VISUALIZING TIME SERIES DATA IN PYTHON

Clean your time series data

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The CO2 level time series

A snippet of the weekly measurements of CO2 levels at the Mauna Loa Observatory, Hawaii.

```
             datestamp    co2
datestamp
1958-03-29  1958-03-29  316.1
1958-04-05  1958-04-05  317.3
1958-04-12  1958-04-12  317.6
...
...
2001-12-15  2001-12-15  371.2
2001-12-22  2001-12-22  371.3
2001-12-29  2001-12-29  371.5
```

Finding missing values in a DataFrame

```
In [1]: print(df.isnull())
                co2
datestamp
1958-03-29  False
1958-04-05  False
1958-04-12  False
...

In [2]: print(df.notnull())
                co2
datestamp
1958-03-29   True
1958-04-05   True
1958-04-12   True
...
```

Counting missing values in a DataFrame

```
In [1]: print(df.isnull().sum())
datestamp     0
co2          59
dtype: int64
```

Replacing missing values in a DataFrame

```
In [1]: print(df)
...
5  1958-05-03  316.9
6  1958-05-10    NaN
7  1958-05-17  317.5
...

In [2]: df = df.fillna(method='bfill')

In [3]: print(df)
...
5  1958-05-03  316.9
6  1958-05-10  317.5
7  1958-05-17  317.5
...
```

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Let's practice!

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Plot aggregates of your data

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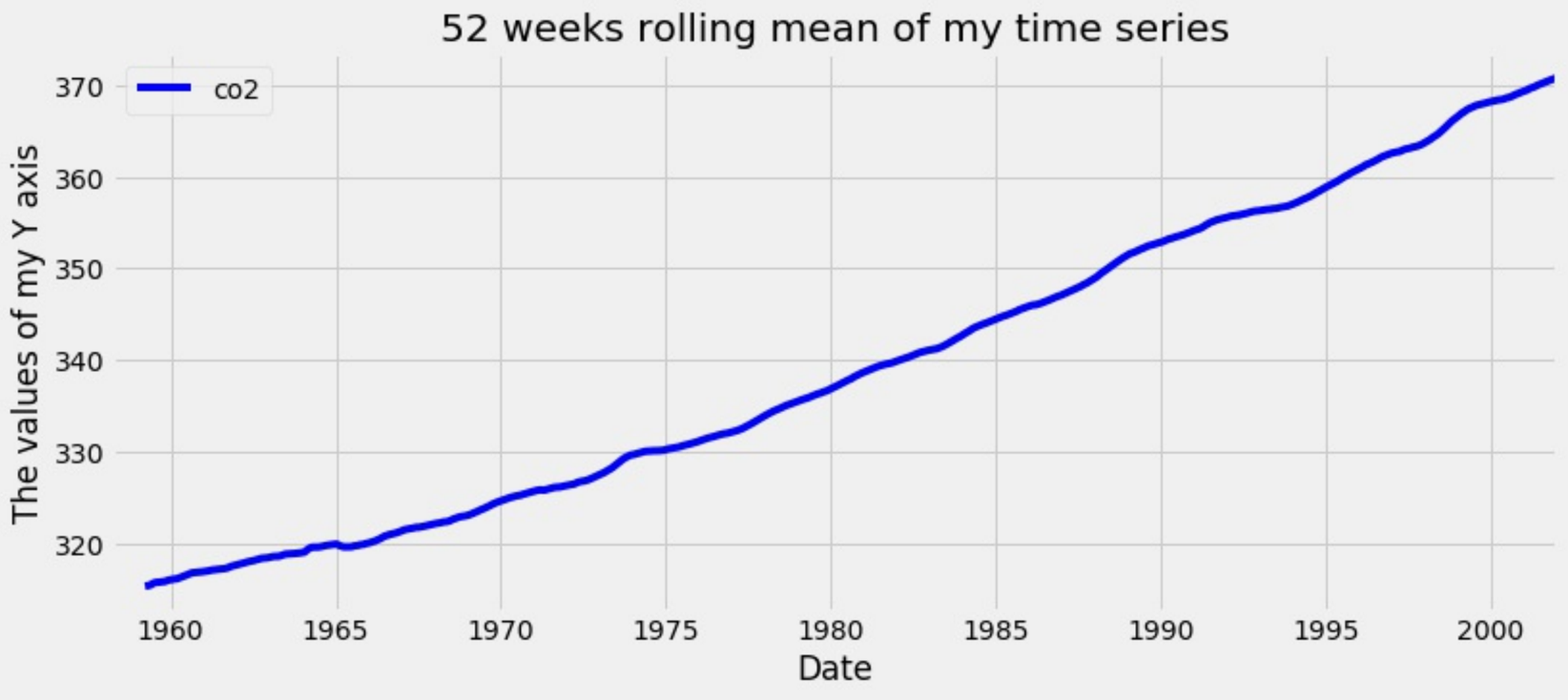
Moving averages

