

Lab Center – Hands-On Lab – Part TWO

Analysing Weather Data

Session 1239 - IBM Think2020 IoT Lab

Hyper-Local Weather and Crop prediction using Watson: Analysing Weather Data using Jupyter Notebook

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20200501



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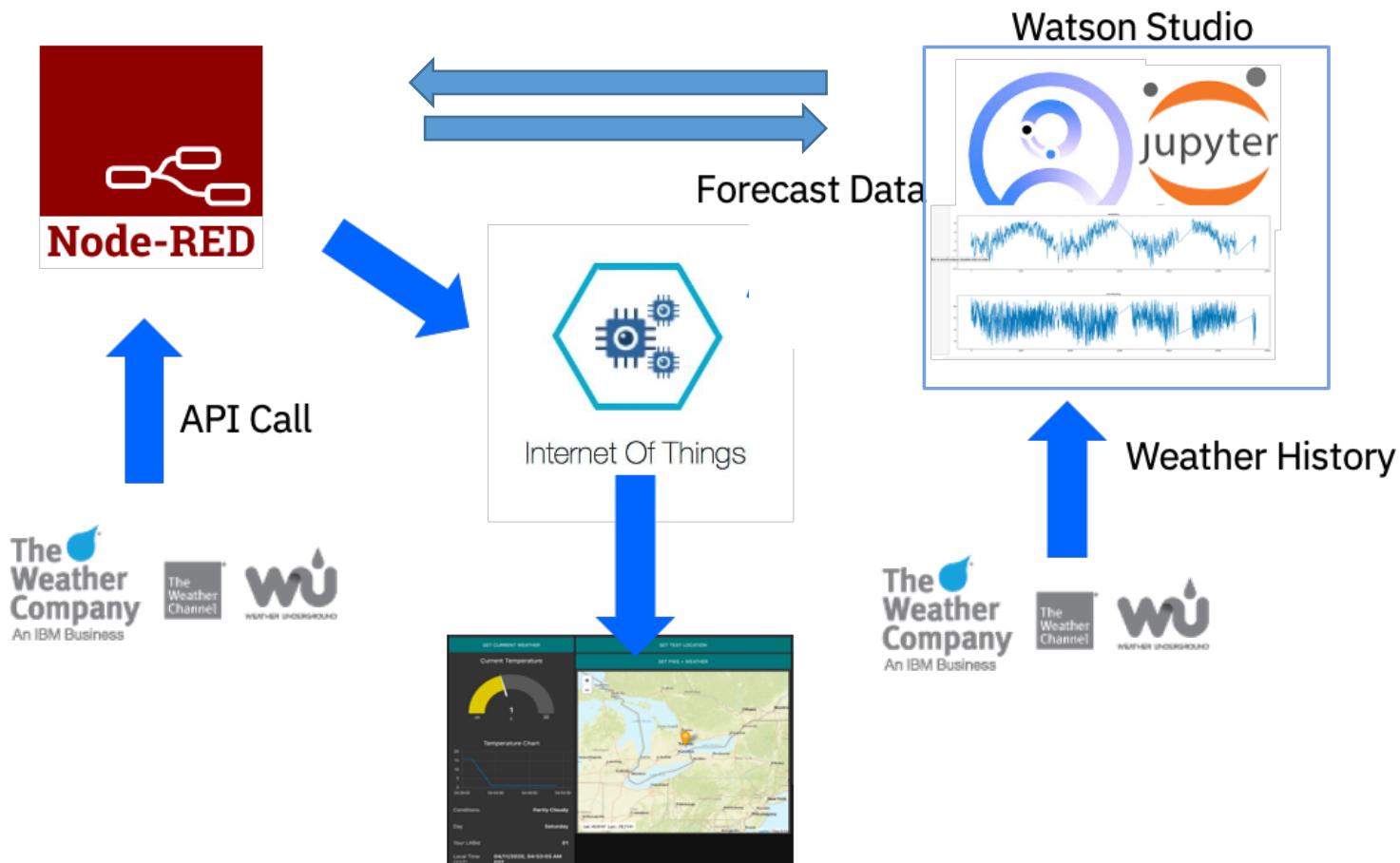
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1 Objective

In this part of the LAB we will setup a WatsonStudio Instance with a Jupyter Notebook to analyse some weather data (ideally our own weather data we collected in previous years). Once we analyse the data we will setup a connection to our Node-RED instance and query the data and display it in Node-RED.

Note: We will walkthrough Part two together 1^{s.t}

Here is the High-level Architecture of our current setup.



1.1 Pre-Requisite

Please sign up for a free WatsonStudio/IBM Cloud account [Register for WatsonStudio](#)
<https://dataplatform.cloud.ibm.com/registration/stepone>

Tip: use WatsonStudio with FireFox and Node-RED / LAB instructions in Chrome so you can switch back and forth between the environments easier.

Create an empty project with the name Think2020. You will be ask to add an object store just follow the steps.

The screenshot shows the 'Create a project' interface in IBM Watson Studio. It features two main sections: 'Create an empty project' and 'Create a project from a sample or file'. The 'Create an empty project' section includes a circular icon with a hand holding a wrench over a circuit board, and a text box explaining the process of preparing, analyzing, or modeling data. A 'NEW' badge indicates an AutoAI experiment tool. The 'Create a project from a sample or file' section includes a circular icon with a hand holding a document, and a text box explaining how to start fast by loading existing assets or choosing a curated sample project.

The screenshot shows the 'My projects' interface in IBM Watson Studio, specifically the 'Think2020' project page. The top navigation bar includes 'My projects / Think2020', 'Upgrade', and a bell icon. Below the navigation are tabs for 'Overview', 'Assets', 'Environments', 'Jobs', 'Deployments', 'Access Control', and 'Settings'. The 'Overview' tab is selected. The project details include: 'Last Updated: Apr 28, 2020'; 'Readme' (with a link); 'Recent activity' (empty); 'Overview' (showing 'Date created: Apr 28, 2020', 'Description: No description available', 'Storage: 0 Byte used (Cloud Object Storage)', 'Collaborators: mcd crfun (Admin)', and a 'View all (1)' link); and a 'Readme' section (with a note about using standard Markdown syntax).

1.2 Download the github repository

Downloading the github repository



markusvankempen / ThinkLab1239

Code Issues Pull requests Actions Projects Wiki Security Insights Settings

IBM Think2020 IoT Lab - Hyper Localized Weather and Crop prediction using Watson

think2020 iot ibm think conference weather node-red javascript python pythonnotebook watson watsonstudio

Manage topics

56 commits 1 branch 0 packages 0 releases 1 contributor

Branch: master New pull request

markusvankempen Add files via upload

data Add files via upload

extra Create pwsdevice.py

images Add files via upload

instructions Add files via upload

node-red Create final.json

Clone with HTTPS Use SSH
https://github.com/markusvankempen/ThinkLab1239

Open in Desktop Download ZIP 3 hours ago

5 days ago

Download the github repository form here
<https://github.com/markusvankempen/ThinkLab1239>
and unzip the file onto your VM / Desktop.

1.3 Import the Jupyter Notebook

Go back to the WatsonStudio browser window and import the notebook

IBM Watson Studio

My projects / Think2020

Overview Assets Environments Jobs Deployments Access Control Settings

Think2020

Last Updated: Apr 28, 2020

Readme

Overview

Date created Apr 28, 2020

Description No description available

Storage 0 Byte used Cloud Object Storage

Collaborators mcd crfun Admin

View all (1)

Choose asset type

Available asset types

Notebook Run small pieces of code to process your data and immediately view the results.

