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# Artificial Intelligence Using for Weather Forecasting

**V. Ramesh[1], G. Raju[2]**
[1]CSE Department, Assistant Professor , Sri Indu College of Engineering & Technology, Hyderabad, Telengana, India
[2]CSE Department, Assistant Professor, Vaagdevi College of Engineering, Hyderabad, Telengana, India

## ABSTRACT

Weather forecasting is very a statistical measure than a binary decision. We have a tendency to will develop an intelligent weather predicting module since this has become a necessary tool. This tool considers measures like most temperature, minimum temperature and rain for a sampled period of days and is analyzed. An intelligent prediction based on the obtainable data is accomplished using machine learning techniques. The analysis and prediction are supported linear regression that predicts consequent day's weather with smart accuracy. An accuracy of over ninetieth is obtained, supported the data set. Recent studies have mirrored that machine-learning techniques achieved higher performance than traditional statistical methods. Machine learning, a branch of computing has been established to be a robust technique for predicting and analyzing a given data set. The module plays an important role in agricultural, industrial and supply fields wherever the weather outlook is a crucial criterion.

**Keywords:** Weather Forecasting, Machine Learning, Artificial Intelligence, Linear Regression

## I. INTRODUCTION

Weather prediction, in general, is a complicated method and difficult task. It needs various parameters to forecast the weather. Monitoring and predicting weather helps in numerous fields like agriculture, travel, pollution dispersion, communication, disaster management, etc. henceforward the foretelling of weather plays a significant role in on a daily basis today facet, utilizing the requirements of a standard man to analysis scientists. This explains why foretelling cannot be foretold with easier means that.

Within the gift times their area unit high definition satellite images to accurately predict the forecast of the future days; however, the method is neither straightforward nor economical. Here this module helps the United States to predict the weather using the past knowledge and analyze it with an honest rate of accuracy and proves to be an easy one. The module involves the utilization of ideas related to AI and machine learning tools. Among the assorted tools, we have chosen simple regression technique. One factor that is to be done obligatorily by the user is to update the previous day's weather parameters alternatively the module fails to use linear regression to predict, as every tool dealing with machine learning involves the constant renewal of past data.

## II. RELATED WORKS

The authors in [1] prohibited the prediction of atmospherically temperature using Support vector machine. This helped to grasp regarding defects of SVM. The prediction interval mistreatment hydrological knowledge that helped North American nation to understand regarding the uncertainty was mentioned in (2). The authors in [4], foreseen the quantity of alternative energy generated using weather outlook provided AN example of the way to use the forecast in daily life. Prediction of the utmost temperature using support vector machine helped North American nation within the prediction temperature method was mentioned in (3). In [5], the authors gave AN intuition of various kernels employed in support vector machine. Forecasting using artificial neural network provided on the utilization of prognostication using ANN (7). From the literature survey, we tend to get AN intuition of the way to method our work more.

## III. FUNCTIONS

### A. Hypothesis

To describe a supervised learning problem, the output is predicted according to the given inputs. We are aware of how the output arrives for the particular input. In hypothesis function, the aim is to predict a hypothesis, which is as close as to the output... To be simply told the cost function renders hypothesis, which has the least distance or measure to the output.

$$h(x) = h\theta(x) = \theta 0 + \theta 1X1 + \ldots \theta n\, Xn \qquad (1)$$

Where h(X) is the hypothesis function, X is the input (in matrix) and theta (θ) is the parameter corresponding to X. Theta are set of values, which makes the mean square error minimum.

### B. Cost function

Cost function is a mathematical function, which makes the above hypothesis to be closer to the output. Therefore, this function minimizes the mean square error. The cost function is explained as given in equation 2

$$J(\Theta) = \frac{1}{2*m} * \sum_{i=1}^{m} (h(x) - y)\text{^}2 \qquad \text{---(2)}$$

Where J ( ) is the cost function(x) is the hypothesis function, m is the number of training examples and y is the output. The cost function should denote the minimum distance between the hypothesis curve and the output curve.

