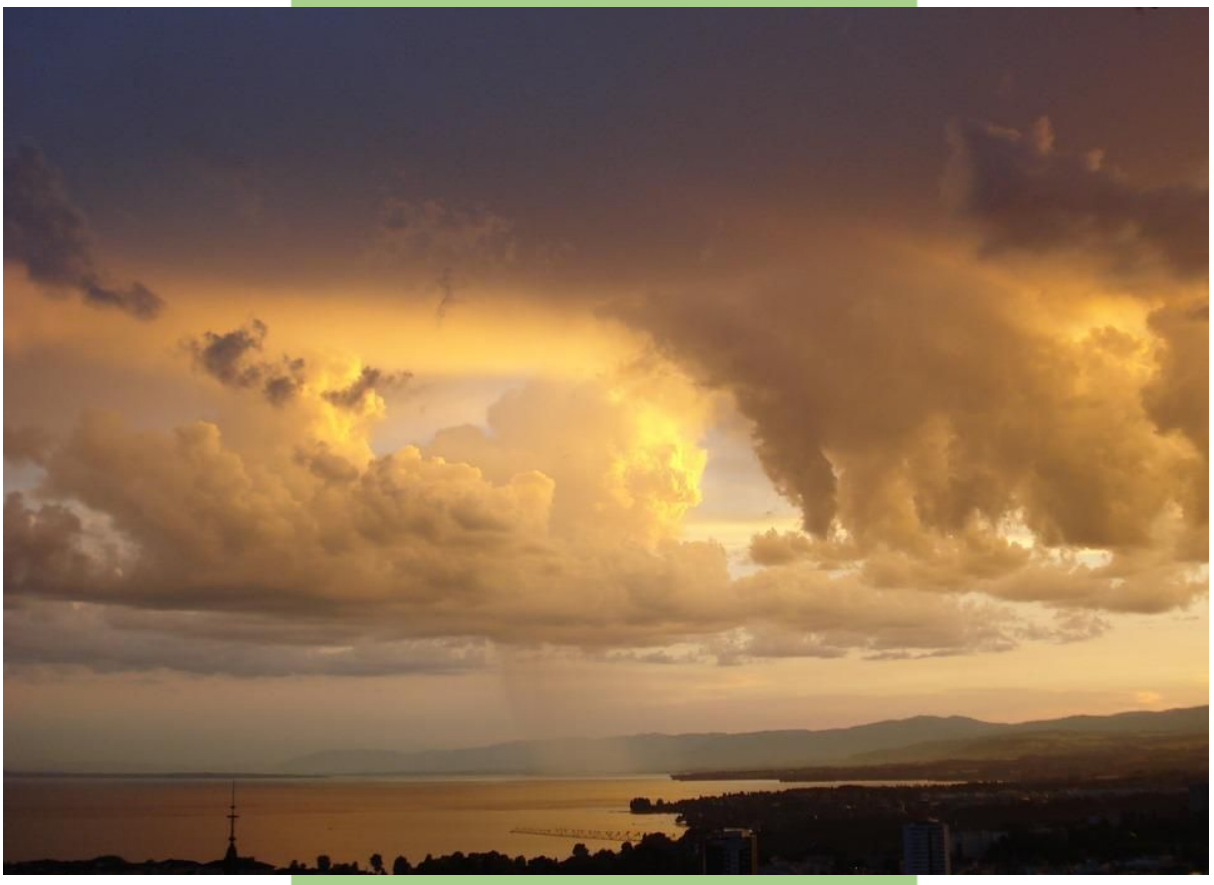
2017

Rainfall Prediction Project



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COSC 4590 – Machine Learning

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Objectives

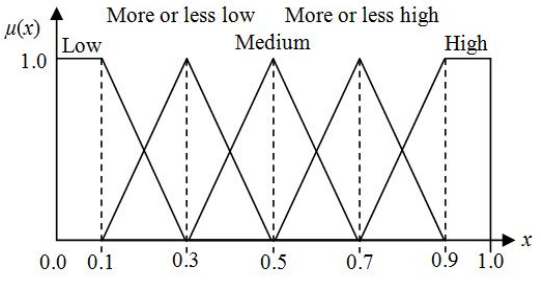
1. Predict weather using fuzzy logic
2. Create accurate prediction using data sets which are provided
3. Test program via dummy input and match output with reality
4. Import a dataset to MatLab to use for analysis
5. Implement the fuzzy logic toolbox to obtain forecast of rainfall

