Weather

December 19, 2018

```
In [1]: import pickle
        import pandas as pd
        import numpy as np
        from sklearn.metrics import explained_variance_score, \
            mean_absolute_error, \
            median_absolute_error
        from sklearn.model_selection import train_test_split
        import matplotlib
        import matplotlib.pyplot as plt
        %matplotlib inline
```

0.1 Reading Data

```
In [2]: df = pd.read_csv('weatherdata.csv')
        df.head()
```

Out[2]:

	STATION	NAME	LATITUDE	LONGITUDE	ELEVATION	DATE	TAVG	TMAX	TMIN
0	USW00094728	NY CITY CENTRAL PARK, NY US	40.77898	-73.96925	42.7	2008-01-01	NaN	47	37
1	USW00094728	NY CITY CENTRAL PARK, NY US	40.77898	-73.96925	42.7	2008-01-02	NaN	38	17
2	USW00094728	NY CITY CENTRAL PARK, NY US	40.77898	-73.96925	42.7	2008-01-03	NaN	20	12
3	USW00094728	NY CITY CENTRAL PARK, NY US	40.77898	-73.96925	42.7	2008-01-04	NaN	36	16
4	USW00094728	NY CITY CENTRAL PARK, NY US	40.77898	-73.96925	42.7	2008-01-05	NaN	43	32

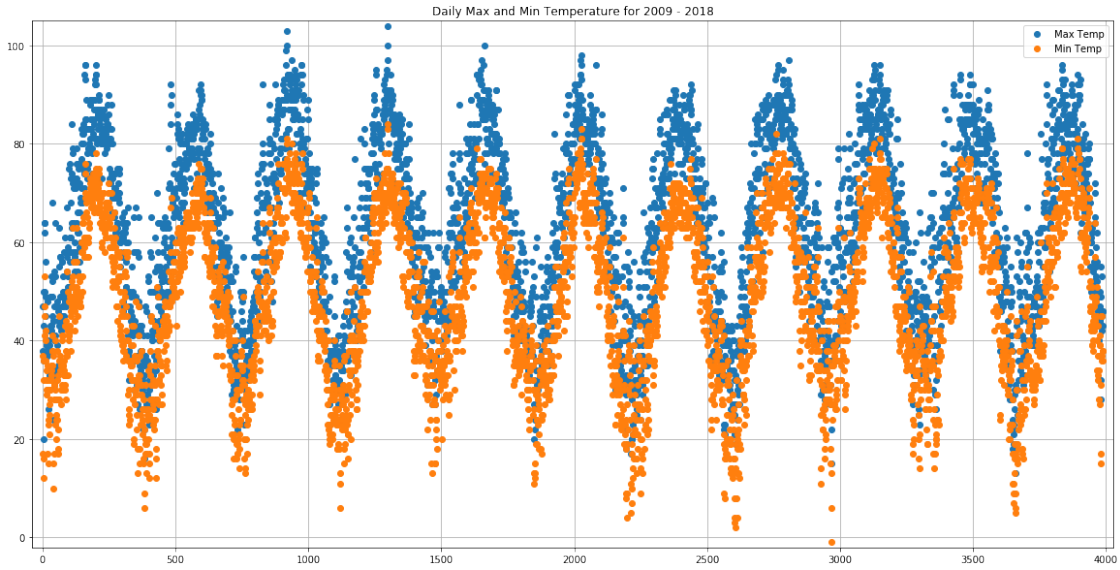
0.2 Looking At Temperature

Max and min temperature over all the days for the past 9 years (3988 days). Day 500: 05-15-2009 Day 1000: 09-27-2010 Day 1500: 02-09-2012 Day 2000: 06-23-2013 Day 2500: 11-05-2014 Day 3000: 03-19-2016 Day 3500: 08-01-2017 Day 3988: 12-01-2018

```
In [3]: num = [i for i in range(1, df.shape[0] + 1)]
        plt.figure(figsize = (20, 10))
```

```
        plt.plot(num, df['TMAX'].values.reshape(3988, 1), 'o')
        plt.plot(num, df['TMIN'].values.reshape(3988, 1), 'o')
        plt.margins(0.01)
        plt.grid()
        plt.title('Daily Max and Min Temperature for 2009 - 2018')
        plt.legend(['Max Temp', 'Min Temp'])
```

```
Out[3]: <matplotlib.legend.Legend at 0x1e090390358>
```



0.3 Parsing for Yearly Data

Separating data into years from 2009 to 2018 (most of 2018).

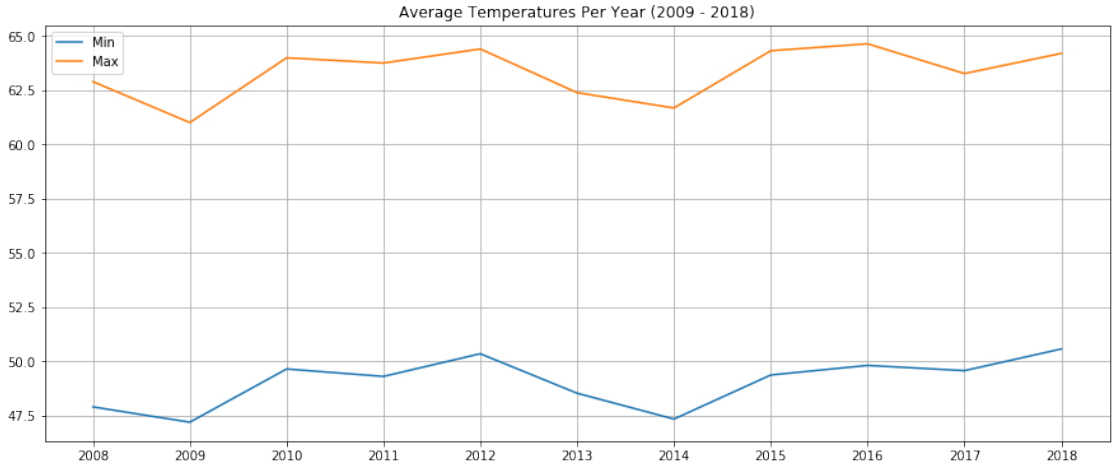
```
In [4]: avg2008 = df[df['DATE'].between('2008', '2009')]
        avg2009 = df[df['DATE'].between('2009', '2010')]
        avg2010 = df[df['DATE'].between('2010', '2011')]
        avg2011 = df[df['DATE'].between('2011', '2012')]
        avg2012 = df[df['DATE'].between('2012', '2013')]
        avg2013 = df[df['DATE'].between('2013', '2014')]
        avg2014 = df[df['DATE'].between('2014', '2015')]
        avg2015 = df[df['DATE'].between('2015', '2016')]
        avg2016 = df[df['DATE'].between('2016', '2017')]
        avg2017 = df[df['DATE'].between('2017', '2018')]
        avg2018 = df[df['DATE'] >= '2018-01']
```

Getting the average maximum and minimum temperature per year. The data is plotted to show the overall trend from year to year.