- In the field of time series analysis, a moving average can be used for many different purposes:
  - smoothing out short-term fluctuations
  - removing outliers
  - highlighting long-term trends or cycles.

The moving average model

```
In [1]: co2_levels_mean = co2_levels.rolling(window=52).mean()

In [2]: ax = co2_levels_mean.plot()

In [3]: ax.set_xlabel("Date")

In [4]: ax.set_ylabel("The values of my Y axis")

In [5]: ax.set_title("52 weeks rolling mean of my time series")

In [6]: plt.show()
```

A plot of the moving average for the CO2 data



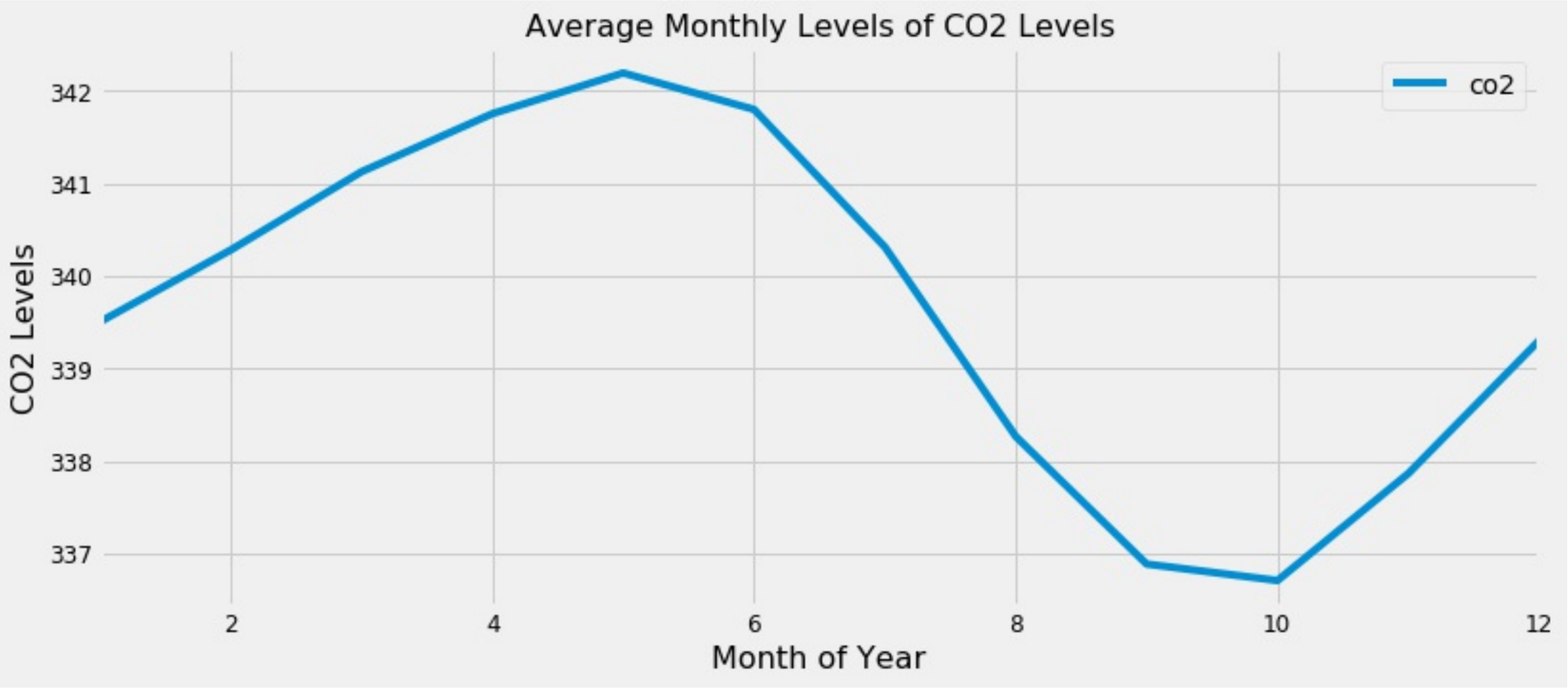
Computing aggregate values of your time series

```
In [1]: co2_levels.index
DatetimeIndex(['1958-03-29', '1958-04-05',...],
              dtype='datetime64[ns]', name='datestamp',
              length=2284, freq=None)

In [2]: print(co2_levels.index.month)
array([ 3,  4,  4, ..., 12, 12, 12], dtype=int32)

In [3]: print(co2_levels.index.year)
array([1958, 1958, 1958, ..., 2001, 2001, 2001], dtype=int32)
```

