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TITLE: WEATHER FORECASTING

CHAPTER 1

INTRODUCTION

Weather Forecasting is one of the scientific method of predicting the weather. Weather is observed at the given time period, state of atmosphere. The weather forecasting was one of the challenging task to the researchers and scientist. To forecast the weather we use few parameters like temperature, rainfall, humidity and wind. The weather forecasting is done, based on the historical values. The historical values are those values which are recorded in the previous years. Weather prediction plays a major role in agriculture, boating, travelling, pilots etc. Weather prediction is used in agriculture, because based on the weather the farmer can cultivate his land, prediction used for travelling because based on the weather itself a person can make plan to travel, suppose if it is rainy next two days the person can change the plan according to it. In case if it is rainy can cloudy even pilots can't travel. Even prediction is used for travelling in ship, because based on the weather itself even they can travel.

In olden days they use to predict the weather based on the wind direction, based on it they use to predict that it may rain or not. Weather prediction is done on the state of atmosphere at any given location of time. Ancient weather forecasting is done on the method of observing the atmosphere pattern. For example, if the sunset is in red colour then they predict that the weather to be fair weather. However, these predictions not prove reliable. Weather forecasting can also be made as the web application, whereas images, graphics etc. so these can be more easy to understand. The role of the admin person is to add the dataset to the database and based on the dataset it should calculate the weather and it should predict the weather. This application can be used in Air Traffic, Marine, Agriculture, Forestry, Military, and Navy etc.

In weather forecasting the prediction is done based on the physics, by variety of statistical and empirical methods. And based on the atmospheric condition like changes in the earths for example snow, ice cover, storm, tides, and floods.

Weather prediction is achieved for estimating the unknown weather based on that current conditions. Climate forecasting has become a popular novelty. In 1812 Napoleon in Moscow was the only person who studied o the cold climate conditions. Then with the development advanced scientific methods they use to predict weather. Then there was the rapid development in the techniques to predict the weather and now we have 140 principles regarding the weather forecasting. These principles where basically made on the historical dataset.

As we know the weather condition around the world changes rapidly and continuously. And the correct forecasting is very important to everyone in life. From the agriculture to industry, from traveling to daily community, we all dependent on the weather heavily. As the world is suffering from the climate change and its side effects.

The current weather forecasting is heavily depend on the complex physical models and the need to be run on the large computer system.

As the weather systems can travel a log way over time in all directions, the weather of one place depends on that of others considered. In this we are collecting the related data from the past dataset and then predicting the weather.

People consider how this weather prediction plays a key role in their real life. And then they started to learn about that, from the previous weather forecasting to the modern forecasting equipment and how these technology saved life by giving in advance warning of natural hazards. People started to forecast the weather prediction from the ancient times itself, and they started to develop many equipment like weather balloons, satellites, Doppler, computer simulation algorithms and programs. Now, many people depend on the weather prediction technology, where this helps them to plant crops, natural disasters, floods, tornadoes etc.

Actually people without thinking today that this morning, we can forecast the weather similarly around the world have been predicting the weather for many years like thousands of years. After this people started to depend on the weather forecasting techniques and started to create the app in mobile, watches etc. In an ancient time Chinese use to forecast the weather by the observing the

pattern of event occurs in each day. Not only the Chinese people but also many people use to predict the weather by the pattern recognition itself.

After this they understood that this technique doesn't give them the accurate weather and sometime the weather prediction was false and then they started to think about the weather forecasting with the accurate values. People consider how this weather prediction plays a key role in their real life. And then they started to learn about that, from the previous weather forecasting to the modern forecasting equipment and how these technology saved life by giving in advance warning of natural hazards.

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Some, where use to predict the weather by the historical data means they use to keep record of all the information about the weather, time etc. and others use to calculate by using many algorithms to predict the weather. When they started to do this they, where able to avoid many hazards, tsunami, heavy rainfall, snowfall etc. where this help many lives in the world. In every place, or whatever the work we do all these things will be dependent on the temperature or the climate condition etc.