In [5]:
```
maxavg2008 = avg2008['TMAX'].values.mean()
maxavg2009 = avg2009['TMAX'].values.mean()
maxavg2010 = avg2010['TMAX'].values.mean()
maxavg2011 = avg2011['TMAX'].values.mean()
maxavg2012 = avg2012['TMAX'].values.mean()
maxavg2013 = avg2013['TMAX'].values.mean()
maxavg2014 = avg2014['TMAX'].values.mean()
maxavg2015 = avg2015['TMAX'].values.mean()
maxavg2016 = avg2016['TMAX'].values.mean()
maxavg2017 = avg2017['TMAX'].values.mean()
maxavg2018 = avg2018['TMAX'].values.mean()

yr = [i for i in range(2008, 2019)]
maxavg = [maxavg2008, maxavg2009, maxavg2010, maxavg2011, maxavg2012,
          maxavg2013, maxavg2014, maxavg2015, maxavg2016, maxavg2017, maxavg2018]

minavg2008 = avg2008['TMIN'].values.mean()
minavg2009 = avg2009['TMIN'].values.mean()
minavg2010 = avg2010['TMIN'].values.mean()
minavg2011 = avg2011['TMIN'].values.mean()
minavg2012 = avg2012['TMIN'].values.mean()
minavg2013 = avg2013['TMIN'].values.mean()
minavg2014 = avg2014['TMIN'].values.mean()
minavg2015 = avg2015['TMIN'].values.mean()
minavg2016 = avg2016['TMIN'].values.mean()
minavg2017 = avg2017['TMIN'].values.mean()
minavg2018 = avg2018['TMIN'].values.mean()

#minyr = [i for i in range(2008, 2019)]
minavg = [minavg2008, minavg2009, minavg2010, minavg2011, minavg2012,
          minavg2013, minavg2014, minavg2015, minavg2016, minavg2017, minavg2018]

plt.figure(figsize = (15, 6))
plt.plot(yr, minavg)
plt.plot(yr, maxavg)
plt.xticks(yr)
plt.grid()
plt.legend(['Min', 'Max'])
plt.title("Average Temperatures Per Year (2009 - 2018)")

for i in range(0, 11):
    print("Year: {0} \t MaxTemp: {1:0.2f} \t MinTemp: {2:0.2f}".format(yr[i], maxavg[i]
```

```
Year: 2008          MaxTemp: 62.88          MinTemp: 47.89
Year: 2009          MaxTemp: 61.00          MinTemp: 47.19
Year: 2010          MaxTemp: 63.98          MinTemp: 49.64
Year: 2011          MaxTemp: 63.74          MinTemp: 49.30
Year: 2012          MaxTemp: 64.39          MinTemp: 50.34
```

```
Year: 2013          MaxTemp: 62.38          MinTemp: 48.52
Year: 2014          MaxTemp: 61.67          MinTemp: 47.33
Year: 2015          MaxTemp: 64.31          MinTemp: 49.36
Year: 2016          MaxTemp: 64.63          MinTemp: 49.81
Year: 2017          MaxTemp: 63.25          MinTemp: 49.56
Year: 2018          MaxTemp: 64.19          MinTemp: 50.56
```



0.4 Results for Year Data:

1) Lowest temperatures are in 2009 and 2014. They were much colder than most other years.
2) Possible trend involves a very cooler year (like 2009 and 2014). Then a rise for a few years to a peak and then fall in temperature for a few years towards another cooler year that has similar temperatures as those before it.
3) 2019 could possibly be another increase with average temperatures at around 65 or decrease to around 63.5

Separating data into months (i.e. January 2008, January 2009, ... , January 2018 in one set). February is assumed to only be 28 days for all years.

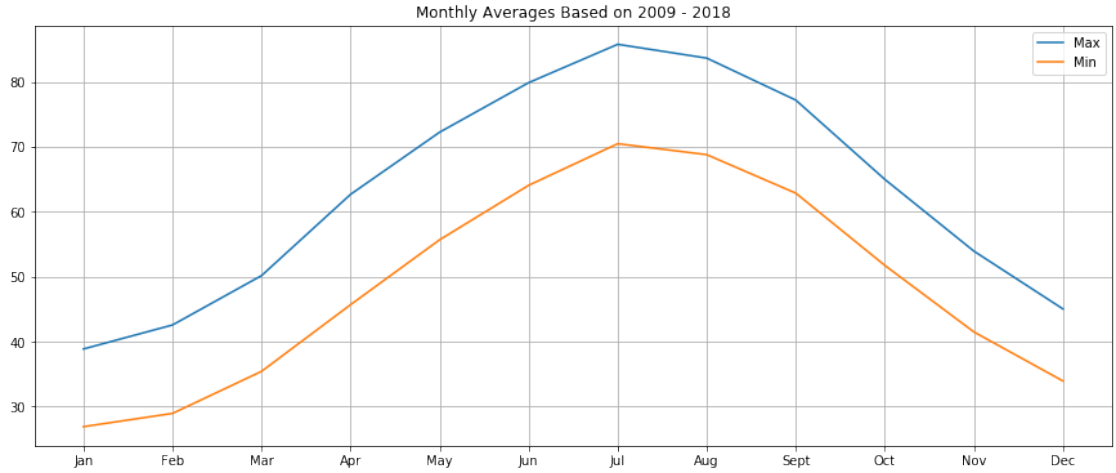
```
In [6]: # January
        dataJan = np.vstack((avg2008[:31], avg2009[:31], avg2010[:31], avg2011[:31], avg2012[:3
                             avg2013[:31], avg2014[:31], avg2015[:31], avg2016[:31], avg2017[:31
        maxavgJan = dataJan[:, 7].mean()
        minavgJan = dataJan[:, 8].mean()


        # February
        dataFeb = np.vstack((avg2008[31:59], avg2009[31:59], avg2010[31:59], avg2011[31:59], av
                             avg2013[31:59], avg2014[31:59], avg2015[31:59], avg2016[31:59], avg
        maxavgFeb = dataFeb[:, 7].mean()
```

```
minavgFeb = dataFeb[:, 8].mean()


# March
dataMar = np.vstack((avg2008[60:91], avg2009[59:90], avg2010[59:90], avg2011[59:90], av
                     avg2013[59:90], avg2014[59:90], avg2015[59:90], avg2016[60:91], avg
maxavgMar = dataMar[:, 7].mean()
minavgMar = dataMar[:, 8].mean()


# April
dataApr = np.vstack((avg2008[91:121], avg2009[90:120], avg2010[90:120], avg2011[90:120]
                     avg2013[90:120], avg2014[90:120], avg2015[90:120], avg2016[91:121]
maxavgApr = dataApr[:, 7].mean()
minavgApr = dataApr[:, 8].mean()


# May
dataMay = np.vstack((avg2008[121:152], avg2009[120:151], avg2010[120:151], avg2011[120
                     avg2013[120:151], avg2014[120:151], avg2015[120:151], avg2016[121:1
maxavgMay = dataMay[:, 7].mean()
minavgMay = dataMay[:, 8].mean()


# June
dataJune = np.vstack((avg2008[152:182], avg2009[151:181], avg2010[151:181], avg2011[151
                     avg2013[151:181], avg2014[151:181], avg2015[151:181], avg2016[152:1
maxavgJune = dataJune[:, 7].mean()
minavgJune = dataJune[:, 8].mean()


# July
dataJuly = np.vstack((avg2008[182:213], avg2009[181:212], avg2010[181:212], avg2011[181
                     avg2013[181:212], avg2014[181:212], avg2015[181:212], avg2016[182:1
maxavgJuly = dataJuly[:, 7].mean()
minavgJuly = dataJuly[:, 8].mean()


# August
dataAug = np.vstack((avg2008[213:244], avg2009[212:243], avg2010[212:243], avg2011[212
                     avg2013[212:243], avg2014[212:243], avg2015[212:243], avg2016[213:1
maxavgAug = dataAug[:, 7].mean()
minavgAug = dataAug[:, 8].mean()


# September
dataSept = np.vstack((avg2008[244:274], avg2009[243:273], avg2010[243:273], avg2011[243
                     avg2013[243:273], avg2014[243:273], avg2015[243:273], avg2016[244:1
```

```
maxavgSept = dataSept[:, 7].mean()
minavgSept = dataSept[:, 8].mean()


# October
dataOct = np.vstack((avg2008[274:305], avg2009[273:304], avg2010[273:304], avg2011[273
                     avg2013[273:304], avg2014[273:304], avg2015[273:304], avg2016[274:3
maxavgOct = dataOct[:, 7].mean()
minavgOct = dataOct[:, 8].mean()


# November
dataNov = np.vstack((avg2008[305:335], avg2009[304:334], avg2010[304:334], avg2011[304
                     avg2013[304:334], avg2014[304:334], avg2015[304:334], avg2016[305:3
maxavgNov = dataNov[:, 7].mean()
minavgNov = dataNov[:, 8].mean()


# December
dataDec = np.vstack((avg2008[-31:], avg2009[-31:], avg2010[-31:], avg2011[-31:], avg201
                     avg2013[-31:], avg2014[-31:], avg2015[-31:], avg2016[-31:], avg2017
maxavgDec = dataDec[:, 7].mean()
minavgDec = dataDec[:, 8].mean()


x = ['Jan', 'Feb', 'Mar', 'Apr', 'May', 'Jun', 'Jul', 'Aug', 'Sept', 'Oct', 'Nov', 'Dec
ymax = [maxavgJan, maxavgFeb, maxavgMar, maxavgApr, maxavgMay, maxavgJune, maxavgJuly,
        maxavgNov, maxavgDec]
ymin = [minavgJan, minavgFeb, minavgMar, minavgApr, minavgMay, minavgJune, minavgJuly,
        minavgNov, minavgDec]
plt.figure(figsize = (15, 6))
plt.plot(x, ymax)
plt.plot(x, ymin)
plt.grid()
plt.legend(['Max', 'Min'])
plt.title("Monthly Averages Based on 2009 - 2018")

for i in range(0, len(x)):
    print("Month: " + x[i] + "\t MaxTemp: {0:.2f} \t MinTemp: {1:.2f}".format(ymax[i],
```

```
Month: Jan          MaxTemp: 38.86          MinTemp: 26.89
Month: Feb          MaxTemp: 42.55          MinTemp: 28.93
Month: Mar          MaxTemp: 50.16          MinTemp: 35.41
Month: Apr          MaxTemp: 62.67          MinTemp: 45.68
Month: May          MaxTemp: 72.23          MinTemp: 55.67
Month: Jun          MaxTemp: 79.86          MinTemp: 64.06
Month: Jul          MaxTemp: 85.77          MinTemp: 70.46
Month: Aug          MaxTemp: 83.64          MinTemp: 68.78
```

