Predicting weather using Artificial Neural Network

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project report titled "**Predicting weather using Artificial Neural Network**"is the bonafide work of "**YANDA SAKETH [Reg No: RA1911026010076] and SOUMYADEEP MUHERJEE [Reg No: RA1911026010078]**", who carried out the project work under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

Weather forecasting has become an important field of research in the last few decades. In most of the cases the researcher had attempted to establish a linear relationship between the input weather data and the corresponding target data. Artificial Neural Network (ANN) has evolved out to be a better technique to bring out the structural relationship between the various entities.

ACKNOWLEDGEMENT

I would like to express my deepest gratitude to my guide, Dr. C. AMUTHADEVI her valuable guidance, consistent encouragement, personal caring, timely help and providing me with an excellent atmosphere for doing research. All through the work, in spite of her busy schedule, she has extended cheerful and cordial support to me for completing this research work.

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Introduction

Weather forecasting is the application of science and technology to predict the state of the atmosphere for a given location. Weather forecasts are made by collecting quantitative data about the current state of the atmosphere and using scientific understanding of atmospheric processes to project how the atmosphere will evolve

Motivation & Objective

Weather warnings are important forecasts because they are used to protect life and property. Forecasts based on temperature and precipitation are important to agriculture, and therefore to traders within commodity markets. Temperature forecasts are used by utility companies to estimate demand over coming days. On an everyday basis, people use weather forecasts to determine what to wear on a given day.

Why Artificial Neural Network

In order to predict weather in a very effective way and to help overcome all such problems we have proposed a weather forecasting model using Artificial Neural Network. The advantage which ANN has over other weather forecasting method is that the ANN minimizes the error using various algorithms and gives us a predicted value which is nearly equal to the actual value. Such network is simulated over newer data to find out the weather trend in future course

Features

Due to the advancement of modern computer hardware there have been many improvements in numerical weather prediction . We are using ANN which is based on smart analyzing the trend from historical data.

The other models are accurate in calculation but not in predictions the can not able to adapt the irregular patterns of data which can neither be written in form of function or deducted as formula.

Use of ANN will give more accurate result. Here, the error may or may not reduce completely. But, the accuracy will improve as compared to other forecasts.

Introduction to the elements of the model

This Model is build using Artificial Neural Networks.

Key software used:

Jupyter Notebook

Python

Scikit learn

Neural Networks

Literature Review

Mohsen Hayati states that ANN for one day ahead prediction of temperature. Here multilayer perceptron (MLP) is trained for ten years meteorological data from Iran which was divided into four seasons namely spring, summer, fall and winter. MLP is a network of three layers having sigmoid transfer function for hidden layers and linear transfer function for output layer. Hidden neurons were decided using the trial and error method. It was concluded that MLP has minimum prediction error, good performance and reasonable prediction accuracy. They have used historical data for ten years and achieve minimum error and reasonable accuracy.

R Lee proposed an innovative, intelligent, multi-agent based environment called as intelligent Java Agent Development Environment (iJADE). It is used for weather prediction of eleven weather stations in Hong Kong using five years data which provides more than 7000 data records. The model uses GA for input node selection, a fuzzy classification for rainfall parameters and neural network for training using a BPN. Its experimental results are more accurate than single point sources using similar network and other networks like Radial Basis Function Network, Learning Vector Quantization and Naive Bayesian Network

Research Methodology

Weather forecasting is an application in meteorology and has been one of the most scientifically and technologically challenging problems around the world in the last century. In this, we are investigating the use of data mining techniques in forecasting maximum temperature, rainfall, evaporation and wind speed. This was carried out using Artificial Neural Network and meteorological data collected from previous 3 years.

Data Collection: the data used for this work was collected from different official websites and Metrological Department. The case data covered the period of 36 months.

Data Transformation: this step is also known as data consolidation. It is the stage in which the selected data is transformed into forms appropriate for data mining.

Data Mining Stage: It is divided into three phases. At each phase the algorithm is used to analyze the meteorological datasets. The testing method adopted for this research was percentage split that train on a percentage of the dataset, cross validation on it and test on the remaining percentage.

Comparison Between Artificial Neural Network and Back Propagation

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the new structure of the information processing system.

Components of a modern weather forecasting system include the following modules: data collection, data assimilation and numerical weather prediction.