Plotting aggregate values of your time series

```
In [1]: index_month = co2_levels.index.month

In [2]: co2_levels_by_month = co2_levels.groupby(index_month).m

In [3]: co2_levels_by_month.plot()

In [4]: plt.show()
```

Plotting aggregate values of your time series



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Summarizing the values in your time series data

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Obtaining numerical summaries of your data

- What is the average value of this data?
- What is the maximum value observed in this time series?

Obtaining numerical summaries of your data

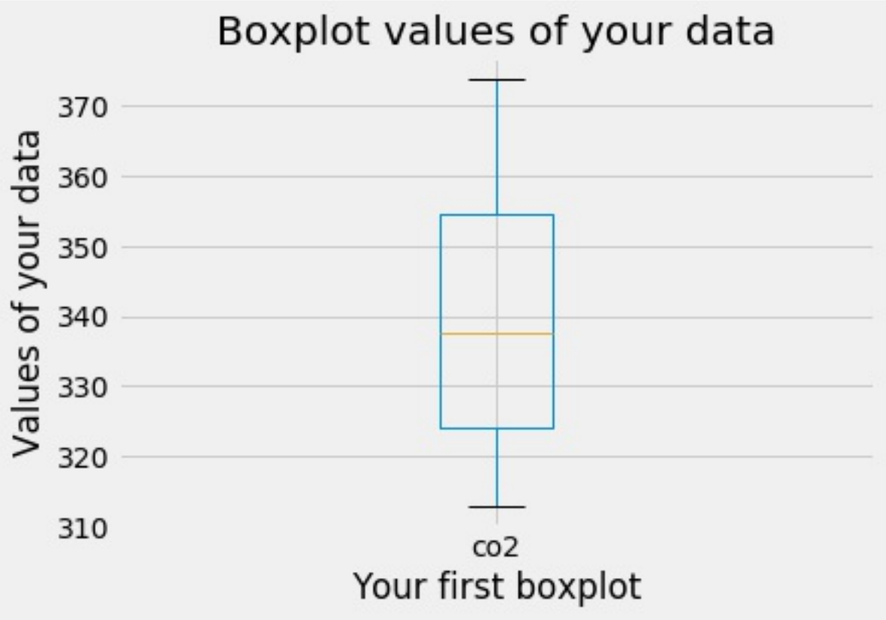
The .describe() method automatically computes key statistics of all numeric columns in your DataFrame

```
In [1]: print(df.describe())
                co2
count  2284.000000
mean    339.657750
std      17.100899
min     313.000000
25%     323.975000
50%     337.700000
75%     354.500000
max     373.900000
```

