Exploring Weather Trends

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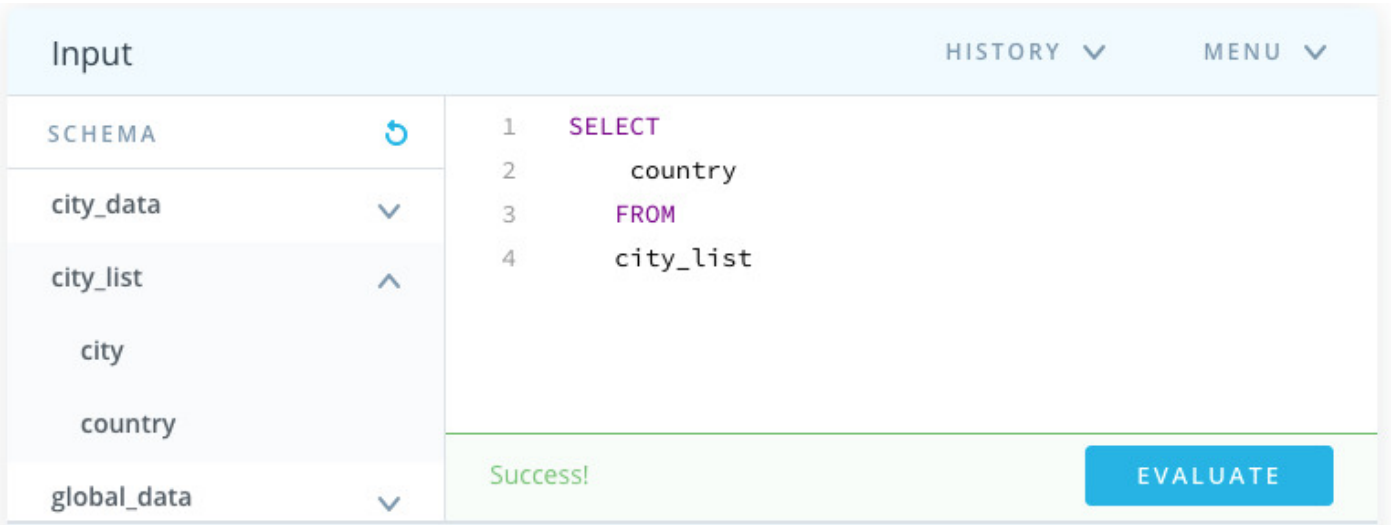
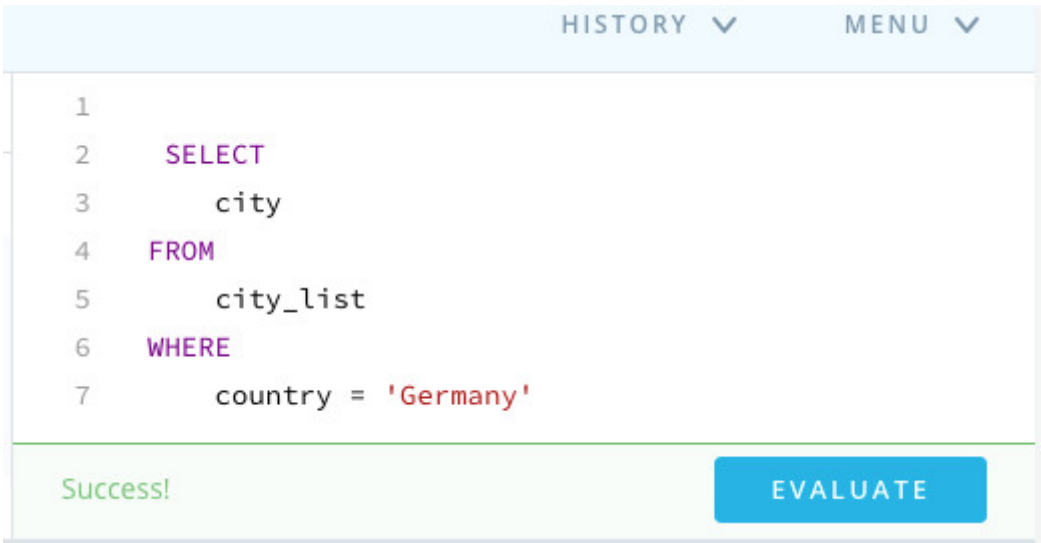
The general idea of this project is to analyze local and global temperature data and compare the temperature trends where you live to overall global temperature trends.

