Get the Data

Either use the provided .csv file or (optionally) get fresh (the freshest?) data from running an SQL query on StackExchange:

Follow this link to run the query from StackExchange to get your own .csv file

```
select dateadd(month, datediff(month, 0, q.CreationDate), 0) m, TagName, count(*) from PostTags pt join Posts q on q.Id=pt.PostId join Tags t on t.Id=pt.TagId where TagName in ('java','c','c++','python','c#','javascript','assembly','php','perl','ruby','visual basic','swift','r','object-c','scratch','go','swift','delphi') and q.CreationDate < dateadd(month, datediff(month, 0, getdate()), 0) group by dateadd(month, datediff(month, 0, q.CreationDate), 0), TagName order by dateadd(month, datediff(month, 0, q.CreationDate), 0)
```

Import Statements

```
import pandas as pd
import matplotlib.pyplot as plt
```

Data Exploration

Read the .csv file and store it in a Pandas dataframe - with given column names.

```
df = pd.read_csv("QueryResults.csv", names=['DATE', 'TAG', 'POSTS'], header=0)
```

Examine the first 5 rows and the last 5 rows of the of the dataframe

```
df.head()
```

	DATE	TAG	POSTS
0	2008-07-01 00:00:00	c#	3
1	2008-08-01 00:00:00	assembly	8
2	2008-08-01 00:00:00	c	83
3	2008-08-01 00:00:00	c#	506
4	2008-08-01 00:00:00	c++	164

```
df.tail()
```

	DATE	TAG	POSTS
2351	2022-09-01 00:00:00	php	3801
2352	2022-09-01 00:00:00	python	21627
2353	2022-09-01 00:00:00	r	4139
2354	2022-09-01 00:00:00	ruby	489
2355	2022-09-01 00:00:00	swift	1901

Check how many rows and how many columns there are.(dimensions of the dataframe).

```
df.shape
```

```
(2356, 3)
```

Count the number of entries in each column of the dataframe

```
df.count()
```

```
DATE     2356
TAG      2356
POSTS    2356
dtype: int64
```

Calculate the total number of post per language. Which Programming language has had the highest total number of posts of all time?

```
df.groupby("TAG").sum()
```

```
C:\Users\AS-Computer\AppData\Local\Temp\ipykernel_9652\3643815953.py:1: FutureWarning: The default value of numeric_only in Dat
  df.groupby("TAG").sum()
```

TAG	POSTS
assembly	41178
c	385507
c#	1559333
c++	776599
delphi	50096
go	64563
java	1865248
javascript	2425727
perl	67127
php	1444890
python	2025795
r	464396
ruby	225735
swift	318630

```
df.groupby("TAG").sum().idxmax()
```

```
C:\Users\AS-Computer\AppData\Local\Temp\ipykernel_9652\1743975303.py:1: FutureWarning: The default value of numeric_only in Dat
  df.groupby("TAG").sum().idxmax()
POSTS    javascript
dtype: object
```

```
df.groupby("TAG").sum().max()
```

```
C:\Users\AS-Computer\AppData\Local\Temp\ipykernel_9652\495894068.py:1: FutureWarning: The default value of numeric_only in Data
  df.groupby("TAG").sum().max()
POSTS    2425727
dtype: int64
```

Some languages are older (e.g., C) and other languages are newer (e.g., Swift). The dataset starts in September 2008.

How many months of data exist per language? Which language had the fewest months with an entry?

```
df.groupby("TAG").count()
```

TAG	DATE	POSTS
assembly	170	170
c	170	170

Data Cleaning

Let's fix the date format to make it more readable. We need to use Pandas to change format from a string of "2008-07-01 00:00:00" to a datetime object with the format of "2008-07-01"

```
df.DATE[1]
# df["DATE"][1]
```

```
'2008-08-01 00:00:00'
```

```
type(df.DATE[1])
```

```
str
```

```
new_date = pd.to_datetime(df["DATE"][1])
type(new_date)
```

```
pandas._libs.tslibs.timestamps.Timestamp
```

```
df.DATE = pd.to_datetime(df["DATE"])
df.head()
```

	DATE	TAG	POSTS
0	2008-07-01	c#	3
1	2008-08-01	assembly	8
2	2008-08-01	c	83
3	2008-08-01	c#	506
4	2008-08-01	c++	164

Data Manipulation

What are the dimensions of our new dataframe? How many rows and columns does it have? (After pivvoting it) Print out the column names and print out the first 5 rows of the dataframe.

```
df.columns
```

```
Index(['DATE', 'TAG', 'POSTS'], dtype='object')
```

```
df.shape
```

```
(2356, 3)
```

```
pivoted_df = df.pivot(index="DATE", columns="TAG", values="POSTS")
pivoted_df.head()
```