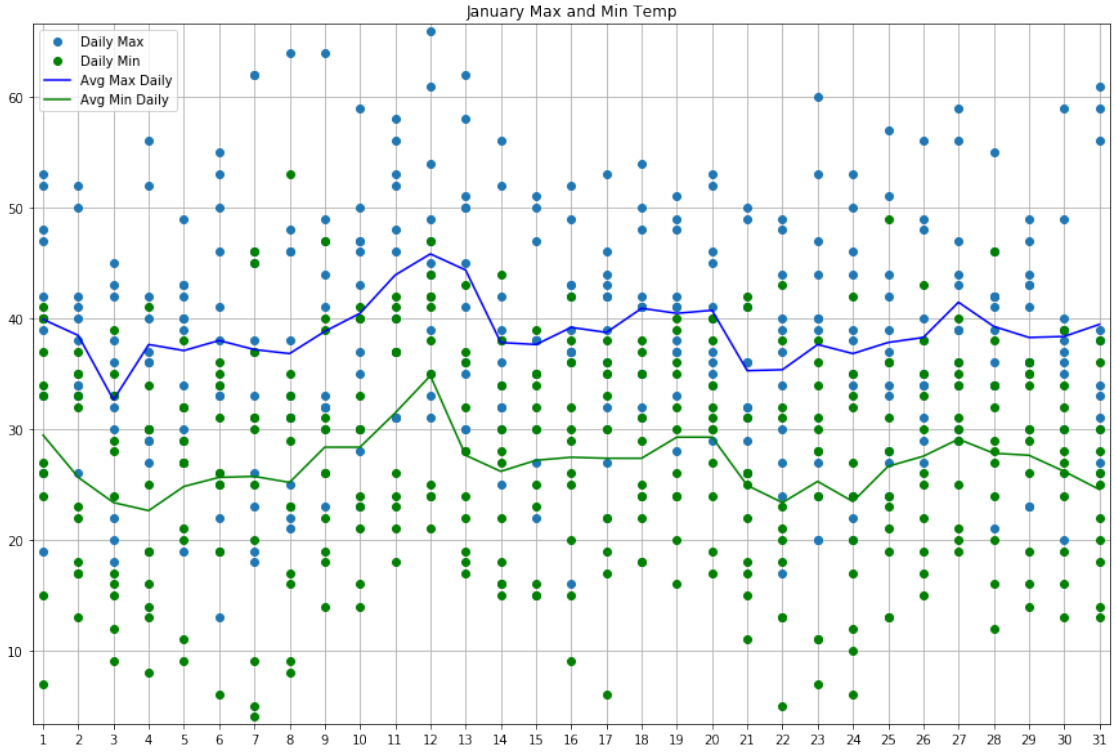
```
Month: Sept          MaxTemp: 77.18          MinTemp: 62.85
Month: Oct          MaxTemp: 64.97          MinTemp: 51.72
Month: Nov          MaxTemp: 53.92          MinTemp: 41.48
Month: Dec          MaxTemp: 45.03          MinTemp: 33.93
```



0.5 January Data

```
In [7]: day = [1]
        for i in range(2, 32):
            day = np.vstack((day, [i]))
        allJan = day
        for i in range(2009, 2019):
            allJan = np.vstack((allJan, day))

        maxAvgJan = np.zeros((31, 1))
        for i in range(0, 31):
            for j in range(2008, 2019):
                maxAvgJan[i] = maxAvgJan[i] + dataJan[31 * (j - 2008) + i, 7]
        dayJan = [[j] for j in range(1, 32)]
        maxAvgJan = maxAvgJan / 11

        minAvgJan = np.zeros((31, 1))
        for i in range(0, 31):
            for j in range(2008, 2019):
                minAvgJan[i] = minAvgJan[i] + dataJan[31 * (j - 2008) + i, 8]
        minAvgJan = minAvgJan / 11

        plt.figure(figsize = (15, 10))
        plt.plot(allJan, dataJan[:, 7], 'o')
        plt.plot(allJan, dataJan[:, 8], 'go')
```

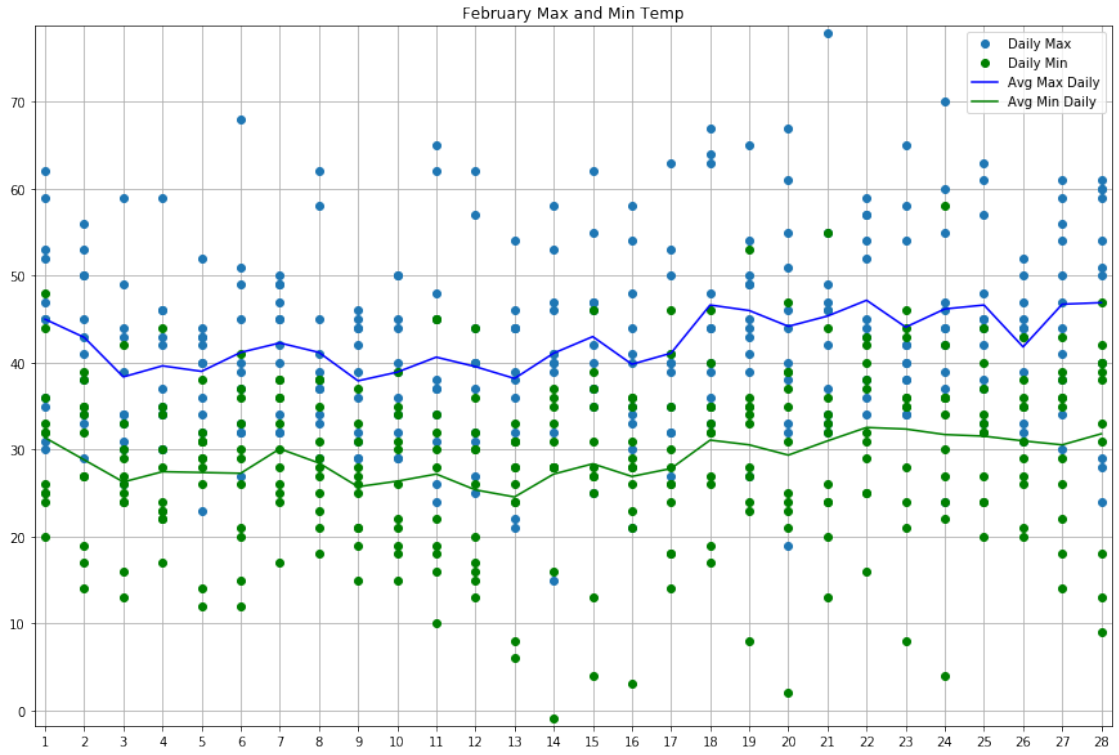
```
plt.plot(dayJan, maxAvgJan, 'b-')
plt.plot(dayJan, minAvgJan, 'g-')
plt.title("January Max and Min Temp")
plt.legend(['Daily Max','Daily Min', 'Avg Max Daily', 'Avg Min Daily'])
plt.xticks(dayJan)
plt.margins(0.01)
plt.grid()
```



0.6 February Data

In [8]:
```
day = [1]
for i in range(2, 29):
    day = np.vstack((day, [i]))
allFeb = day
for i in range(2009, 2019):
    allFeb = np.vstack((allFeb, day))

maxAvgFeb = np.zeros((28, 1))
for i in range(0, 28):
    for j in range(2008, 2019):
        maxAvgFeb[i] = maxAvgFeb[i] + dataFeb[28 * (j - 2008) + i, 7]
dayFeb = [[j] for j in range(1, 29)]
maxAvgFeb = maxAvgFeb / 11
```