### C. Gradient descent

Gradient descent is a differential equation which minimizes the theta ( ) value in order to minimize the cost function after repeated iterations. In mat lab, the following function represented by equation (3) is implemented to converge the value of the cost function. This can be made only by minimizing the theta value in consecutive steps.

$$\theta j := \theta j - \alpha \frac{\partial}{\partial \theta j} J(\theta) \qquad \text{--- (3)}$$

Here j is the theta value of a particular iteration value and J ( ) is the cost function

### D. Normal equation

The normal equation gives the best value of theta for the hypothesis without any need for Iterations as done in gradient descent.

$$\theta = (X^T X)^{-1} X^T Y \text{ ----(4)}$$

The normal equation plays a vital role in predicting the probability of the forecasted day, (i.e.) whether it was a rainy, sunny, or cloudy day

### E. multiclass classification

In the multi class classification the classified output values are more than two cases, i.e. more than the usual 0's and 1's. In this case, we need to predict one of the three classes, sunny, rainy, or cloudy. Hence we go for multi class classification which uses a the algorithm of logistic regression, except the fact that it can handle more than 2 classes

## IV. METHODOLOGY

Weather cannot be predicted with the good percentage of accuracy. It is an art to forecast the weather with terribly low deviations and creating it fetches sensible results. However, weather forecasting tends to deviate a lot of and has moderate accuracy.

The entire results printed are completed victimization the MATLAB tool by implementing Victimization idea. Initially, three weeks knowledge of Georgia homeboy temperature minimum temperature rainfall and therefore the corresponding day is place within the column of a matrix and therefore the matrix is drawn as X. the sort of the day is drawn as 1for sunny, cloudy as two and rainy as three. They are place in an exceedingly column and the matrix is drawn as Y. Initially, the values of theta are zeros that end in hypothesis (h(x)) as zero. The hypothesis and Y are wont to realize the worth of value performs. The obtained (cost perform from equation 2) is distributed to gradient descent (equation 3) and the updated theta values are acquired. Once more they are fed into {the value the value the price} perform to induce the new cost perform. This method is perennial for much iteration until the precise price of theta and price perform is obtained. It has to be the smallest amount among all the iterated values. The obtained alphabetic character is planned with against the amount of days that is that the hypothesis curve. The predicting day's most temperature is found by finding the worth of y (max temperature) within the plot by work the worth of x (the corresponding day) by extending the hypothesis

curve. Similarly, constant procedure is completed for locating minimum temperature and rainfall. The values of foretold max, min temperatures and downfall are increased with theta to induce a price which can be within the vary of (1 to 3) because the sunny day drawn by one, cloudy drawn by two and rainy as three.

In the method finding a decent price of theta is that the major task for predicting the sort of the day. The worth of alphabetic character found may also be done using traditional equation. to find the worth of alphabetic character from the conventional equation the X and Y matrices are enforced within the equation(4).The obtained price of theta is then increased by the anticipated price of the max, min temperature and rainfall to induce the worth of the type of day.(Sunny or cloudy or rainy).

The error verification process is explained in the error verification and detection column

## V. WEATHER CLASSIFIER ANALYSIS

The plots in figure (Figure 1.3, Figure 1.4, and Figure 1.5) show the curves obtained by plotting max temperature (Celsius) Vs number of days, min temperature (Celsius) Vs number of days and rainfall (in mm) Vs number of days. The curves are obtained by evaluating the cost function along with gradient descent. The theta obtained is used for plotting the curve (hypothesis)... The curved plot is due to the polynomial function used in plotting the data.

