In [1]:
```python
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import os
%matplotlib inline

df1 = pd.read_csv('D:\\Data Scientist Masters Program\\Data Science with Python\\Pro
df1.head()

df1[df1.isnull()].count()
#No Nulls
df1.describe(include='all')
```

Out[1]:

	Customer Complaint	Date	Date_month_year	Time	Received Via	City	State	Zip code	Stat
count	2224	2224	2224	2224	2224	2224	2224	2224.000000	22
unique	1841	91	91	2190	2	928	43	NaN	
top	Comcast	24-06-15	24-Jun-15	12:41:14 PM	Customer Care Call	Atlanta	Georgia	NaN	Solv
freq	83	218	218	2	1119	63	288	NaN	9
mean	NaN	NaN	NaN	NaN	NaN	NaN	NaN	47994.393435	Na
std	NaN	NaN	NaN	NaN	NaN	NaN	NaN	28885.279427	Na
min	NaN	NaN	NaN	NaN	NaN	NaN	NaN	1075.000000	Na
25%	NaN	NaN	NaN	NaN	NaN	NaN	NaN	30056.500000	Na
50%	NaN	NaN	NaN	NaN	NaN	NaN	NaN	37211.000000	Na
75%	NaN	NaN	NaN	NaN	NaN	NaN	NaN	77058.750000	Na
max	NaN	NaN	NaN	NaN	NaN	NaN	NaN	99223.000000	Na

EDA and Cleanup the data set

In [2]:
```python
df1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 2224 entries, 250635 to 363614
Data columns (total 10 columns):
 #   Column                     Non-Null Count  Dtype
---  ------                     --------------  -----
 0   Customer Complaint         2224 non-null   object
 1   Date                       2224 non-null   object
 2   Date_month_year            2224 non-null   object
 3   Time                       2224 non-null   object
 4   Received Via               2224 non-null   object
 5   City                       2224 non-null   object
 6   State                      2224 non-null   object
 7   Zip code                   2224 non-null   int64
 8   Status                     2224 non-null   object
 9   Filing on Behalf of Someone 2224 non-null  object
dtypes: int64(1), object(9)
memory usage: 191.1+ KB
```

TASK 1 - Provide the trend chart for the number of complaints at monthly and daily granularity levels.

```python
df1['Date_month_year'] = pd.to_datetime(df1['Date_month_year'])
```

In [3]:
```python
df1['Created_Month'] =  df1['Date_month_year'].apply(lambda x: x.month)
df1['Created_Day'] = df1['Date_month_year'].apply(lambda x: x.day)
df1['Created_Day of Week'] = df1['Date_month_year'].apply(lambda x: x.dayofweek)
```

In [4]:
```python
dmap = {0:'Mon',1:'Tue',2:'Wed',3:'Thur',4:'Fri',5:'Sat',6:'Sun'}
df1['Created_Day of Week']=df1['Created_Day of Week'].map(dmap)
df1.head(5)
```

Out[4]:

| Ticket #	Customer Complaint	Date	Date_month_year	Time	Received Via	City	State	Zip code	Statı
250635	Comcast Cable Internet Speeds	22-04-15	2015-04-22	3:53:50 PM	Customer Care Call	Abingdon	Maryland	21009	Closε
223441	Payment disappear - service got disconnected	04-08-15	2015-08-04	10:22:56 AM	Internet	Acworth	Georgia	30102	Closε
242732	Speed and Service	18-04-15	2015-04-18	9:55:47 AM	Internet	Acworth	Georgia	30101	Closε
277946	Comcast Imposed a New Usage Cap of 300GB that …	05-07-15	2015-07-05	11:59:35 AM	Internet	Acworth	Georgia	30101	Opε
307175	Comcast not working and no service to boot	26-05-15	2015-05-26	1:25:26 PM	Internet	Acworth	Georgia	30101	Solvε

