

Lab Practice - V

Assignment NO. 07 [DL]

Title :- Convolutional Neural Network :
Use MNIST Fashion Dataset and
create a classifier to classify
fashion clothing into categories.

Objective :- Students should be able to use
MNIST Fashion Dataset and
create a classifier to classify
fashion clothing into categories.

Prerequisite :- concept of classification
concept of Deep Neural network.

Contents for theory :-

1. What is CNN
2. The MNIST Dataset
3. Classification Using CNN

Theory :-

What is CNN:

Convolutional Neural Networks (CNN) are commonly used for image classification tasks, and they are designed to automatically learn and extract features from input images.

In a typical CNN architecture for image classification, there are several layers.

including Convolutional Layers, pooling layers, and fully connected layers. Here's a diagram of a simple CNN architecture for the digit classification task:

The input to the network is an image of size 28×28 pixels, and the output is a probability distribution over the 10 possible digits (0 to 9).

Overall, CNNs are powerful tools for image recognition:

- Image classification: CNN can be used for object detection in images and videos, such as recognizing faces.
- Object Detection: Object Detection involves identifying location of objects in an image and drawing bounding boxes around them.
- Semantic Segmentation: This involves partitioning an image into segments and assigning each segment a semantic label.
- Natural Language Processing: CNN can also be used for sentiment analysis and text classification.
- Medical imaging: CNN are used in medical imaging for tasks such as diagnosing diseases from x-rays and identifying tumors from MRI scans.

How Convolutional Neural Network work on classification using MNIST Dataset:

CNN work on classification tasks by learning to automatically extract features from input images and using those features to make predictions. Here's how it works:

- > Input Layer: Takes in the image data as input.
- > Convolutional layers: Convolutional layers apply filters to the input images to extract relevant features.
- > Activation functions: Activation function is applied to the output of each convolutional layer to introduce non-linearity into the network.
- > Pooling Layers: Pooling layers downsample the feature maps to reduce the spatial dimensions of the data.
- > Dropout layers: Dropout is used to prevent overfitting by randomly dropping out a percentage of the neurons in the network during training.
- > Loss function: A loss function is used to compute the difference between the predicted probabilities and actual labels.
- > optimization: An optimization algorithm, such as stochastic gradient descent, is used

to minimize the loss function by adjusting the values of the network parameters.

Training : The network is trained on a large dataset of labeled images, adjusting the values of the parameters to minimize the loss function.

Prediction: Once trained, the network can be used to classify new images by passing them through the network and computing output probability distribution.

MNIST Dataset :-

MNIST Dataset is a collection of 70,000 grayscale images of 28×28 pixels representing 10 different clothing categories. MNIST Fashion dataset was released by Zalando Research in 2017 and has since become popular Dataset.

The categories of clothing are as follows :-

- Tshirts / Top
- Sneakers
- Trousers
- bags
- Pullovers
- ankle boots
- Dresses
- coats
- sandals
- shirts

Here are general steps to perform Convolutional Neural network (CNN) on the MNIST Fashion Dataset :

- Import necessary libraries including Tensorflow, Keras, Numpy and Matplotlib
- Load the dataset using Keras' built-in function, `keras.datasets.fashion_mnist.load_data()`.

This will provide training and testing sets.

- Preprocess data by normalizing pixel values between 0 and 1, and reshaping images to be of size (28, 28, 1).
- Define CNN architecture, including number and size of filters, activation functions and pooling layers.
- Compile the model by specifying loss function, optimizer and evaluation metrics.
- Train the CNN on the training set using the `fit()` function.
- Evaluate the performance of the model on the testing set using the `evaluate()` function. This will provide metrics such as accuracy and loss on the test set.

Conclusion :- In this way we can classify fashion clothing into categories using CNN.