Data Connection Connected data AutoAI experiment Notebook Dashboard

Visual Recognition ... Natural Language Lea... Watson Machine Lea... Deep learning experi... Modeler flow Data Refinery flow

Streams flow Decision Optimizatio...

Find then notebook [WS-PartOne.ipynb](#) in your downloaded/zip file on you VM/Desktop. It should be in a directory that looks something like : ... /thinklab1239/note-books/

IBM Watson Studio

New notebook

Blank From file From URL

Name
Type notebook name here

Description (optional)
Type your description here

Select runtime
Default Python 3.6 XS (2 vCPU 8 GB)

The selected runtime has 2 vCPU and 8 GB RAM.
It consumes 1 capacity unit per hour.
[Learn more](#) about capacity unit hours and Watson Studio pricing plans.

Language
 Python 3.6

IBM Watson Studio Upgrade mcd crfun's Account

New notebook

Blank **From file** From URL

Name
WS-PartOne

Description (optional)
Type your description here

Select runtime
Default Python 3.6 XS (2 vCPU 8 GB RAM)

The selected runtime has 2 vCPU and 8 GB RAM.
It consumes 1 capacity unit per hour.
[Learn more](#) about capacity unit hours and Watson Studio pricing plans.

Notebook file
Upload only .ipynb files. 52 MB max file size.

Drag and drop files here or upload.
WS-PartOne.ipynb

Create

Click create. You should see the following screen.

IBM Watson Studio

My projects / Think2020 / WS-PartOne

File Edit View Insert Cell Kernel Help

Run Format Markdown

LAB1239 - Watson Studio - Part1

```
In [1]: #Based on NOAA data / Python Book in
#https://dataplatform.cloud.ibm.com/exchange/public/entry/view/a7432f0c29c5bda2fb42749f363bd9ff
#
```

```
In [2]: ls
```

```
FabirxSensor8x8.ipynb          forecast.ipynb
Krakow_2007_2018.csv           input_data.xlsx
LICENSE                         jfk_weather.csv
MonthlyRainPrediction.ipynb     jfk_weather.csv.zip
MonthlyRainPrediction20200425.ipynb jfk_weather.csv.zip
MontlyRainPredictions.ipynb    jfk_weather_cleaned.csv
Part 1 - Data Cleaning (1).ipynb jfk_weather_cleaned.csv.zip
README.md                        machine-learning-predict-weather-master
Untitled.ipynb                  model_selection.ipynb
Untitled1.ipynb                 open_csv.py
WU-Ground                      realtimeplottingtest.ipynb
Weather_forecasting-master   requirements.txt
exploratory_analysis.ipynb      results.xlsx
fabfabric-5.csv                  tensorflow-lstm-regression-master
```

```
In [2]: #Read Data File
import pandas as pd
import io
import requests
import calendar
import json
import matplotlib.pyplot as plt
import seaborn as sns

#YEDINBURG_weather.csv.zip
```

1.4 How to navigate Jupyter Notebook

Just a quick couple of pointers to how to execute a Notebook. The Notebook has documentation and code cell both can be “execute” with the arrow button on the top. After execution of a cell, you may see result at the bottom on the cell. The cursors will be automatically move to the next cell.

My projects / Think2020 / WS-PartOne

File Edit View Insert Cell Kernel Help

LAP - Watson - Part1

Using weather data using Python and pandas

In [2]:

```
#Download NOAA data / Python Book in https://dataplatform.cloud.ibm.com/exchange/public/entry/view/a7432f0c29c5bda2fb42749f363bd9f#version20200428 -mvk@ca.ibm.com
```

In [5]:

```
!ls /
```

```
bin etc media opt root sbin sys usr
dev home lib64 mnt proc run srv tmp var
```

In [6]:

```
#Read Data File
import pandas as pd
import io
import requests
import calendar
import json
import matplotlib.pyplot as plt
import seaborn as sns

#IEDINBURG_weather.csv.zip
url="https://github.com/markusvankempen/ThinkLab1239/blob/main/JFK_Weather_Cleaned_MVK.csv?raw=true"
#s=requests.get(url).content

station = "myPWS"
data_raw=pd.read_csv(url, compression='zip')
#data_raw=pd.read_csv("/Users/mvankempen@ca.ibm.com/Downloads/jfk_weather_cleaned_mvk.csv")
data_raw = data_raw.set_index(pd.DatetimeIndex(data_raw['DATE']))
#data_raw.drop(['DATE'], axis=1, inplace=True)
#data_raw['day'] = data_raw['DATE'].apply(lambda x: x.date())
data_raw['day'] = pd.to_datetime(data_raw['DATE'])

data_raw.head()
```

Note: Will see execution result once the Notebook is imported but these are just from save from an old session you always need to start from the top to execute the cell once you opened a Notebook /Put in Edit Mode

My projects / Think2020 / WS-PartOne

File Edit View Insert Cell Kernel Help

DATE visibility dry_bulb_temp_f wet_bulb_temp_f dew_point_temp_f relative_humidity wind_speed station_pressure sea_level_pressure precip altimeter_setting wind_c

	DATE	visibility	dry_bulb_temp_f	wet_bulb_temp_f	dew_point_temp_f	relative_humidity	wind_speed	station_pressure	sea_level_pressure	precip	altimeter_setting	wind_c
2010-01-01	2010-01-01 01:00:00	1.00	6.0	33.0	32.0	31.0	92.0	0.0	29.97	29.99	0.01	29.99
	2010-01-01 02:00:00	2.00	6.0	33.0	33.0	32.0	96.0	0.0	29.97	29.99	0.02	29.99
	2010-01-01 03:00:00	3.00	5.0	33.0	33.0	32.0	96.0	0.0	29.97	29.99	0.00	29.99
	2010-01-01 04:00:00	4.00	5.0	33.0	33.0	32.0	96.0	0.0	29.97	29.97	0.00	29.97
	2010-01-01 05:00:00	5.00	5.0	33.0	32.0	31.0	92.0	0.0	29.97	29.96	0.00	29.95

Checking Data

In [7]:

```
#Check data like precip - we will see some error so we need to adjust them
plt.figure(figsize=(18,8))
data_raw["precip"].plot()
```

Out[7]:

TIP: Use the Save Button regularly

1.5 Fixing Outliers in our Weather data

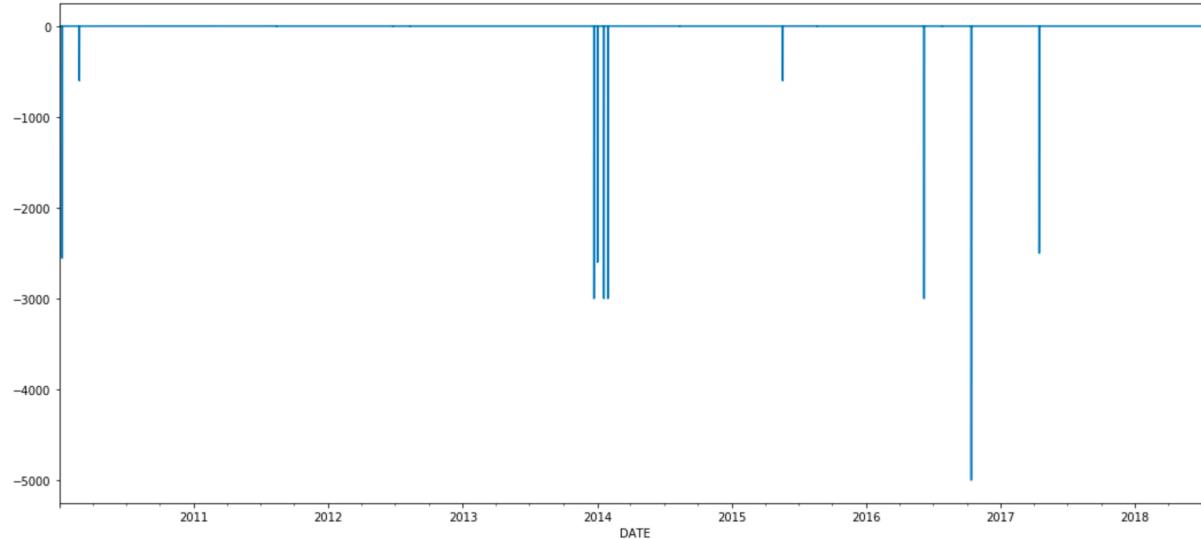
We will read a csv file with weather data in the Notebook/Python and display the columns and rows of data. Data is taken by the hour from 2010 -2018. When you have executed the first code cell you will see the data/structure of the file (*See above picture*). Our first task is to get a picture of the data to check consistency etc.