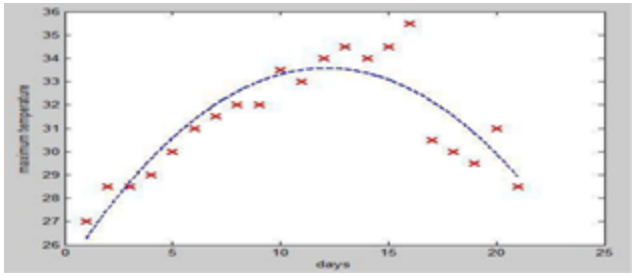


**Figure 1.3.** Maximum temperature Vs Days

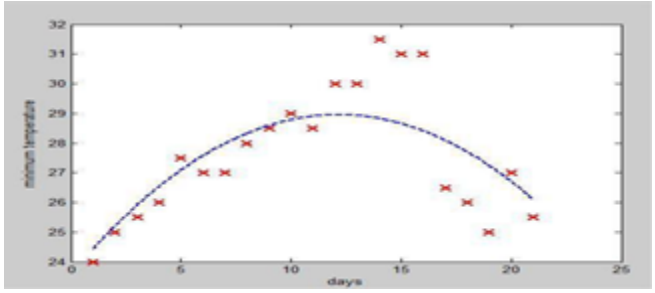


**Figure 1.4.** Minimum temperature Vs Days

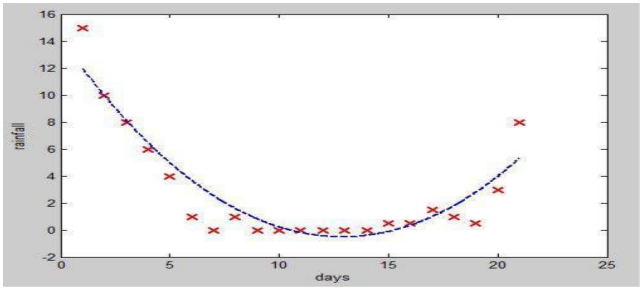


**Figure 1.5.** Rainfall vs. Days

The following hypothesis in fig (1.3, 1.4, and 1.5) will be a curve, which has the least distance (perpendicular) between itself and the output points. the gradient descent undergoes numerous iteration to minimize the value of theta, which is gives, the shape of the curve (hypothesis).

## ERRORS & THEIR DETECTIONS

The training set error and cross-validation error are calculated to understand the errors present in the prediction. The error is usually because of over fitting (high variance) or under fitting (high bias) of curves. A two-hundredth of information is taken from the cross-validation set and another two-hundredth of information is taken for the check set. Remaining hour of information is evaluated for the training set. The cross-validation set knowledge and the training set data are plotted by having the variety of coaching examples within the x-axis and error within the y-axis. By doing, therefore, we will infer whether the hypothesis is suffering from high bias or high variance... each is subjected to extend the error and therefore ought to be compensated. Suppose if the coaching set error is high, then the hypothesis is said to possess high bias. If the cross-validation set error is high, then the hypothesis is claimed to possess high variance. The values for plotting the curve of error vs. range {of coaching} examples for training set is obtained by having the hour of coaching set. Each training set knowledge is loaded during a stack one at a time and its price perform is obtained by computing the letter of the alphabet from the info in stack through gradient descent. The obtained price perform area unit the values plotted within the error curves. After the cost, the price perform value is obtained A knowledge of training set is loaded into the stack and also the procedure is recurrent for the complete knowledge to get the error curves

The case of cross-validation error, the error plot is obtained by price perform values wherever the letter of the alphabet utilized in price perform is obtained by victimization all the values of Cross validation set knowledge through gradient descent, however, the thought stack is enforced with every cross-validation data loaded at a time to seek out price perform values. Note: Here the worth is obtained using the theta from gradient descent. Where the complete cross-validation set, knowledge was used while not the thought of the stack