In [5]:
```python
#number of complaints monthly
plt.figure(figsize=(8,4))
bymonth = df1.groupby('Created_Month').count().reset_index()
lp = sns.lineplot(x='Created_Month', y= 'Customer Complaint', data = bymonth, sort=F
ax = lp.axes
ax.set_xlim(0,13)
ax.annotate('Max complaints in Jun', color='red',
            xy=(6, 1060), xycoords='data',
            xytext=(0.8, 0.85), textcoords='axes fraction',
            arrowprops=dict(facecolor='black', shrink=0.1),
            horizontalalignment='right', verticalalignment='top')
```

Out[5]: Text(0.8, 0.85, 'Max complaints in Jun')

Max complaints in Jun
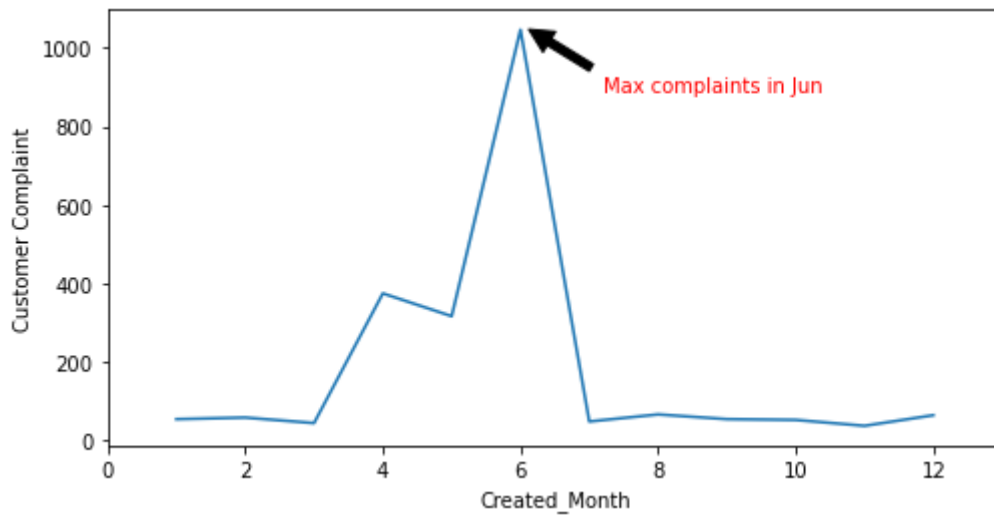
```
In [6]:  #number of complaints Daily
         plt.figure(figsize=(18,6))
         byday = df1.groupby('Created_Day').count().reset_index()
         lp = sns.lineplot(x='Created_Day', y= 'Customer Complaint', data = byday, sort=False
         ax = lp.axes
         ax.set_xlim(0,32)
```

Out[6]: (0.0, 32.0)
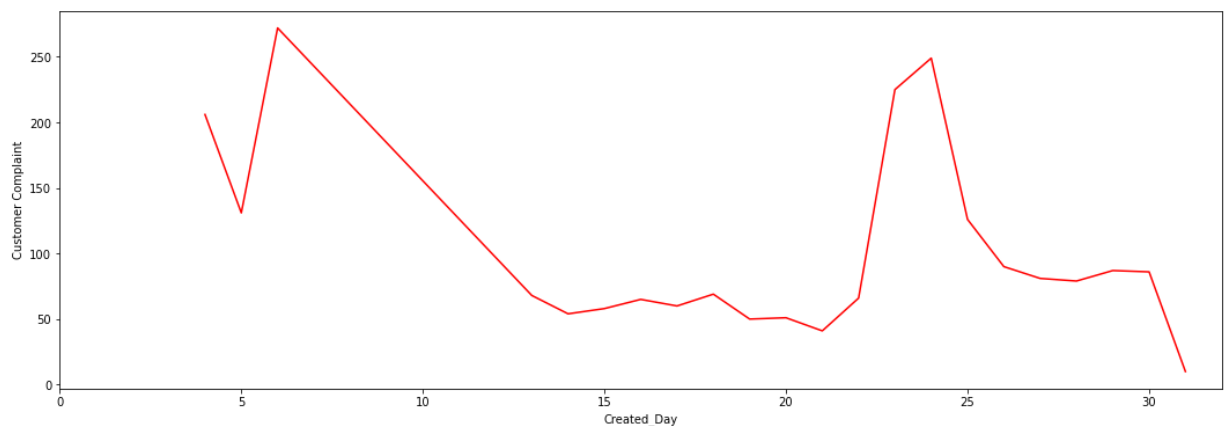

```
In [7]:  #number of complaints based on created day of the week
         sns.countplot(x='Created_Day of Week', data = df1, order=df1['Created_Day of Week'].
         #More number of complaints on Tuesday and wednesday
```

