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Weather Forecasting Using Graph Neural Networks and Physics-informed Neural Networks

The weather plays a crucial role in decisions that people make on daily basis, especially in the agriculture, transportation, energy sectors. Therefore, accurate and efficient weather forecasting is of utmost significance. Predicting weather patterns has been an endeavor humanity has engaged in since ancient times. Over the years, various approaches have been used to forecast the weather. Currently, there are two main methods for weather forecasting: numerical modeling and machine learning (ML)-based modeling. Numerical modeling relies on complex numerical simulations of atmospheric physics, while ML-based modeling is data-driven and does not depend on such simulations. We explore the application of machine learning in weather forecasting, with a specific focus on two ML architectures: Graph Neural Networks (GNNs) and Physics-informed Neural Networks (PINNs). The GNNs model atmospheric interactions on a graph structure, while PINNs incorporate physical laws to constrain model learning and improve generalization. We also compare the performance of GNNs and PINNs in weather prediction. Our results demonstrate improved accuracy, efficiency, and enhanced prediction especially in capturing complex spatial and temporal relationships in weather data.

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None

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