TAG	assembly	c	c#	c++	delphi	go	java	javascript	perl	php	python	r	ruby	swift
DATE														
2008-07-01	NaN	NaN	3.0	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
2008-08-01	8.0	83.0	506.0	164.0	14.0	NaN	222.0	164.0	28.0	159.0	120.0	NaN	70.0	NaN
2008-09-01	28.0	318.0	1646.0	753.0	104.0	NaN	1132.0	636.0	130.0	476.0	537.0	6.0	287.0	NaN
2008-10-01	15.0	303.0	1989.0	808.0	112.0	NaN	1149.0	724.0	127.0	612.0	508.0	NaN	247.0	NaN
2008-11-01	17.0	259.0	1731.0	734.0	141.0	NaN	957.0	582.0	97.0	501.0	451.0	1.0	158.0	NaN

```
pivoted_df.shape
```

```
(171, 14)
```

```
pivoted_df.columns
```

```
Index(['assembly', 'c', 'c#', 'c++', 'delphi', 'go', 'java', 'javascript',
       'perl', 'php', 'python', 'r', 'ruby', 'swift'],
      dtype='object', name='TAG')
```

Count the number of entries per programming language. Why might the number of entries be different? - NaN values were inserted by pivoting the table when there were no posts for a language in that month

```
pivoted_df.count()
```

```
TAG
assembly      170
c             170
c#            171
c++           170
delphi        170
go            155
java          170
javascript    170
perl          170
php           170
python        170
r             168
ruby          170
swift         162
dtype: int64
```

Substitute the number 0 for each NaN value in the DataFrame. fillna() method. The inplace argument means that we are updating reshaped_df.

```
pivoted_df.fillna(0, inplace=True)
```

```
pivoted_df.head()
```

TAG	assembly	c	c#	c++	delphi	go	java	javascript	perl	php	python	r	ruby	swift
DATE														
2008-07-01	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2008-08-01	8.0	83.0	506.0	164.0	14.0	0.0	222.0	164.0	28.0	159.0	120.0	0.0	70.0	0.0
2008-09-01	28.0	318.0	1646.0	753.0	104.0	0.0	1132.0	636.0	130.0	476.0	537.0	6.0	287.0	0.0
2008-10-01	15.0	303.0	1989.0	808.0	112.0	0.0	1149.0	724.0	127.0	612.0	508.0	0.0	247.0	0.0
2008-11-01	17.0	259.0	1731.0	734.0	141.0	0.0	957.0	582.0	97.0	501.0	451.0	1.0	158.0	0.0

We can also check if there are any NaN values left in the entire DataFrame

```
pivoted_df.isna().values.any()
```

```
False
```

Data Visualisaton with with Matplotlib

Using the [matplotlib documentation] ploting a single programming language (e.g., java) on a chart.

```
pivoted_df["java"].head()
```

