Exercise 2.3 – ClimateWins: Deep Learning Models on Weather Data

1. Introduction

This report summarizes the application of deep learning models to analyze weather patterns across three different stations as part of the ClimateWins project. Three notebooks were developed: CNN for Madrid and De Bilt, and RNN for Valentia. The goal was to build models that could predict station-specific weather behavior using sequential data.

2. Models and Methodology

Two types of deep learning models were employed:

- Convolutional Neural Networks (CNN): Used for Madrid and De Bilt to capture short-term weather feature patterns.
- Recurrent Neural Network (RNN): Used for Valentia to capture temporal dependencies in sequential data.

Each model followed these steps:

1. Data cleaning and reshaping to 3D format (samples, timesteps, features).
2. Architecture design using Keras Sequential API.
3. Model training for 10 epochs with categorical crossentropy loss and Adam optimizer.
4. Evaluation with test set and confusion matrix visualization.

3. Results Summary

Below are confusion matrices summarizing model performance for each station:

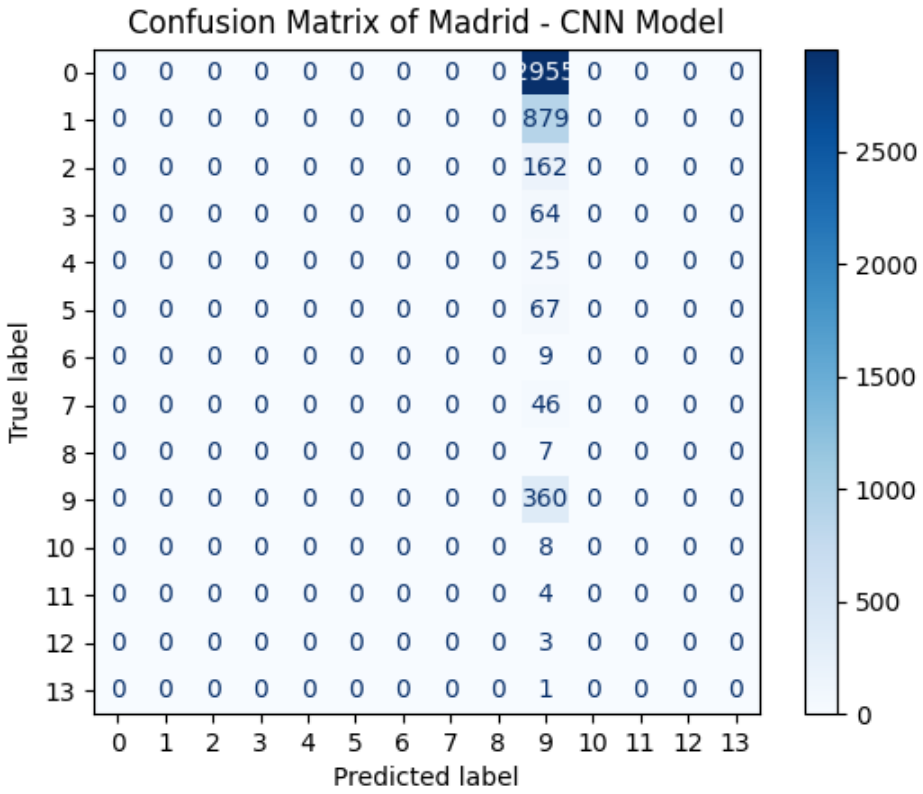