1. Extracting the data

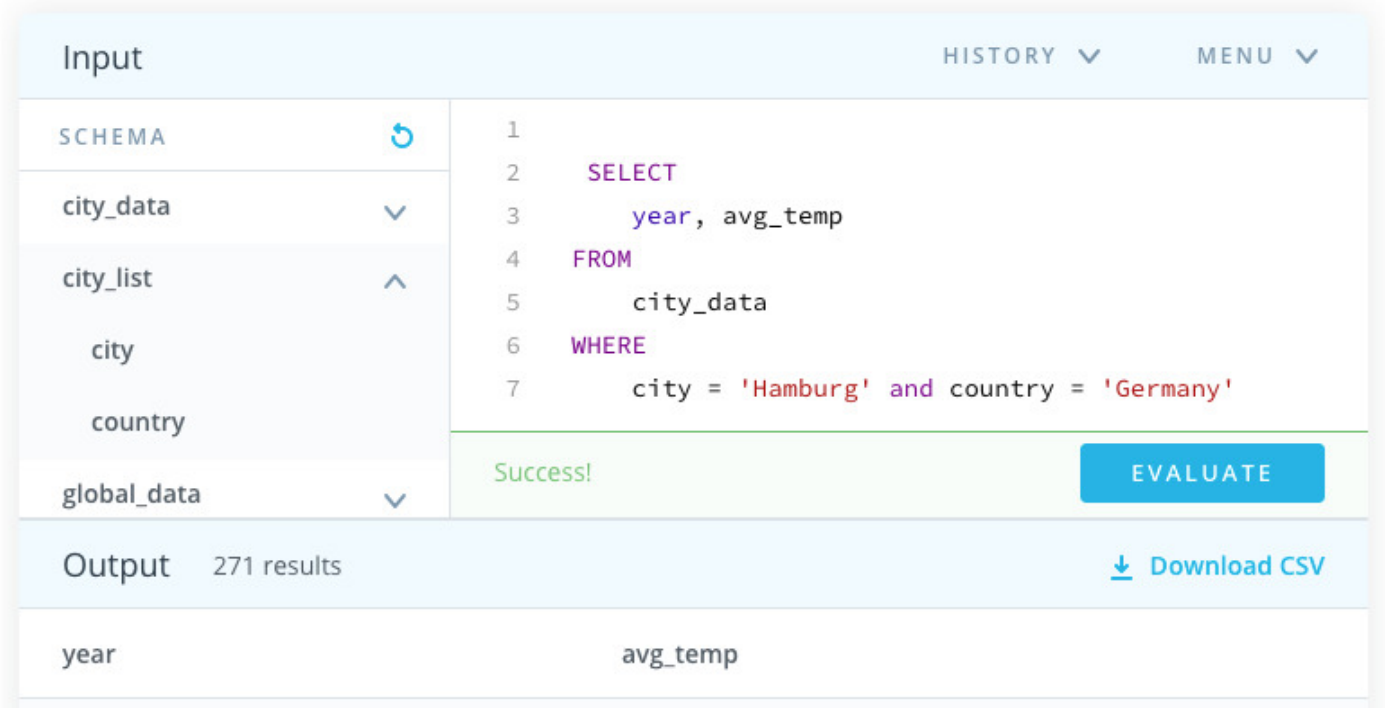
The first step is to extract the data from the database using SQL queries. Knowing that the columns that were available in the city_list table, I ran the query which gave me the countries available (to check if my country was on the list).



Then I ran the query to show the list of German cities available in the table.



Since the closest city to me is Hamburg, I ran a query on the city_data table to extract the year and average temperature for the city of Hamburg in Germany. Then I exported this data to CSV file format.



Next I ran the query to extract the year and average temperature from the global_data table

2. Data Preprocessing and Analysis

Since I am more comfortable in Python, I preferred to use this tool to analyse the CSV than Excel or Google sheets. I imported the csv files into a dataframe using PANDAS library and since there were some missing unavailable data, i used the fillna function to turn them to zeros.