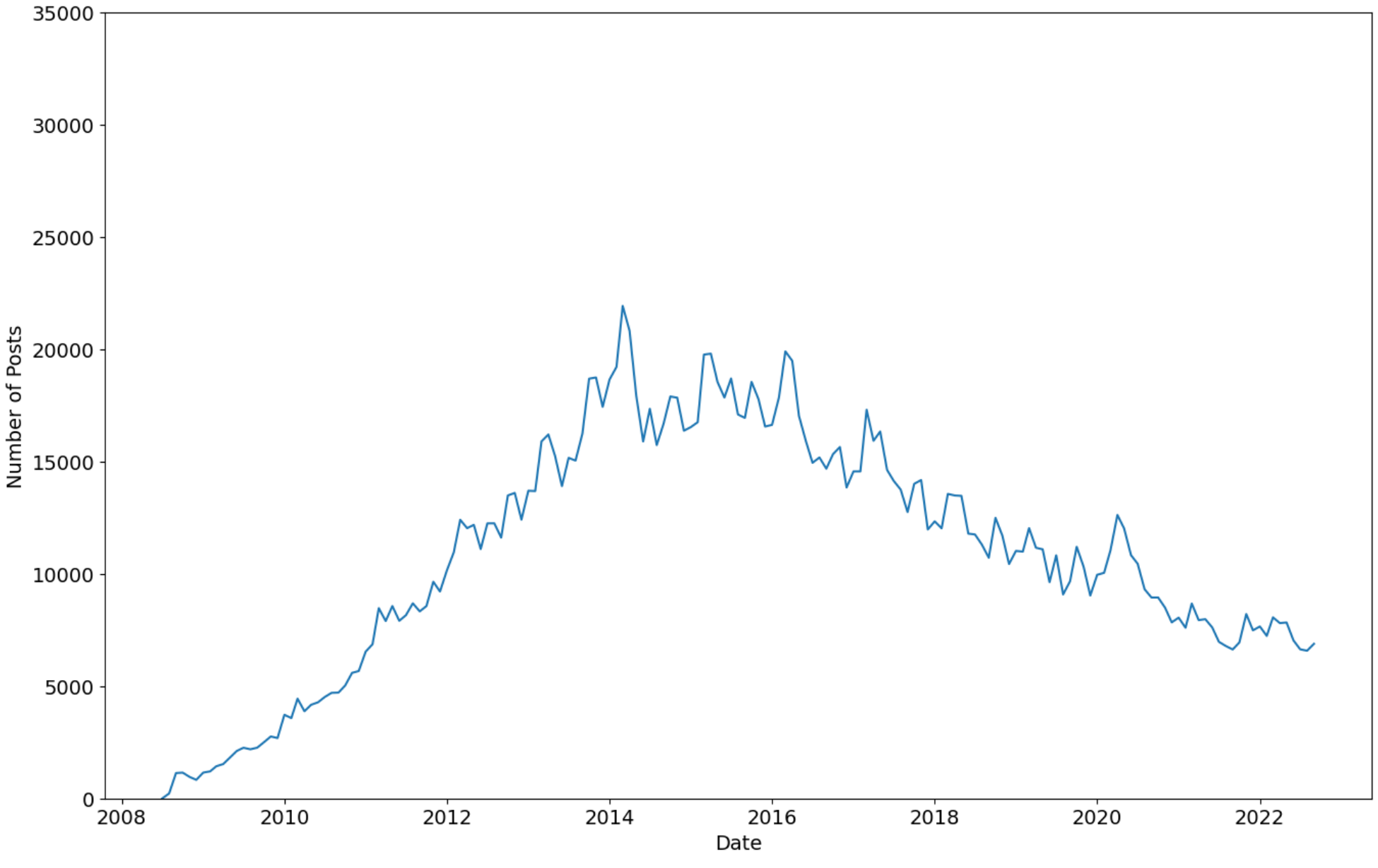
```
DATE
2008-07-01       0.0
2008-08-01     222.0
2008-09-01    1132.0
2008-10-01    1149.0
2008-11-01     957.0
Name: java, dtype: float64
```

```
pivoted_df.index
```

```
DatetimeIndex(['2008-07-01', '2008-08-01', '2008-09-01', '2008-10-01',
               '2008-11-01', '2008-12-01', '2009-01-01', '2009-02-01',
               '2009-03-01', '2009-04-01',
               ...
               '2021-12-01', '2022-01-01', '2022-02-01', '2022-03-01',
               '2022-04-01', '2022-05-01', '2022-06-01', '2022-07-01',
               '2022-08-01', '2022-09-01'],
              dtype='datetime64[ns]', name='DATE', length=171, freq=None)
```

```
plt.figure(figsize=(16,10))
plt.xticks(fontsize=14)
plt.yticks(fontsize=14)
plt.xlabel("Date", fontsize=14)
plt.ylabel("Number of Posts", fontsize=14)
plt.ylim(0, 35000)
plt.plot(pivoted_df.index, pivoted_df["java"])
```

```
[<matplotlib.lines.Line2D at 0x2254f758c10>]
```