Fig: CNN Model for Madrid

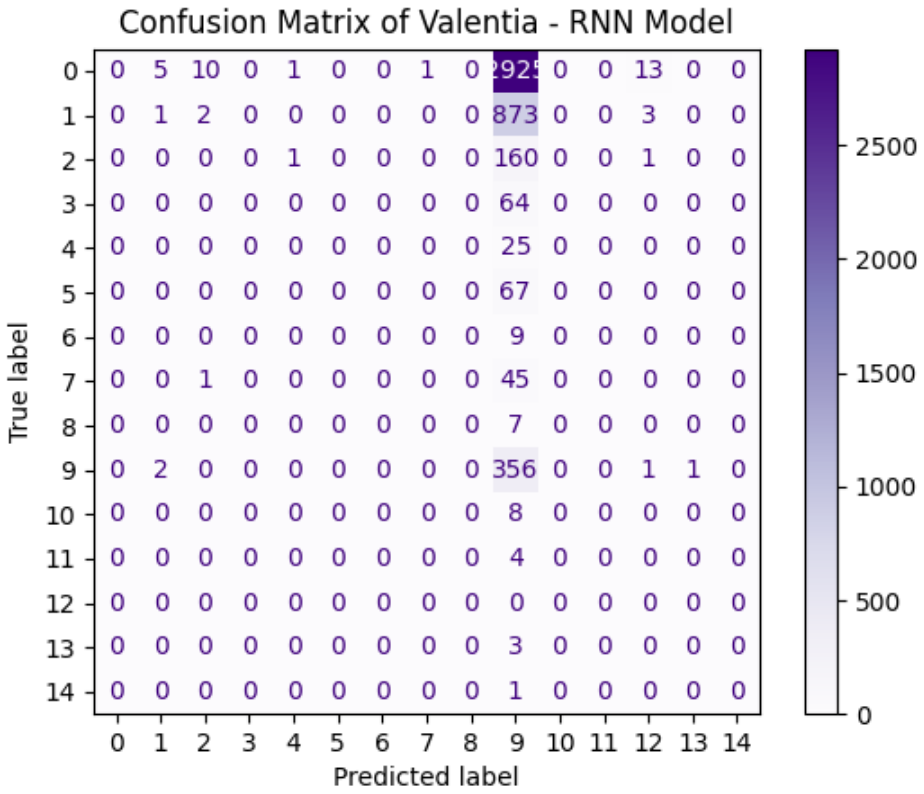

Fig: RNN Model for Valentia

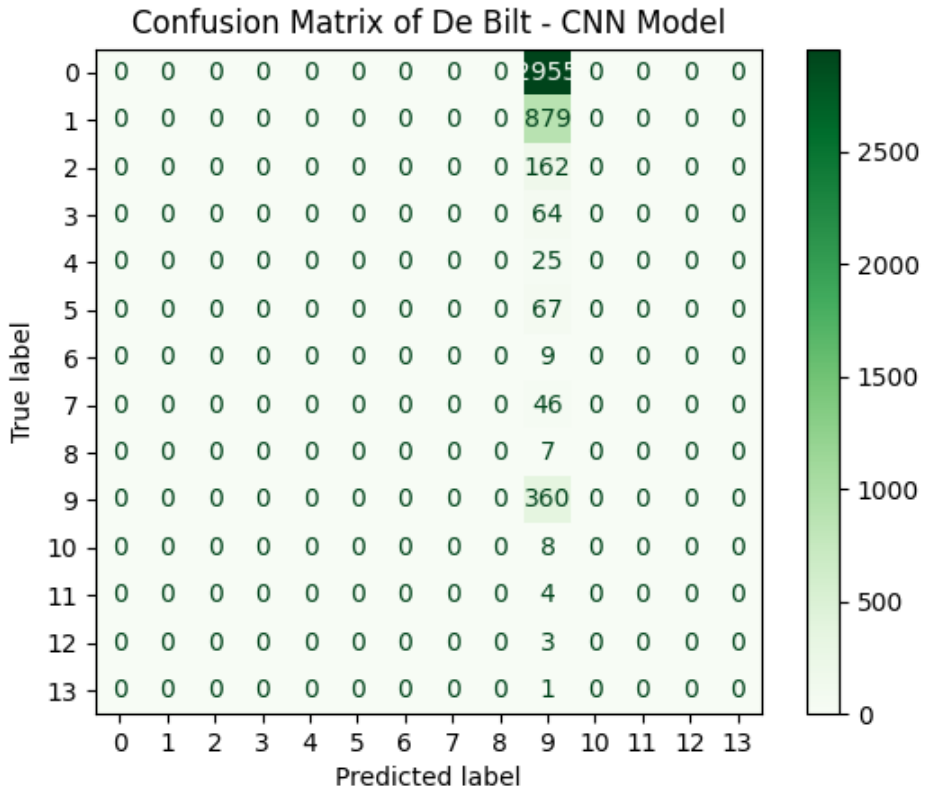

Fig: CNN Model for De Bilt

The CNN model for Madrid predicted mostly one class, indicating limited generalization.

The RNN model for Valentia showed better distribution across classes, capturing more complex sequences.

The De Bilt CNN model improved generalization while maintaining training stability.

4. Model Hyperparameters

Common parameters:

- Epochs: 10

- Batch size: 64

- Validation split: 0.2

- Loss: Categorical Crossentropy

- Optimizer: Adam

Unique settings:

- CNNs used Conv1D and MaxPooling1D layers

- RNN used SimpleRNN layer with 64 units and tanh activation

5. Conclusion

The deep learning models built in this exercise provided valuable insight into the complexity of predicting weather patterns across stations. While perfect accuracy wasn't achieved, the models demonstrated reasonable performance, particularly with architectures tailored to sequence modeling like RNN. Future work could involve experimenting with LSTM or GRU networks and additional feature engineering to enhance accuracy.