In [ ]:
```
import pandas as pd
import numpy as np
from datetime import datetime as dt
import matplotlib.pyplot as plt
import seaborn as sns
```

1. Reading CSV file

In [ ]:
```
data_set=pd.read_csv('Comcast_telecom_complaints_data.csv')
data_set
```

Out[ ]:

	Ticket #	Customer Complaint	Date	Date_month_year	Time	Received Via	City	State	Zip code	Status	Filing on Behalf of Someone
0	250635	Comcast Cable Internet Speeds	22-04-15	22-Apr-15	3:53:50 PM	Customer Care Call	Abingdon	Maryland	21009	Closed	No
1	223441	Payment disappear - service got disconnected	04-08-15	04-Aug-15	10:22:56 AM	Internet	Acworth	Georgia	30102	Closed	No
2	242732	Speed and Service	18-04-15	18-Apr-15	9:55:47 AM	Internet	Acworth	Georgia	30101	Closed	Yes
3	277946	Comcast Imposed a New Usage Cap of 300GB that ...	05-07-15	05-Jul-15	11:59:35 AM	Internet	Acworth	Georgia	30101	Open	Yes
4	307175	Comcast not working and no service to boot	26-05-15	26-May-15	1:25:26 PM	Internet	Acworth	Georgia	30101	Solved	No
...	...	...	...	...	...	...	...	...	...	...	...
2219	213550	Service Availability	04-02-15	04-Feb-15	9:13:18 AM	Customer Care Call	Youngstown	Florida	32466	Closed	No
2220	318775	Comcast Monthly Billing for Returned Modem	06-02-15	06-Feb-15	1:24:39 PM	Customer Care Call	Ypsilanti	Michigan	48197	Solved	No
2221	331188	complaint about comcast	06-09-15	06-Sep-15	5:28:41 PM	Internet	Ypsilanti	Michigan	48197	Solved	No
2222	360489	Extremely unsatisfied Comcast customer	23-06-15	23-Jun-15	11:13:30 PM	Customer Care Call	Ypsilanti	Michigan	48197	Solved	No

	Ticket #	Customer Complaint	Date	Date_month_year	Time	Received Via	City	State	Zip code	Status	Filing on Behalf of Someone
2223	363614	Comcast, Ypsilanti MI Internet Speed	24-06-15	24-Jun-15	10:28:33 PM	Customer Care Call	Ypsilanti	Michigan	48198	Open	Yes

2224 rows × 11 columns

2. Dropping any duplicates

In [ ]:
```
data_set.drop_duplicates(inplace=True)
```

3. Renaming column to lowercase and replacing empty with _

In [ ]:
```
data_set.columns = list(map(lambda x: x.replace(' ','_').lower() , data_set.columns))
```

4. Renaming ticket_# with proper column name as 'ticketNo'

In [ ]:
```
data_set.rename(columns = {'ticket_#' : 'ticketNo'},inplace=True)
```

5. Replacing invalid entry in ticketNo column

In [ ]:
```
data_set.drop(index = data_set[data_set.ticketNo == 'comcas'].index,inplace=True)
```

6. Converting column data types

In [ ]:
```
data_set.ticketNo= data_set.ticketNo.astype(int)
data_set.zip_code= data_set.zip_code.astype(int)
data_set.customer_complaint=data_set.customer_complaint.astype(str)
```

7. Converting date column to dateTime format

- 7.1 Creating a new column with 'full_date'

In [ ]:
```
data_set["full_date"] = data_set["date_month_year"] + " " + data_set["time"]
data_set["date_month_year"] = pd.to_datetime(data_set["date_month_year"])
data_set["full_date"] = pd.to_datetime(data_set["full_date"])
```

8. Setting index to the newly created date

In [ ]:
```
updated_data_set = data_set.set_index(data_set["full_date"])
updated_data_set
```

Out[ ]:

full_date	ticketNo	customer_complaint	date	date_month_year	time	received_via	city	state	zip_code	status	filing_on_behal
2015-04-22 15:53:50	250635	Comcast Cable Internet Speeds	22-04-15	2015-04-22	3:53:50 PM	Customer Care Call	Abingdon	Maryland	21009	Closed	
2015-08-04 10:22:56	223441	Payment disappear - service got disconnected	04-08-15	2015-08-04	10:22:56 AM	Internet	Acworth	Georgia	30102	Closed	
2015-04-18 09:55:47	242732	Speed and Service	18-04-15	2015-04-18	9:55:47 AM	Internet	Acworth	Georgia	30101	Closed	
2015-07-05 11:59:35	277946	Comcast Imposed a New Usage Cap of 300GB that ...	05-07-15	2015-07-05	11:59:35 AM	Internet	Acworth	Georgia	30101	Open	
2015-05-26 13:25:26	307175	Comcast not working and no service to boot	26-05-15	2015-05-26	1:25:26 PM	Internet	Acworth	Georgia	30101	Solved	
...	...	...	...	...	...	...	...	...	...	...	
2015-02-04 09:13:18	213550	Service Availability	04-02-15	2015-02-04	9:13:18 AM	Customer Care Call	Youngstown	Florida	32466	Closed	