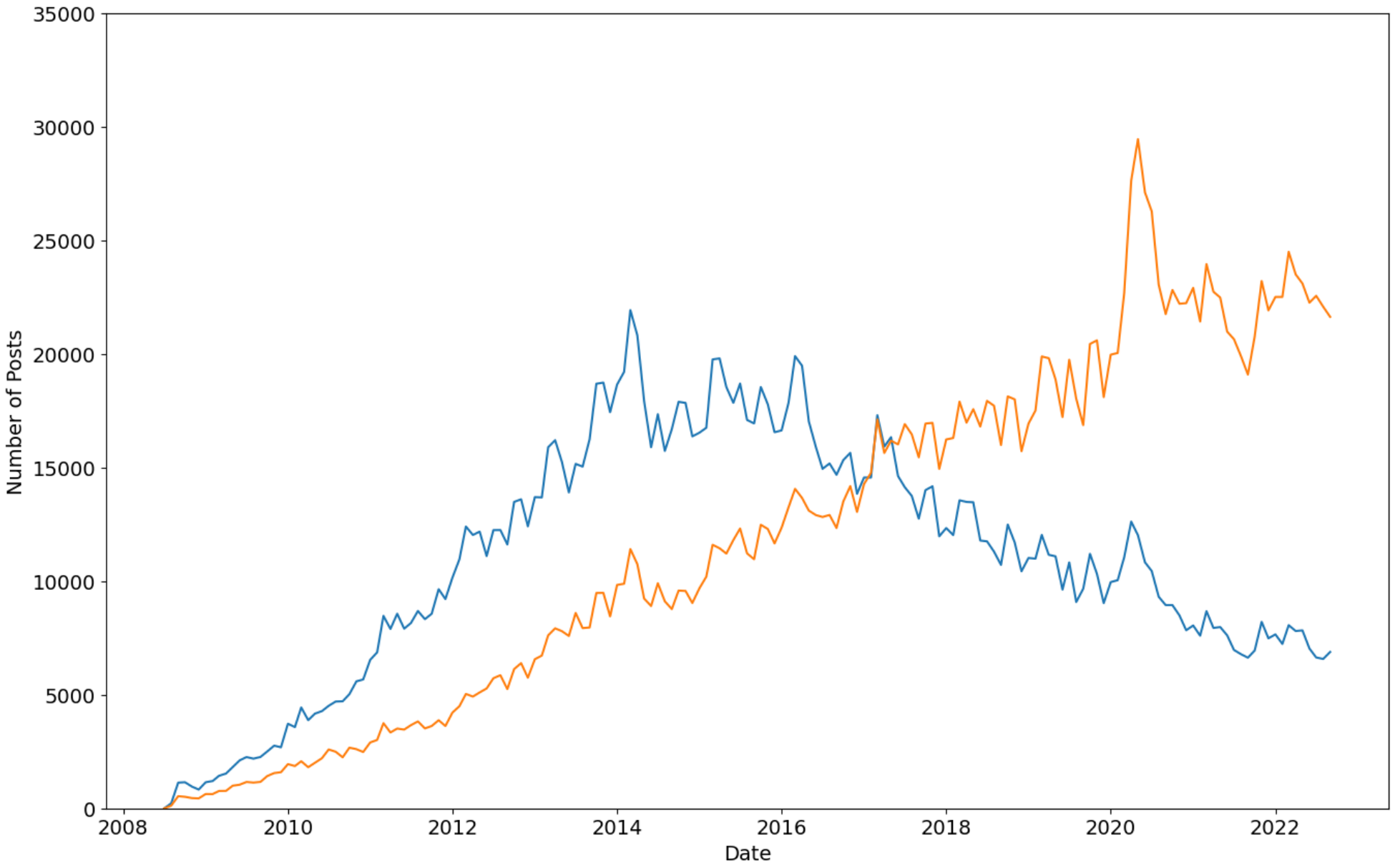


Show two lines (e.g. for Java and Python) on the same chart.

```
plt.figure(figsize=(16,10))
plt.xticks(fontsize=14)
plt.yticks(fontsize=14)
plt.xlabel("Date", fontsize=14)
plt.ylabel("Number of Posts", fontsize=14)
plt.ylim(0, 35000)
# plt.plot(pivoted_df.index, pivoted_df[["java","python"]])

plt.plot(pivoted_df.index, pivoted_df.java)
plt.plot(pivoted_df.index, pivoted_df.python)
```

```
[<matplotlib.lines.Line2D at 0x2254f5e0710>]
```



Showing all the languages on the same chart.