Below we simply plot the precipitation (rain) data into a chart. We can see there is something wrong with some of the data. This kind of data glitch can happen when your PWS is cleaned or if there is an power outage/surge. It's always good practice to analyze the consistency to the data/columns and remove the outliers.

Checking Data

```
#Check data like precip - we will see some error so we need to adjust them
plt.figure(figsize=(18,8))
data_raw[ "precip" ].plot()
```

: <matplotlib.axes._subplots.AxesSubplot at 0x7fba5e45a4e0>



Exercise:

We see in image above that there is negative rain on some days hours of the year. In order to get consistency we need to add some code in the Code Cell bellow ... Something which simply zeros the entries like:

```
data_raw = data_raw[data_raw['precip'] > -500] #Fixing
```

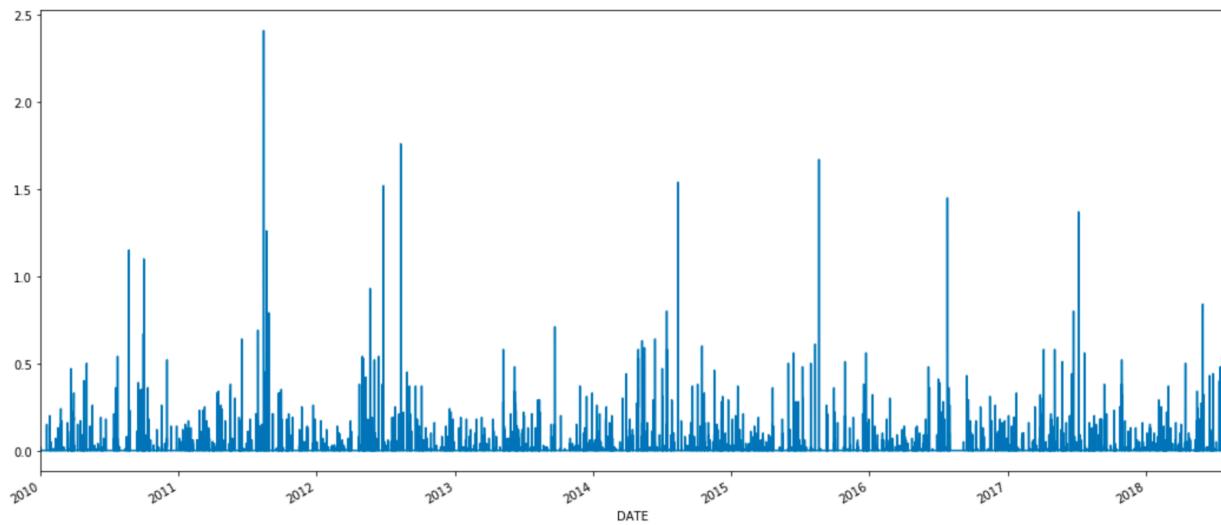
Feel free to experiment with the code!

<https://stackoverflow.com/questions/23199796/detect-and-exclude-outliers-in-pandas-data-frame>

Once the code is executed with the fix we should see all rain data being positive in the chart.

Fixing Data

```
[8]: # Can we fix the outliers ????  
data_raw = data_raw[data_raw['precip'] > -500] #Fixing  
plt.figure(figsize=(18,8))  
data_raw[ "precip"].plot()  
  
ut[8]: <matplotlib.axes._subplots.AxesSubplot at 0x7fba5d2a7be0>
```



1.6 Preprocessing Weather data

At the end we want to the data by month with Dry and Rainy days. In the next code sections, we add the Month name and drop some columns form out data set.

My projects / Think2020 / WS-PartOne

File Edit View Insert Cell Kernel Help

In [5]:

```
import calendar
#hourly_data_renamed['precip'].sum()
# Assign the "day" to every date entry
#hourly_data_renamed['day'] = hourly_data_renamed.apply(lambda x: x.date())
#len(hourly_data_renamed['relative_humidity'] > 96)
#hourly_data_renamed[hourly_data_renamed['raining'] == True].groupby('day').any()
mydata=data_raw
mydata['day']=mydata.index
mydata['rain']=data_raw['relative_humidity'] > 96
mydata['day']=mydata['day'].apply(lambda x: x.date())
mydata['raintotal']=mydata.groupby('day')[['precip']].sum()
mydata['month']=mydata['day'].apply(lambda x: x.month)
mydata['month_name']=mydata['month'].apply(lambda x: calendar.month_abbr[x])
mydata.head()
```

Out[5]:

	relative_humidity	wind_speed	station_pressure	sea_level_pressure	precip	...	wind_direction_sin	wind_direction_cos	pressure_tendency_incr	pressure_tendency_decr	press
0	92.0	0.0	29.97	29.99	0.01	...	0.0	1.0	0	1	
0	96.0	0.0	29.97	29.99	0.02	...	0.0	1.0	0	1	
0	96.0	0.0	29.97	29.99	0.00	...	0.0	1.0	0	1	
0	96.0	0.0	29.95	29.97	0.00	...	0.0	1.0	0	1	
0	92.0	0.0	29.93	29.98	0.00	...	0.0	1.0	0	1	

My projects / Think2020 / WS-PartOne

File Edit View Insert Cell Kernel Help

In [12]:

```
columns_drop = [
    'dew_point_temp_f',
    'sea_level_pressure',
    'altimeter_setting',
    'wind_direction_sin',
    'wind_direction_cos',
    'pressure_tendency_incr',
    'pressure_tendency_decr',
    'pressure_tendency_const'
]
mydata=mydata.drop(columns=columns_drop)
print(len(mydata[mydata.precip >= 0.06]))
#print(len(mydata[mydata.relative_humidity >= 99]))
#mydata['rainh']=if(mydata.relative_humidity > 0.1
#mydata.replace({'rainh': {True: 1, False:0}}, inplace=True)
mydata['rainh']=mydata.precip.apply(lambda x: (x>=0.06),1,0)
mydata["2010-01-17":].head()
```

1786

Out[12]:

DATE	visibility	dry_bulb_temp_f	wet_bulb_temp_f	relative_humidity	wind_speed	station_pressure	precip
2010-01-17 00:00:00	2010-01-17 0:00	10.0	33.0	31.0	82.0	7.0	30.12 0.0 2010-C
2010-01-17 01:00:00	2010-01-17 1:00	9.0	34.0	32.0	85.0	7.0	30.11 0.0 2010-C
2010-01-17 02:00:00	2010-01-17 2:00	9.0	31.0	30.0	89.0	0.0	30.09 0.0 2010-C
2010-01-17 03:00:00	2010-01-17 3:00	9.0	32.0	31.0	88.0	0.0	30.10 0.0 2010-C
2010-01-17 04:00:00	2010-01-17 4:00	9.0	33.0	32.0	89.0	0.0	30.11 0.0 2010-C

Exercise: Drop the **web_bulb_temp_f** and the **station pressure** columns as well .