TYPES OF WEATHER FORECASTING

There are four different types of weather forecasting:

CLIMATOLOGY FORECASTING METHOD:

This is the simple method use to predict the weather. Meteorologists mainly use this technique after reviewing weather statistics collected over many years and then calculating the averages. They use to forecast the weather based on the weather condition. This technique works only when the weather pattern remain same, but outside factor changes the weather frequently, as weather changes due to the global warming, but this method is not good for forecasting the weather. This is known as the climatology forecasting.

ANALOG FORECASTING METHOD:

This technique is difficult to forecast the weather. Because in this method it requires finding a particular day in the past with the same weather to the current forecast, where this is difficult to do so. This technique is use to forecast the similar type of weather based on the analog comparison, but even any small difference in the past and the current weather condition, there is a great change in the outcomes, so this technique is not a good choice to compile a weather prediction. This is known as the analog forecasting method.

PERSISTENCE AND TRENDS FORECASTING METHOD:

In this technique they should have some skill to predict the weather because it will relies to the past trends. Sometimes in an ideal world, the atmosphere will slowly changes, and which equates to predict tomorrow and that remains the same as today. This technique requires only that what you stay abreast of current weather condition and it know the region's climate average. This technique is known as the persistence and trends forecasting method.

NUMERICAL WEATHER FORECASTING METHOD:

This technique of forecasting relies on the computers to forecast the weather. And massive supercomputers are used to complete the forecasting models, with the help of meteorologists use to forecast the weather based on the multiple condition of atmosphere like temperature, wind speed, and wind direction, rainy, snowfall and other conditions etc.

Here the person determines the data to determine the weather forecast for the day. These techniques is good for the algorithms used by the software to forecast the weather. Sometime when equations

lack to the precision, then they may lead to errors. But numerical weather forecasting gives the accurate values compared to other methods. This is known as the numerical weather forecasting method.

APPLICATION OF WEATHER FORECASTING

Weather forecasting is used in many fields, they play a major role in every field. And forecasting is important to avoid any situation like floods, tsunamis etc.

AIR TRAFFIC:

Because of the aviation industry which is sensitive to the weather, and accurate weather forecasting is important. The fog are the low ceilings which can avoid many aircraft from landing and taking off the aircraft. And icing also significant in-flight hazards. And the thunderstorms, can also cause the problem for all aircraft due to the updraft and outflow boundaries etc. they may also cause the damage to the aircraft in the flight due to the large hail, strong winds, lightning etc. Additionally, the airports can often change which runway is being used to take the benefits of the headwind. And this can often reduce the distance which is required for takeoff, and they may eliminate the potential crosswind

MARINE:

For the commercial and for the recreational use of waterways, they can be limited by the wind direction, speed, and by the wave periodicity and by the heights, and by the tides and precipitation.

These things can influence the safety of the marine transit.

AGRICULTURE:

Basically most of the farmers depend on the weather forecasts to decide what work to be done on the particular day. For example, the drying hay is feasible in the dry weather. Where this is useful to the cotton, wheat, corn crops.

FORESTRY:

The weather prediction of wind, precipitation and humidity these are useful to avoid and control the wild fires. The development of the harmful insects can also be predicted by determining the weather.

1.2 PROBLEM STATEMENT

To design and implement weather forecasting using machine learning and python

1.3 MOTIVATION OF WEATHER FORECASTING

In ancient time the weather was predicted based on the climate pattern condition. For example if the color of the sky is red then the weather is said to be in fair weather. Where this technique was enabled to predict the weather accurately this leads to many disaster. After this, to predict the weather accurately they started to collect the past dataset. Then by using linear regression algorithm technique they started to predict the weather.

