Weeks 5-6

Introduction Simple Deep Learning Basics

1. **Overview of Deep Learning: Concepts, Types, and Applications**

* Define deep learning and its significance in the field of artificial intelligence.
* Explain the difference between traditional machine learning and deep learning.
* Discuss various types of deep learning architectures, such as feedforward neural networks, convolutional neural networks (CNNs) and recurrent neural networks (RNNs).

1. **Neural Networks Basics**

* Introduce the building blocks of neural networks: neurons, layers, and activation functions.
* Discuss the architecture of a neural network, including input layer, hidden layers, and output layer.
* Explain the process of forward propagation and backpropagation for training neural networks.
* Explore common activation functions such as sigmoid, ReLU, and softmax.

1. **Introduction to Deep Learning Framework [Tensorflow, Keras, Pytorch]:**

* Introduce deep learning frameworks such as TensorFlow or PyTorch and explain their role in simplifying the implementation of deep learning models.

**Exercise 1: Build and Train a Feedforward Neural Network for MNIST Handwritten Digits Classification**

**Objective:**

Implement a simple feedforward neural network using TensorFlow or PyTorch to classify handwritten digits from the MNIST dataset.

**Steps:**

* Load the MNIST dataset.
* Normalize the pixel values of images to be between 0 and 1.
* Build a neural network with one hidden layer containing 128 neurons.
* Use ReLU activation function for the hidden layer.
* Use softmax activation function for the output layer with 10 neurons (one for each digit).
* Train the model using Adam optimizer and categorical cross-entropy loss function.
* Evaluate the accuracy of the model on the test dataset.

**Exercise 2: Build and Train a Convolutional Neural Network (CNN) for CIFAR-10 Image Classification**

**Objective:**

Implement a convolutional neural network (CNN) using TensorFlow or PyTorch to classify images from the CIFAR-10 dataset.

**Steps:**

* Load the CIFAR-10 dataset.
* Normalize the pixel values of images to be between 0 and 1.
* Build a CNN with two convolutional layers followed by max pooling and two fully connected layers.
* Use ReLU activation function for all layers except the output layer.
* Use softmax activation function for the output layer with 10 neurons (one for each class).
* Train the model using Adam optimizer and categorical cross-entropy loss function.
* Evaluate the accuracy of the model on the test dataset.

**Exercise 3: Build and Train a Recurrent Neural Network (RNN) for Sentiment Analysis**

**Objective:**

Implement a recurrent neural network (RNN) using TensorFlow or PyTorch to perform sentiment analysis on text data.

**Steps:**

* Load a dataset of text reviews and their corresponding sentiment labels.
* Tokenize the words in the reviews and convert them into numerical representations.
* Build an RNN with one LSTM or GRU layer followed by a fully connected layer.
* Use tanh activation function for the recurrent layer and sigmoid activation function for the output layer.
* Train the model using Adam optimizer and binary cross-entropy loss function.
* Evaluate the accuracy of the model on the test dataset.