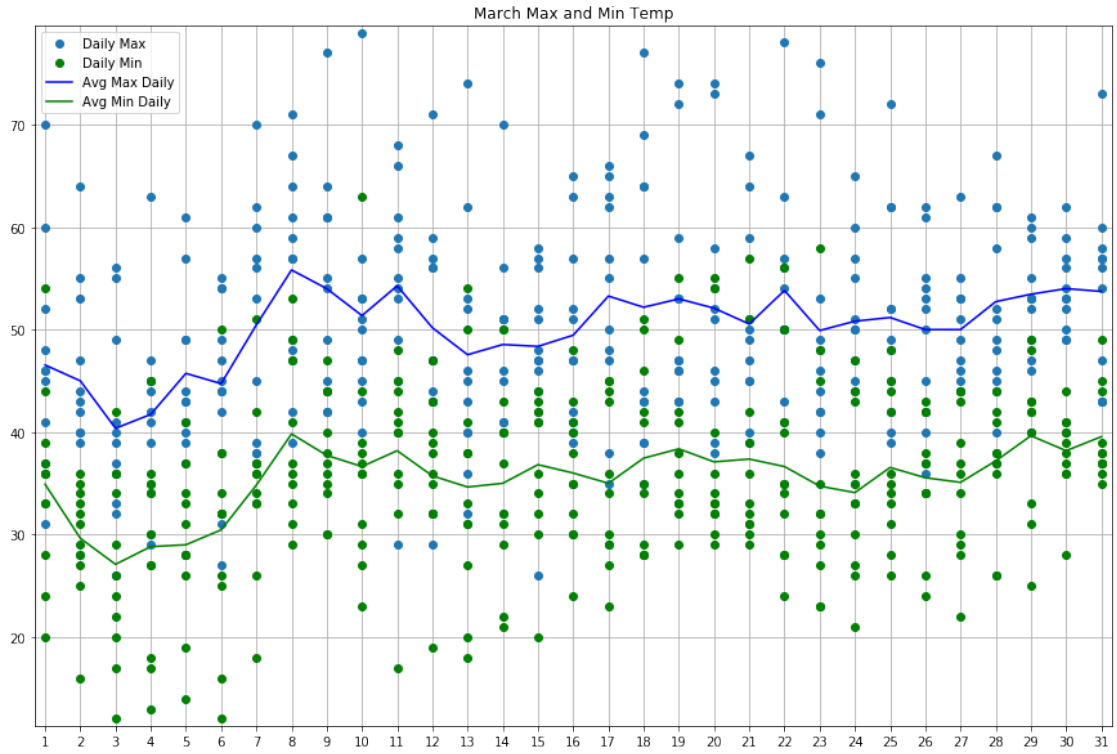
```
minAvgFeb = np.zeros((28, 1))
for i in range(0, 28):
    for j in range(2008, 2019):
        minAvgFeb[i] = minAvgFeb[i] + dataFeb[28 * (j - 2008) + i, 8]
minAvgFeb = minAvgFeb / 11

plt.figure(figsize = (15, 10))
plt.plot(allFeb, dataFeb[:, 7], 'o')
plt.plot(allFeb, dataFeb[:, 8], 'go')
plt.plot(dayFeb, maxAvgFeb, 'b-')
plt.plot(dayFeb, minAvgFeb, 'g-')
plt.title("February Max and Min Temp")
plt.legend(['Daily Max','Daily Min', 'Avg Max Daily', 'Avg Min Daily'])
plt.xticks(dayFeb)
plt.margins(0.01)
plt.grid()
```



0.7 March Data

In [9]:
```
day = [1]
for i in range(2, 32):
    day = np.vstack((day, [i]))
```

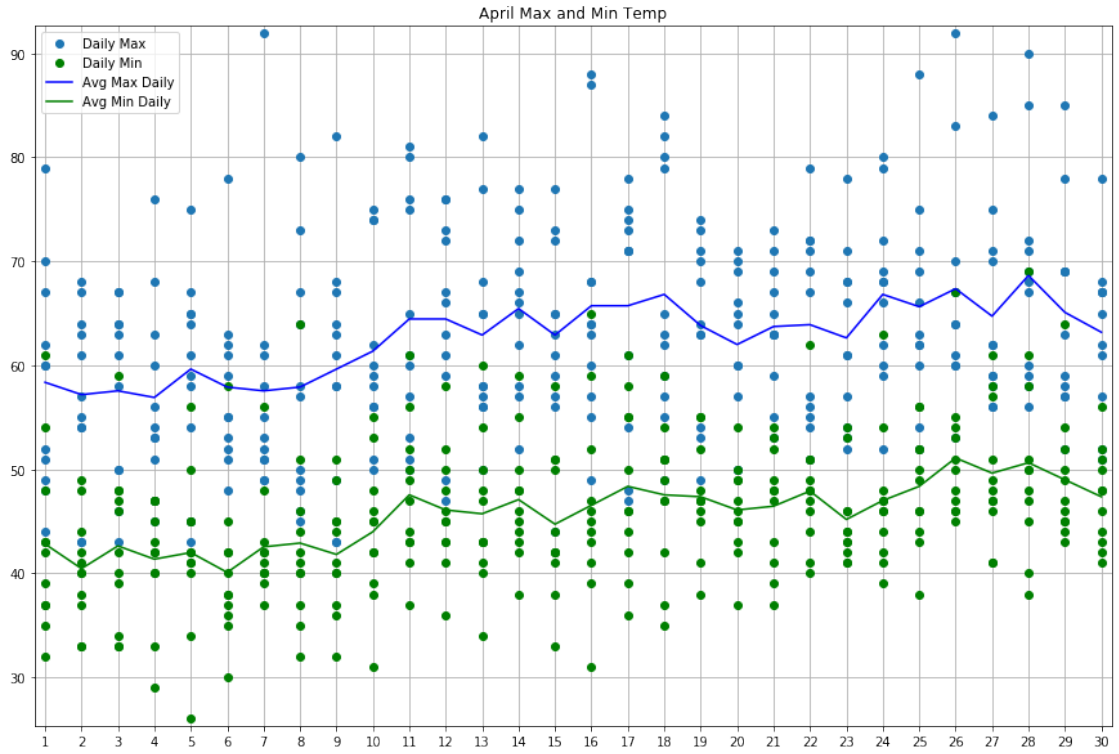
```
allMar = day
for i in range(2009, 2019):
    allMar = np.vstack((allMar, day))

maxAvgMar = np.zeros((31, 1))
for i in range(0, 31):
    for j in range(2008, 2019):
        maxAvgMar[i] = maxAvgMar[i] + dataMar[31 * (j - 2008) + i, 7]
dayMar = [[j] for j in range(1, 32)]
maxAvgMar = maxAvgMar / 11

minAvgMar = np.zeros((31, 1))
for i in range(0, 31):
    for j in range(2008, 2019):
        minAvgMar[i] = minAvgMar[i] + dataMar[31 * (j - 2008) + i, 8]
minAvgMar = minAvgMar / 11

plt.figure(figsize = (15, 10))
plt.plot(allMar, dataMar[:, 7], 'o')
plt.plot(allMar, dataMar[:, 8], 'go')
plt.plot(dayMar, maxAvgMar, 'b-')
plt.plot(dayMar, minAvgMar, 'g-')
plt.title("March Max and Min Temp")
plt.legend(['Daily Max','Daily Min', 'Avg Max Daily', 'Avg Min Daily'])
plt.xticks(dayMar)
plt.margins(0.01)
plt.grid()
```



0.8 April Data

```
In [10]: day = [1]
         for i in range(2, 31):
             day = np.vstack((day, [i]))
         allApr = day
         for i in range(2009, 2019):
             allApr = np.vstack((allApr, day))

         maxAvgApr = np.zeros((30, 1))
         for i in range(0, 30):
             for j in range(2008, 2019):
                 maxAvgApr[i] = maxAvgApr[i] + dataApr[30 * (j - 2008) + i, 7]
         dayApr = [[j] for j in range(1, 31)]
         maxAvgApr = maxAvgApr / 11

         minAvgApr = np.zeros((30, 1))
         for i in range(0, 30):
             for j in range(2008, 2019):
                 minAvgApr[i] = minAvgApr[i] + dataApr[30 * (j - 2008) + i, 8]
         minAvgApr = minAvgApr / 11

         plt.figure(figsize = (15, 10))
```

