Temperature Prediction Using Neural Networks

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ABSTRACT

Weather is affected by numerous factors and it is extremely difficult to predict any expect of it with high accuracy and precision because of the same. Temperature of a given city is affected by all sorts of global and local phenomena.

We employed a Neural Network to predict future temperature of various city. We calculated predicted mean temperature for more than 20 cities. We here show the predicted mean temperatures for Atlanta, New York, Chicago and Portland. We then compare the results for various models that we have tried.

All walks of life are affected by weather and an accurate and precise prediction is desirable. Agricultural and industrial sector are particularly in need of temperature and weather prediction.

I. INTRODUCTION

An artificial neural network consists of nodes, or artificial neurons that is used to vaguely emulate how actual neurons in a biological system behave. Just as for natural neural networks, the artificial neural network *learns* to perform some task based on the input or examples.

For different kinds of tasks, one requires different kinds of Neural Networks. For classification problem, convolution neural networks are the most effective. For our purpose, where time series forecasting is required, back-propagation is an ideal tool.

In order to *learn*, the neural network has to modify how much weight it assigns to different variables. Different algorithms use different ways of doing the same. Back-propagation, or backwards propagation of errors, computes the error at the output and propagates the error backwards to the neural network's layers to modify the said weights. We have used *Keras* to train our model, which implements back-propagation automatically.

II. DATA

The data used is of some of the major cities of USA. For Atlanta, the available data is from 1st January 1930 to 31st December 2005. That is 31,197 days. Similarly, for New York City the available data is from 1948 to 2005. For all the cities, the data available includes daily mean temperature, daily maximum and minimum temperature, maximum, minimum and mean humidity, daily precipitation data etc. We have used the mean temperature data for predictions.

The neural network uses 99% data to make predictions for longer than a season to check seasonal trends and reserves the rest 1% to test the predictions against. For short-term predictions, the network uses 99.5 % data to train and tests itself against the rest of the 0.5%.

III. APPROACH

The data is available for a very long period of time, the problem is to predict the variable value on $(p+1)^{st}$ day given the value of variables on the previous p days. In our problem, we have to predict tomorrow's temperature given temperature data of previous p days. Let us call p, the *period length*.

A. Architecture

The network is made up of an input layer, an output layer and 1 hidden layer between the two. For period length $p = 1$, the hidden layer has 8 neurons. The number of neurons in the hidden layers needs to be be adjusted with change in number of neurons in input layer. The output layer has 1 neuron which gives us the predicted value of mean temperature for that day.

- **Input Layer::** p neurons.
- **Hidden Layer::** 8 neurons.
- **Output Layer::** 1 neuron.
- **Loss Function::** Mean Square Error (MSE).
- **Optimizer::** Adam Optimizer

IV. RESULTS

The results are shown for 4 different cities, namely, Atlanta, Chicago, New York City and Portland.

For each city, there are two graphs shown, the first one for each city depicts the predicted temperature for approximately 5 months. It can be seen that it is nearly in perfect match with the actual mean temperatures during those five months.

In addition to this, second figure for each city exhibits the daily predicted mean temperature for approximately 4 years. This shows that the prediction is also able to follow the seasonal trends.

V. DISCUSSION AND REMARKS

Earlier, we had used tensorflow library and checked the model on stock prices data, we got results that did not stood up to the test data mainly because of the algorithm used, thus, we changed our algorithm and employed Keras to ensure backpropagation.