1.4 METHODOLOGY OF WEATHER FORECASTING

The weather forecasting is done using machine learning with python. Here we collecting the data from the historical dataset and then to predict weather we are using the linear regression algorithm were this is based on the supervised learning technique. Linear regression is the task use to predict the required value based on the dependent variable and independent variable. Then we do data training and data testing. After testing the data we get the required output based on the given data

CHAPTER 2

SYSTEM REQUIREMENT AND LANGUAGE USED

2.1 HARDWARE SYSTEM CONFIGURATION:

Process	-Intel core i5
Speed	-1.8 GHz
Ram	-256 MB(min)
Hard disk	-10 GB

SOFTWARE SYSTEM CONFIGURATION:

Operating system	-windows10
Programming language	- machine learning with python
Compiler	-anaconda

2.2 ABOUT THE LANGUAGE

This project is implemented using machine learning with python. Python is a high level, interpreted, general purpose programming language. This language is always described as “bacteria included” language due to its comprehensive standard library. The purpose of weather prediction is to give the accurate possible forecast value of what the weather will be in the future.

The important is to aspects of day to day life, including aviation, boating, other modes of transportation, farming, tourism, sports, etc. Without accurate weather forecast people involved in activities like the ones I have listed may end up in dangerous situation they were unprepared for and end up injured or worse. Pilots need to know the weather to plan their flights, sailors need to know what the weather will be like to plan their activities, and farmers need to know what the weather will be like to help them plan watering, fertilizer and pesticide application, and harvest activities.

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

Numerical weather prediction models are computer simulation of the atmosphere. They take the analysis as the starting point and evolve the state of the atmosphere forward in time using understanding of physics and fluid dynamics.

The complicated equations which govern how the state of a fluid change with time require supercomputers to solve them.

