**Neural Networks and Deep Learning ICP-4:**

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**Video link:** [**https://drive.google.com/file/d/1AvPunqopuo8TYmyujMq9BjTP52np1vXX/view?usp=sharing**](https://drive.google.com/file/d/1AvPunqopuo8TYmyujMq9BjTP52np1vXX/view?usp=sharing)

**Github link:** [**https://github.com/PavanNagaSaiG/Neural\_Network\_DeepLearning**](https://github.com/PavanNagaSaiG/Neural_Network_DeepLearning)

**Question-1**

**A screenshot of a computer program

Description automatically generated**

**A computer code with black text

Description automatically generated**

**Explanation:**

* The script imports necessary tools from Keras to build an autoencoder, a type of neural network used for compressing and decompressing data.
* An autoencoder model is designed with two main parts: an encoder that compresses input data (images) into a 32-unit representation, and a decoder that tries to reconstruct the original image from this compressed form.
* The autoencoder model is compiled with a specific optimizer and loss function, setting it up for training.
* The script loads the Fashion MNIST dataset, which is a collection of small grayscale images of clothing items, splitting it into training and test sets.
* The image data is prepared for the network by transforming it into the correct form (floats between 0 and 1) and shape (flattened arrays).
* Finally, the model is trained using the training data, with the learning process running five times over the entire dataset, and its learning performance is evaluated using a separate set of test images.

**Output:**

**A screenshot of a computer program

Description automatically generated**

**A screenshot of a computer code

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**A computer screen shot of a program

Description automatically generated**

**A screenshot of a computer program

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**Explanation:**

* Import and Data Preparation: The code begins by importing necessary libraries and modules for building the model, loading the dataset, performing numerical computations and plotting visualizations. Then, it loads the Fashion MNIST dataset and normalizes it by dividing pixel values by 255, reshaping it into the appropriate form for the neural network.
* Autoencoder Definition: It defines a deep autoencoder model with an additional hidden layer using Keras' functional API. The autoencoder has an input layer, two hidden layers (one for encoding and one for decoding), and an output layer for reconstructed output.
* Model Compilation: After defining the structure of the autoencoder, it compiles the model using the Adadelta optimizer, binary cross-entropy loss function, and accuracy metric.
* Model Training: The autoencoder is trained using the normalized and reshaped training data. The training process is also validated using the test data. This step involves forward propagation, back-propagation, and weight updates for a specified number of epochs.
* Prediction: After training, the autoencoder is used to make predictions on the test data to reconstruct input data.
* Visualization and Evaluation: The original test images and the corresponding reconstructed images are displayed for comparison. Finally, the loss and accuracy of the model on both training and test data are plotted over the training epochs to evaluate the model's performance.

Output:

A collage of images of clothes

Description automatically generated

A graph with numbers and lines

Description automatically generated

A graph with numbers and lines

Description automatically generated

A screenshot of a computer program

Description automatically generated

A computer code with text

Description automatically generated

**Explanation:**

* Necessary Keras modules are loaded for building and training the model.
* The encoded data's dimension is set to 32, indicating a compression ratio of around 24.5 assuming the input size is 784.
* An input placeholder of 784 dimensions is created for holding our data.
* The encoder part of the autoencoder model is designed, which compresses the input image to a lower dimensional space.
* The decoder part of the autoencoder is designed, which attempts to reconstruct the original image from the encoded version.
* The autoencoder model is compiled with specified optimizer and loss function, and it is then trained using noisy versions of the Fashion MNIST dataset, where the target is to recreate the clean images.

**Output:**

A screenshot of a computer

Description automatically generated

A screenshot of a computer program

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A screenshot of a computer program

Description automatically generated

A screenshot of a computer program

Description automatically generated

A close-up of a computer screen

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Explanation:

* The script builds an autoencoder model, a type of neural network that learns to encode and decode the input data, using Keras. It sets up the input, encoding, and decoding layers and compiles the model.
* The Fashion MNIST dataset is loaded, normalized, and reshaped. Then, artificial noise is added to the test data to create "noisy" versions of the images.
* The model is trained on the noisy version of the training images, with the original, noise-free images as targets. This teaches the autoencoder to remove noise from images.
* After training, the model is used to reconstruct the test images from their noisy versions, effectively denoising them.
* Finally, the script plots and displays examples of the noisy test images and their denoised versions. It also plots the training and validation loss and accuracy for each epoch, helping to visualize the model's learning process and performance.

Output:

A screenshot of a computer

Description automatically generated

A group of squares with different shapes

Description automatically generated

A graph with numbers and lines

Description automatically generated

A graph with blue and orange lines

Description automatically generated