Out[7]: <AxesSubplot:xlabel='Created_Day of Week', ylabel='count'>
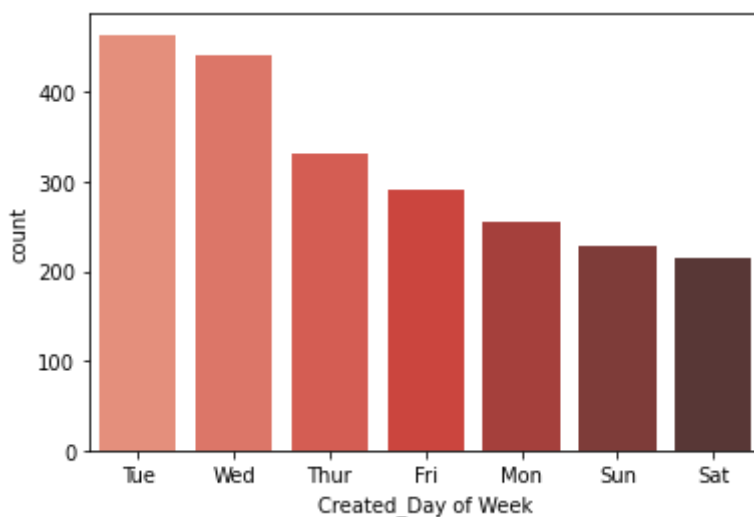
TASK 2 - Provide a table with the frequency of complaint types.

```
In [8]: df1['Customer Complaint'] = df1['Customer Complaint'].str.title()
        CT_freq = df1['Customer Complaint'].value_counts()
        CT_freq
```

```
Out[8]: Comcast                                                          102
        Comcast Data Cap                                                  30
        Comcast Internet                                                  29
        Comcast Data Caps                                                 21
        Comcast Billing                                                   18
                                                                         ...
        Monthly Data Caps                                                  1
        Comcast/Xfinity Poor Service, Fraudulent Billing And Collection    1
        Lost Emails/Billing                                                1
        Improper Billing And Non Resolution Of Issues                      1
        Comcast, Ypsilanti Mi Internet Speed                               1
        Name: Customer Complaint, Length: 1740, dtype: int64
```

```
In [9]: import nltk
        %pip install wordcloud
```

```
Requirement already satisfied: wordcloud in c:\users\drona\anaconda3\lib\site-packag
es (1.8.1)
Requirement already satisfied: pillow in c:\users\drona\anaconda3\lib\site-packages
(from wordcloud) (8.0.1)
Requirement already satisfied: numpy>=1.6.1 in c:\users\drona\anaconda3\lib\site-pac
kages (from wordcloud) (1.21.2)
Requirement already satisfied: matplotlib in c:\users\drona\anaconda3\lib\site-packa
ges (from wordcloud) (3.3.2)
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.3 in c:\users
\drona\anaconda3\lib\site-packages (from matplotlib->wordcloud) (2.4.7)
Requirement already satisfied: python-dateutil>=2.1 in c:\users\drona\anaconda3\lib
\site-packages (from matplotlib->wordcloud) (2.8.1)
Requirement already satisfied: kiwisolver>=1.0.1 in c:\users\drona\anaconda3\lib\sit
e-packages (from matplotlib->wordcloud) (1.3.0)
Requirement already satisfied: cycler>=0.10 in c:\users\drona\anaconda3\lib\site-pac
kages (from matplotlib->wordcloud) (0.10.0)
Requirement already satisfied: certifi>=2020.06.20 in c:\users\drona\anaconda3\lib\s
ite-packages (from matplotlib->wordcloud) (2020.6.20)
Requirement already satisfied: six in c:\users\drona\anaconda3\lib\site-packages (fr
om cycler>=0.10->matplotlib->wordcloud) (1.15.0)
Note: you may need to restart the kernel to use updated packages.
```

```
In [10]: from wordcloud import WordCloud, STOPWORDS
         common_complaints = df1['Customer Complaint'].dropna().tolist()
         common_complaints =''.join(common_complaints).lower()

         list_stops = ('Comcast','Now','Company','Day','Someone','Thing','Also','Got','Way','

         for word in list_stops:
             STOPWORDS.add(word)
```

```
In [11]: wordcloud = WordCloud(stopwords=STOPWORDS,
                               background_color='white',
                               width=1200,
                               height=1000).generate(common_complaints)
```

```
In [12]: plt.figure( figsize=(10,12) )
         plt.imshow(wordcloud)
         plt.title('Frequent words for customer complaints')
         plt.axis('off')
         plt.show()
         #Internet complaints are Maximum
```