Introduction

Purpose of this project is to analyze a CSV file containing weather data from the year 1995 to 2017 to make a program that will give a prediction of the likelihood of rainfall. Since there is never a 100 percent chance of rainfall on any given day we have used Fuzzy Logic to obtain a percentage chance. Our prediction is obtained by using the Fuzzy Logic Toolbox in Matlab and using a dataset of weather data provided by MeteoBlue.com. We have fuzzified our data with the min and max values of each input value such as: Temperature, Wind Speed, Humidity, Sea Level Pressure, and Cloudiness. MatLab then uses the Fuzzy Logic Triangular Membership function to obtain the result as a percentage.

Models

- Fuzzy Logic triangular membership function



Code:

```
clear all,
clc,
close all;
f=readfis('RainfallPredictor.fis')
a=input('What is the temperature (in Fahrenheit (0-120 degrees) 0=Very Cold, 30=Cold,
60=Normal, 90=Hot, 120=Very Hot ) ? =');
b=input('How much is the humidity percentage ? (1-100, -1 is super dry, 100 very sticky ,60
feels normal)');
c=input('What is the current pressure (From 990 to 1040 Bars,Normally it is around 1020)?
=');
d=input('How cloudy is it ?(0-10, 0 is clear sky ,3 few clouds, 5 some clouds, 8 many clouds,
10 is dark sky)');
e=input('How fast is the wind (0-40 Mph ,0 No wind, 5 Breeze, 15 windy, 25 Strong Wind,
40 Very Strong Wind  ) ? =');
g=evalfis([a b c d e ], f);
disp(['Rainfall Prediction : %',num2str(g)])
```

Motivation

There are many reasons why it is important for us to know rainfall patterns in Corpus Christi. The main reason this is important is because other people can analyze this data to detect when there will be a tornado or hurricane. Understanding rainfall prediction can be

very beneficial to meteorologists to identify patterns that were similar to those that happened before natural disasters. Having this knowledge will be very useful to do city evacuations and severe weather warnings. Also in general, it is helpful to know if there is a high chance of rainfall on the current day so that the people of the city can wear appropriate clothing and remember to wear their jacket or bring their umbrella when they go outside.

Data Set

Our data set contains approximately 20,000 values which is the input values of each hour from January 1st, 1995 to June of 2017. The purpose of using 20,000 values was to get better accuracy and pattern recognition since the dataset has a larger search space. We decided not to go too far backwards with our data because we took into account climate change and did not want inaccuracies by taking into account older weather data.

Input Domain

The reason why we used large data is that, we wanted our prediction to be accurate. We used temperature, humidity, wind speed, air Pressure and rainfall from our dataset. We took highest,lowest and mean values of our data set and use it to create graphs of our program. Minimum value represents bottom of the line while largest value represents end of the line. Using this we could use triangular fuzzification to obtain our result.

The Evaluation

Rainfall prediction system that we build using fuzzy logic works as we planed. We were able to find large input to get precise output and we build our rules according to our research from various information from internet. However the rules that we add to our system may not be as good as in industry. The system we build only a representation of what we can do with fuzzy logic. Since there is much more going on predicting rainfall other than temperature,humidity etc, our current program we have not be well-suited for actual

meteorologists since we did not work with a weather specialist to create most accurate rules in order to get best prediction. On the other hand, our program is totally functional and can be modified and is applicable to real world.

Evaluation Criteria

Weather prediction can be done using many different methods. Among these methods are linear regression and exponential smoothing. However, using those approaches does not provide the most accurate results. Another means of doing this is by creating a Neural-Fuzzy Inference System which was noted for its boosted accuracy through the fuzzy logic applied to it. However, Neural-Fuzzy found that since it could not account for climate change the results tended to be inaccurate which is why we decided to use only fuzzy logic.Using fuzzy logic we were able to identify patterns in our Meteoblue dataset and get a decent result for the probability of rain for a certain day.

