



Handwritten Digit Recognition Using a 3-Layer Deep Neural Network

DNN

Deep Learning

Introduction



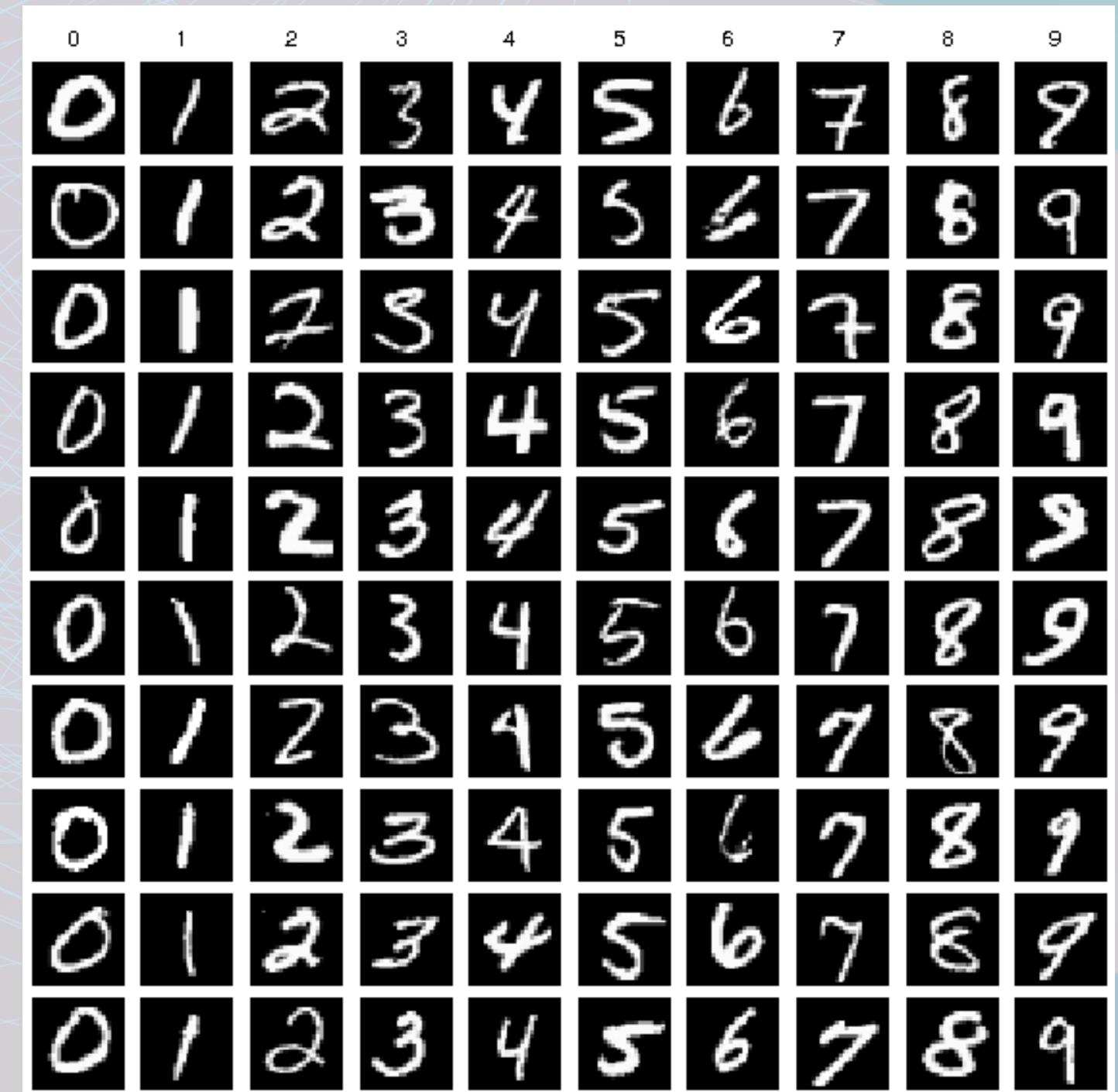
The Handwritten Digit Recognition project explores the application of deep learning in classifying handwritten digits (0-9). Using a 3-layer deep neural network, the model was trained on the MNIST dataset, a benchmark dataset widely used for digit recognition tasks. The trained model was subsequently tested on a custom dataset of handwritten digits created manually.