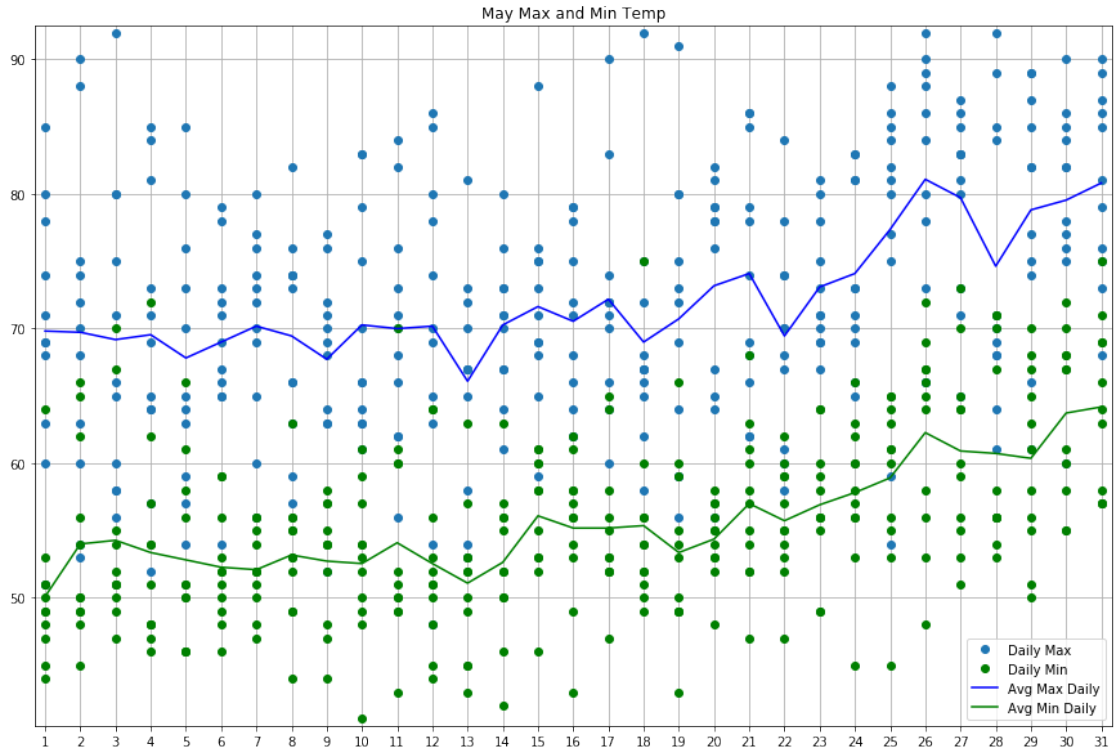
```
plt.plot(allApr, dataApr[:, 7], 'o')
plt.plot(allApr, dataApr[:, 8], 'go')
plt.plot(dayApr, maxAvgApr, 'b-')
plt.plot(dayApr, minAvgApr, 'g-')
plt.title("April Max and Min Temp")
plt.legend(['Daily Max','Daily Min', 'Avg Max Daily', 'Avg Min Daily'])
plt.xticks(dayApr)
plt.margins(0.01)
plt.grid()
```



0.9 May Data

```
In [11]: day = [1]
         for i in range(2, 32):
             day = np.vstack((day, [i]))
         allMay = day
         for i in range(2009, 2019):
             allMay = np.vstack((allMay, day))

         maxAvgMay = np.zeros((31, 1))
         for i in range(0, 31):
             for j in range(2008, 2019):
                 maxAvgMay[i] = maxAvgMay[i] + dataMay[31 * (j - 2008) + i, 7]
```

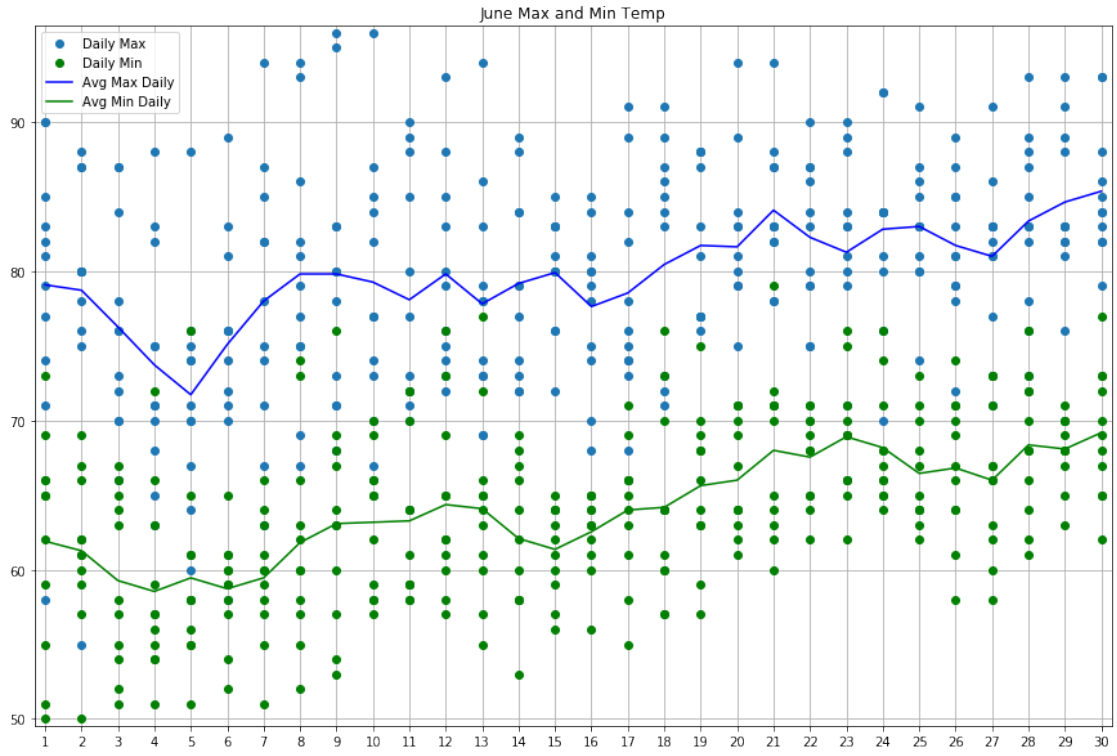
```
dayMay = [[j] for j in range(1, 32)]
maxAvgMay = maxAvgMay / 11

minAvgMay = np.zeros((31, 1))
for i in range(0, 31):
    for j in range(2008, 2019):
        minAvgMay[i] = minAvgMay[i] + dataMay[31 * (j - 2008) + i, 8]
minAvgMay = minAvgMay / 11

plt.figure(figsize = (15, 10))
plt.plot(allMay, dataMay[:, 7], 'o')
plt.plot(allMay, dataMay[:, 8], 'go')
plt.plot(dayMay, maxAvgMay, 'b-')
plt.plot(dayMay, minAvgMay, 'g-')
plt.title("May Max and Min Temp")
plt.legend(['Daily Max','Daily Min', 'Avg Max Daily', 'Avg Min Daily'])
plt.xticks(dayMay)
plt.margins(0.01)
plt.grid()
```