In [42]:

```
import numpy as np
import pandas as pd

df= pd.read_csv('/Users/adaobitether/Documents/UdacityDA/city_data.csv')
city = pd.DataFrame(df).fillna(0)

data= pd.read_csv('/Users/adaobitether/Documents/UdacityDA/global_data.csv')
globaldf= pd.DataFrame(data).fillna(0)
```

In [51]:

```
temptrends = pd.merge(city, globaldf, on='year')
#city.shape
#globaldf.shape
temptrends.head()
```

Out[51]:

	year	avg_temp_x	avg_temp_y
0	1750	9.31	8.72
1	1751	8.94	7.98
2	1752	4.65	5.78
3	1753	8.12	8.39
4	1754	7.88	8.47

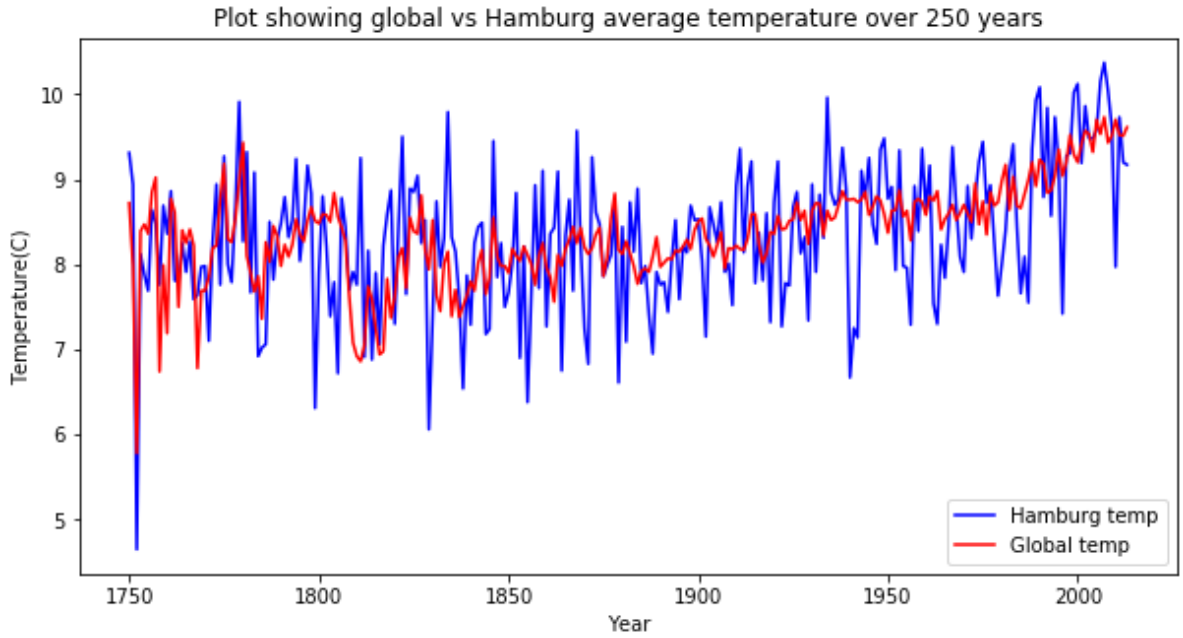
I first visualized the average temperatures of Hamburg and the world in a line chart, using matplotlib, a Python library for plotting graphs and charts, to see how the temperatures have varied over the past 250+ years.

In [59]:

```
import matplotlib.pyplot as plt
%matplotlib inline

plt.figure(figsize=(10,5))
plt.plot(temptrends.year, temptrends.avg_temp_x, 'b-', label='Hamburg temp')
plt.plot(temptrends.year, temptrends.avg_temp_y, 'r-', label='Global temp')
plt.xlabel('Year')
plt.ylabel('Temperature(C)')
plt.title('Plot showing global vs Hamburg average temperature over 250 years')

plt.legend(loc='lower right')
plt.show()
```



From the line chart above, it can be seen that the large variations over the past 250+ years cannot allow us infer anything from the data. So to see a smoother trend over a period, we use the Moving Average. The Simple Moving Average formula is a very basic arithmetic mean over the number of periods. I have made use of a 10 year moving average in this case over a 5-year or 20-year period because it adequately smoothes out the graph without losing critical data.

In [90]:

```
temptrends['MA_Hamburg']=temptrends['avg_temp_x'].rolling(10).mean()
temptrends['MA_Global']=temptrends['avg_temp_y'].rolling(10).mean()
temptrends.head(15)
```

Out[90]:

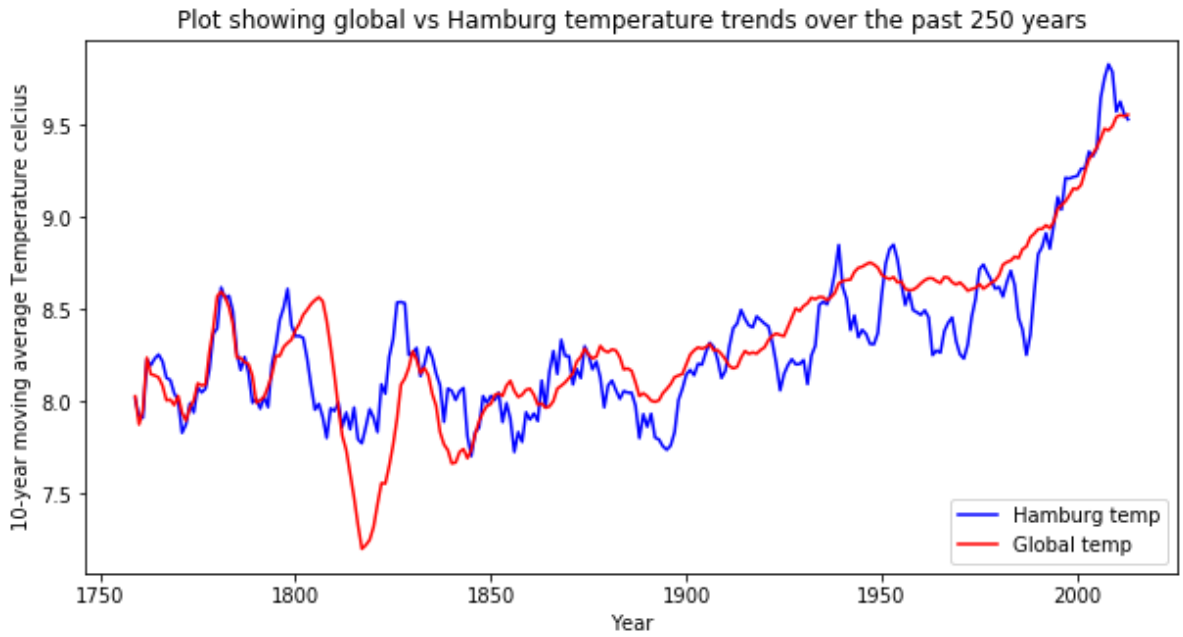
	year	avg_temp_x	avg_temp_y	MA_Hamburg	MA_Global	temp_diff
0	1750	9.31	8.72	NaN	NaN	NaN
1	1751	8.94	7.98	NaN	NaN	NaN
2	1752	4.65	5.78	NaN	NaN	NaN
3	1753	8.12	8.39	NaN	NaN	NaN
4	1754	7.88	8.47	NaN	NaN	NaN
5	1755	7.69	8.36	NaN	NaN	NaN
6	1756	8.64	8.85	NaN	NaN	NaN
7	1757	8.48	9.02	NaN	NaN	NaN
8	1758	7.76	6.74	NaN	NaN	NaN
9	1759	8.69	7.99	8.016	8.030	-0.014
10	1760	8.36	7.19	7.921	7.877	0.044
11	1761	8.86	8.77	7.913	7.956	-0.043
12	1762	7.81	8.61	8.229	8.239	-0.010
13	1763	7.80	7.50	8.197	8.150	0.047
14	1764	8.25	8.40	8.234	8.143	0.091

Finally, I used a line chart to then visualise the trend using the 10-year moving averages of the Hamburg and Global data.

In [58]:

```
plt.figure(figsize=(10,5))
plt.plot(temptrends.year, temptrends.MA_Hamburg, 'b-', label='Hamburg temp')
plt.plot(temptrends.year, temptrends.MA_Global, 'r-', label='Global temp')
plt.xlabel('Year')
plt.ylabel('10-year moving average Temperature celcius')
plt.title('Plot showing global vs Hamburg temperature trends over the past 250 years

plt.legend(loc='lower right')
plt.show()
```



Observations

1. From the chart, it is easy to observe a steady rise in average temperatures both regionally and Globally. The numerical values can also be gotten for this:

In [91]:

```
globaldf['avg_temp'].iloc[-1]-globaldf['avg_temp'].iloc[0]
```

Out[91]:

```
1.1099999999999994
```

In [92]:

```
city['avg_temp'].iloc[-1]-city['avg_temp'].iloc[0]
```

Out[92]:

```
2.9399999999999995
```

There has been a 1.1 degree rise in average temperature globally and a 2.9 degree (C) rise in temperature in Hamburg, since the temperature readings began (Mid 1700s).

2. From the chart, it is easy to observe that fluctuations in Hamburg's temperature had a steady effect on the global temperatures in earlier times. Between 1800 and 1850, there was a mirrored drop in Hamburg's temperature which is mirrored by the global temperature, to further prove this.
    - Therefore one can say that there must have been a similar dip in other regional temperatures, resulting in a drop in a large drop in global temperature.
    - However, these temperature trends stopped mirroring each other from around 1900. It becomes hard to see a correlation between the fluctuations in Hamburg's local temperature and the fluctuations in Global temperature. Global temperature seems to follow a steady rising pattern.

