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Abstract

Deep neural networks and artificial intelligence have been successfully applied in numerous applications today. This paper represent a method for forecasting the temperature using a neural network and historical temperature data. Convolutional neural networks are used to predict temperature across a wide area. To be more precise, we train the CNN model using the daily average temperature data map set and show that it can accurately forecast the temperature based on its historical temperature data values. Here, the model assists in determining the optimum results for any climatic zone and categorizes the climate into four types: temperature, humidity, rain, and wind. The study demonstrates how a sizable amount of data is split up into different datasets that CNN manages for precise weather predictions.

Keyword

Convolution Neural Network, Deep Learning, Time Series Prediction.

1. Introduction

Precise and trustworthy weather forecasts are highly prized in many facets of life. Decision-making in many industries, including agriculture, aviation, and the production of renewable energy, depends on accurate weather forecasts. Furthermore, extreme weather can hurt individuals and cause property damage, therefore it's imperative to provide accurate warnings when dangerous weather is anticipated. The weather classification model appears like this when no human involvement is present. The study presents a method for better climate prediction that forecasts the weather using CNN. In order to predict future values, the prediction technique primarily relies on collecting historical input values from intervals. Additionally, Convolutional Neural Networks (CNNs), a type of deep learning technique, can be used to categorise, identify, and forecast trends in data related to environmental change.

2. Literature review

A significantly improved deep convolutional neural network (CNN)-based global weather forecasting system is described by Jonathan A et al. It predicts a number of essential atmospheric variables on a global grid[1].

Jose F. et al speak for Deep learning is one of the most efficient machine learning techniques for solving difficult huge data challenges. The majority of data produced by smart devices today is made up of time series, and predicting them is one of the most prevalent and urgent problems in almost all academic subjects. Therefore, the combined consideration of these two topics in this survey provides readers with a broad grasp of how deep learning techniques are applied to time series forecasting. An explanation of the most widely used deep-learning architectures for time series data in recent years has been provided, with a focus on key practical aspects that can significantly impact the outcomes.

It has focused particularly on the search for hyper-parameters, the frameworks for deploying the various architectures, and the current hardware in order to facilitate the challenging training of the suggested network topologies. A research of the deep neural networks used to forecast time series in various application areas has been done in this survey in order to give a strong framework for comparison in later works and to highlight which designs have not been thoroughly investigated in particular applications. [2].

In their research paper, Jinli Dou and colleagues demonstrate that conventional techniques for predicting short-term wind power depend primarily on numerical weather prediction (NWP) data from a single station in a single-time cross section and do not utilize spatiotemporal correlation mining of the data. For time series data, this calls for the

adoption of deep learning architectures. As a result, a prediction technique based on CNN is recommended. Initially, based on a theoretical examination of the convolution. We developed a number of convolution neural network structures and simulated the input while taking into consideration the time correlation. Following that, a number of error evaluation criteria were used to evaluate the correlation between single-layer and multilayer feedforward neural networks as well as the convolutional neural networks prediction approach[3].

3. Deep Learning

Machine learning can be thought of as a subset of deep learning. It is a field that relies on studying computer algorithms to learn and advance on its own. Deep learning uses artificial neural networks, which are created to mimic how humans think and learn, whereas machine learning uses simpler principles. Up until recently, the complexity of neural networks was constrained by computational capacity. Larger, more complicated neural networks are now possible thanks to developments in big data analytics, which enables computers to watch, learn, and respond to complex events more quickly than people. Speech recognition, language translation, and image categorization have all benefited from deep learning. Any pattern recognition issue may be resolved with it without the need for human interaction.

Deep learning is powered by artificial neural networks, which include numerous layers. Such networks include deep neural networks (DNNs), where each layer is capable of carrying out complicated operations like representation and abstraction to make sense of text, sound, and image data. Deep learning, often regarded as the machine learning area with the greatest rate of growth, is being employed by more and more businesses to develop novel business models.