Frequent words for customer complaints


```
In [13]:   from nltk.corpus import stopwords
           from nltk.stem.wordnet import WordNetLemmatizer
           import string

           stop = set(stopwords.words('english'))
           exclude = set(string.punctuation)
           lemma = WordNetLemmatizer()
```

```
In [14]:   nltk.download('wordnet')
```

```
[nltk_data] Downloading package wordnet to
[nltk_data]     C:\Users\drona\AppData\Roaming\nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
```

Out[14]:   True

```
In [15]:   def clean(doc):
               stop_free = " ".join([i for i in doc.lower().split() if i not in stop])
               punc_free = "".join([ch for ch in stop_free if ch not in exclude])
               normalized = " ".join(lemma.lemmatize(word) for word in punc_free.split())
               return normalized
```

```
In [16]:   doc_complete = df1['Customer Complaint'].tolist()
           doc_clean = [clean(doc).split() for doc in doc_complete]
```

```
In [17]:   %pip install gensim
           import gensim
           from gensim import corpora
```

```
Requirement already satisfied: gensim in c:\users\drona\anaconda3\lib\site-packages
(4.0.1)
Requirement already satisfied: Cython==0.29.21 in c:\users\drona\anaconda3\lib\site-
```

```
packages (from gensim) (0.29.21)
Requirement already satisfied: smart-open>=1.8.1 in c:\users\drona\anaconda3\lib\sit
e-packages (from gensim) (5.1.0)
Requirement already satisfied: scipy>=0.18.1 in c:\users\drona\anaconda3\lib\site-pa
ckages (from gensim) (1.5.2)
Requirement already satisfied: numpy>=1.11.3 in c:\users\drona\anaconda3\lib\site-pa
ckages (from gensim) (1.21.2)
Note: you may need to restart the kernel to use updated packages.
```

```
C:\Users\drona\anaconda3\lib\site-packages\gensim\similarities\__init__.py:15: UserW
arning: The gensim.similarities.levenshtein submodule is disabled, because the optio
nal Levenshtein package <https://pypi.org/project/python-Levenshtein/> is unavailabl
e. Install Levenhstein (e.g. `pip install python-Levenshtein`) to suppress this warn
ing.
  warnings.warn(msg)
```

In [18]:
```python
dictionary = corpora.Dictionary(doc_clean)
dictionary
```

Out[18]: `<gensim.corpora.dictionary.Dictionary at 0x22661aabc40>`

In [19]:
```python
doc_term_matrix = [dictionary.doc2bow(doc) for doc in doc_clean]
doc_term_matrix
```

Out[19]:
```
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         [(38, 1), (112, 1)],
         [(0, 1), (1, 1)],
         [(258, 1), (443, 1), (539, 1), (588, 1), (882, 1)],
         [(883, 1), (884, 1)],
         [(1, 1), (8, 1)],
         [(1, 1), (102, 1)],
         ...]
```

In [20]:
```python
from gensim.models import LdaModel
```

In [21]:
```python
num_topic = 9
ldamodel = LdaModel(doc_term_matrix,num_topics=num_topic,id2word = dictionary,passes
```