Observation

We observed that, our program worked as we wanted and planned. We were able to find right input, use it , and get a output using fuzzy logic.We could also use neural networks to also get a prediction on rainfall but we decided to work with fuzzy logic because, end-user can only answer couple survey-like questions to get quick answer without hassle of putting numbers. Our point of view, fuzzy logic is the great way to implement on weather prediction. In our daily life we use fuzzy words to describe our environment, so that we decided to use closest technical approach to problem whereby, we thought fuzzy logic was the best fit for our solution.

Ultimately, we can develop and improve more what we have done to get best prediction for future. We may add more attributes, more variables and write real world rules

to get the best prediction which can be useful for people sails or needs weather prediction without internet connection.

Conclusion

In our daily life, we are able to find out what the weather will be like instantly, in case we have no access tools we can use this project, we can predict current weather conditions using our senses.

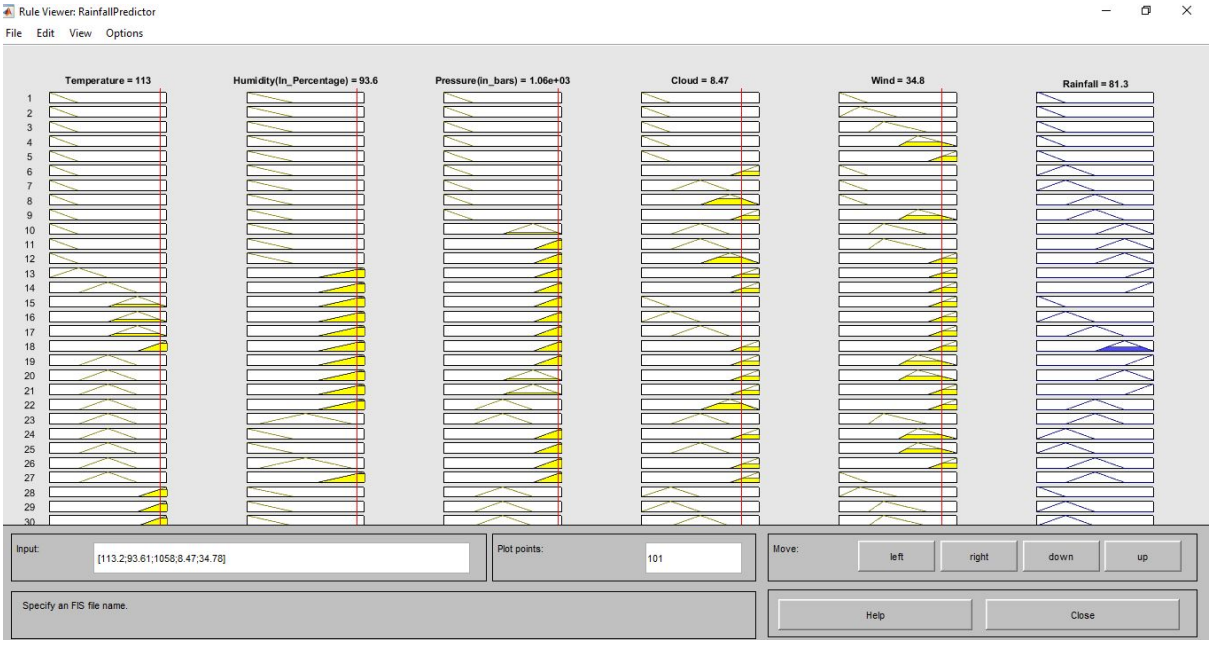
Using Fuzzy Logic we build predict rainfall via using attributes like temperature, humidity, intensity of clouds, pressure and wind. We predict rainfall using sensations like: Hot or Cold Very Windy or Calm,Sticky or Dry,Clear or Dark Sky.We added attributes to matlab and process them using fuzzy logic toolbox.We set rules in order to get rainfall percentage.Attributes have fuzzy values like very high,high,medium,low and very low rather than using precise numbers.After we enter input for attributes we are able to find out rainfall prediction .