This project emphasizes:

- The ability of deep learning models to generalize across datasets.
- The challenges associated with recognizing varying handwriting styles.
- The importance of preprocessing → for improving model performance.

Dataset

- **Training Dataset (MNIST):**
 - 60,000 grayscale images for training.
 - 10,000 grayscale images for testing.
 - Image Size: 28×28, White digits on a black background.
- **Custom Testing Dataset:**
 - 10 handwritten digit images created by us.
 - Images preprocessed to match MNIST format:
 - Grayscale, resized to 28×28, normalized, and inverted colors.





Model Architecture

- **3-Layer Deep Neural Network:**
 - **Input Layer:** Flatten images into 1D arrays of 784 pixels.
 - **Hidden Layers:**
 - Layer 1: 128 neurons, ReLU activation.
 - Layer 2: 64 neurons, ReLU activation.
 - **Output Layer:**
 - **10 neurons (one for each digit), Softmax activation for classification.**
- **Optimizer:** Adam
- **Metric:** Accuracy



Training and Testing

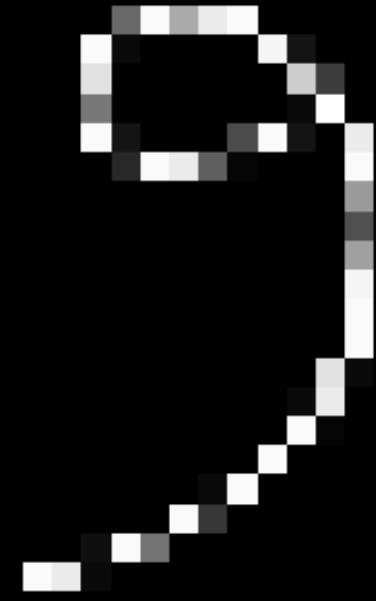
- **Training (MNIST Dataset):**
 - Epochs: 10
 - Batch Size: 32
 - Validation Split: 20%
 - Results:
 - Training Accuracy: 98%
 - Validation Accuracy: 97%
 - Test Accuracy: 98.5%
- **Custom Dataset Testing:**
 - Model achieved 80% accuracy.
 - Out of 10 images:
 - 8 correctly classified.
 - 2 misclassified (1 and 8).



Results and Observations

- **Correctly Identified Digits:**
 - 0, 2, 3, 4, 5, 6, 7, 9.
- **Misclassified Digits:**
 - 1 → Predicted as 7: Likely due to stroke similarity.
 - 8 → Predicted as 3: Loop irregularities may have caused confusion.
- **Overall Performance:**
 - Strong accuracy on digits with distinct shapes (e.g., 0, 3, 7).
 - Misclassifications highlight sensitivity to handwriting variations.

