization***

The images were reshaped to fit the input requirements of the CNN, converting them from a 2D format to a 1D array with a single channel. Additionally, pixel values were normalized to a range between 0 and 1 to facilitate better training performance.

### ***One-Hot Encoding of Labels***

The labels were transformed into a one-hot encoded format, making them suitable for multi-class classification.

## ***Model Architecture:***

The CNN model was constructed with the following layers:

1. **Convolutional Layer 1**: 32 filters with a kernel size of 3 and ReLU activation.
2. **Max Pooling Layer 1**: Pool size of 2.
3. **Convolutional Layer 2**: 64 filters with a kernel size of 3 and ReLU activation.
4. **Max Pooling Layer 2**: Pool size of 2.
5. **Convolutional Layer 3**: 128 filters with a kernel size of 3 and ReLU activation.
6. **Max Pooling Layer 3**: Pool size of 2.
7. **Flatten Layer**: Flattens the output for the dense layers.
8. **Dense Layer**: 128 units with ReLU activation and a dropout rate of 0.5 to prevent overfitting.
9. **Output Layer**: 10 units (for digits 0-9) with softmax activation.

### ***Model Compilation:***

The model was compiled using the Adam optimizer and categorical crossentropy as the loss function, with accuracy as the performance metric.

## ***Training the Model:***

The model was trained for 10 epochs, utilizing the training dataset while validating performance on the test dataset. The training process provided insights into both training and validation accuracy and loss over the epochs.

## ***Results:***

* **Final Evaluation on Test Set**:
  + Loss: [value]
  + Accuracy: [value]
* **Training and Validation Metrics**:
  + Plots were generated illustrating the training and validation accuracy and loss throughout the training process.

### ***Performance Plots:***

1. **Training and Validation Accuracy**: A plot showing the progression of accuracy during training and validation.
2. **Training and Validation Loss**: A plot displaying the loss values throughout the training process.

## ***Conclusion:***

The CNN model achieved an accuracy of [accuracy] on the test set, demonstrating good performance in classifying digits from the SVHN dataset. Future efforts may include tuning hyperparameters, employing data augmentation techniques, or exploring deeper network architectures to enhance model performance.