full_date	ticketNo	customer_complaint	date	date_month_year	time	received_via	city	state	zip_code	status	filing_on_behal
2015-02-06 13:24:39	318775	Comcast Monthly Billing for Returned Modem	06-02-15	2015-02-06	1:24:39 PM	Customer Care Call	Ypsilanti	Michigan	48197	Solved	
2015-09-06 17:28:41	331188	complaint about comcast	06-09-15	2015-09-06	5:28:41 PM	Internet	Ypsilanti	Michigan	48197	Solved	
2015-06-23 23:13:30	360489	Extremely unsatisfied Comcast customer	23-06-15	2015-06-23	11:13:30 PM	Customer Care Call	Ypsilanti	Michigan	48197	Solved	
2015-06-24 22:28:33	363614	Comcast, Ypsilanti MI Internet Speed	24-06-15	2015-06-24	10:28:33 PM	Customer Care Call	Ypsilanti	Michigan	48198	Open	

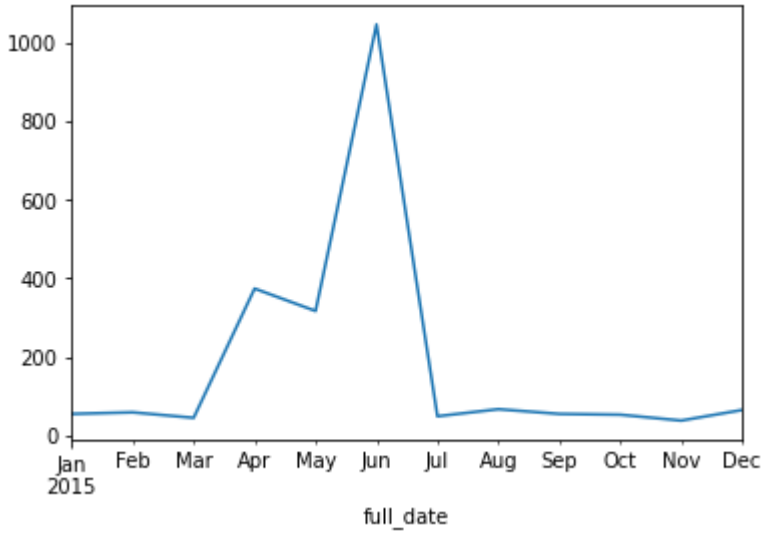
2223 rows × 12 columns

9. Creating Monthwise trend chart

Q : Provide the trend chart for the number of complaints at monthly and daily granularity levels.

In [ ]:
```
chart_monthly=updated_data_set.groupby(pd.Grouper(freq="M"))
chart_monthly.size().plot()
```

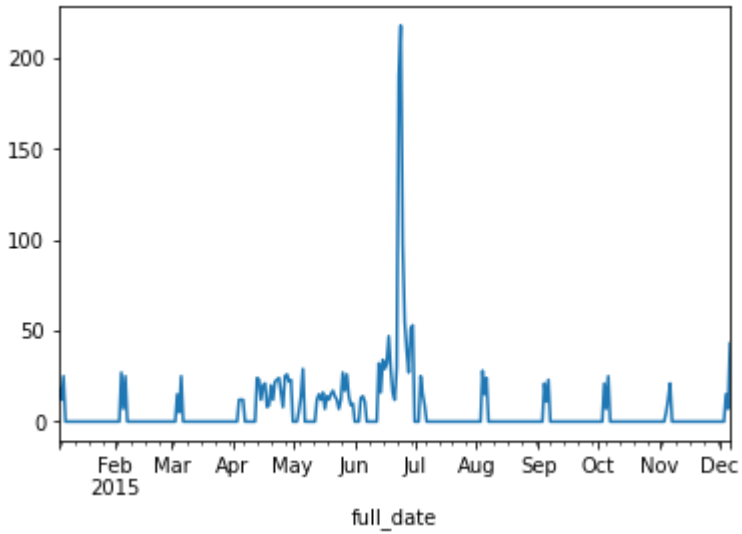
Out[ ]:
```
<AxesSubplot:xlabel='full_date'>
```



10. Creating Daywise trend chart

In [ ]:
```
chart_daily=updated_data_set.groupby(pd.Grouper(freq="D"))
chart_daily.size().plot()
```