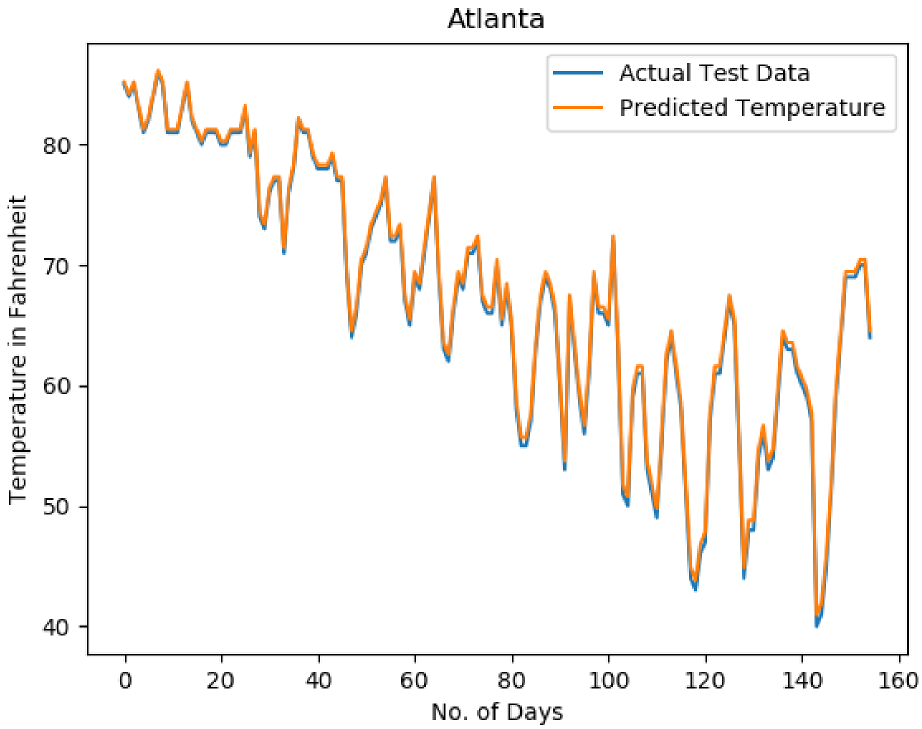

FIG. 1. **Atlanta : 6 months**

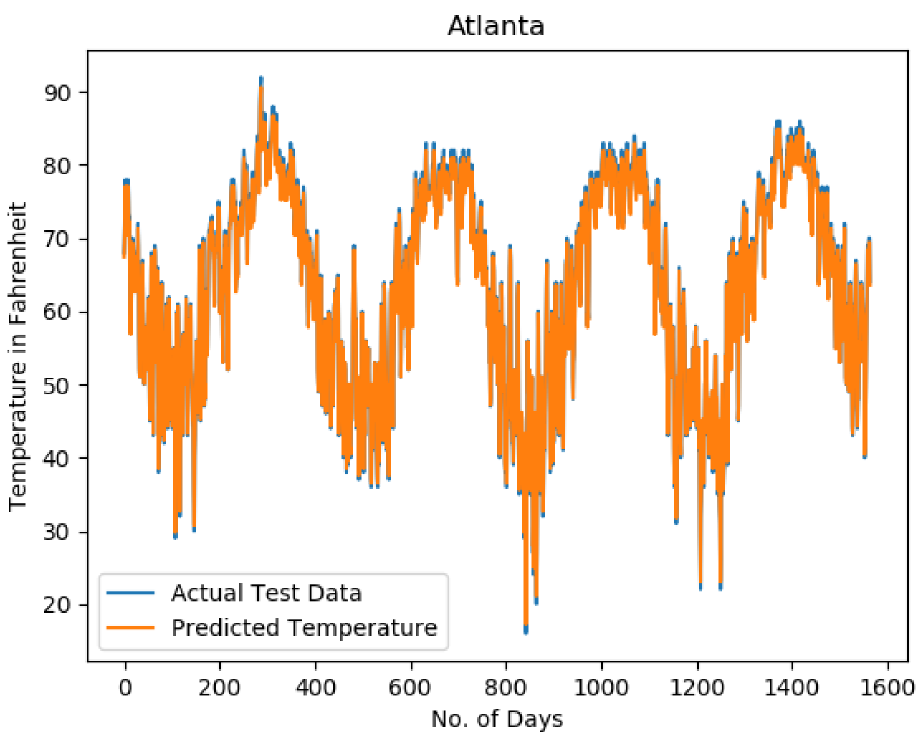

FIG. 2. **Atlanta : 4 years**