1.6.1 Group the data by DAY

Here is the data group from hours to days and calculating hours of rain during the day and rain in mm/in.

Calculating Rain per Day

```
In [26]: #
data=mydata.groupby('day')['relative_humidity'].max().reset_index()
data=data.set_index(data['day'])
data.index.name="index"
data['rain_mm'] = pd.Series(mydata.groupby('day')['precip'].sum(), index=data.index)
data['rain_daily_hours'] = pd.Series(mydata.groupby('day')['rainh'].sum(), index=data.index)
data['temp_f_max']= pd.Series(mydata.groupby('day')['dry_bulb_temp_f'].mean(), index=data.index)
#
#
#
print("Records by day since 2010 - 2018-07 =" +str(len(data)))
print("Total Days with data.relative_humidity >= 96 = " + str(len(data[data.relative_humidity > 95]))) ## use prec/rain
print("Total Days with data.rain_mm > 0.15 = " + str(len(data[data.rain_mm >= 0.17])))
#
#
data=data.set_index(data['day'])
data.index = pd.to_datetime(data.index)
data.index.name="index"
data['date'] = pd.to_datetime(data['day'])
data['ym'] = data.date.apply(lambda x: x.strftime('%Y%m'))
#
#
#
data['rainy']= data.rain_mm >= 0.15
data['rainday'] = data.rainy.apply(lambda x: (x>=0.15),1,0)
#
#
#
print("Rainy days in 2017 with data.rain_mm >= 0.15 = "+str(len(data["2017":"2017"][data.rain_mm >= 0.17])))
print("Rainy days in 2016 with data.rain_mm >= 0.15 = "+str(len(data["2016":"2016"][data.rain_mm >= 0.17])))
data['2010-01-17 ":"2012'].head(10)

Records by day since 2010 - 2018-07 =3130
Total Days with data.relative_humidity >= 96 = 488
Total Days with data.rain_mm > 0.15 = 488
Rainy days in 2017 with data.rain_mm >= 0.15 = 58
Rainy days in 2016 with data.rain_mm >= 0.15 = 51
```

Exercise:

There are some discrepancies between **rain_mm** and **relative_humidity**. Try to get the days of **rain_mm** and **relative_humidity** to match up. See above; 488 days in 8 years see to be a good number.

1.6.2 Group the data and calculating Dry and Wet days

Creating a couple of dataframes and merging back together to get Wet/Dry days per month:

Grouping and Calculating Dry and Wet days.

```
[?7]: #Calucate Wet and Dry days
monthly = pd.DataFrame(data.groupby('ym')['rainy'].value_counts())
monthly.columns = ['Days']
monthly.reset_index(inplace = True)
monthly.columns = ['month', 'Rainy', 'Days']
monthly.replace({'Rainy': {True: "Wet", False: "Dry"}}, inplace=True)
monthly.head()

#
#
ndata=monthly.pivot(index ='month', columns ='Rainy')
#
#
ndata=ndata.droplevel(0, axis=1)
ndata.reset_index(inplace = True)
ndata.fillna(0)
dataX=data.merge(ndata, left_on='ym', right_on='month')
dataX.reset_index(inplace = True)

dataX=dataX.set_index(dataX['date'])

dataX.drop(columns='index')
dataX[ "2010-01-17": "2012"].head(10)
```

	index	day	relative_humidity	rain_mm	rain_daily_hours	temp_f_max	date	ym	rainy	rainday	month	Dry	Wet	
t[27]:														
	date													
	2010-01-17	16	2010-01-17	96.0	0.64	5.0	37.250000	2010-01-17	201001	True	True	201001	29.0	2.0
	2010-01-18	17	2010-01-18	89.0	0.02	0.0	42.416667	2010-01-18	201001	False	False	201001	29.0	2.0
	2010-01-19	18	2010-01-19	96.0	0.00	0.0	40.416667	2010-01-19	201001	False	False	201001	29.0	2.0
	2010-01-20	19	2010-01-20	79.0	0.00	0.0	37.791667	2010-01-20	201001	False	False	201001	29.0	2.0
	2010-01-21	20	2010-01-21	75.0	0.00	0.0	31.000000	2010-01-21	201001	False	False	201001	29.0	2.0

Next we check the distribution of Dry /Wet days.

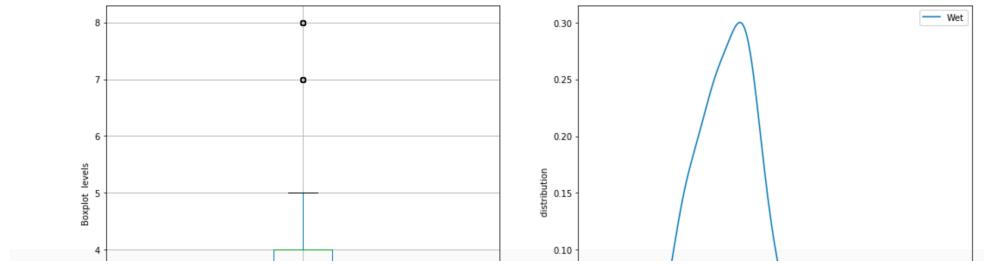
Check Distribution

```
[30]: import numpy as np
import matplotlib.pyplot as plt
def plotBoxNdendity(data,col=None):
    if col in data.columns:
        plt.figure(figsize=(18,8))

        ax1 = plt.subplot(121)
        data.boxplot(col,ax=ax1)
        ax1.set_ylabel('Boxplot levels', fontsize=10)

        ax2 = plt.subplot(122)
        data[col].plot(ax=ax2,legend=True,kindle='density')
        ax2.set_ylabel('distribution', fontsize=10)

    else:
        print("Column not in the data")
plotBoxNdendity(dataX[ '2010' ],'Wet')
#plotBoxNdendity(dataWeekly, 'rainday')
```



Exercise: Try multiple plots with different years.

Like

```
plotBoxNdendity(dataX[ : '2012' ],'Wet')
plotBoxNdendity(dataX[ : '2014' ],'Wet')
```

1.6.3 Sampling Monthly data

Here we resample the daily / hourly data to a month, so we get a nice small dataset.