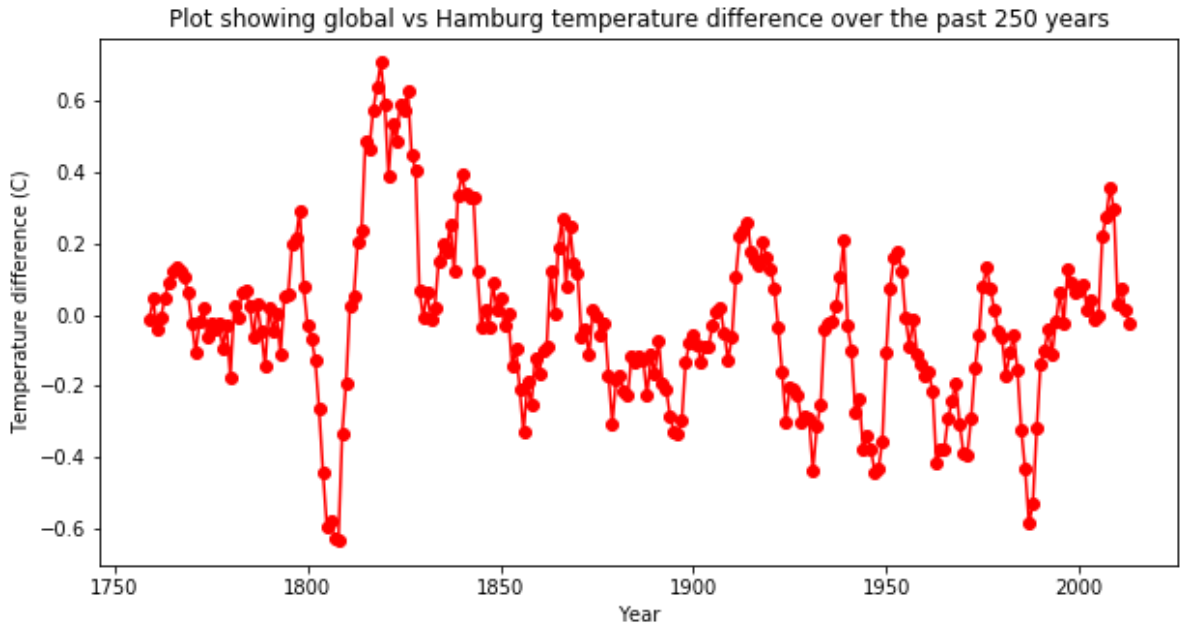
3. The temperature difference between Hamburg and the world has changed over time. To visualize this more clearly, I have created a temperature difference chart below:

In [94]:

```
temptrends['temp_diff']=temptrends['MA_Hamburg']- temptrends['MA_Global']
#temptrends.head(15)
plt.figure(figsize=(10,5))
plt.plot(temptrends.year, temptrends.temp_diff, 'r-o')
plt.xlabel('Year')
plt.ylabel('Temperature difference (C)')
plt.title('Plot showing global vs Hamburg temperature difference over the past 250 y
```

Out[94]:

```
Text(0.5, 1.0, 'Plot showing global vs Hamburg temperature difference
over the past 250 years')
```



- Between 1750s and 1800, the temperature difference stayed very close to 0, with little deviation. However as time went by, Hamburg became either much warmer or much colder.
- The average temperature difference between Hamburg and the world is minimal at -0.026 degrees celcius, with a standard deviation of 0.23 (as shown below).

In [85]:

```
temptrends.describe()
```

Out[85]:

	year	avg_temp_x	avg_temp_y	MA_Hamburg	MA_Global	temp_diff
count	264.000000	264.000000	264.000000	255.000000	255.000000	255.000000
mean	1881.500000	8.328902	8.359394	8.317514	8.344286	-0.026773
std	76.354437	0.845307	0.575184	0.413786	0.440769	0.235041
min	1750.000000	4.650000	5.780000	7.706000	7.203000	-0.636000
25%	1815.750000	7.790000	8.077500	8.031500	8.053000	-0.164500
50%	1881.500000	8.320000	8.365000	8.243000	8.274000	-0.028000
75%	1947.250000	8.890000	8.700000	8.488000	8.636500	0.087500
max	2013.000000	10.370000	9.730000	9.829000	9.556000	0.708000

4. There is a noticeably steep rise in temperature from the end of the 20th century to the 2000s in both Hamburg and the world which indicates a large increase in global warming events in this era.

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