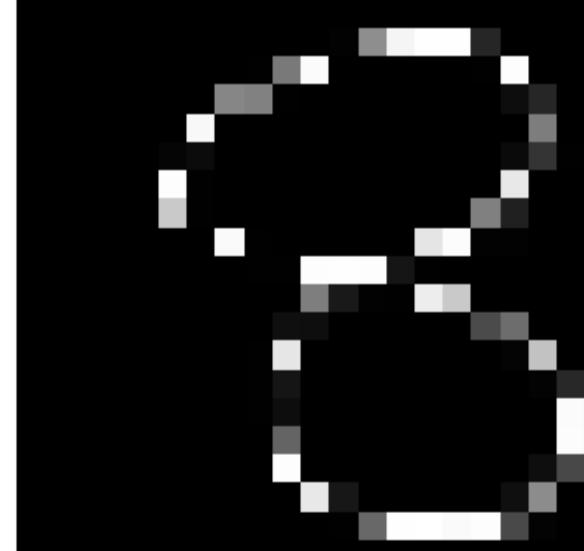
True: 9, Predicted: 9



True: 6, Predicted: 6



True: 8, Predicted: 3



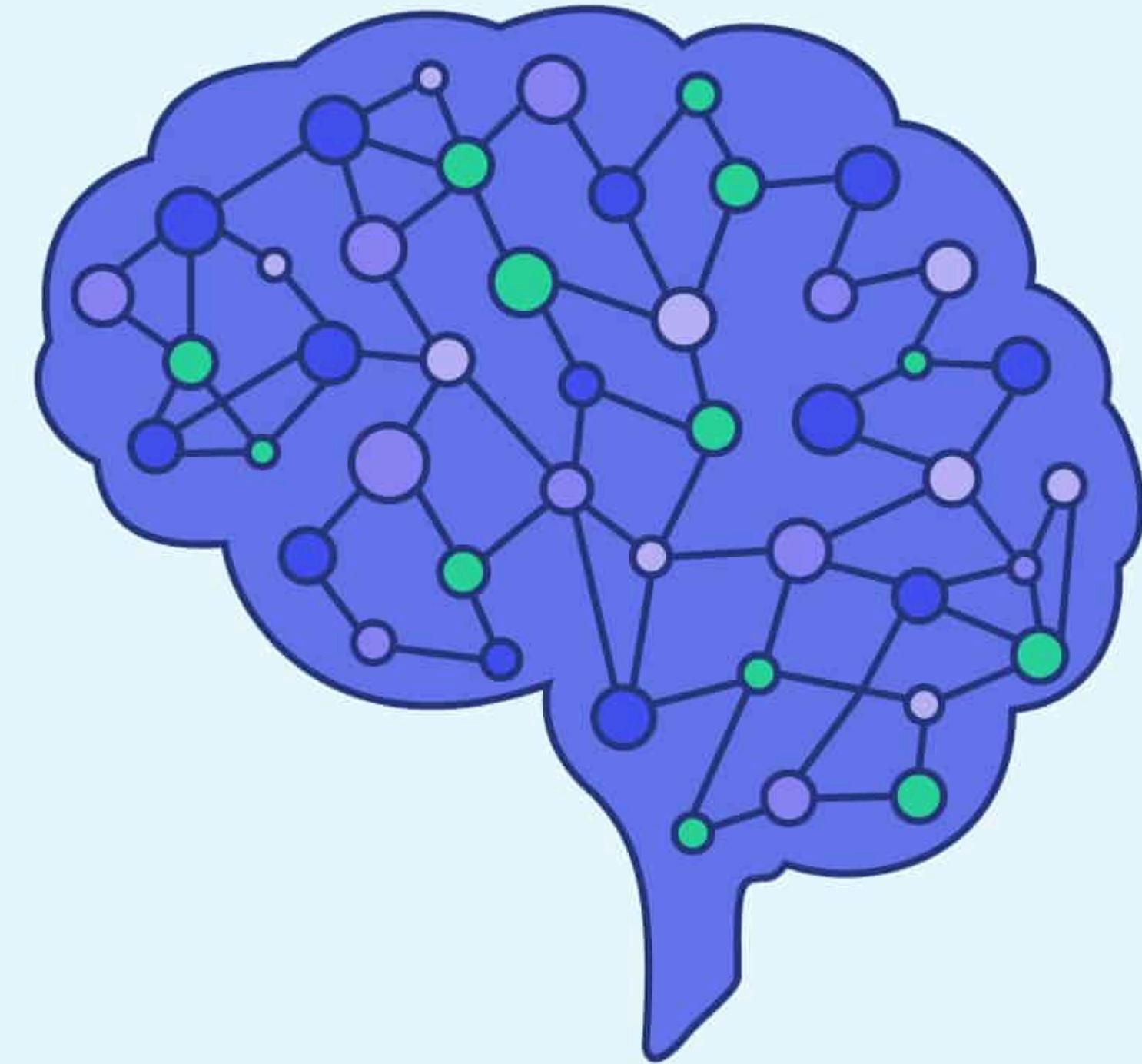
True: 1, Predicted: 2



Implementation



Model



Prediction

Thank You!

Thank you for exploring the world of DL with us. For more information, please visit-



www.github.com/saky-semicolon