Creating Monthly Data

```
?3]: #data.index = pd.to_datetime(data.index, unit='s')
#data['date']=pd.to_datetime(data['date'], infer_datetime_format=True)
#data.index = pd.to_datetime(data.index)
dataM=dataX.resample('M').max(); # monthly
dataM[ 'year' ] = dataM[ 'day' ].apply(lambda x: x.year)
dataM[ 'month' ] = dataM[ 'day' ].apply(lambda x: x.month)
dataM[ "month_name" ] = dataM[ 'month' ].apply(lambda x: calendar.month_abbr[x])
dataM[ "temp_c_max" ] = round((dataM[ "temp_f_max" ] - 32) * 5/9,2)
dataM=dataM.drop(columns = "relative_humidity")
dataM=dataM.drop(columns = "index")
dataM=dataM.drop(columns = "day")
dataM=dataM.drop(columns = "rain_mm")
dataM=dataM.drop(columns = "rain_daily_hours")
dataM=dataM.drop(columns = "rainday")
dataM=dataM.drop(columns = "ym")
dataM=dataM.drop(columns = "temp_f_max")
dataM=dataM.drop(columns = "rainy")
dataM=dataM.drop(columns = "month")
#dataM=dataM.drop(columns = "temp_c_max")
dataM=dataM.drop(columns = "date")

#dataM[dataM.relative_humidity >= 98].head()
dataM[ '2017-01':].head()
```

```
t[23]:      Dry  Wet  year month_name temp_c_max
          date
2017-01-31  22.0   9.0  2017        Jan     10.51
2017-02-28  25.0   3.0  2017        Feb     14.05
2017-03-31  22.0   5.0  2017        ..     16.10
```

#Exercise:

Try adding or leaving out some columns, like average temperature (`mean()`) or temperature in Fahrenheit

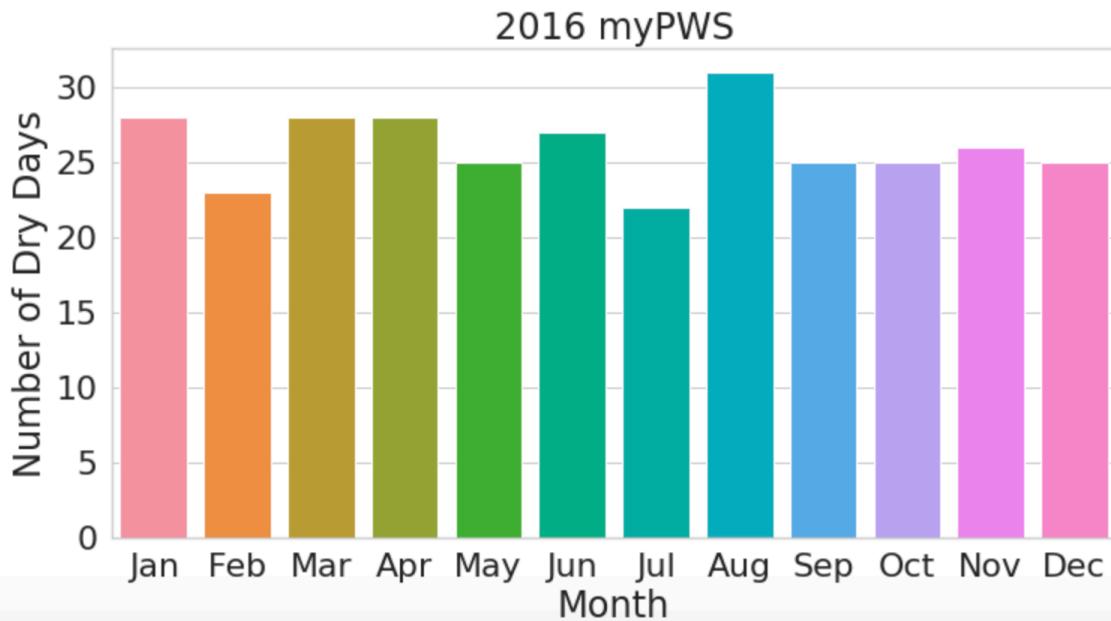
1.6.4 Plot the Monthly data.

Plot the Monthly sample data

```
37]: import matplotlib.pyplot as plt
      import seaborn as sns
      # Monthly plot of rainy days
      plt.figure(figsize=(12,6))
      sns.set_style("whitegrid")
      sns.set_context("notebook", font_scale=2)
      sns.barplot(x="month_name", y="Dry", data=dataM["2016-01":"2016-12"])

      plt.xlabel("Month")
      plt.ylabel("Number of Dry Days")
      plt.title("2016 {}".format(station))
      #Exercise display different years / data Elements

      it[37]: Text(0.5, 1.0, '2016 myPWS')
```



Exercise

Display different years / data Elements like temperature

1.7 Playground for Query testing

Here we will work on the data queries, which we will send via commands from Node-RED, to get back the data. From Node-RED we will send a command call getInfo which should give us information about the data size — maybe the amount of years we have in the dataset. Take a look at the different function examples and execute them.

```
In [49]: # GetInfo
dataY = dataM.resample('Y').mean(); # yearly averages
dataY.year.count()
getInfo = '{"cmd": "getInfo", "tablesize": "' + str(len(dataM)) + '", "years": "' + str(dataY.year.count()) + '"}'; # yearly av
print(getInfo)

{"cmd": "getInfo", "tablesize": 103, "years": 9}

In [48]: #getJan2017
datain = {'cmd' : 'getInfo'}
dry=dataM[ "2017": "2017"].loc[dataM[ 'month_name'] == 'Apr'].values[0][0]
wet=dataM[ "2017": "2017"].loc[dataM[ 'month_name'] == 'Apr'].values[0][1]
yy=dataM[ "2017": "2017"].loc[dataM[ 'month_name'] == 'Apr'].values[0][2]
mm=dataM[ "2017": "2017"].loc[dataM[ 'month_name'] == 'Apr'].values[0][3]
temp=dataM[ "2017": "2017"].loc[dataM[ 'month_name'] == 'Apr'].values[0][4]
mvk = {'Wet': wet, 'Dry' : dry, "Month" : mm , "Year":yy}
mvk[ "cmd"] = datain[ "cmd"]
mvk

Out[48]: {'Wet': 6.0, 'Dry': 24.0, 'Month': 'Apr', 'Year': 2017, 'cmd': 'getInfo'}

In [50]: #Get A range
sel= dataM["2017-01":"2017-03"]
mvk=sel.reset_index().to_json(orient='records')
getInfo={"cmd": "cmd", "info": []}
info=json.loads(mvk)
getInfo[ 'info']=info
getInfo[ "cmd"] = datain[ "cmd"]
print(getInfo)

{'cmd': 'getInfo', 'info': [{"date': 1485820800000, 'Dry': 22.0, 'Wet': 9.0, 'year': 2017, 'month_name': 'Ja
3.0, 'year': 2017, 'month_name': 'Feb', 'temp_c_max': 14.05}, {"date": 1490918400000, 'Dry': 26.0, 'Wet': 5.

In [54]: #GetRain
-----
```

Above data example are the dataset/json we will send back to Node-RED based on the query/command. We will need to implement these functions in the next sections.

2 Connecting to Node-RED

In the next section we will install some websocket packages and adjust the URL to our Node-RED instance.

We need to install the `websocket-client` client via a unix command like:

```
!pip install websocket-client
```

Just uncomment the command and execute it.