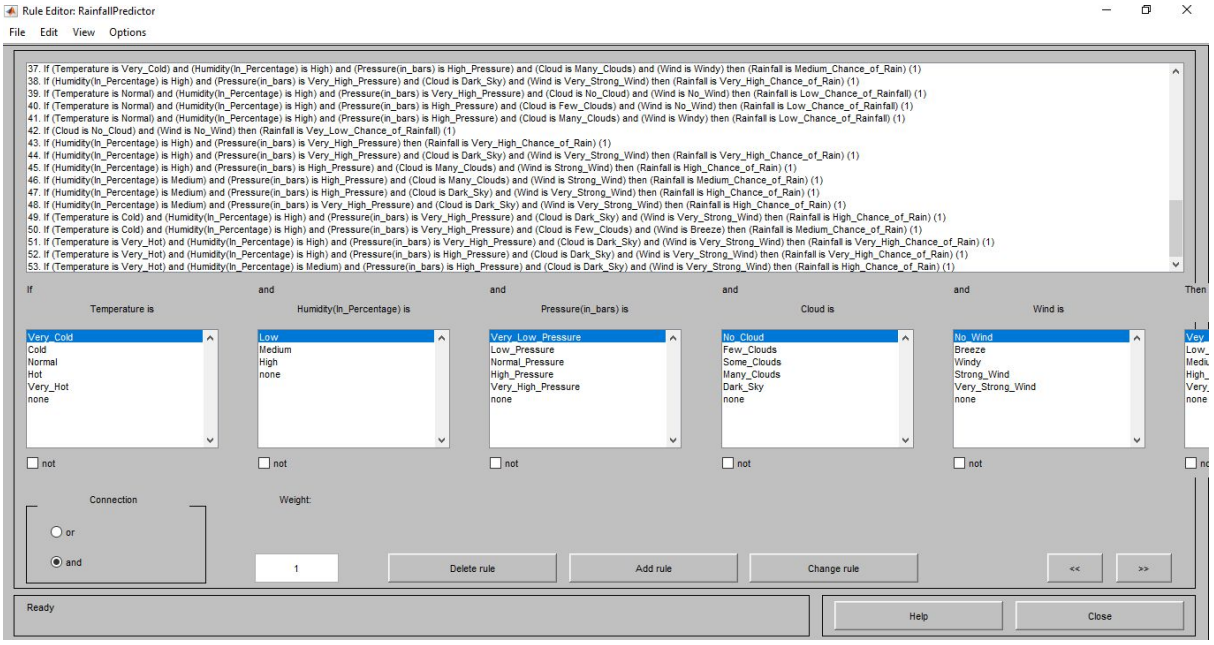
Future Work

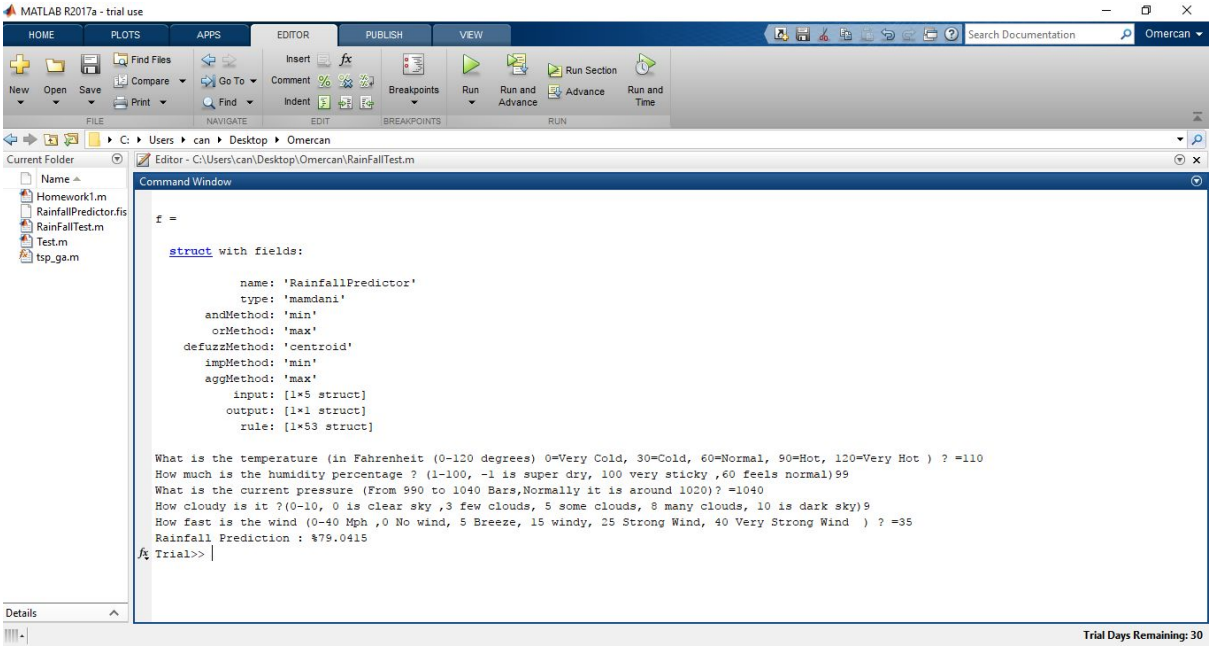
In the future we can use this data to help create severe weather alert programs. By identifying rainfall patterns we can predict days that have a high likelihood of flooding, hurricanes, or tornadoes and can incorporate that in a program that can notify people of the city about weather alerts. This would allow us to create something similar to what