Data collection: Observations of atmospheric pressure, temperature, wind speed, wind direction, humidity and precipitation are made near the earth's surface by trained observers, automatic weather stations.

Data assimilation: During the data assimilation process, information gained from the observations is used in conjunction with a numerical model most recent forecast for the time that observations were made to produce the meteorological analysis.

Numerical weather prediction: Numerical Weather Prediction (NWP) uses the power of computers to make a forecast. Complex computer programs, also known as forecast models, run on supercomputers and provide predictions on many atmospheric variables such as temperature, pressure, wind and rainfall.

Back propagation is a common method of teaching artificial

neural networks how to perform a given task. It is a supervised learning method, and is a generalization of the delta rule. It requires a teacher that knows, or can calculate, the desired output for any input in the training set

For better understanding, the back propagation learning algorithm can be divided into two phases: propagation and weight update.

Propagation Each propagation involves the following steps:

1. Forward propagation of a training pattern's input through the neural network in order to generate the propagation's output activations.

2. Backward propagation [4] of the propagation's output activations through the neural network using the training pattern's target in order to generate the deltas of all output and hidden neuron.

Weight update For each weight-synapse:

1. Multiply its output delta and input activation to get the gradient of the weight.

2. Bring the weight in the opposite direction of the gradient by subtracting a ratio of it from the weight.

Library Used

To build the model I have used few important libraries namely:

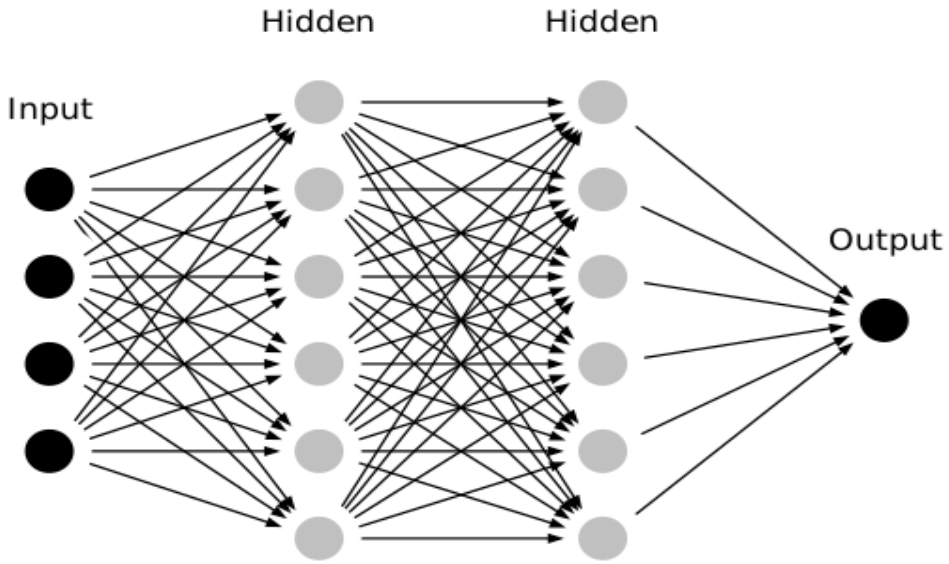
Numpy

Pandas

MLP Classifier

Grid Search CV

Model



jupyter predicting_weather (autosaved)

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```
    'hidden_layer_sizes': (
        (2,), (10,), (50,50),
    )
}
nn = MLPClassifier(max_iter=2000, random_state=0)
gridsearch = GridSearchCV(nn, parameters, cv=3)
gridsearch.fit(X_train, y_train)
```

Out[36]:
```
GridSearchCV(cv=3, estimator=MLPClassifier(max_iter=2000, random_state=0),
             param_grid={'hidden_layer_sizes': ((2,), (10,), (50, 50))})
```

Display grid search results.

In [37]:
```
print(gridsearch.cv_results_['params'])
print(gridsearch.cv_results_['mean_test_score'])
```

```
[{'hidden_layer_sizes': (2,)}, {'hidden_layer_sizes': (10,)}, {'hidden_layer_sizes': (50, 50)}]
[0.90424355 0.89487179 0.88450873]
```

Predictions using the best neural network.

In [38]:
```
best_nn = gridsearch.best_estimator_
y_pred = best_nn.predict(X_test)
print(accuracy_score(y_test, y_pred))
```

```
0.8938938938938938
```