Connecting to Node-RED

```
In [26]: #Create commincation with Node-RED instance
#You need to instal the client 1st
!pip install websocket-client
import websocket
import _thread
import time
import json

def on_open(ws):
    print("on open")
    ws.send(mysdata.loc[mysdata['month_name'] == 'Jan'])
    def run(*args):
        for i in range(10000):
            hbeat = '{"cmd":"Python NB HeartBeat"}'
            print("send cmd")
            ws.send(hbeat)
            time.sleep(1000)

    _thread.start_new_thread(run, ())

# ws.send("Watson Studio Listen open")
ws.on_open = on_open
ws.run_forever()

start_websocket_listener()
```

Once executed you will see some output at the bottom to of the cell —see below

```
# ws.send("Watson Studio Listen open")
ws.on_open = on_open
ws.run_forever()

start_websocket_listener()

Collecting websocket-client
  Downloading https://files.pythonhosted.org/packages/4c/5f/f61b420143ed1c8dc69f9eaec5ff1ac361
  |██████████| 204kB 9.3MB/s eta 0:00:01
Requirement already satisfied: six in /opt/conda/envs/Python36/lib/python3.6/site-packages (fr
Installing collected packages: websocket-client
Successfully installed websocket-client-0.57.0
connecting
on open
```

Adjust the line below with your Node-RED instance, such as: thinklab???.mybluemix.net/ws/myweather/

```

 69     getInfo={"cmd": "cmd", "info":[]}
 70     info=json.loads(mvk)
 71     getInfo['info']=info
 72     getInfo["cmd"]=datain['cmd']
 73     print(getInfo)
 74     ws.send(json.dumps(getInfo))
 75
 76     if (datain['cmd'] == 'getTemp'):
 77         yy=datain['year']
 78         mm=datain['month']
 79         temp=dataM[yy:yy].loc[dataM['month_name'] == mm].values[0][4]
 80         getInfo = {'Temp' :temp, "Month" : mm , "Year":yy}
 81         getInfo["cmd"]的数据in['cmd']
 82         print(getInfo)
 83         ws.send(json.dumps(getInfo))
 84     if (datain['cmd'] == 'getAll'):
 85         mydata.to_json()
 86
 87
 88 except:
 89     print("Error no json / no valid command")
 90 ##### ws://thinklab2020nr.mybluemix.net/ws/myweather/"
 91 ##### use your own instance
 92 def start_websocket_listener():
 93     #websocket.enableTrace(True)
 94     ws = websocket.WebSocketApp("ws://thinklab1239.mybluemix.net/ws/myweather/", #<<<<< ADJUST
 95                                         on_message = on_message,
 96                                         on_error = on_error,
 97                                         on_close = on_close)
 98     print("connecting")
 99     # ws.send("Watson Studio Listen open")
100     ws.on_open = on_open
101     ws.run_forever()
102
103

```

When you have adjusted the cell with your instance name, execute the cell again
You should see at the bottom of the cell some text like:

```

 99     # ws.send("Watson Studio Listen open")
100     ws.on_open = on_open
101     ws.run_forever()
102
103 start_websocket_listener()

connecting
on open

```

In []: 1 **### Start with Part Two**

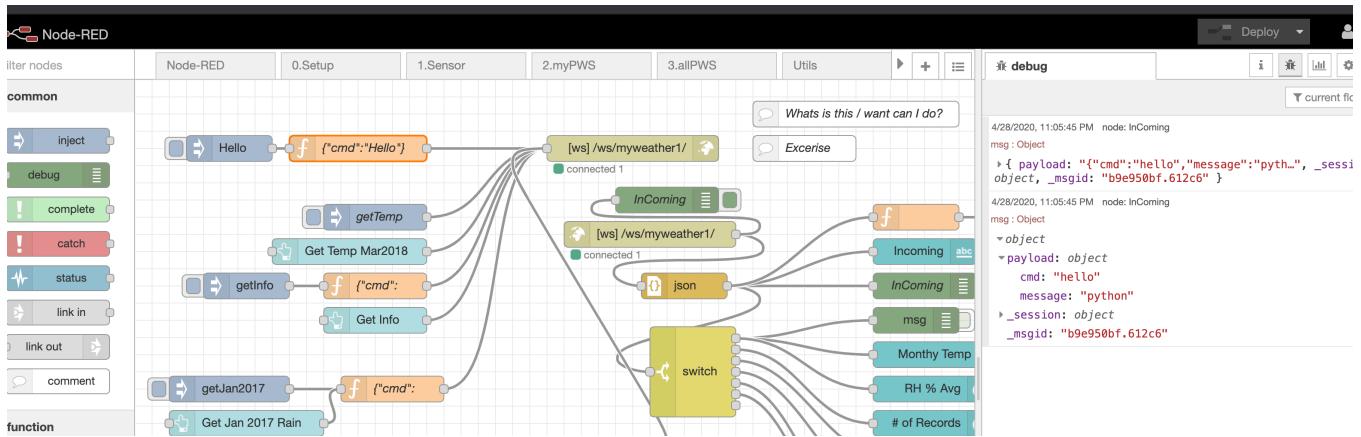
Once you see this, let's switch back to Node-RED and the Weather History Tab

Note: Keep WatsonStudio open. We will switch between Node-RED our Dashboard and the Watson studio.

If you run into connection issue check the troubleshoot section .

3 Sending a command to Python

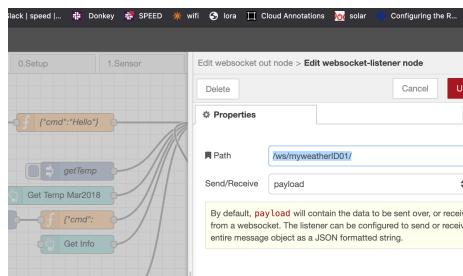
Back in Node-RED, click on the “Weather history” tab. You should see a green info message on the websocket connection with a message like “connected 1”. If this is the case, send a hello message and see if you receive a hello back, and check the message in Node-RED



Note: If everything is working you should see as above in the debug console.

Troubleshooting:

1. Check the hostname in the Python Notebook should be ws://thinklab???.mybluemix.net/ws/myweather/ With your lab ID instead of ??
2. If you cannot get a connection change the websocket endpoint in the Notebook and Node-RED



Make sure it's the same on both sides. You will need to stop and restart the cell in the Notebook

3. The Notebook websocket might be closed, in which case you must restart the cell.

```
hello
{"cmd": "hello", "message": "python"}

closed
```