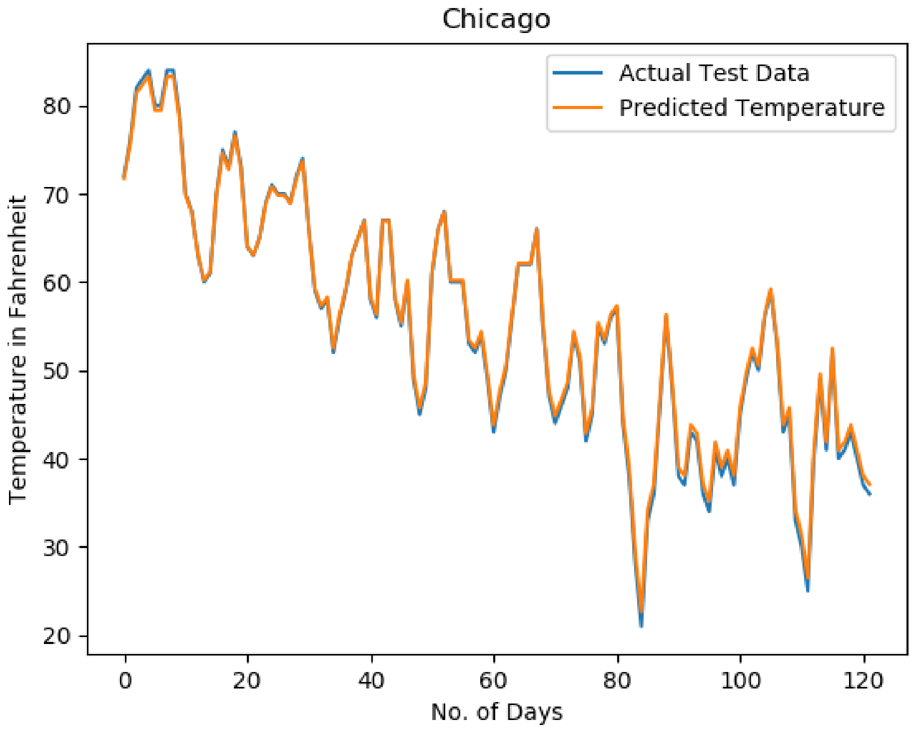

FIG. 3. **Chicago : 5 months**

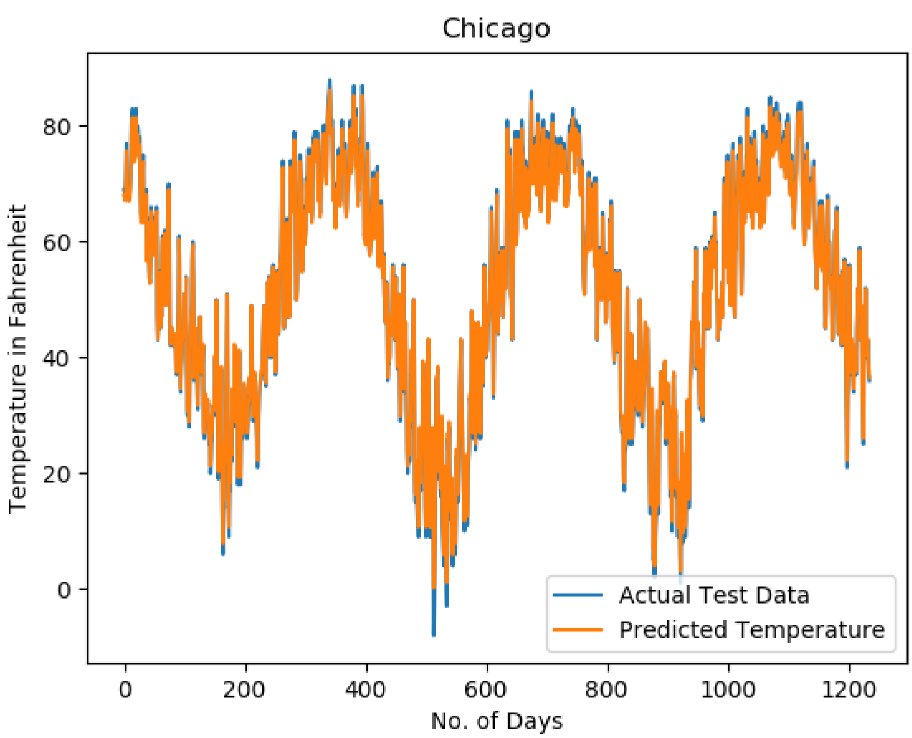

FIG. 4. **Chicago : 4 years**