TAMU-CC's Code Blue does with it's weather alerts for student so it will have real world application and usability.

Screenshots:




Rule Editor: RainfallPredictor
File Edit View Options
37. If (Temperature is Very_Cold) and (Humidity(In_Percentage) is High) and (Pressure(in_bars) is High_Pressure) and (Cloud is Many_Clouds) and (Wind is Windy) then (Rainfall is Medium_Chance_of_Rain) (1)
38. If (Humidity(In_Percentage) is High) and (Pressure(in_bars) is Very_High_Pressure) and (Cloud is Dark_Sky) and (Wind is Very_Strong_Wind) then (Rainfall is Very_High_Chance_of_Rain) (1)
39. If (Temperature is Normal) and (Humidity(In_Percentage) is High) and (Pressure(in_bars) is Very_High_Pressure) and (Cloud is No_Cloud) and (Wind is No_Wind) then (Rainfall is Low_Chance_of_Rainfall) (1)
40. If (Temperature is Normal) and (Humidity(In_Percentage) is High) and (Pressure(in_bars) is High_Pressure) and (Cloud is Few_Clouds) and (Wind is No_Wind) then (Rainfall is Low_Chance_of_Rainfall) (1)
41. If (Temperature is Normal) and (Humidity(In_Percentage) is High) and (Pressure(in_bars) is High_Pressure) and (Cloud is Many_Clouds) and (Wind is Windy) then (Rainfall is Low_Chance_of_Rainfall) (1)
42. If (Cloud is No_Cloud) and (Wind is No_Wind) then (Rainfall is Very_Low_Chance_of_Rainfall) (1)
43. If (Humidity(In_Percentage) is High) and (Pressure(in_bars) is Very_High_Pressure) then (Rainfall is Very_High_Chance_of_Rain) (1)
44. If (Humidity(In_Percentage) is High) and (Pressure(in_bars) is Very_High_Pressure) and (Cloud is Dark_Sky) and (Wind is Very_Strong_Wind) then (Rainfall is Very_High_Chance_of_Rain) (1)
45. If (Humidity(In_Percentage) is High) and (Pressure(in_bars) is High_Pressure) and (Cloud is Many_Clouds) and (Wind is Strong_Wind) then (Rainfall is High_Chance_of_Rain) (1)
46. If (Humidity(In_Percentage) is Medium) and (Pressure(in_bars) is High_Pressure) and (Cloud is Many_Clouds) and (Wind is Strong_Wind) then (Rainfall is Medium_Chance_of_Rain) (1)
47. If (Humidity(In_Percentage) is Medium) and (Pressure(in_bars) is High_Pressure) and (Cloud is Dark_Sky) and (Wind is Very_Strong_Wind) then (Rainfall is High_Chance_of_Rain) (1)
48. If (Humidity(In_Percentage) is Medium) and (Pressure(in_bars) is Very_High_Pressure) and (Cloud is Dark_Sky) and (Wind is Very_Strong_Wind) then (Rainfall is High_Chance_of_Rain) (1)
49. If (Temperature is Cold) and (Humidity(In_Percentage) is High) and (Pressure(in_bars) is Very_High_Pressure) and (Cloud is Dark_Sky) and (Wind is Very_Strong_Wind) then (Rainfall is High_Chance_of_Rain) (1)
50. If (Temperature is Cold) and (Humidity(In_Percentage) is High) and (Pressure(in_bars) is Very_High_Pressure) and (Cloud is Few_Clouds) and (Wind is Breeze) then (Rainfall is Medium_Chance_of_Rain) (1)
51. If (Temperature is Very_Hot) and (Humidity(In_Percentage) is High) and (Pressure(in_bars) is Very_High_Pressure) and (Cloud is Dark_Sky) and (Wind is Very_Strong_Wind) then (Rainfall is Very_High_Chance_of_Rain) (1)
52. If (Temperature is Very_Hot) and (Humidity(In_Percentage) is High) and (Pressure(in_bars) is High_Pressure) and (Cloud is Dark_Sky) and (Wind is Very_Strong_Wind) then (Rainfall is Very_High_Chance_of_Rain) (1)
53. If (Temperature is Very_Hot) and (Humidity(In_Percentage) is Medium) and (Pressure(in_bars) is High_Pressure) and (Cloud is Dark_Sky) and (Wind is Very_Strong_Wind) then (Rainfall is High_Chance_of_Rain) (1)
If
Temperature is
Very_Cold
Cold
Normal
Hot
Very_Hot
none
and
Humidity(In_Percentage) is
Low
Medium
High
none
and
Pressure(in_bars) is
Very_Low_Pressure
Low_Pressure
Normal_Pressure
High_Pressure
Very_High_Pressure
none
and
Cloud is
No_Cloud
Few_Clouds
Some_Clouds
Many_Clouds
Dark_Sky
none
and
Wind is
No_Wind
Breeze
Windy
Strong_Wind
Very_Strong_Wind
none
Then
not
Connection
or
and
Weight:
1
Delete rule
Add rule
Change rule
<<
>>
Ready
Help
Close