CHAPTER 3

SYSTEM DESIGN

3.1 ARCHITECTURE

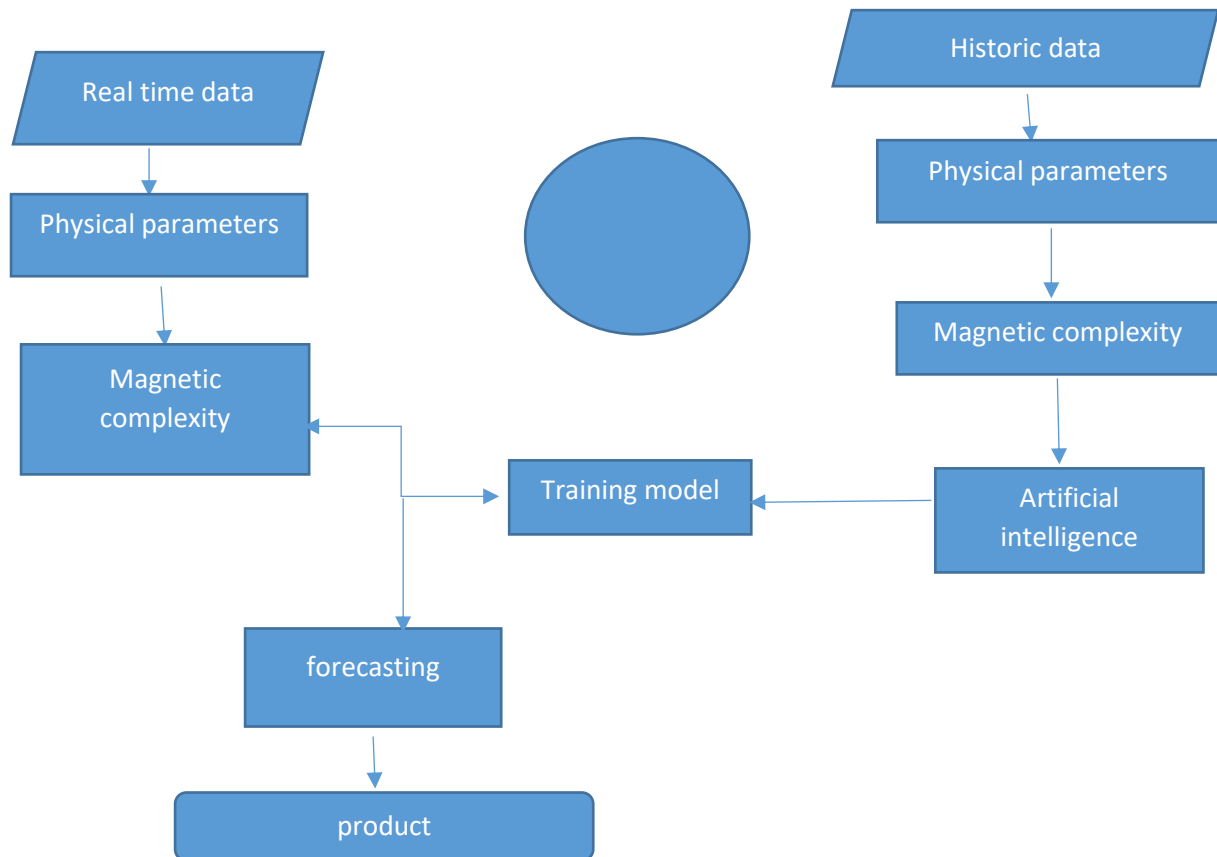


Fig:3.1 THE ARCHITECTURE OF WEATHER FORECASTING

We collected real weather data from different parameters such as temperature, humidity, pressure, wind direction etc. And develop the program according to the dataset, to determine the weather forecast. After collecting the data from the historical dataset, the data is analysed.

Then the data is trained by using the algorithm named as linear regression were this is based on the supervised learning technique. Regression is the task to predict the required data based on the dependent and independent variable. Then the data is tested, after testing the data we get the required output based on the data given.

3.2FLOW CHART

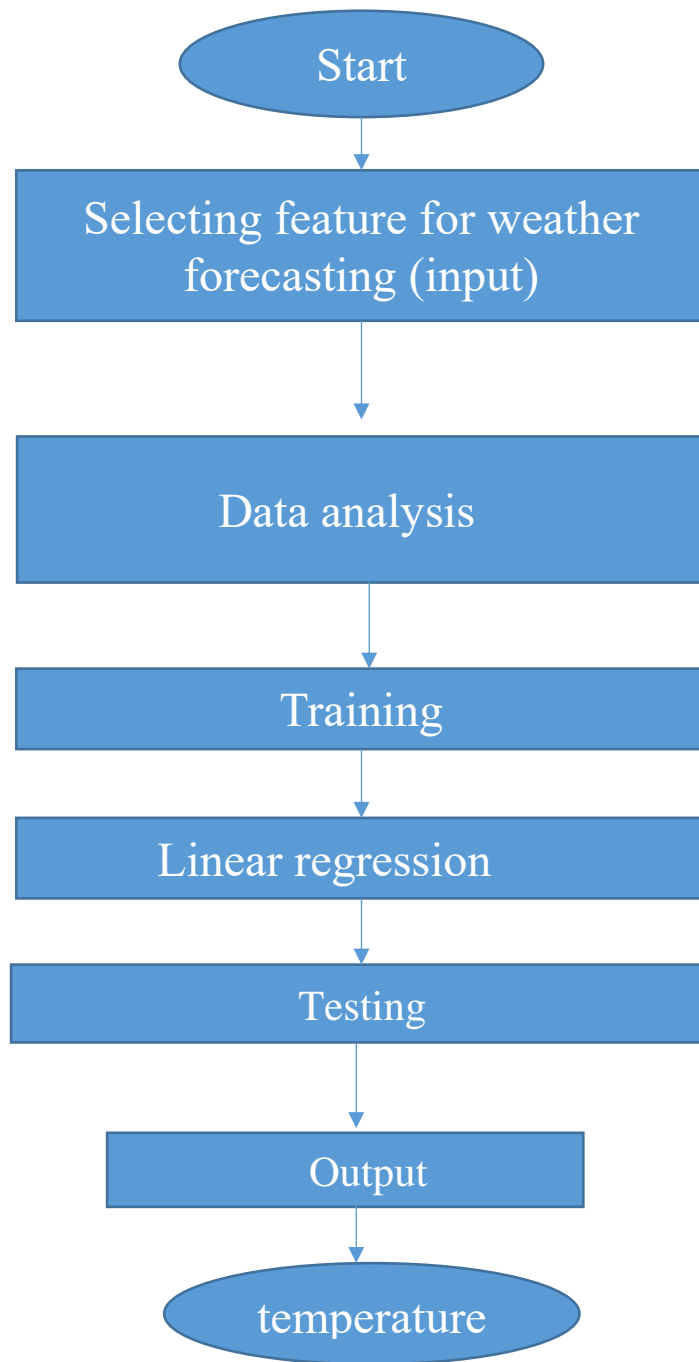


Fig3.2 FLOW CHART

3.3 ALGORITHM

Step 1: start

Step 2: recording the weather data (temperature, pressure, wind speed and direction, humidity Etc.