In [22]:
```python
topics = ldamodel.show_topics()
for topic in topics:
    print(topic)
    print()
```

```
(0, '0.164*"data" + 0.142*"comcast" + 0.132*"cap" + 0.031*"usage" + 0.029*"xfinity"
+ 0.027*"without" + 0.022*"fee" + 0.013*"limit" + 0.013*"cable" + 0.011*"modem"')

(1, '0.121*"comcast" + 0.048*"service" + 0.029*"switch" + 0.029*"bill" + 0.026*"hom
e" + 0.021*"monopoly" + 0.020*"increased" + 0.019*"bait" + 0.017*"availability" + 0.
014*"hbo"')

(2, '0.057*"service" + 0.031*"speed" + 0.030*"paying" + 0.027*"broadband" + 0.022*"s
hitty" + 0.021*"rate" + 0.020*"throttled" + 0.020*"credit" + 0.019*"change" + 0.017
*"claim"')
```

(3, '0.199*"service" + 0.060*"internet" + 0.048*"comcast" + 0.035*"customer" + 0.032
"poor" + 0.024"day" + 0.020*"comcastxfinity" + 0.017*"cable" + 0.016*"outage" + 0.
015*"show"')

(4, '0.282*"comcast" + 0.120*"internet" + 0.072*"service" + 0.025*"charge" + 0.016
"problem" + 0.012"throttling" + 0.010*"business" + 0.009*"refund" + 0.008*"contrac
t" + 0.007*"mb"')

(5, '0.168*"complaint" + 0.144*"comcast" + 0.024*"charging" + 0.021*"sale" + 0.015
"scam" + 0.015"regarding" + 0.015*"ps4" + 0.014*"week" + 0.013*"consumer" + 0.013
*"much"')

(6, '0.065*"bill" + 0.058*"comcast" + 0.039*"price" + 0.034*"charge" + 0.026*"connec
tion" + 0.021*"account" + 0.018*"installation" + 0.017*"unreliable" + 0.016*"email"
+ 0.015*"2"')

(7, '0.176*"billing" + 0.129*"comcast" + 0.057*"service" + 0.049*"practice" + 0.042
"issue" + 0.042"unfair" + 0.031*"pricing" + 0.020*"customer" + 0.018*"terrible" +
0.016*"help"')

(8, '0.235*"internet" + 0.160*"speed" + 0.055*"slow" + 0.032*"issue" + 0.027*"false"
+ 0.025*"throttling" + 0.020*"connectivity" + 0.018*"cramming" + 0.018*"deceptive" +
0.016*"advertising"')

In [23]:
```python
word_dict = {}
for i in range(num_topic):
    words = ldamodel.show_topic(i,topn = 20)
    word_dict['Topic '+"{}".format(i)]=[i[0] for i in words]
```

In [24]:
```python
pd.DataFrame(word_dict)
```

Out[24]:

	Topic 0	Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6	
0	data	comcast	service	service	comcast	complaint	bill	
1	comcast	service	speed	internet	internet	comcast	comcast	c
2	cap	switch	paying	comcast	service	charging	price	
3	usage	bill	broadband	customer	charge	sale	charge	p
4	xfinity	home	shitty	poor	problem	scam	connection	
5	without	monopoly	rate	day	throttling	regarding	account	
6	fee	increased	throttled	comcastxfinity	business	ps4	installation	
7	limit	bait	credit	cable	refund	week	unreliable	cu
8	cable	availability	change	outage	contract	consumer	email	
9	modem	hbo	claim	show	mb	much	2	
10	monthly	monthly	provided	failure	low	streaming	said	mono
11	contract	go	provider	billed	issue	device	back	c
12	charge	system	term	signal	unauthorized	every	phone	in
13	overage	fee	request	slowing	quality	ordered	people	misl
14	provide	security	advertised	appointment	plan	false	high	
15	bill	price	competition	option	xfinity	changing	lied	frau
16	refusal	credit	getting	bad	300gb	bill	cable	de
17	notice	blocking	transfer	cancelling	throttle	miss	information	

