Artificial Intelligence

Deep Learning Assignment

Problem Description

You are given the **MNIST dataset** with 60,000 handwritten digits represented as black-and-white images of size 28×28×1. The goal of the assignment is to train **Deep Neural Networks (DNNs)** for the **classification of handwritten digits (0–9)**.

In addition, you are provided with the following **Google Colab link**, which contains the Python code for constructing Neural Networks using the **TensorFlow** library, along with the MNIST dataset:

👉

https://colab.research.google.com/drive/19Rqsry7ctkQRB23Ch9hiYPQ2NA9X9OGd?usp=sharing

Figure 1: Example architecture of a Deep Neural Network (DNN). The DNN receives an image as input in vector form and predicts the probability that the digit belongs to one of the classes (0–9).

Tasks

1. **Hyper-parameter Tuning**

   o Find better parameters for the Neural Network (e.g., number of layers, number of neurons per layer, learning rate, epochs, and activation function).

   o Construct a table with the different values you tested and the corresponding accuracy of the network.

   o Justify (if possible) why you selected the specific values.

2. **Improvements**

   o Apart from Task 1, try to improve the performance of the network.

   o This can be achieved either through the **network architecture** or through the **data**.

   o Implement one improvement and report the accuracy achieved with it.

3. **Understanding Questions**
   a. Do you consider the MNIST dataset good for training a model? Justify your answer.
   b. Do you believe that all pixels are important for predicting the class of a digit?
   c. In what cases is it a good idea to use Deep Neural Networks?
   d. Can Deep Learning be used in all three branches of Machine Learning (Supervised Learning, Unsupervised Learning, and Reinforcement Learning)?