Summarizing your data with boxplots

```
In [1]: ax1 = df.boxplot()

In [2]: ax1.set_xlabel('Your first boxplot')

In [3]: ax1.set_ylabel('Values of your data')

In [4]: ax1.set_title('Boxplot values of your data')

In [5]: plt.show()
```

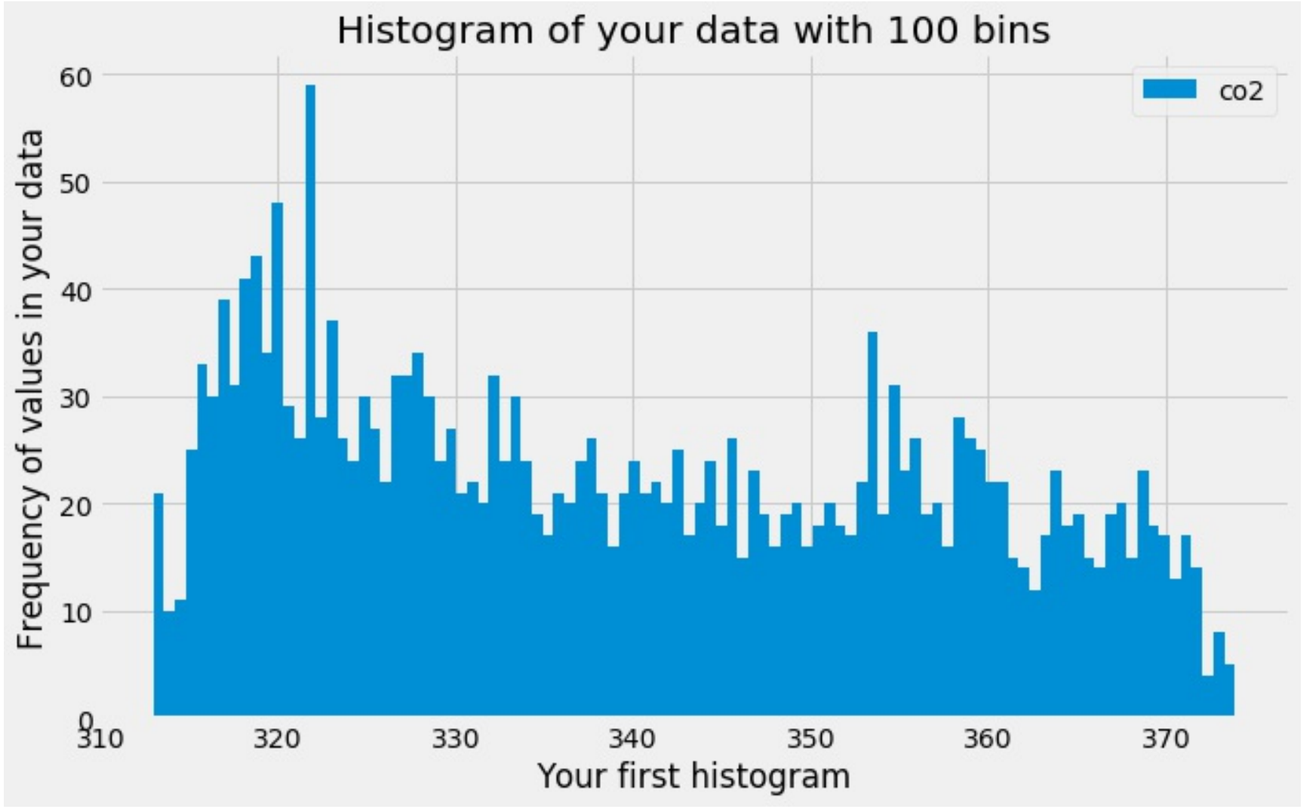
A boxplot of the values in the CO2 data



Summarizing your data with histograms

```
In [1]: ax2 = df.plot(kind='hist', bins=100)

In [2]: ax2.set_xlabel('Your first histogram')

In [3]: ax2.set_ylabel('Frequency of values in your data')

In [4]: ax2.set_title('Histogram of your data with 100 bins')

In [5]: plt.show()
```