	Topic 0	Topic 1	Topic 2	Topic 3	Topic 4	Topic 5	Topic 6	T
18	still	bundle	misrepresentation	horrible	access	concerning	charged	
19	mbps	ask	bandwidth	lack	month	book	month	ext

TASK 3 - Create a new categorical variable with value as Open and Closed. Open & Pending is to be categorized as Open and Closed & Solved is to be categorized as Closed

```
In [25]: df1['Highlevel_Status'] = ["Open" if Status=="Open" or Status=="Pending" else "Close
```

```
In [26]: df1['Highlevel_Status'].unique()
```

```
Out[26]: array(['Closed', 'Open'], dtype=object)
```

TASK 4 - Provide state wise status of complaints in a stacked bar chart. Use the categorized variable from Q3

```
In [27]: df1['State'] = df1['State'].str.title()
         st_cmp = df1.groupby(['State','Highlevel_Status']).size().unstack().fillna(0)
```

```
In [28]: st_cmp
```

Out[28]:

Highlevel_Status	Closed	Open
State		
Alabama	17.0	9.0
Arizona	14.0	6.0
Arkansas	6.0	0.0
California	159.0	61.0
Colorado	58.0	22.0
Connecticut	9.0	3.0
Delaware	8.0	4.0
District Of Columbia	15.0	2.0
Florida	201.0	39.0
Georgia	208.0	80.0
Illinois	135.0	29.0
Indiana	50.0	9.0
Iowa	1.0	0.0
Kansas	1.0	1.0
Kentucky	4.0	3.0
Louisiana	12.0	1.0
Maine	3.0	2.0
Maryland	63.0	15.0
Massachusetts	50.0	11.0
Michigan	92.0	23.0
Minnesota	29.0	4.0

Highlevel_Status	Closed	Open
State		
Mississippi	23.0	16.0
Missouri	3.0	1.0
Montana	1.0	0.0
Nevada	1.0	0.0
New Hampshire	8.0	4.0
New Jersey	56.0	19.0
New Mexico	11.0	4.0
New York	6.0	0.0
North Carolina	3.0	0.0
Ohio	3.0	0.0
Oregon	36.0	13.0
Pennsylvania	110.0	20.0
Rhode Island	1.0	0.0
South Carolina	15.0	3.0
Tennessee	96.0	47.0
Texas	49.0	22.0
Utah	16.0	6.0
Vermont	2.0	1.0
Virginia	49.0	11.0
Washington	75.0	23.0
West Virginia	8.0	3.0

```
In [29]:  st_cmp.sort_values('Closed',axis = 0,ascending=True).plot(kind="barh", figsize=(10,8
```

```
Out[29]:  <AxesSubplot:ylabel='State'>
```
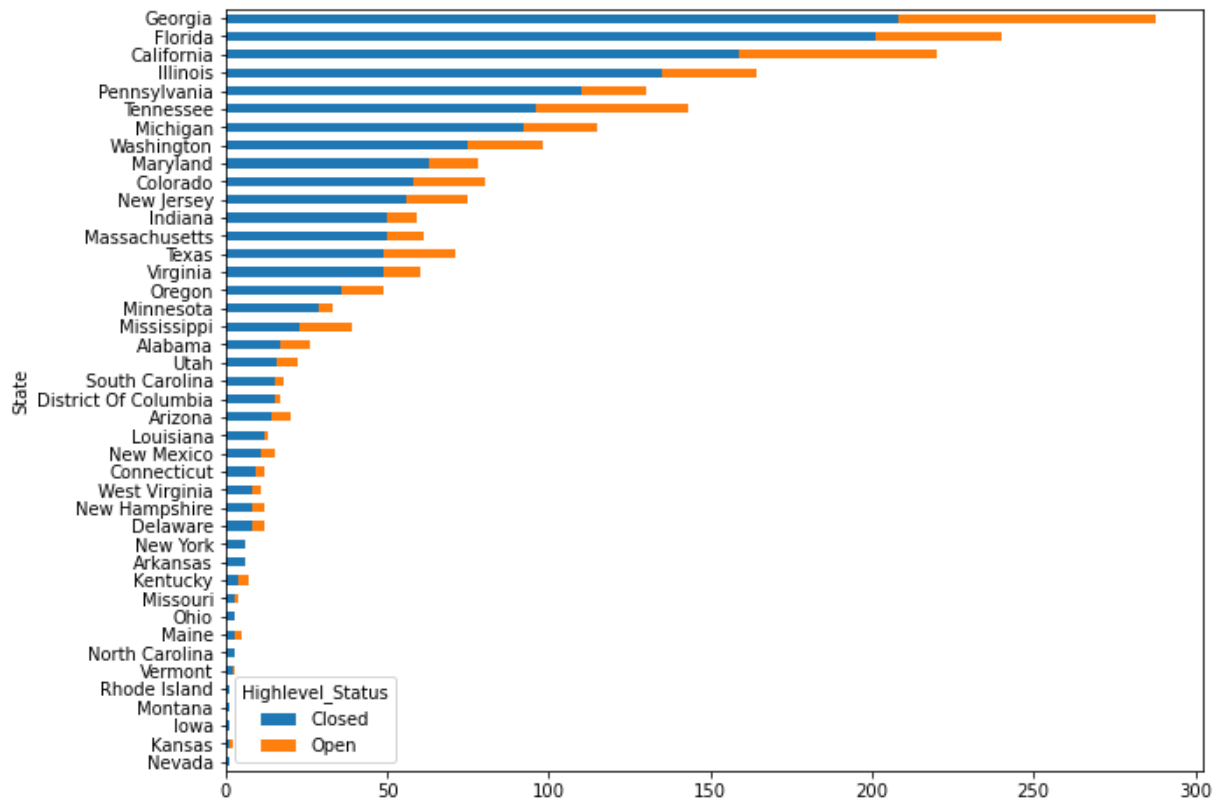
TASK 5 - Which state has the maximum complaints Which state has the highest percentage of unresolved complaints

```
In [30]:  df1.groupby(["State"]).size().sort_values(ascending=False).to_frame().rename({0: "Co
```