[27]: **## Start with Part Two**

In the Notebook cell you should see message at the bottom like.

```
def __init__(self, ip='127.0.0.1', port=8888, open_browser=True):
    self.ip = ip
    self.port = port
    self.open_browser = open_browser
    self._start_websocket_if_needed()

def _start_websocket_if_needed(self):
    if self.open_browser:
        browser = webbrowser.get('chrome')
        browser.open('http://{}:{}'.format(self.ip, self.port))

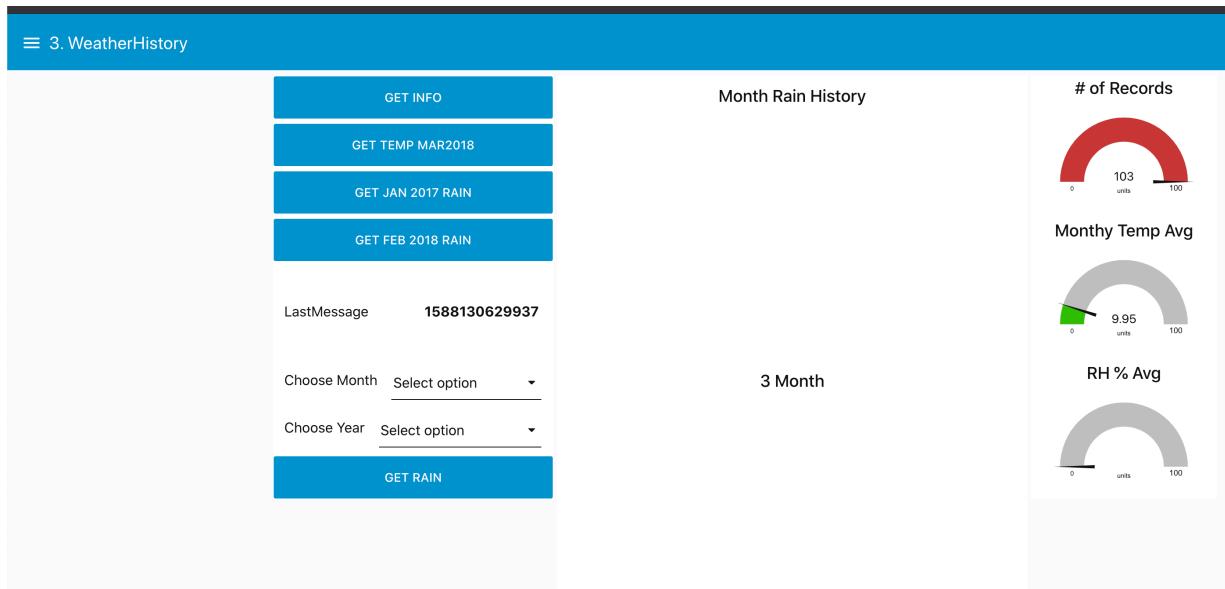
    if self.ip == '127.0.0.1':
        self._start_ws()
    else:
        self._start_ws(ip=self.ip)

def _start_ws(self, ip='127.0.0.1'):
    ws = websocket.WebSocketApp("ws://{}:{}".format(ip, self.port),
                               on_message=lambda ws, message: self._on_message(ws, message),
                               on_error=lambda ws, error: self._on_error(ws, error),
                               on_close=lambda ws: self._on_close(ws))

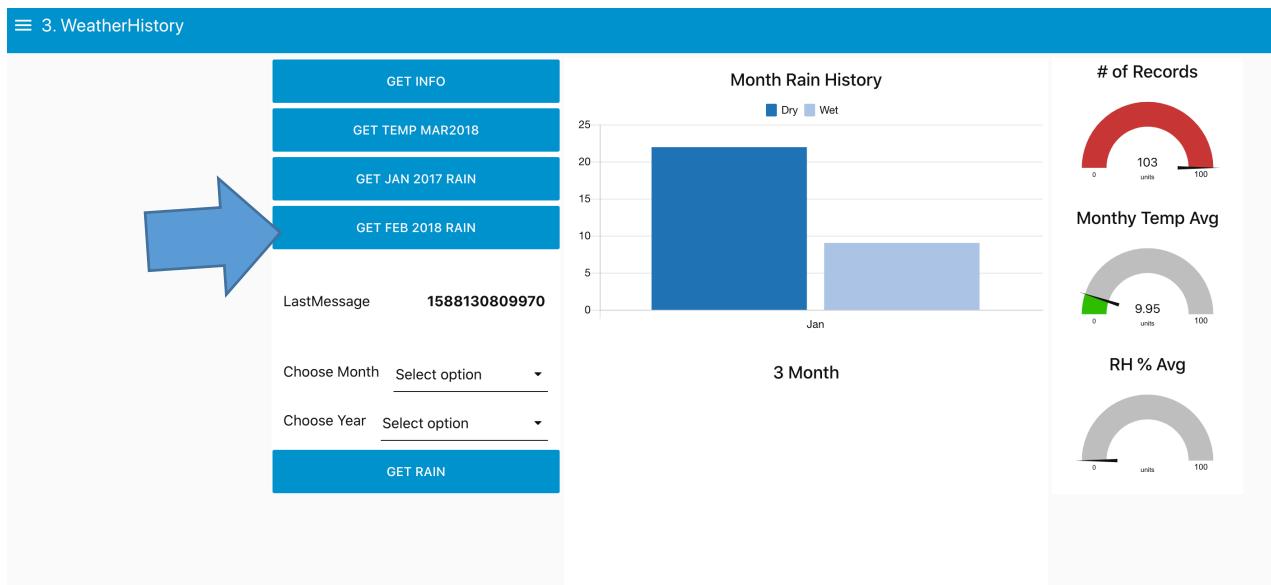
    ws.on_open = self._on_open
    ws.run_forever()
```

4 Using the Dashboard and data Queries

Once we got all the connections working let's look at our Dashboard.
Select the 3. WeatherHistory Menu



Click on the Jan and Feb Rain buttons to retrieve the data from your Notebook. You should get some data back which is displayed.



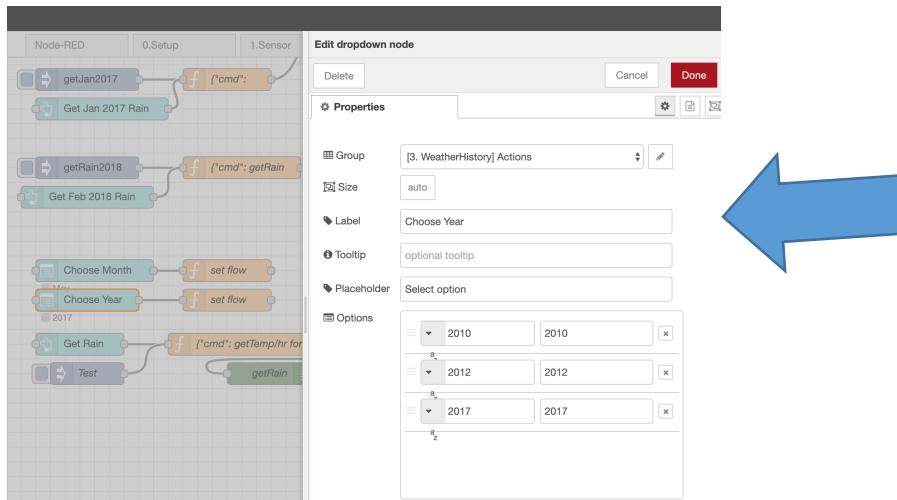
Flip back and check the message on Node-RED and NoteBook.

4.1 Adding more functionality

We now have functionality to get Temperature in some Months with Dry and Wet Days. We need to add more flexible function to get Rain Data from Notebook. We also need to add some more data such as years and months to the dashboard drop-downs.

Exercise

1. Add more Month and Years to the Drop down on the Dashboard.



2. Fix the code in the Notebook to return the data base on the drop down selection ... see getRain command.
- 3.

```

ws.send(getInfo)

if (datain['cmd'] == 'getJan2017'):
    dry=dataM["2017":"2017"].loc[dataM['month_name'] == 'Jan'].values[0][0]
    wet=dataM["2017":"2017"].loc[dataM['month_name'] == 'Jan'].values[0][1]
    yy=dataM["2017":"2017"].loc[dataM['month_name'] == 'Jan'].values[0][2]
    mm=dataM["2017":"2017"].loc[dataM['month_name'] == 'Jan'].values[0][3]
    getInfo = {'Wet': wet, 'Dry': dry, "Month" : mm , "Year":yy}
    getInfo["cmd"]的数据['cmd']
    print(getInfo)
    ws.send(json.dumps(getInfo))
#Get Rain for a month Month in coming {"cmd":"getRain","month": "Feb", "year": "2018"}
if (datain['cmd'] == 'getRain'):

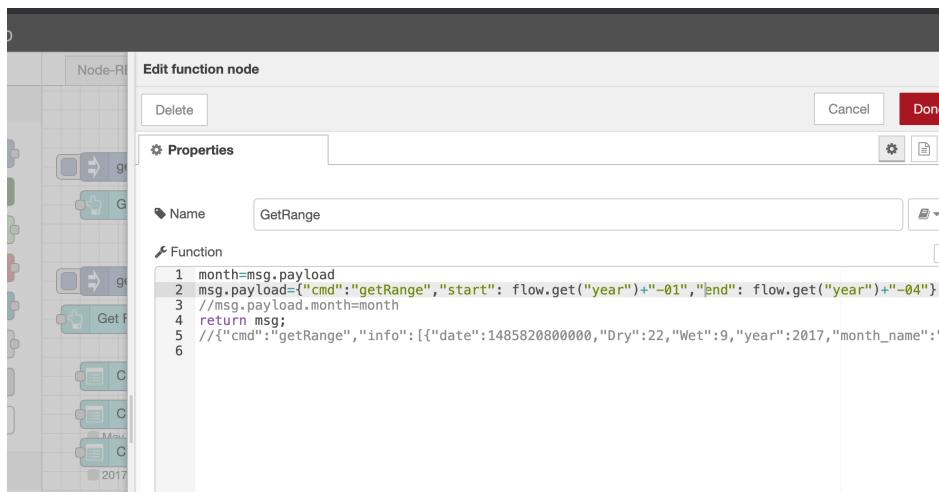
# Exercise Change here see above function
#
    getInfo = {'Wet': wet, 'Dry': dry, "Month" : "FixCode" , "Year": "FixCode"}
    getInfo["cmd"]的数据['cmd']
    print(getInfo)
    ws.send(json.dumps(getInfo))