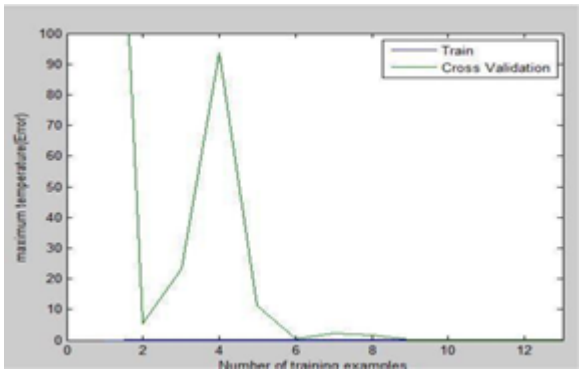


**Figure 1.6**. Error verification for Maximum temperature vs. days

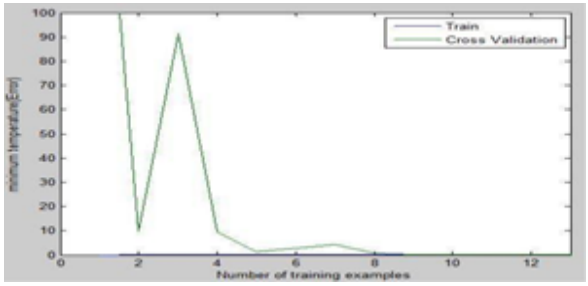


**Figure 1.7**. Error verification for Minimum temperature Vs days

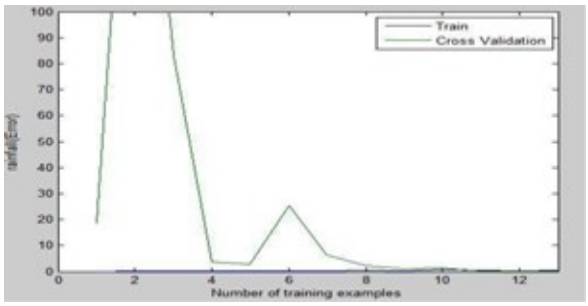


**Figure. 1.8.** Error verification for Rainfall Vs Days

All the curves in the plot should have to tend towards x axis of the plot and should have to touch the x-axis as the number of training examples increases. The height of the curves edge at the end from the x-axis determines the value of error that occurs in prediction. However, in the plots we can observe that the curve touches the x-axis showing that there will be no error in the prediction process. Page Layout

## VI. RESULTS

The prediction for the next day's weather which follows maximum, minimum, rainfall and the type of the day (whether it is sunny or cloudy or rainy) is predicted with a good rate of accuracy using the plots obtained from fig(1.3,1.4,1.5) through hypothesis by getting the value of y-axis from the curve by substituting the x axis value

The margins must be set as follows:

| Parameters or Features: | 22nd day prediction | 23rd day prediction |
|---|---|---|
| Max.Temperature | 27.8138 | 26.5903 |
| Min Temperature | 25.42222 | 24.6687 |
| Rainfall | 6.8656 | 8.5715 |
| Type of the day | Rainy day | Rainy day |

Which is the date of the next day? On finding the forecast using the predicted values of maximum temperature, minimum temperature and rainfall we get the following output in the two forms:
For the 22nd day: Using Normal Equation: Theta computed from the normal equations:

| Theta 1 | Theta 2 | Theta 3 | Theta 4 |
|---|---|---|---|
| 11.447015 | -0.457802 | 0.176650 | 0.007970 |

Using linear Regression with Multiple variables: Theta computed from gradient descent

| Theta 1 | Theta 2 | Theta 3 | Theta 4 |
|---|---|---|---|
| 2.00000 | -0.858447 | 0.183849 | 0.086995 |

The Forecast is = 2.893347e+00
From the result through normal equation and linear regression with multiple variables, we can conclude that the forecasted weather is going to be a cloudy day with 89% chance of being a rainy day. However, the regression module tends to fit the data well and predicts accurate result a small amount of error is observed. The error is predicted by running the module for the

parameters of past days and comparing it with the data present in the dataset

| METRIC | ACTUAL VALUE | PREDICTED VALUE | % DEVIATION |
|---|---|---|---|
| Max temp: | 34 | 33.57 | 1.26% |
| Min temp: | 30 | 28.95 | 3.5% |
| Rainfall: | 0 | 0 | 0% |

## VII. CONCLUSION

The results can even be verified by multi-class classification using logistic regression and with artificial neural network. However, the disadvantage of using the artificial neural network and multi-classification is that they offer U.S.A. an output of the day and not the closest price likelihood of however the day goes to be. The support vector machine can even be utilized in predicting the information and works the best once there is an outsize range of options and classifications gift however redundant options should be avoided. The only effort that is to be taken by the user is to update the information set to indicate correct results. And it works well once the information set is significantly giant enough to supply a minimum of a seventh of the data to be forecast. For instance, if the data set has been taken for one year, the forecast weather is going to be correct for the primary fifty-two days. Once there square measure a lot of options and a lot of coaching examples (dataset) the forecast works best. The module helps in watching and predicting the weather with a good rate of accuracy, particularly in an efficient manner.

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