4. Time series prediction

A time series is a collection of measurements that are gathered at regular intervals and arranged chronologically. Physical or chemical events that do not include variables that change over time are uncommon. Because of this, the development of time series forecasting techniques has been successful and is present in practically all scientific fields. A time series is described as a collection of values that have been collected over time and are arranged chronologically. Despite the fact that time is a continuous variable, time series data are sampled at regular intervals (fixed sampling frequency). The most difficult component to model in real-world time series is the relevant irregular component since the mean and variance are not stationary (constant across time). Because it is so difficult to generate reliable predictions for them, many traditional forecasting techniques attempt to divide the target time series into these three parts and make predictions for each one independently.

Graphic representations of time series are possible. The time is specifically identified by the x-axis, while the values recorded at precise time stamps are identified by the y-axis. This visualization enables the visual identification of a series' most prominent characteristics, such as the strength of oscillations, the presence of seasons and cycles, or the existence of aberrant data or outliers [2].

5. Convolutional Neural Network

CNN is a type of neural network design that is particularly suited for handling two-dimensional input. In this study, a system that can forecast weather using a Convolutional Neural Network (CNN) algorithm based on satellite photos of the Indian meteorological Department reduces the impact of these natural calamities. CNN is an algorithm that processes two-dimensional data by using the Neural Network function, which can simulate the function of the human brain. in a complex image for the programme to find its features. Four variables from the Indian Meteorological Department (IMD), India, including wind speed, humidity, rain, and temperature, were used in the study to create a weather forecast.

6. SAMPLE DATA

IMD has a large amount of observed weather data needed to make weather predictions, but the study will only use some of them. Satellite photos of wind, rain, temperature, and humidity are the main source of information for the study.

6.1 Dataset

It may be claimed that, to some extent, the accuracy of the forecasted results depends on the quality of the input datasets. As is well known, PBs of meteorological observation data have been collected by sensors and autonomous observing platforms such as ocean-based, ground-based, air-based, and space-based. CNN use large amount of data

to perform complex calculations. For calculating weather prediction more than 1000 images can be used at a time with user fixed size pixels.

6.2 Pre-process an Image

Before being used for model training and inference, the satellite images must first undergo image preprocessing. This includes adjustments to the size, orientation, and color. Reducing the size of input weather images will greatly speed up model training time without significantly affecting model performance if the input weather images are extremely huge. The purpose of pre-processing is to raise the image's quality so that we can analyze it more effectively. Preprocessing allows us to eliminate unwanted distortions and improve specific qualities that are essential for the application we are working on.

6.3 Train, Validation and Testing Dataset

The huge amount of data that is utilized to predict the weather has been divided into three separate sets:–

- Training Dataset
- Validation Dataset
- Testing Dataset

Training Dataset

This is the real dataset a model is trained on. In order to forecast the result or to make the best decisions, the model observes and learns from this data. The majority of the training data is gathered from various sources to ensure optimum model performance. The sample of satellite weather image data that the CNN model was fitted with. The dataset offers as the model's training field, allowing it to find any hidden features or patterns. The training set should include a wide range of inputs so that the model can be trained in all scenarios and anticipate any future unseen data sample. The training dataset uses 80% of the data.

Validation Dataset

The performance of the CNN model as it is being trained is checked using the validation set, a set of data that isn't included in the training set. The information from this validation technique is used to alter the hyper parameters and configurations of the CNN model. Similar to a critic, it determines whether or not training is going in the proper direction. While being trained on the training set, the model is periodically assessed on the validation set. In order to prevent the CNN model from overfitting, which happens when the model becomes extraordinarily good at detecting samples in the training set but struggles to generalize to new data and provide accurate classifications, the dataset was split into a validation set.

Test Dataset

This dataset, which is utilized only after the model has finished being trained, is separate from the training set but has some characteristics with it in terms of the probability distribution of the classes. A testing set is often a well-organized dataset including data from various scenarios that the model is likely to encounter when employed in the real world. It is not regarded as a good practice to frequently use the validation and testing set combined as a testing set. The model is considered to have over fitted if its accuracy on training data is higher than that on testing data. About 20–25% of the total data available for the project are represented by this data.

7. CONCLUSIONS

Due to the abundance of meteorological data, it can occasionally be challenging to make accurate weather predictions. Therefore, in order to accurately predict the weather, we need to effectively organise the vast amount of data. Divided into two parts, a train dataset and a testing dataset, was that substantial amount of data. 20% of the data is kept aside for testing to ensure accuracy and the remaining 80% is used to build the train dataset.

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