0.10 June Data

In [12]:
```
day = [1]
for i in range(2, 31):
```

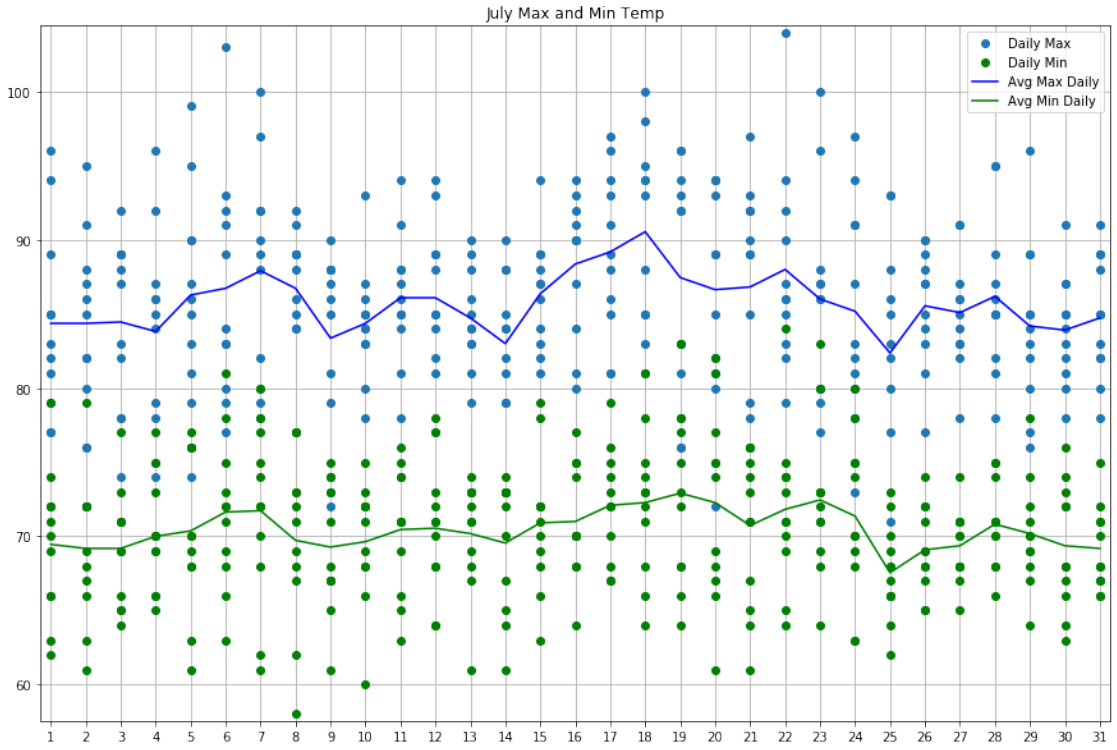
```
    day = np.vstack((day, [i]))
allJune = day
for i in range(2009, 2019):
    allJune = np.vstack((allJune, day))

maxAvgJune = np.zeros((30, 1))
for i in range(0, 30):
    for j in range(2008, 2019):
        maxAvgJune[i] = maxAvgJune[i] + dataJune[30 * (j - 2008) + i, 7]
dayJune = [[j] for j in range(1, 31)]
maxAvgJune = maxAvgJune / 11

minAvgJune = np.zeros((30, 1))
for i in range(0, 30):
    for j in range(2008, 2019):
        minAvgJune[i] = minAvgJune[i] + dataJune[30 * (j - 2008) + i, 8]
minAvgJune = minAvgJune / 11

plt.figure(figsize = (15, 10))
plt.plot(allJune, dataJune[:, 7], 'o')
plt.plot(allJune, dataJune[:, 8], 'go')
plt.plot(dayJune, maxAvgJune, 'b-')
plt.plot(dayJune, minAvgJune, 'g-')
plt.title("June Max and Min Temp")
plt.legend(['Daily Max','Daily Min', 'Avg Max Daily', 'Avg Min Daily'])
plt.xticks(dayJune)
plt.margins(0.01)
plt.grid()
```



0.11 July Data

```
In [13]: day = [1]
         for i in range(2, 32):
             day = np.vstack((day, [i]))
         allJuly = day
         for i in range(2009, 2019):
             allJuly = np.vstack((allJuly, day))

         maxAvgJuly = np.zeros((31, 1))
         for i in range(0, 31):
             for j in range(2008, 2019):
                 maxAvgJuly[i] = maxAvgJuly[i] + dataJuly[31 * (j - 2008) + i, 7]
         dayJuly = [[j] for j in range(1, 32)]
         maxAvgJuly = maxAvgJuly / 11

         minAvgJuly = np.zeros((31, 1))
         for i in range(0, 31):
             for j in range(2008, 2019):
                 minAvgJuly[i] = minAvgJuly[i] + dataJuly[31 * (j - 2008) + i, 8]
         minAvgJuly = minAvgJuly / 11

         plt.figure(figsize = (15, 10))
```

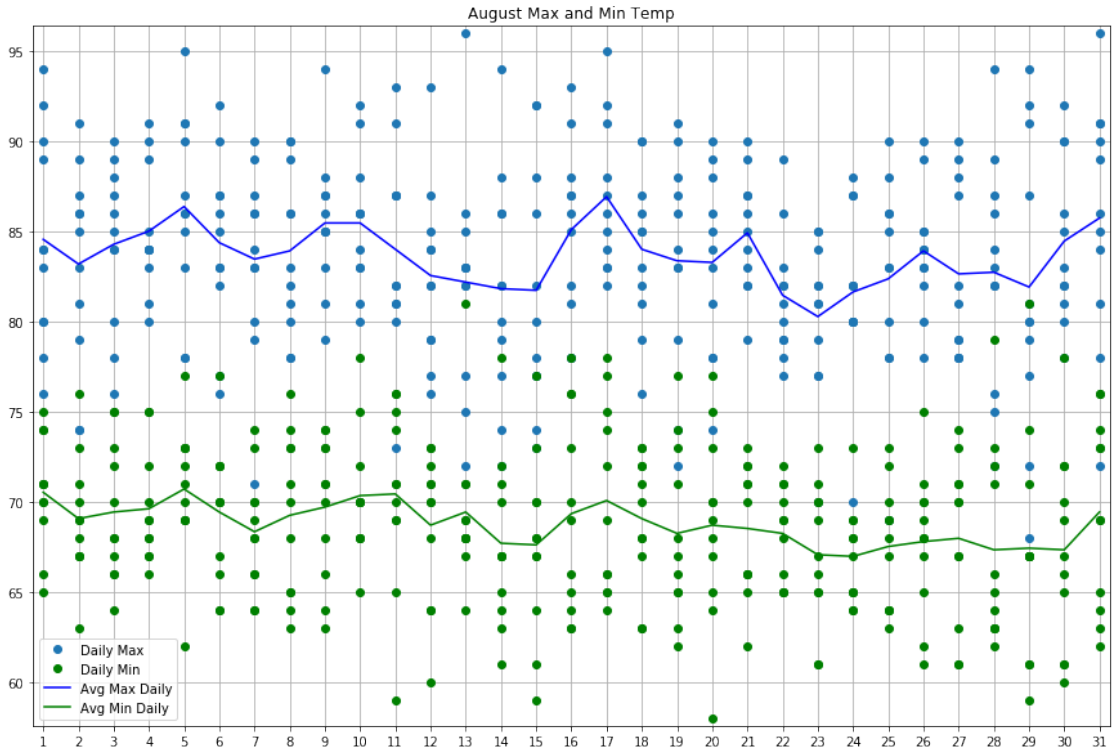
```
plt.plot(allJuly, dataJuly[:, 7], 'o')
plt.plot(allJuly, dataJuly[:, 8], 'go')
plt.plot(dayJuly, maxAvgJuly, 'b-')
plt.plot(dayJuly, minAvgJuly, 'g-')
plt.title("July Max and Min Temp")
plt.legend(['Daily Max','Daily Min', 'Avg Max Daily', 'Avg Min Daily'])
plt.xticks(dayJuly)
plt.margins(0.01)
plt.grid()
```



0.12 August Data

In [14]:
```
day = [1]
for i in range(2, 32):
    day = np.vstack((day, [i]))
allAug = day
for i in range(2009, 2019):
    allAug = np.vstack((allAug, day))

maxAvgAug = np.zeros((31, 1))
for i in range(0, 31):
    for j in range(2008, 2019):
        maxAvgAug[i] = maxAvgAug[i] + dataAug[31 * (j - 2008) + i, 7]
```

