MNIST DATASET OF HANDWRITTEN DIGITS

COURSE REPRESENTS :
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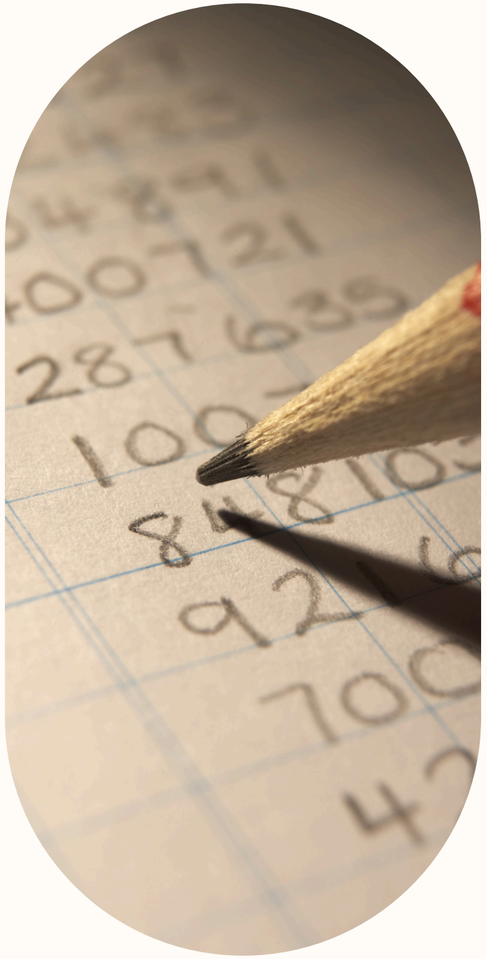

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INTRODCTION

Handwritten digit recognition is crucial in fields like automated data entry, postal services, and banking. Our project tackles this problem using the MNIST dataset, which includes 70,000 grayscale images of digits. Each image is 28x28 pixels, and the dataset is a standard for evaluating image classification algorithms. We explored two machine learning and deep learninng models—CNN, SVM, Decision Trees, and MLP—to see which model best handles the variability in handwriting styles. Through this comparison, we aim to determine the most effective approach for accurate and reliable digit classification.

OUR GOALS

- Analyze the Performance of Different Models
- Evaluate Classification Accuracy
- Disseminate Results and Recommendations

EXPLOR

Number of Classes: **Total: 10 (Digits 0-9)**

Types of Images:

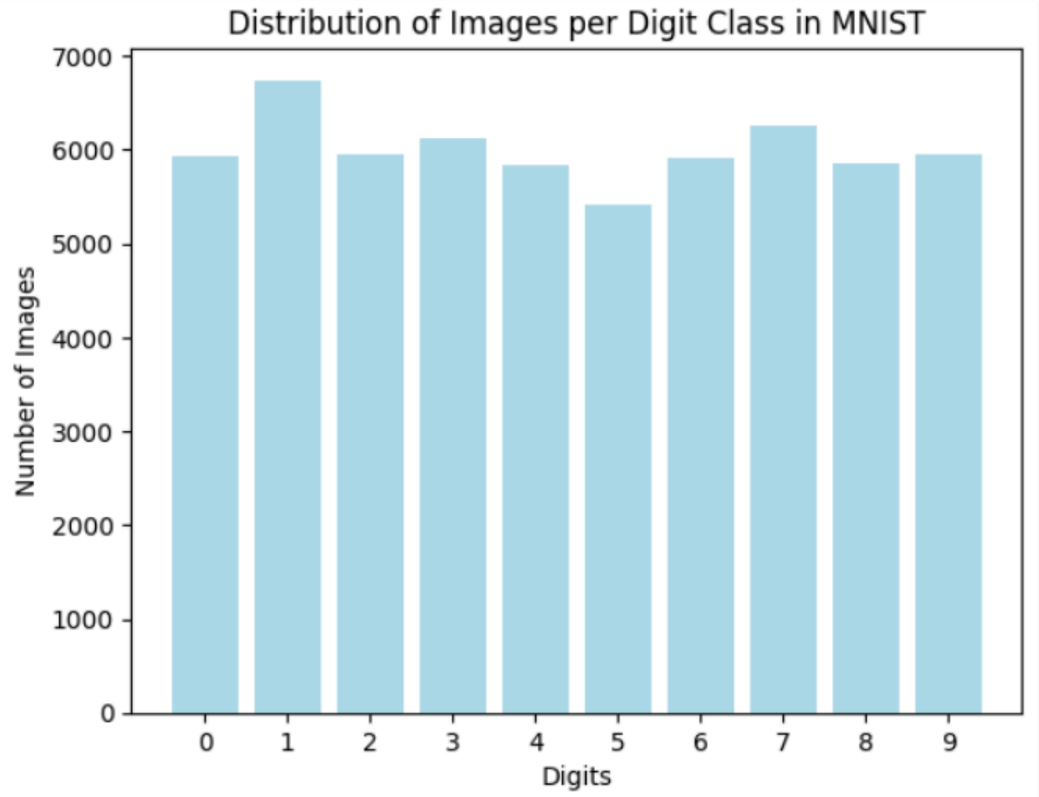
Format: Grayscale (28x28 pixels)
Total: 70,000 images splited into (60,000 training, 10,000 testing)

Variability:

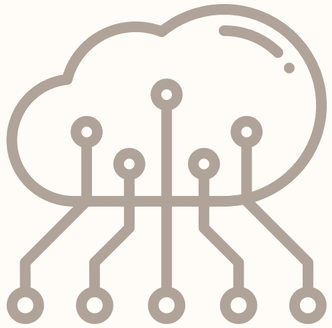
Diverse handwriting styles and sizes

Preprocessing Challenges:

No missing images; dataset is well-balanced



PREPROCESSING



Techniques:

Normalization

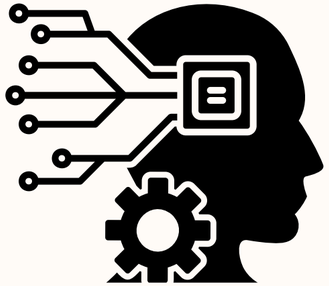
initially ranging from 0 to 255, are scaled to a range of 0 to 1 , Normalized values make the model more efficient at learning from the data.

Reshaping

Each 28x28 image is converted into a single vector with 784 features, for CNN is reshaped to 28x28x1

One-Hot Encoding

convert categorical data into a numerical (binary) 0,1 format that machine learning models can understand.



MACHINE LEARNING

DECISON TREE

Accuracy: 88%

Precision: 88%

Recall: 85%

F1-score: 85%

Support Vecror Machine

Accuracy: 94.04%

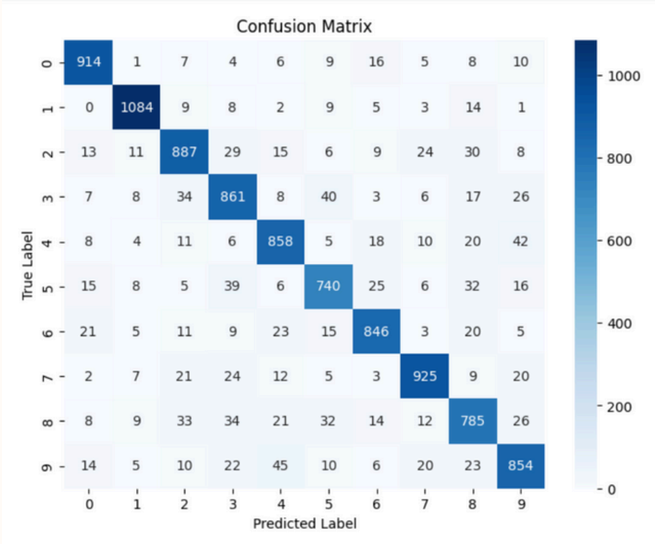
Precision: 95%

Recall: 93%

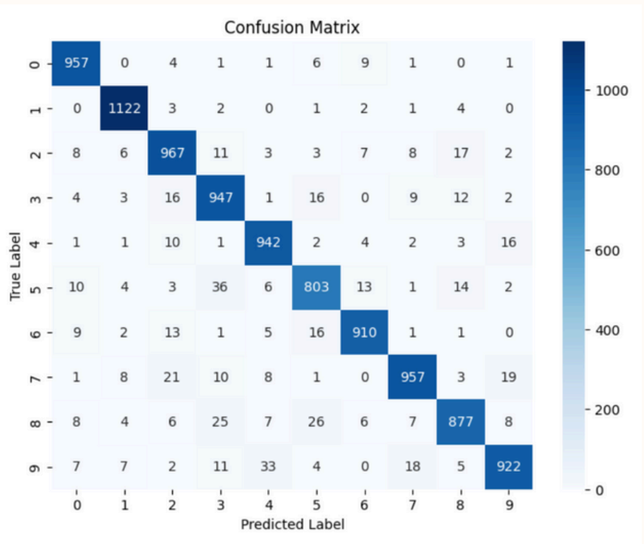
F1-score: 93%

MACHINE LEARNING

DECISON TREE



SVM



DEEP LEARNING

CNN MODEL

Model: "sequential"

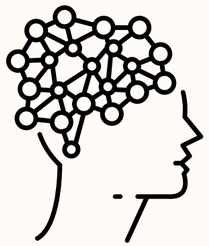
Layer (type)	Output Shape	Param #
reshape (Reshape)	(None, 28, 28, 1)	0
conv2d (Conv2D)	(None, 26, 26, 32)	320
max_pooling2d (MaxPooling2D)	(None, 13, 13, 32)	0
conv2d_1 (Conv2D)	(None, 11, 11, 64)	18,496
max_pooling2d_1 (MaxPooling2D)	(None, 5, 5, 64)	0
flatten (Flatten)	(None, 1600)	0
dense (Dense)	(None, 128)	204,928
dropout (Dropout)	(None, 128)	0