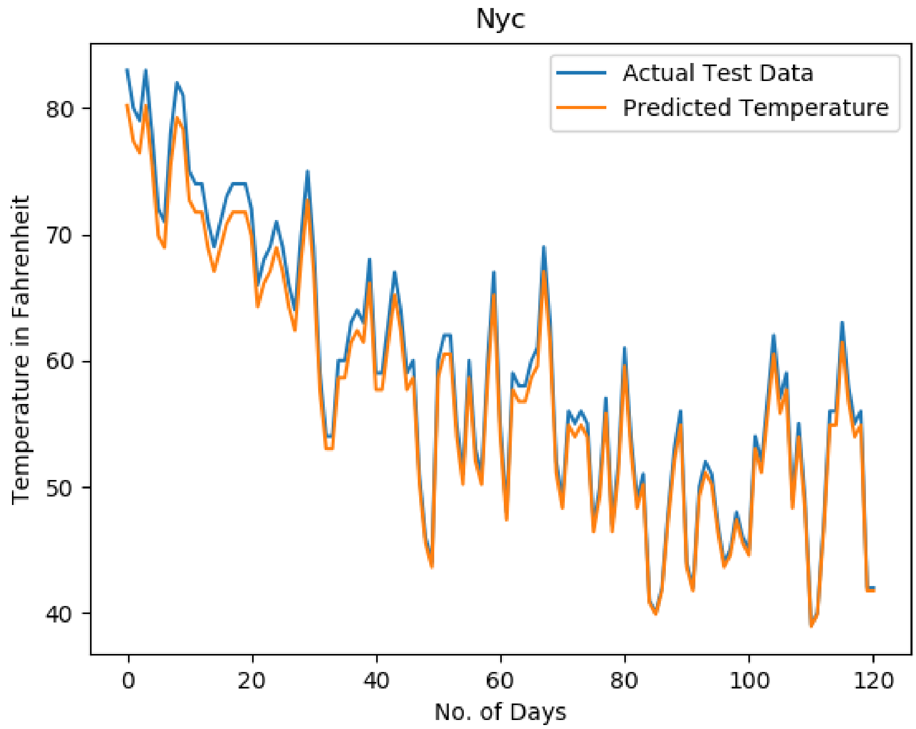

FIG. 5. **New York City : 5 months**

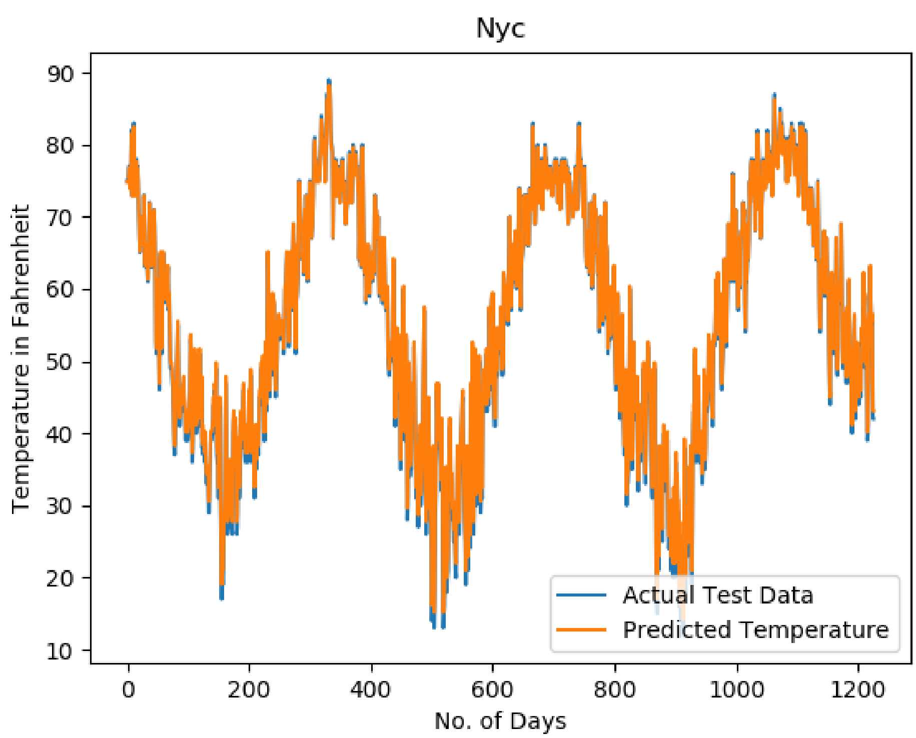

FIG. 6. **Chicago : 4 years**