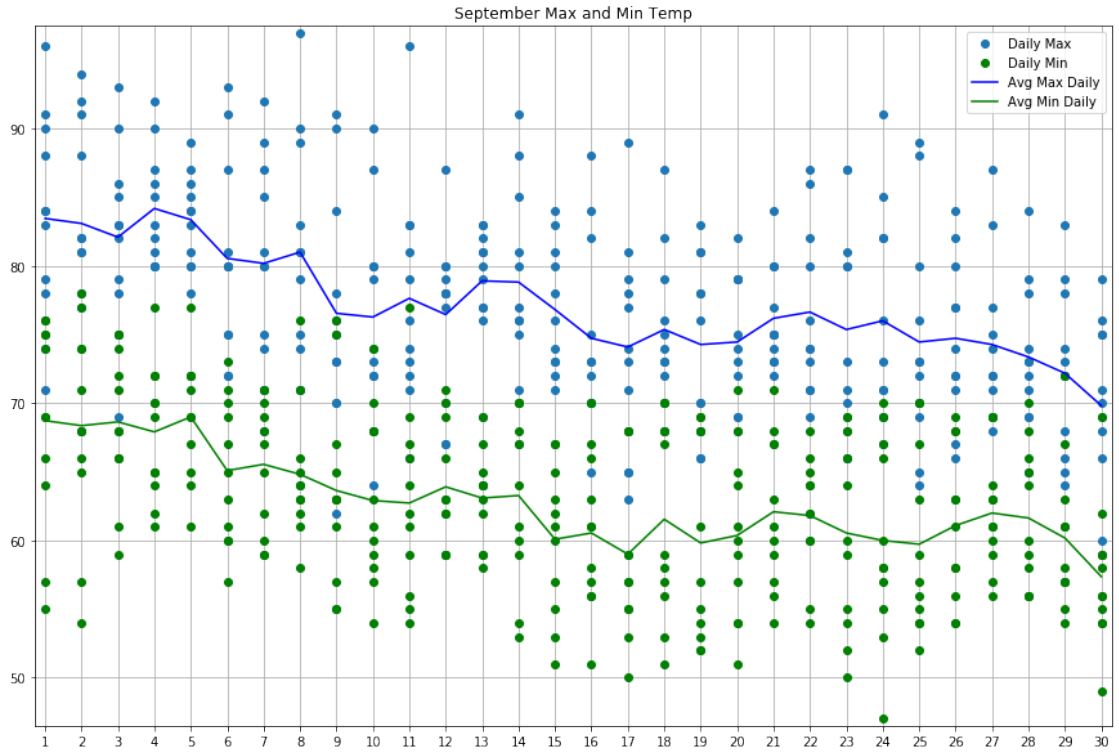
```
dayAug = [[j] for j in range(1, 32)]
maxAvgAug = maxAvgAug / 11

minAvgAug = np.zeros((31, 1))
for i in range(0, 31):
    for j in range(2008, 2019):
        minAvgAug[i] = minAvgAug[i] + dataAug[31 * (j - 2008) + i, 8]
minAvgAug = minAvgAug / 11

plt.figure(figsize = (15, 10))
plt.plot(allAug, dataAug[:, 7], 'o')
plt.plot(allAug, dataAug[:, 8], 'go')
plt.plot(dayAug, maxAvgAug, 'b-')
plt.plot(dayAug, minAvgAug, 'g-')
plt.title("August Max and Min Temp")
plt.legend(['Daily Max','Daily Min', 'Avg Max Daily', 'Avg Min Daily'])
plt.xticks(dayAug)
plt.margins(0.01)
plt.grid()
```



0.13 September Data

In [15]:
```
day = [1]
for i in range(2, 31):
```

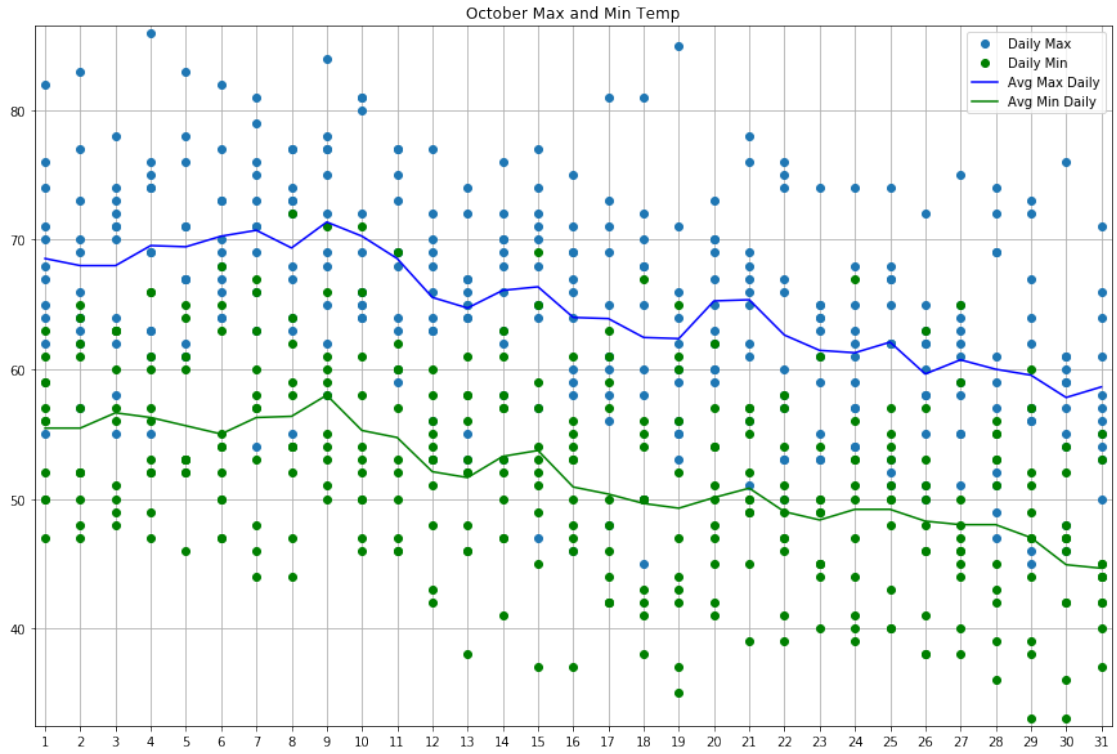
```
    day = np.vstack((day, [i]))
allSept = day
for i in range(2009, 2019):
    allSept = np.vstack((allSept, day))

maxAvgSept = np.zeros((30, 1))
for i in range(0, 30):
    for j in range(2008, 2019):
        maxAvgSept[i] = maxAvgSept[i] + dataSept[30 * (j - 2008) + i, 7]
daySept = [[j] for j in range(1, 31)]
maxAvgSept = maxAvgSept / 11

minAvgSept = np.zeros((30, 1))
for i in range(0, 30):
    for j in range(2008, 2019):
        minAvgSept[i] = minAvgSept[i] + dataSept[30 * (j - 2008) + i, 8]
minAvgSept = minAvgSept / 11

plt.figure(figsize = (15, 10))
plt.plot(allSept, dataSept[:, 7], 'o')
plt.plot(allSept, dataSept[:, 8], 'go')
plt.plot(daySept, maxAvgSept, 'b-')
plt.plot(daySept, minAvgSept, 'g-')
plt.title("September Max and Min Temp")
plt.legend(['Daily Max','Daily Min', 'Avg Max Daily', 'Avg Min Daily'])
plt.xticks(daySept)
plt.margins(0.01)
plt.grid()
```



0.14 October Data

```
In [16]: day = [1]
         for i in range(2, 32):
             day = np.vstack((day, [i]))
         allOct = day
         for i in range(2009, 2019):
             allOct = np.vstack((allOct, day))

         maxAvgOct = np.zeros((31, 1))
         for i in range(0, 31):
             for j in range(2008, 2019):
                 maxAvgOct[i] = maxAvgOct[i] + dataOct[31 * (j - 2008) + i, 7]
         dayOct = [[j] for j in range(1, 32)]
         maxAvgOct = maxAvgOct / 11

         minAvgOct = np.zeros((31, 1))
         for i in range(0, 31):
             for j in range(2008, 2019):
                 minAvgOct[i] = minAvgOct[i] + dataOct[31 * (j - 2008) + i, 8]
         minAvgOct = minAvgOct / 11

         plt.figure(figsize = (15, 10))
```