Step 3: collecting the dataset from the weather recorded.

Step 4: then the data is trained

Step 5: linear regression is to predict the data from the dependent and independent variable.

Step 6: then the data is tested.

Step 7: end

3.4 CODE AND IMPLEMENTATION

```
Import pandas as pd
```

```
From sklearn.model_selection import train_test_split
```

```
from sklearn import preprocessing
```

```
from sklearn.ensemble import RandomForestRegressor
```

```
from sklearn.pipeline import make_pipeline
```

```
from sklearn.model_selection import GridSearchCV
```

```
from sklearn.metrics import mean_squared_error
```

```
from sklearn.metrics import r2_score
```

```
from sklearn.externals import joblib
```

```
from sklearn.preprocessing import RobustScaler
```

```
import csv
```

```
import datetime
```

```
from sklearn.svm import SVR
```

```
import sklearn.svm as svm
```

```
from sklearn.linear_model import LinearRegression
```

```

import os

dataset_url1 = 'https://opendata-download-
metobs.smhi.se/api/version/1.0/parameter/2/station/71420/period/corrected-archive/data.csv'

dataset_url2 = 'https://opendata-download-
metobs.smhi.se/api/version/1.0/parameter/2/station/71420/period/latest-months/data.csv'

data1 = pd.read_csv(dataset_url1, sep=';', skiprows=3607, names= [

    'Fran Datum Tid (UTC)', 'till', 'day', 'temperature', 'Kvalitet', 'Tidsutsnitt:', 'Unnamed: 5'

])

data2 = pd.read_csv(dataset_url2, sep=';', skiprows=15, names= [

    'Fran Datum Tid (UTC)', 'till', 'day', 'temperature', 'Kvalitet', 'Tidsutsnitt:', 'Unnamed: 5'

])

def train_data():

    x = data1.drop('Kvalitet', axis = 1)

    x = x.drop('Unnamed: 5', axis = 1)

    x = x.drop('Fran Datum Tid (UTC)', axis = 1)

    x = x.drop('Tidsutsnitt:', axis = 1)

    y = x.temperature

    X = x.drop('temperature', axis= 1)

    x2 = data2.drop('Kvalitet', axis = 1)

    x2 = x2.drop('Unnamed: 5', axis = 1)

    # x2 = x2.drop('Till Datum Tid (UTC)', axis = 1)

    x2 = x2.drop('Fran Datum Tid (UTC)', axis = 1)

    x2 = x2.drop('Tidsutsnitt:', axis = 1)

    y2 = x2.temperature

    X2 = x2.drop('temperature', axis= 1)

```

```

new_dates = []

counter = 0

X = X.append(X2)

dates = X.day

for day in dates:

    day = datetime.datetime.strptime(day, "%Y-%m-%d")

    day2 = (day - datetime.datetime(1970,1,1)).total_seconds()

    new_dates.append(day2)

X.day = new_dates

new_dates= []

for day in X.till:

    day = datetime.datetime.strptime(day, "%Y-%m-%d %H:%M:%S")

    day2 = (day - datetime.datetime(1970,1,1)).total_seconds()

    new_dates.append(day2)

X.till = new_dates

y = y.append(y2)

X_train, X_test, y_train, y_test = train_test_split(X, y,

                                                    test_size=0.5,

                                                    random_state=123,

                                                    )

scaler = preprocessing.StandardScaler().fit(X_train)

X_train_scaled = scaler.transform(X_train)


pipeline = make_pipeline(preprocessing.StandardScaler(),

                          RandomForestRegressor(n_estimators=100))

