School of Computer Science,
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Daily Climate Forecasting

Deadline: 14 Tir 1402

1 Project Description

In this project, you are tasked with developing predictive models to forecast atmospheric pressure using historical climate data from the city of Delhi. The objective of this project is to apply and enhance the machine learning techniques you have learned throughout the course to achieve accurate predictions of mean atmospheric pressure. You are encouraged to explore in-depth the specific neural network architectures tailored for time-series prediction, such as RNN and LSTM models, and understand the dynamics of sequential data through these sophisticated models.
In evaluating your project, we will consider both the performance metrics you achieve and the sophistication of your approach and models. We encourage you to explore various models, techniques, and methodologies to deepen your understanding and showcase your expertise. Remember, the goal is not just to obtain good results using baseline or basic models but rather to demonstrate your understanding of the underlying principles and apply more advanced techniques where appropriate.

2 Dataset Description

This dataset encompasses data from January 1, 2013, to April 24, 2017, in Delhi, India. It includes 1462 training samples and 114 test samples, each characterized by four parameters:

- **meantemp**: The average daily temperature calculated from multiple 3-hour intervals.
- **humidity**: Daily humidity level (in grams of water vapor per cubic meter of air).
- **wind_speed**: Wind speed (measured in km/h).
- **meanpressure**: Atmospheric pressure (measured in atm).

3 Instructions

1. **Data Exploration and Preprocessing:**
   - Perform exploratory data analysis to gain insights into the dataset.
   - Handle missing values, if any, and preprocess the data for further analysis.
   - Visualize the distributions of different features and explore any patterns.
2. **Feature Processing:**
   - Apply feature processing techniques to enhance the quality and relevance of the features for the prediction task.
   - This may involve techniques such as feature scaling, normalization, or transformation to ensure the features are in a suitable range or distribution for the models.
   - Consider exploring techniques such as feature creation to extract meaningful features.
3. **Model Selection and Training:**
   - Train and evaluate different models using appropriate evaluation metrics (e.g., Mean Absolute Error, Mean Squared Error, Root Mean Squared Error, R-squared) on the dataset.
   - Utilize the models that are appropriate for this task, and it is recommended to employ more advanced models.
   - Tune hyperparameters to optimize model performance.
4. **Performance Evaluation and Comparison:**
   - Compare the performance of different models and techniques employed.
   - Analyze the strengths and weaknesses of each approach.
   - Report the achieved results and ensure to compare them with those presented in the paper.
5. **Documentation and Reporting:**
   - Document the entire project, including the steps taken, methods used, and code implementation.
   - Provide an analysis of the obtained results and compare them with the results presented in the paper.
   - If you manage to achieve high results, you're encouraged to reach out to the professor before commencing your report writing. This will enable you to collaborate with the professor to produce a comprehensive and detailed report.

4 Additional Guidance

- Ensure your code is saved in the .ipynb format and thoroughly documented.
- Alongside your code, submit a report file containing a comprehensive analysis of your results.
- Utilize appropriate visualizations and statistical techniques to substantiate your analysis and conclusions.