Out[ ]:
```
<AxesSubplot:xlabel='full_date'>
```



11. Creating a new categorical variable (new_status) out of existing status

Q : 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 [ ]:
```
updated_data_set["new_status"] = ["Open" if status=="Open" or status=="Pending" else "Closed" for status in updated_data_
updated_data_set
```

Out[ ]:

full_date	ticketNo	customer_complaint	date	date_month_year	time	received_via	city	state	zip_code	status	filing_on_behal
2015-04-22 15:53:50	250635	Comcast Cable Internet Speeds	22-04-15	2015-04-22	3:53:50 PM	Customer Care Call	Abingdon	Maryland	21009	Closed	
2015-08-04 10:22:56	223441	Payment disappear - service got disconnected	04-08-15	2015-08-04	10:22:56 AM	Internet	Acworth	Georgia	30102	Closed	
2015-04-18 09:55:47	242732	Speed and Service	18-04-15	2015-04-18	9:55:47 AM	Internet	Acworth	Georgia	30101	Closed	
2015-07-05 11:59:35	277946	Comcast Imposed a New Usage Cap of 300GB that ...	05-07-15	2015-07-05	11:59:35 AM	Internet	Acworth	Georgia	30101	Open	
2015-05-26 13:25:26	307175	Comcast not working and no service to boot	26-05-15	2015-05-26	1:25:26 PM	Internet	Acworth	Georgia	30101	Solved	
...	...	...	...	...	...	...	...	...	...	...	...
2015-02-04 09:13:18	213550	Service Availability	04-02-15	2015-02-04	9:13:18 AM	Customer Care Call	Youngstown	Florida	32466	Closed	
2015-02-06 13:24:39	318775	Comcast Monthly Billing for Returned Modem	06-02-15	2015-02-06	1:24:39 PM	Customer Care Call	Ypsilanti	Michigan	48197	Solved	

full_date	ticketNo	customer_complaint	date	date_month_year	time	received_via	city	state	zip_code	status	filing_on_behal
2015-09-06 17:28:41	331188	complaint about comcast	06-09-15	2015-09-06	5:28:41 PM	Internet	Ypsilanti	Michigan	48197	Solved	
2015-06-23 23:13:30	360489	Extremely unsatisfied Comcast customer	23-06-15	2015-06-23	11:13:30 PM	Customer Care Call	Ypsilanti	Michigan	48197	Solved	
2015-06-24 22:28:33	363614	Comcast, Ypsilanti MI Internet Speed	24-06-15	2015-06-24	10:28:33 PM	Customer Care Call	Ypsilanti	Michigan	48198	Open	

2223 rows × 13 columns

12.Distribution of statewise complaint count

In [ ]:
```
state_sorted=updated_data_set.groupby(["state"]).size().sort_values(ascending=False)
state_sorted=state_sorted.reset_index()
state_sorted=state_sorted.rename({0: "count"}, axis=1)
state_sorted
```

Out[ ]:

	state	count
0	Georgia	288
1	Florida	240
2	California	220
3	Illinois	164
4	Tennessee	142
5	Pennsylvania	130
6	Michigan	115
7	Washington	98

	state	count
8	Colorado	80
9	Maryland	78
10	New Jersey	75
11	Texas	71
12	Massachusetts	61
13	Virginia	60
14	Indiana	59
15	Oregon	49
16	Mississippi	39
17	Minnesota	33
18	Alabama	26
19	Utah	22
20	Arizona	20
21	South Carolina	18
22	District Of Columbia	16
23	New Mexico	15
24	Louisiana	13
25	New Hampshire	12
26	Connecticut	12
27	Delaware	12
28	West Virginia	11
29	Kentucky	7
30	New York	6
31	Arkansas	6
32	Maine	5

	state	count
33	Missouri	4
34	North Carolina	3
35	Vermont	3
36	Ohio	3
37	Kansas	2
38	District of Columbia	1
39	Rhode Island	1
40	Montana	1
41	Iowa	1
42	Nevada	1

13. State with maximum complaints

Q : Which state has the maximum complaints.