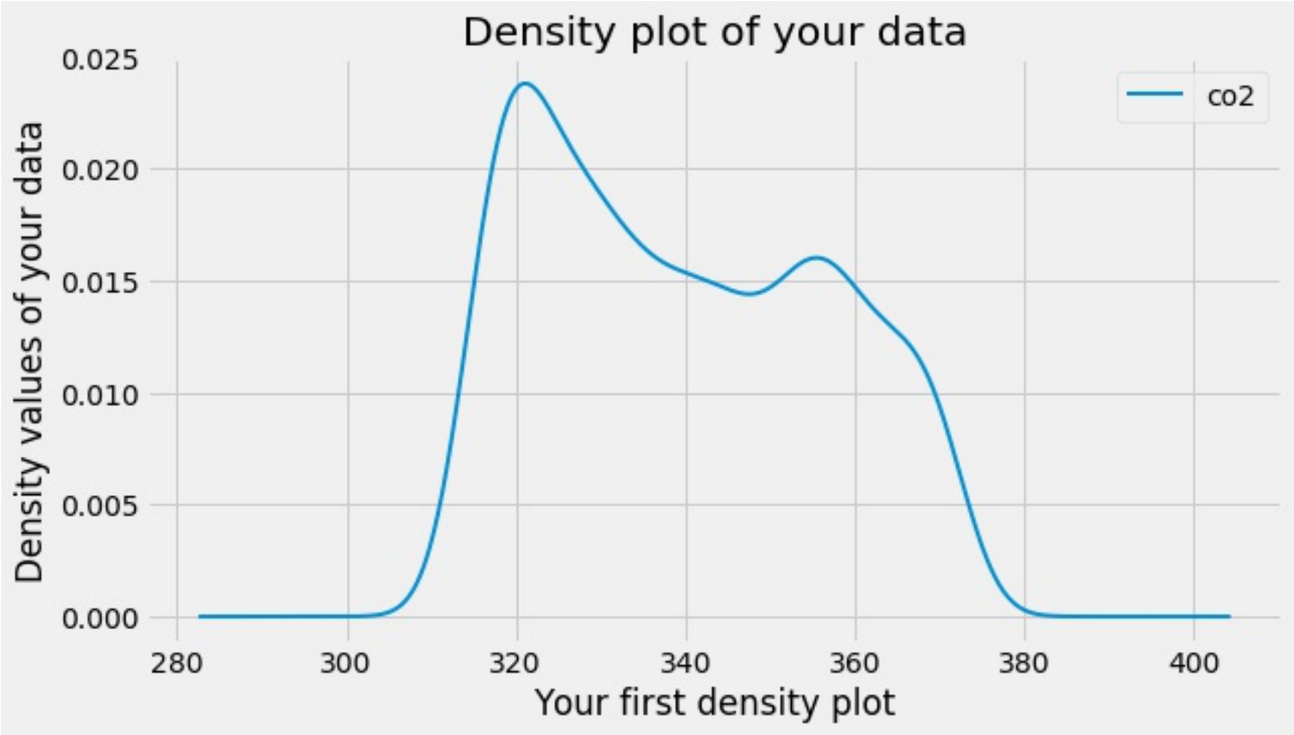
A histogram plot of the values in the CO2 data



Summarizing your data with density plots

```
In [1]: ax3 = df.plot(kind='density', linewidth=2)

In [2]: ax3.set_xlabel('Your first density plot')

In [3]: ax3.set_ylabel('Density values of your data')

In [4]: ax3.set_title('Density plot of your data')

In [5]: plt.show()
```

A density plot of the values in the CO2 data



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