MNIST Digit Classification with Neural Network

Project Overview

This project implements a deep learning based classification system to recognize handwritten digits using the MNIST dataset. The objective is to demonstrate a complete deep learning workflow starting from data loading and preprocessing to model training evaluation and prediction.

Dataset Description

The MNIST dataset consists of grayscale images of handwritten digits ranging from zero to nine. Each image is twenty eight by twenty eight pixels and represented as numerical pixel intensity values. The dataset is widely used as a benchmark for evaluating image classification models.

Data Exploration and Preprocessing

The dataset is loaded and explored to understand its structure and dimensions. Images are reshaped and normalized so that pixel values fall within a consistent range which improves training stability and performance.

Neural Network Architecture

The neural network is built using the Keras Sequential API. It includes a flatten layer followed by dense layers with nonlinear activation functions. The output layer uses softmax activation to predict class probabilities for each digit class.

Model Compilation

The model is compiled using the Adam optimizer. Sparse categorical crossentropy is used as the loss function since the labels are integer encoded. Accuracy is selected as the evaluation metric.

Model Training

The neural network is trained for multiple epochs on the training dataset. Validation data is used to monitor learning progress and reduce overfitting.

Model Evaluation

After training the model is evaluated on the test dataset to assess its performance on unseen handwritten digit images.

Prediction System

The trained model is used to predict digits for new input images. Probability outputs are converted into final digit predictions using the highest probability score.

Key Takeaways

This project highlights the effectiveness of neural networks in image classification tasks and demonstrates the importance of preprocessing proper model design and evaluation.

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