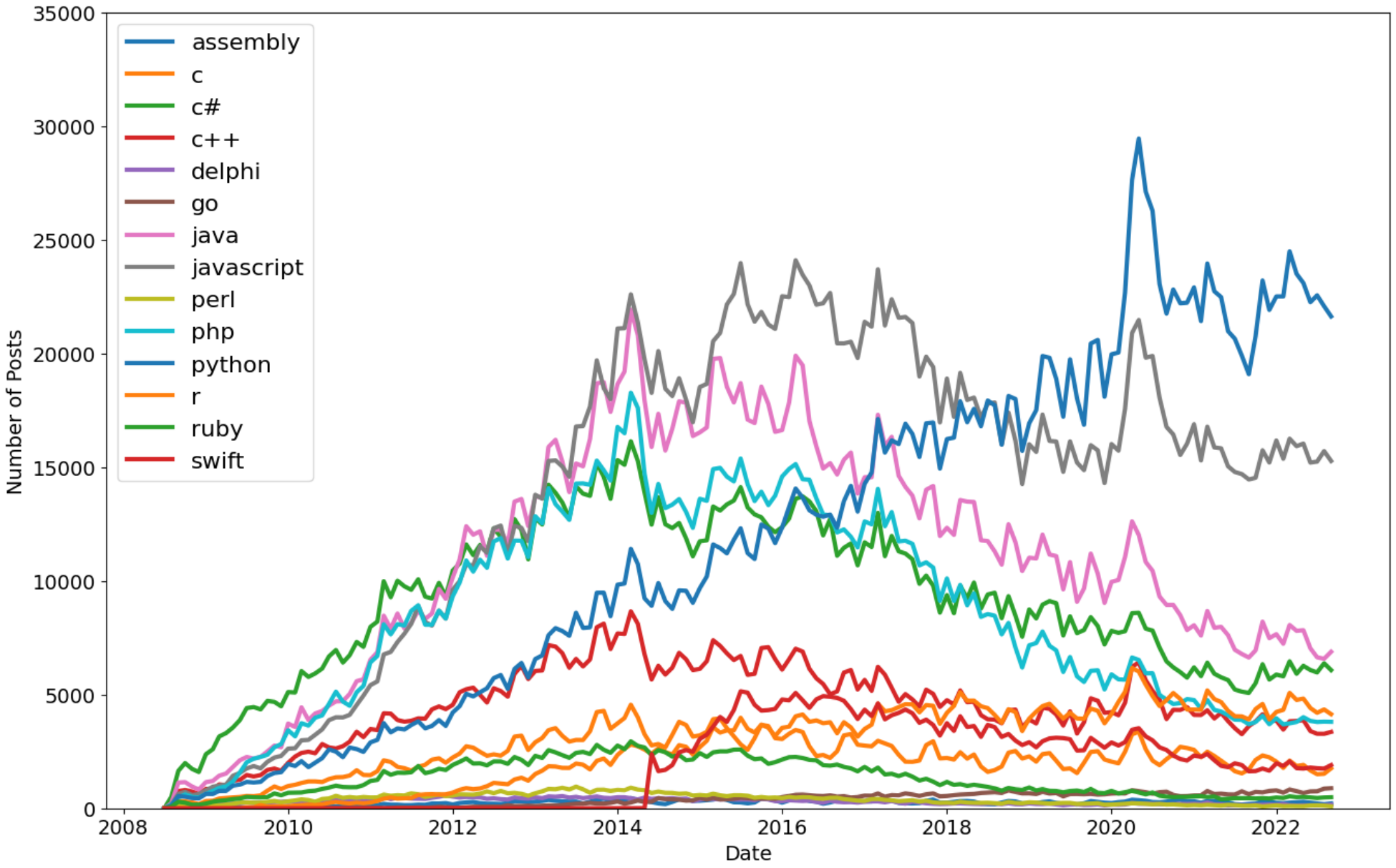
```
plt.figure(figsize=(16,10))
plt.xticks(fontsize=14)
plt.yticks(fontsize=14)
plt.xlabel("Date", fontsize=14)
plt.ylabel("Number of Posts", fontsize=14)
plt.ylim(0, 35000)
# plt.plot(pivoted_df.index, pivoted_df[["java","python"]])

# plt.plot(pivoted_df.index, pivoted_df.java)
# plt.plot(pivoted_df.index, pivoted_df.python)

# iterate through all the languages
for column in pivoted_df.columns:
    plt.plot(pivoted_df.index, pivoted_df[column],
        linewidth=3, label=pivoted_df[column].name)

plt.legend(fontsize=16)
```

```
<matplotlib.legend.Legend at 0x2255104ea50>
```



Smoothing out Time Series Data

Time series data can be quite noisy, with a lot of up and down spikes. To better see a trend we can plot an average of, say 6 or 12 observations. This is called the rolling mean. We calculate the average in a window of time and move it forward by one overservation. Pandas has two handy methods already built in to work this out: rolling() and mean().

```
# window is the number of observations that are averaged
roll_df = pivoted_df.rolling(window=8).mean()

plt.figure(figsize=(16,10))
plt.xticks(fontsize=14)
plt.yticks(fontsize=14)
plt.xlabel("Date", fontsize=14)
plt.ylabel("Number of Posts", fontsize=14)
plt.ylim(0, 35000)

# iterate through all the languages
for column in roll_df.columns:
    plt.plot(roll_df.index, roll_df[column],
        linewidth=3, label=roll_df[column].name)

plt.legend(fontsize=16)
```

```
<matplotlib.legend.Legend at 0x225521aea50>
```