Out[30]:

	Complaint count
State	
Georgia	288

```
In [31]:  #Georgia has highest complaints Complaint count State
```

```
In [32]:  CT = df1.groupby(["State","Highlevel_Status"]).size().unstack().fillna(0)
```

```
In [33]:  CT.sort_values('Closed',axis = 0,ascending=False)[:1]
```

Out[33]:

Highlevel_Status	Closed	Open
State		
Georgia	208.0	80.0

```
In [34]:  #highest percentage of unresolved complaints
```

```
In [35]:  CT['Sum'] = CT['Closed'] + CT['Open']
```

```
In [36]:  CT['Resolved_cmp_prct'] = CT['Closed']/CT['Sum']*100
          CT['Unresolved_cmp_prct'] = CT['Open']/CT['Sum']*100
          CT.sort_values('Open',axis = 0,ascending=False)[:1]
```

Out[36]:

Highlevel_Status	Closed	Open	Sum	Resolved_cmp_prct	Unresolved_cmp_prct
State					
Georgia	208.0	80.0	288.0	72.222222	27.777778

In [37]: *#Georgia state has highest Unresolved complaints when compared to other states*

TASK 6 --- Provide the percentage of complaints resolved till date, which were received through the Internet and customer care calls.

```python
In [38]: cr = df1.groupby(['Received Via','Highlevel_Status']).size().unstack().fillna(0)
         cr['Sum'] = cr['Closed'] + cr['Open']
         cr['Resolved_Per'] = cr['Closed'] / cr['Sum'] *100
         cr['Resolved_Per']
```

```
Out[38]: Received Via
         Customer Care Call    77.211796
         Internet              76.289593
         Name: Resolved_Per, dtype: float64
```

In [39]: cr

Out[39]:

Highlevel_Status	Closed	Open	Sum	Resolved_Per
Received Via				
Customer Care Call	864	255	1119	77.211796
Internet	843	262	1105	76.289593

In [ ]: