

# Handwritten Arabic Digit Recognition Using CNN

Course: CS417 – Neural Network

Faculty of Science – Cairo University

Fall 2025

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## 1. Introduction

Handwritten digit recognition is a fundamental problem in computer vision and optical character recognition (OCR).

In this project, we focus on recognizing handwritten Arabic digits (0–9) using Convolutional Neural Networks (CNNs).

Arabic digit recognition is important for many real-world applications such as form processing, banking systems, and document digitization.

## 2. Dataset

The Arabic MNIST dataset was used in this project. It contains grayscale images of handwritten Arabic digits.

Each image has a resolution of  $28 \times 28$  pixels and belongs to one of 10 classes (digits 0–9). The dataset was split into training, validation, and testing sets.

Link: <https://github.com/iilabau/HAND2020.git>

## 3. Preprocessing

Data preprocessing included:

- Converting images to grayscale
- Normalizing pixel values to the range [0,1]
- Reshaping images to fit CNN input
- Applying degradation and Gaussian noise to generate low-quality samples

## 4. Methodology

A Convolutional Neural Network (CNN) was designed using TensorFlow and Keras.

The architecture consists of:

- Three convolutional layers with ReLU activation
- Batch Normalization and MaxPooling
- Fully connected dense layers
- Dropout for regularization

The model was trained using the Adam optimizer and sparse categorical cross-entropy loss.

EarlyStopping and ModelCheckpoint callbacks were used.

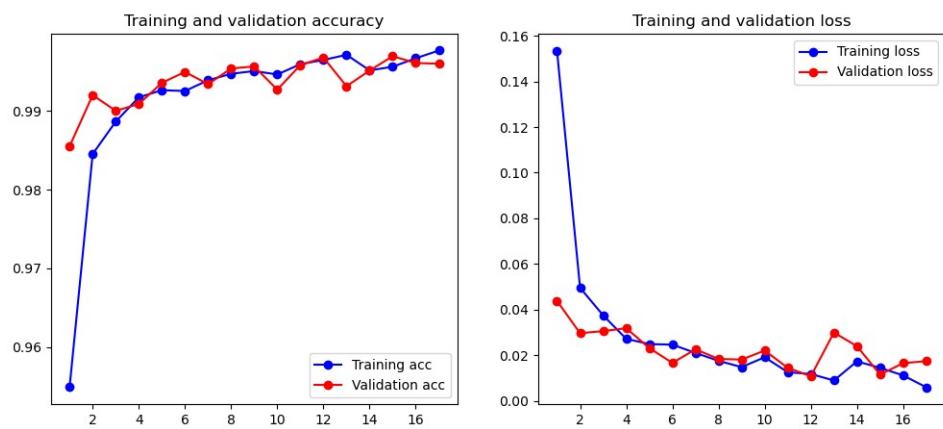
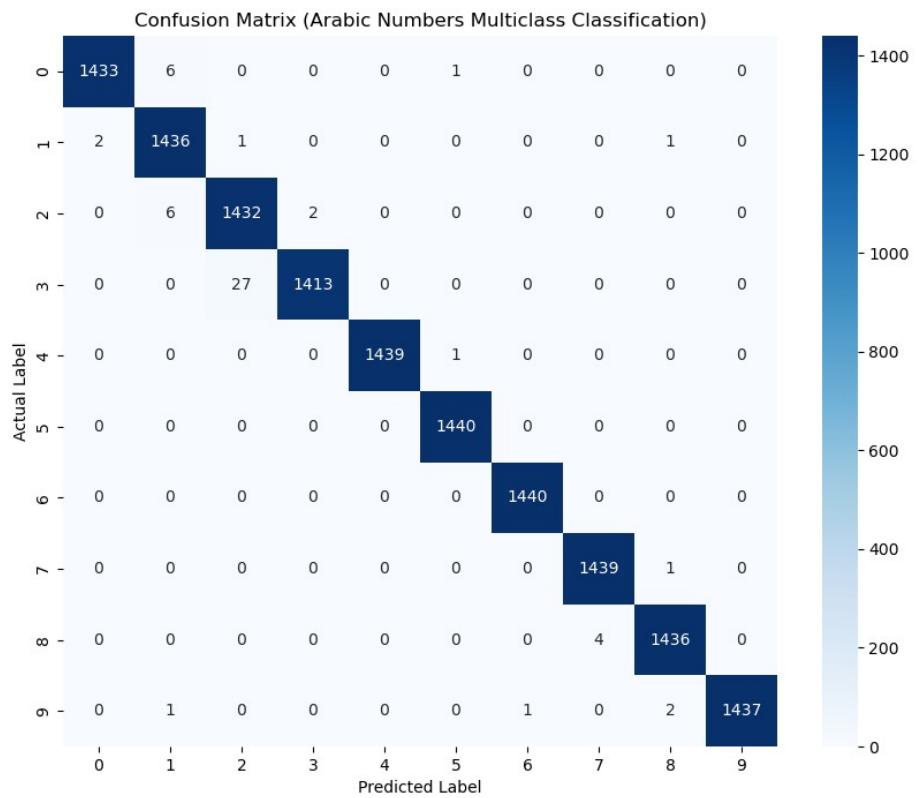
## 5. Results

The trained model achieved high classification accuracy on the test dataset.

Evaluation metrics included:

- Accuracy = 99.61%

A confusion matrix and learning curves were generated to analyze performance.



## 6. Discussion

The CNN model performed well in recognizing most digits.  
Some confusion occurred between visually similar digits.  
Limitations include sensitivity to noise and handwriting variations.

## 7. Conclusion & Future Work

This project demonstrates the effectiveness of CNNs for Arabic handwritten digit recognition.  
Future work may include using deeper architectures, data augmentation, and real-time OCR deployment.

## References

1. Arabic MNIST Dataset
2. TensorFlow Documentation
3. Deep Learning – Goodfellow et al.