```

(see next page)

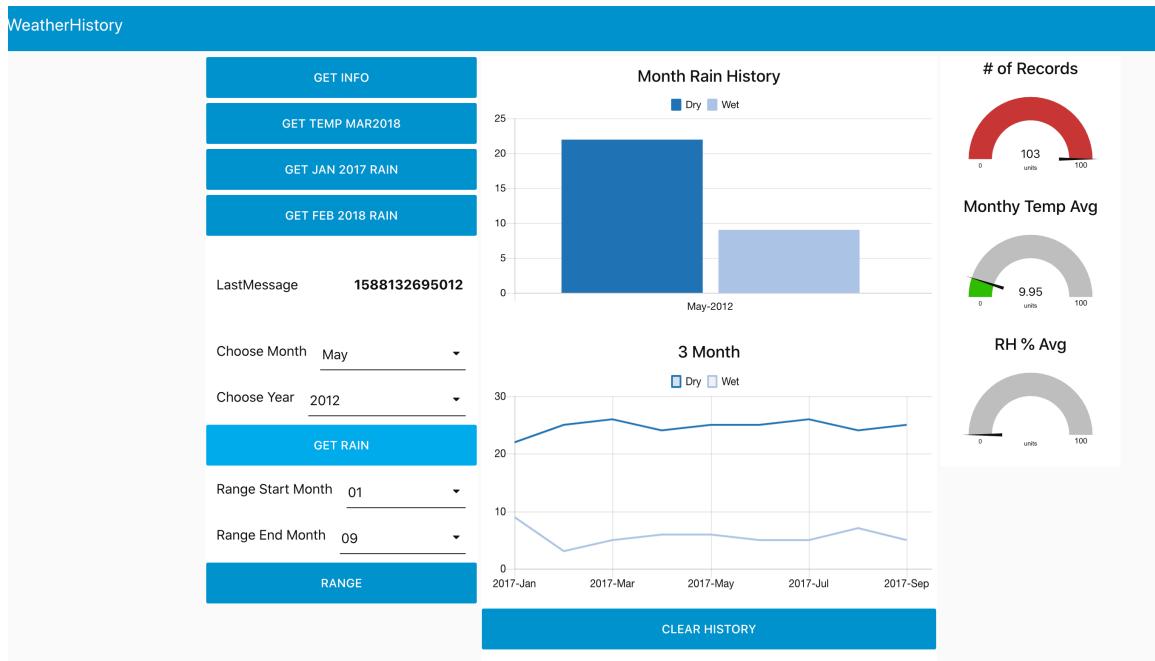
```
#Get Rain for a Month in coming
{"cmd":"getRain","month":"Feb","year":"2018"}
    if (datain['cmd'] == 'getRain'):
        yy=datain['year']
        mm=datain['month']
        dry=dataM[yy:yy].loc[dataM['month_name'] ==
mm].values[0][0]
        wet=dataM[yy:yy].loc[dataM['month_name'] ==
mm].values[0][1]
        getInfo = {'Wet': wet, 'Dry' : dry, "Month" : mm , "Year":yy}
        getInfo["cmd"]=datain['cmd']
        print(getInfo)
        ws.send(json.dumps(getInfo))
```

- The getRange command is hard coded in Node-RED . I always retrieve Jan to March. Add a other dropdown and add the range flow var to the code in Node-RED



```
msg.payload={"cmd":"getRange","start": flow.get("year")+-01,"end": flow.get("year")+-04}
//msg.payload.month=month
return msg;
//{"cmd":"getRange","info":[{"date":1485820800000,"Dry":22,"Wet":9,"year":2017,"month_name":'}
```

You should see something like this if everything is working



Please note: the above exercises are not required for the next part of the lab.
Feel free to move on without coding.

5 Trouble shooting

5.1 WebSocket connection

Make sure install the websocket client in the cell via **!pip install websocket-client**

There are 2 parts to connecting

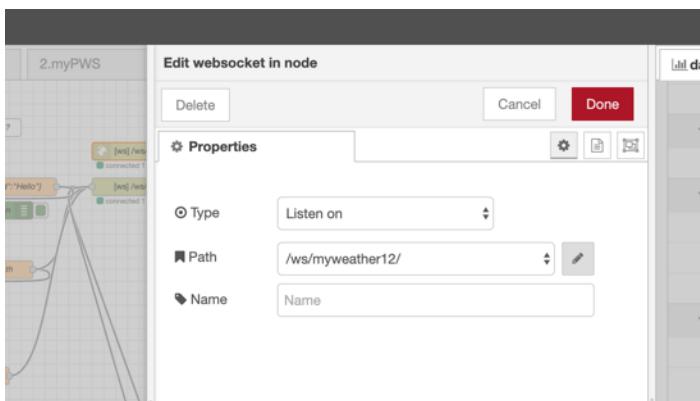
1. Make sure the url in the Python Notebook is correct.

Like

ws://thinklab???.mybluemix.net/ws/myweather12

where ??? is your LabID / Node-RED hostname

2. Make sure Node-RED code is deployed and the websocket path is the same e.g **/ws/myweather12**



Sometimes it helps if you change the path on both ends .. like to **/ws/myweather99** or so

5.2 WebSocket is stuck

Sometimes you cannot tell if the socket works from the Python notebook. Then you need to stop the cell and start again ... try to execute a different cell 1st before starting the notebook again like the hello world once. If you cannot get any reaction from the Notebook try to reload the whole notebook and execute each cell again.

5.3 Queries not working / No data coming into Node-RED

Sometime the queries are not working. You can see that Node-RED send a command like:

```
ws.run_forever()

start_websocket_listener()

Requirement already satisfied: websocket-client in /opt/conda/envs/Python36/lib/p
Requirement already satisfied: six in /opt/conda/envs/Python36/lib/python3.6/site
connecting
on open
send cmd
{"cmd": "getForecastMonth", "month": "Jun", "year": "2020"}
getForecastMonth
Error no json / no valid command
```

In that case a dataset is most likely not initialize like dataF or so ... make sure to stop the notebook than and go thru the query section of the notebook again.

In Part Three of the LAB we will work with Watson Studio so please make sure to sign up for an free account. [Register for WatsonStudio](#)
<https://dataplatform.cloud.ibm.com/registration/stepone>

Get the instructions for LAB Part Three here
<https://github.com/markusvankempen/ThinkLab1239/tree/master/instructions>

For more details got to the github

<https://github.com/markusvankempen/ThinkLab1239>

Cheers
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