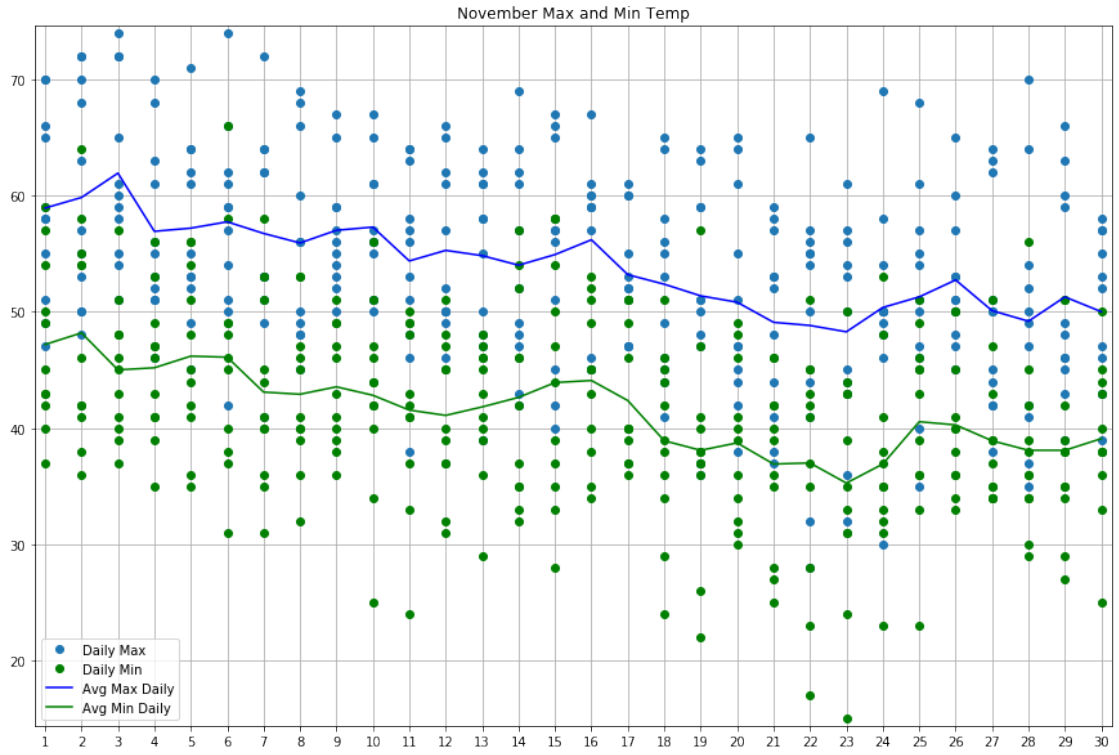
```
plt.plot(allOct, dataOct[:, 7], 'o')
plt.plot(allOct, dataOct[:, 8], 'go')
plt.plot(dayOct, maxAvgOct, 'b-')
plt.plot(dayOct, minAvgOct, 'g-')
plt.title("October Max and Min Temp")
plt.legend(['Daily Max','Daily Min', 'Avg Max Daily', 'Avg Min Daily'])
plt.xticks(dayOct)
plt.margins(0.01)
plt.grid()
```



0.15 November Data

In [17]:
```
day = [1]
for i in range(2, 31):
    day = np.vstack((day, [i]))
allNov = day
for i in range(2009, 2019):
    allNov = np.vstack((allNov, day))

maxAvgNov = np.zeros((30, 1))
for i in range(0, 30):
    for j in range(2008, 2019):
        maxAvgNov[i] = maxAvgNov[i] + dataNov[30 * (j - 2008) + i, 7]
```

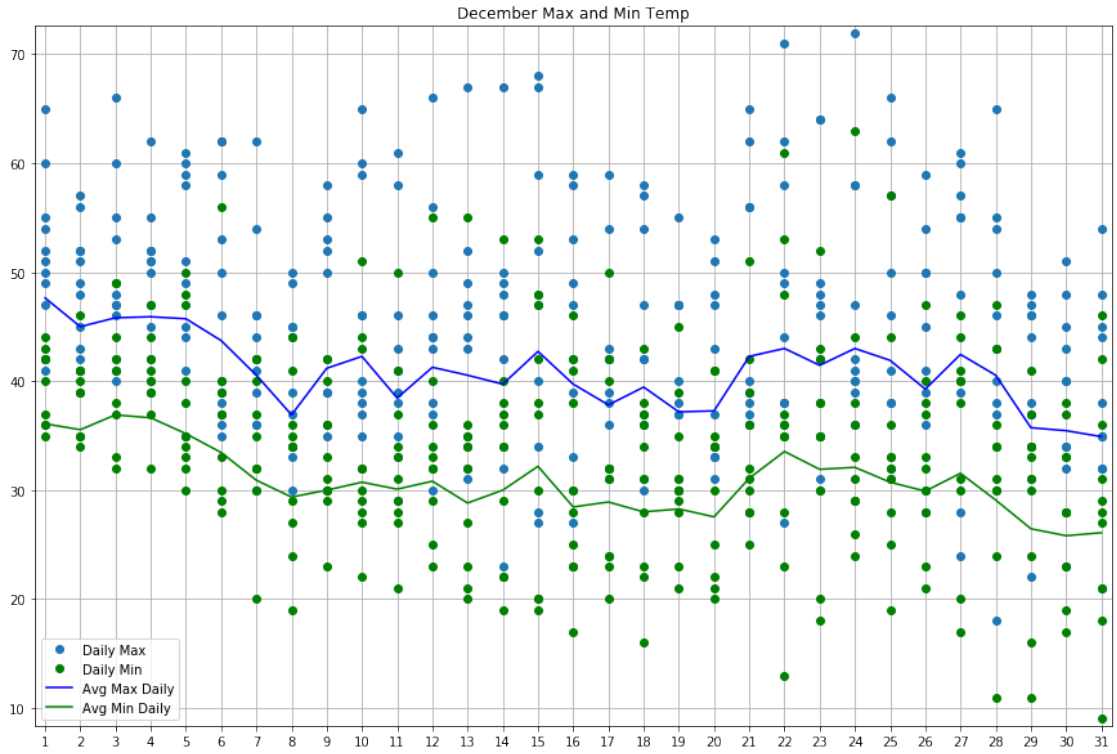
```
dayNov = [[j] for j in range(1, 31)]
maxAvgNov = maxAvgNov / 11

minAvgNov = np.zeros((30, 1))
for i in range(0, 30):
    for j in range(2008, 2019):
        minAvgNov[i] = minAvgNov[i] + dataNov[30 * (j - 2008) + i, 8]
minAvgNov = minAvgNov / 11

plt.figure(figsize = (15, 10))
plt.plot(allNov, dataNov[:, 7], 'o')
plt.plot(allNov, dataNov[:, 8], 'go')
plt.plot(dayNov, maxAvgNov, 'b-')
plt.plot(dayNov, minAvgNov, 'g-')
plt.title("November Max and Min Temp")
plt.legend(['Daily Max','Daily Min', 'Avg Max Daily', 'Avg Min Daily'])
plt.xticks(dayNov)
plt.margins(0.01)
plt.grid()
```



0.16 December Data

In [18]:
```
day = [1]
for i in range(2, 32):
```

```
    day = np.vstack((day, [i]))
allDec = day
for i in range(2009, 2018):
    allDec = np.vstack((allDec, day))

maxAvgDec = np.zeros((31, 1))
for i in range(0, 31):
    for j in range(2008, 2018):
        maxAvgDec[i] = maxAvgDec[i] + dataDec[31 * (j - 2008) + i, 7]
dayDec = [[j] for j in range(1, 32)]
maxAvgDec = maxAvgDec / 11

minAvgDec = np.zeros((31, 1))
for i in range(0, 31):
    for j in range(2008, 2018):
        minAvgDec[i] = minAvgDec[i] + dataDec[31 * (j - 2008) + i, 8]
minAvgDec = minAvgDec / 11

plt.figure(figsize = (15, 10))
plt.plot(allDec, dataDec[:, 7], 'o')
plt.plot(allDec, dataDec[:, 8], 'go')
plt.plot(dayDec, maxAvgDec, 'b-')
plt.plot(dayDec, minAvgDec, 'g-')
plt.title("December Max and Min Temp")
plt.legend(['Daily Max','Daily Min', 'Avg Max Daily', 'Avg Min Daily'])
plt.xticks(dayDec)
plt.margins(0.01)
plt.grid()
```



0.17 Results

There exists multiple days throughout each month where the temperature is more than often not higher than the previous day. Of course, weather occurs in cycles and more data is needed to confirm changes based on other factors (pressure, humidity, wind, etc.). However, it is possible that a certain deviation from a "normal" day (have to define typical status in temperature and other factors) exists on the current day, then the next day would try to return to that normal.

0.18 Some Future Work To Consider

1) Show deviation for daily temperatures for the graphs above instead of the raw temperature. This will more clearly show how often a day is above some type of average.
2) More intensive data with many weather factors