```

```

hyperparameters = { 'randomforestregressor__max_features' : ['auto', 'sqrt', 'log2'],
                    'randomforestregressor__max_depth': [None, 5, 3, 1], }

clf = LinearRegression()

clf.fit(X_train, y_train)

pred = clf.predict(X_test)

joblib.dump(clf, 'weather_predictor.pkl')

def get_the_weather(date):

    weather = data1.day

    temp = data1.temperature

    for i in range(0, len(weather)):

        day = datetime.datetime.strptime(weather[i], "%Y-%m-%d")

        if (day == date):

            return temp[i]

def predict_weather():

    clf = joblib.load('weather_predictor.pkl')

    print("-" * 48)

    print("Enter the details of the date you would like to predict")

    print("\n")

    option = input("Year: ")

    year = option

    option = input("Month number (00): ")

    month = option

    option = input("Day number (00): ")

    theday = option

```

```

day = str(year + "-" + month + "-" + theday plus_one)

day = datetime.datetime.strptime(day, "%Y-%m-%d")

date = (day - datetime.datetime(1970,1,1)).total_seconds()

day_x = str(year + "-" + month + "-" + theday plus_one)

day_x = datetime.datetime.strptime(day_x, "%Y-%m-%d")

date_x = (day_x - datetime.datetime(1970,1,1)).total_seconds()

X = [[date, date_x]]

print("\n")

print("-" * 48)

print("The temperature is predicted to be: " + str(clf.predict(X)[0]))

print("The temperature was actually: " + str(get_the_weather(day)))

print("-" * 48)

print("\n")

def run_program(option):

    if option == 1:

        print("1")

    elif option == 2:

        predict_weather()

def run_menu():

    print("*" * 48)

    print("-" * 10 + " What would you like to do? " + "-" * 10)

    print("\n")

    print("1. Look up the weather on a specific day")

    print("2. Predict the weather on a specific day")

    print("\n")

```



```
    option = input("Enter option: ")

if __name__ == "__main__":

    train_data()

    while True:

        option = run_menu()

        option = predict_weather()

        if option == 2:

            break

        if option == 1:

            break

        option = run_menu()

        if option == 9:

            break

    else:

        run_program(option)
```

CHAPTER 4

RESULT AND DISCUSSION

4.1 SUMMARY OF RESULT OBTAINED

We collected real weather data from different parameters such as temperature, humidity, pressure, wind direction etc. And develop the program according to the dataset, to determine the weather forecast. After collecting the data from the historical dataset, the data is analysed.

Then the data is trained by using the algorithm named as linear regression were this is based on the supervised learning technique. Regression is the task to predict the required data based on the dependent and independent variable. Then the data is tested, after testing the data we get the required output based on the data given.

4.2 OUPUT

```
*****
```

```
----- What would you like to do? -----
```

1. Look up the weather on a specific day
2. Predict the weather on a specific day

Enter option:

Fig:4.2.1 ENTERING THE OPTION

```
Enter option: 2
```

```
-----  
Enter the details of the date you would like to predict
```

```
Year: 2019
```

```
Month number (00): 10
```

```
Day number (00): 31
```

```
-----  
The temperature is predicted to be: 9.544338065223307
```

```
The temperature was actually: None  
-----
```

```
*****
```

Fig:4.2.2 PREDICTING THE TEMPERATURE

CHAPTER 5

CONCLUSION

Based on the unstable atmospheric conditions over a long period of time these are unstable because of perturbations of the weather system, causing the model to provide inaccurate forecast. So this project has been developed to get the accurate forecast. While understanding how climate change effects the extreme weather is still developing, evidence suggest that extreme weather may be affected even more than anticipated. Extreme weather is on the rise and the indication are that it will continue to increase in both predictable and unpredictable ways. This project can be developed for future use by designing additional information like by using time etc.

ADVANTAGES:

- Forecasting is the essence of planning.
- Forecasting forces managers to look ahead.
- Forecasting helps in achieving better coordination.
- Effective forecasting helps in identifying the environmental forces

DISADVANTAGES:

- Measurements at very high atmosphere are not very accurate.
- Depends on the past values
- Required more memory.

REFERENCE

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