MATLAB R2017a - trial use
HOME PLOTS APPS EDITOR PUBLISH VIEW
Search Documentation
Omercan
New Open Save Find Files Compare Print
Go To Find
Insert Comment Indent
Breakpoints
Run Run and Advance Run Section Advance Run and Time
FILE NAVIGATE EDIT BREAKPOINTS RUN
C: Users can Desktop Omercan
Current Folder
Name
Homework1.m
RainFallPredictor.fis
RainFallTest.m
Test.m
tsp_ga.m
Details
Editor - C:\Users\can\Desktop\Omercan\RainFallTest.m
Command Window
f =
struct with fields:
name: 'RainfallPredictor'
type: 'mamdani'
andMethod: 'min'
orMethod: 'max'
defuzzMethod: 'centroid'
impMethod: 'min'
aggMethod: 'max'
input: [1×5 struct]
output: [1×1 struct]
rule: [1×53 struct]
What is the temperature (in Fahrenheit (0-120 degrees) 0=Very Cold, 30=Cold, 60=Normal, 90=Hot, 120=Very Hot) ? =110
How much is the humidity percentage ? (1-100, -1 is super dry, 100 very sticky ,60 feels normal)99
What is the current pressure (From 990 to 1040 Bars,Normally it is around 1020)? =1040
How cloudy is it ?(0-10, 0 is clear sky ,3 few clouds, 5 some clouds, 8 many clouds, 10 is dark sky)9
How fast is the wind (0-40 Mph ,0 No wind, 5 Breeze, 15 windy, 25 Strong Wind, 40 Very Strong Wind) ? =35
Rainfall Prediction : %79.0415
fx Trial>>
Trial Days Remaining: 30

Resources

- Neural Fuzzy Inference System-Based Weather Prediction Model and Its Precipitation Predicting Experiment by Jing Lu, Shengjun Xue , Xiakun Zhang , Shuyu Zhang , and Wanshun Lu
- MATLAB Fuzzy Logic Toolbox
- Climate Change Knowledge Portal
- http://www.nws.noaa.gov/ndfd/
- Climate Change Knowledge Portal at WorldBank.org
- http://sdwebx.worldbank.org/climateportal/
- https://www.ncei.noaa.gov
- MeteoBlue.com (for Dataset)
- https://www.youtube.com/watch?v=h-PekWwPR-k&ab_channel=RohitSalgotra