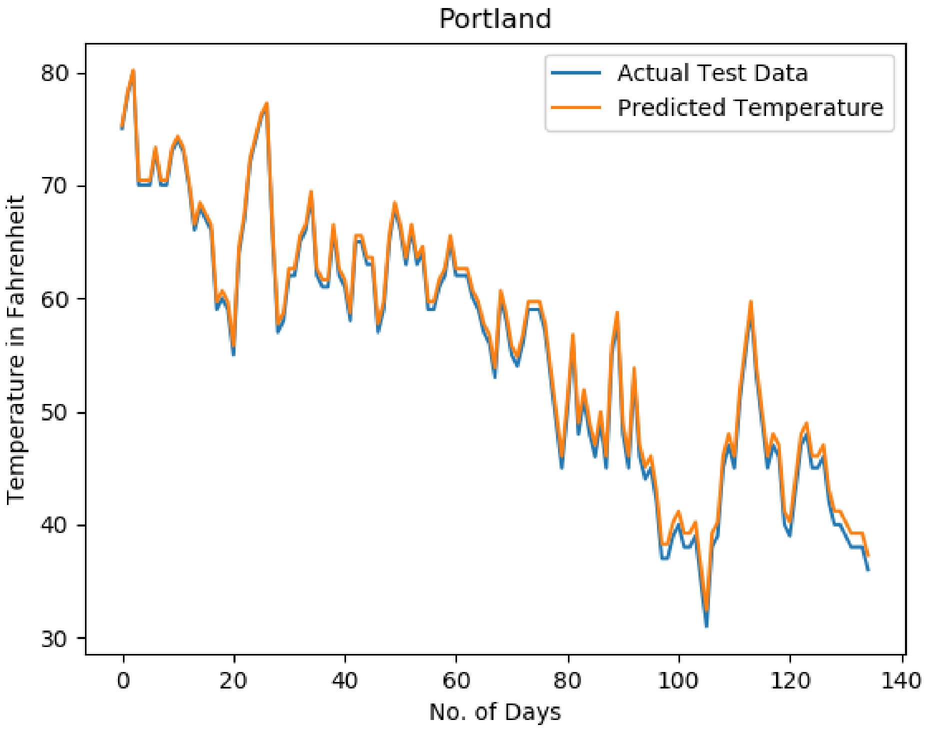

FIG. 7. **Portland : 5 months**

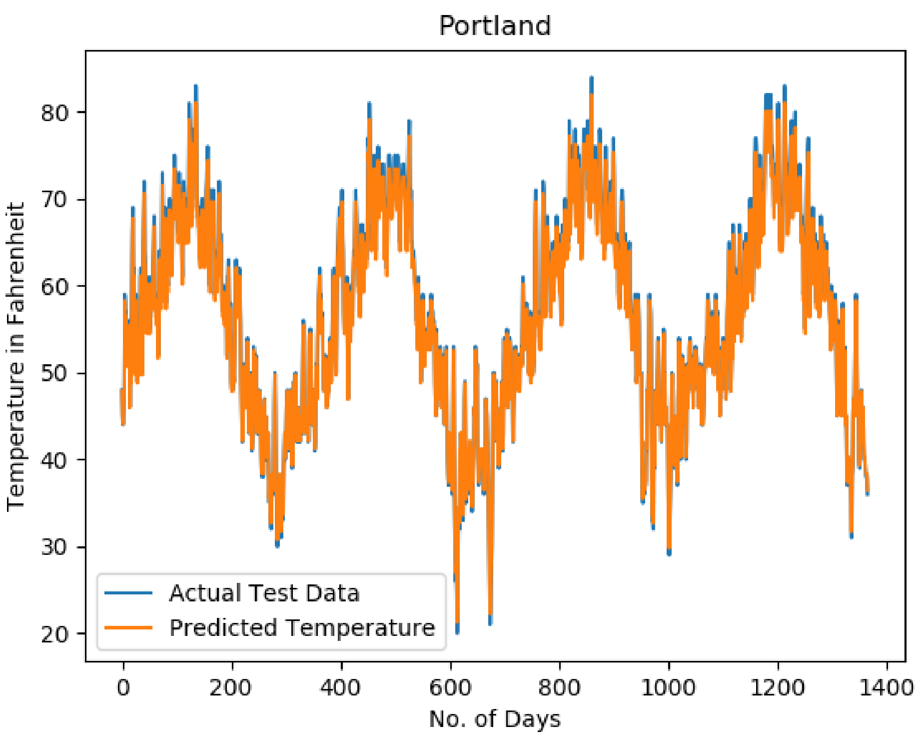

FIG. 8. **Chicago : 4 years**