dense_1 (Dense)	(None, 10)	1,290

Total params: 225,034 (879.04 KB)
Trainable params: 225,034 (879.04 KB)
Non-trainable params: 0 (0.00 B)

DEEP LEARNING

MLP MODEL

Layer (type)	Output Shape	Param #
flatten_1 (Flatten)	(None, 784)	0
dense_2 (Dense)	(None, 128)	100,480
dropout_1 (Dropout)	(None, 128)	0
dense_3 (Dense)	(None, 64)	8,256
dropout_2 (Dropout)	(None, 64)	0
dense_4 (Dense)	(None, 10)	650



DEEP LEARNING

CNN MODEL

The model shows very high accuracy (99.08%), correctly classifying the vast majority of digits.

learning rate of 0.001

We used 8 layers

MLP MODEL

The model performs well with an accuracy of 97.18%

learning rate of 0.0005

We used 5 layers

SUMMARY

Deep Learning	Accuracy	Machine Learning	Accuracy
CNN	99%	SVM	94%
MLP	97%	Decision Tree	88%

Based on the model's accuracy, it seems that the deep learning model, particularly the CNN (Convolutional Neural Network), has demonstrated superior performance.

CONCLUSION

WE COMPARED TWO DEEP LEARNING MODELS FOR HANDWRITTEN DIGIT CLASSIFICATION ON THE MNIST DATASET. THE CONVOLUTIONAL NEURAL NETWORK (CNN) ACHIEVED 99% ACCURACY, OUTPERFORMING THE MULTILAYER PERCEPTRON (MLP) DUE TO ITS ABILITY TO CAPTURE SPATIAL PATTERNS IN IMAGES. THIS HIGHLIGHTS CNNS AS THE OPTIMAL CHOICE FOR COMPLEX VISUAL DATA TASKS REQUIRING PRECISE IMAGE VARIABILITY HANDLING.

THANK YOU

Feel free to ask us any question!