In [ ]:
```
print(state_sorted.max()['state'],'has maximum open complaints with count :',state_sorted.max()['count'])
```

```
West Virginia has maximum open complaints with count : 288
```

14.Distribution of statewise based on new status

In [ ]:
```
complaint_status = updated_data_set.groupby(["state","new_status"]).size().unstack().fillna(0)
complaint_status
```

Out[ ]:

new_status	Closed	Open
state		
Alabama	17.0	9.0
Arizona	14.0	6.0

new_status	Closed	Open
state		
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	14.0	2.0
District of Columbia	1.0	0.0
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
Mississippi	23.0	16.0
Missouri	3.0	1.0
Montana	1.0	0.0
Nevada	1.0	0.0

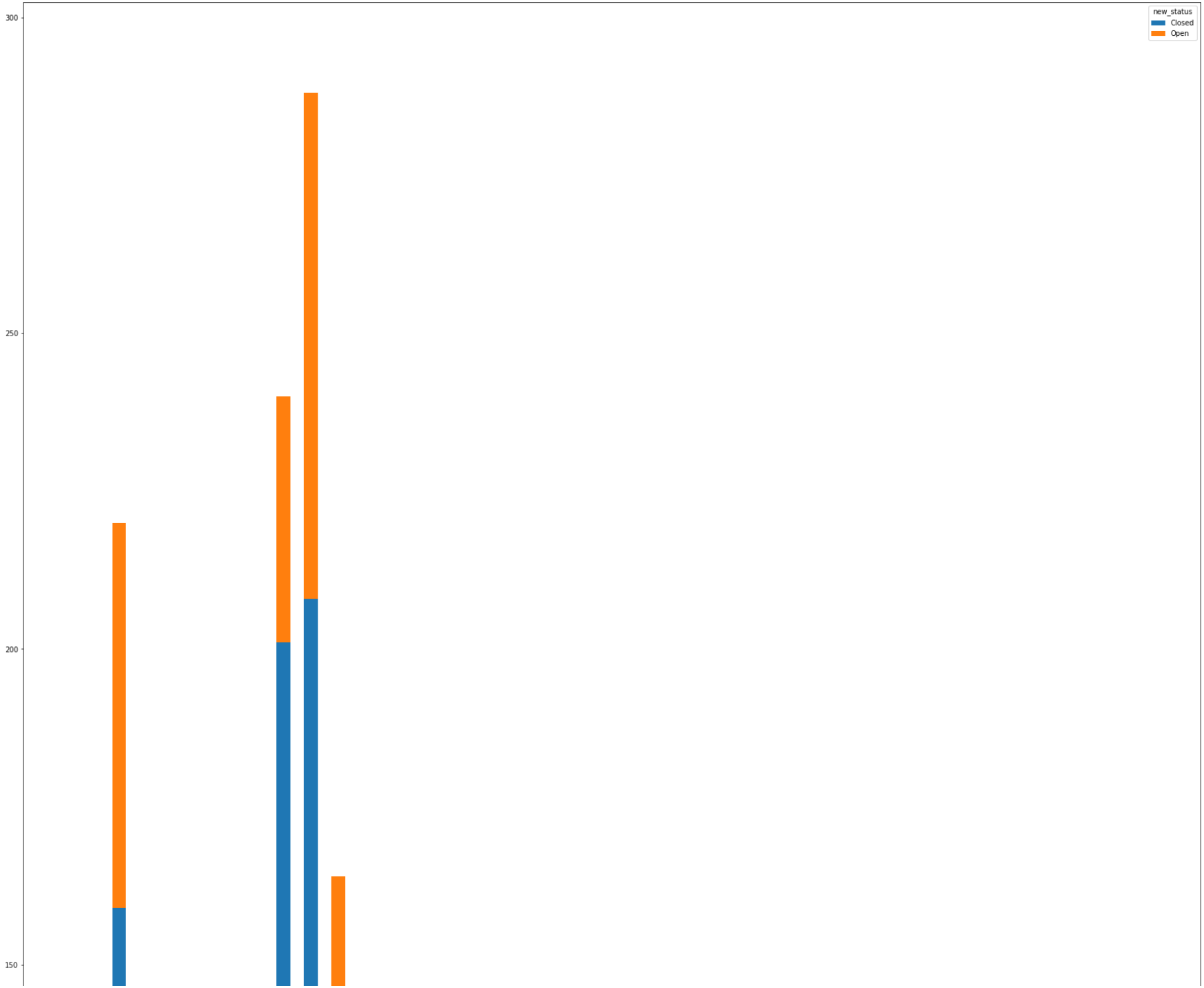
new_status	Closed	Open
state		
New Hampshire	8.0	4.0
New Jersey	56.0	19.0
New Mexico	11.0	4.0
New York	6.0	0.0
North Carolina	3.0	0.0
Ohio	3.0	0.0
Oregon	36.0	13.0
Pennsylvania	110.0	20.0
Rhode Island	1.0	0.0
South Carolina	15.0	3.0
Tennessee	95.0	47.0
Texas	49.0	22.0
Utah	16.0	6.0
Vermont	2.0	1.0
Virginia	49.0	11.0
Washington	75.0	23.0
West Virginia	8.0	3.0

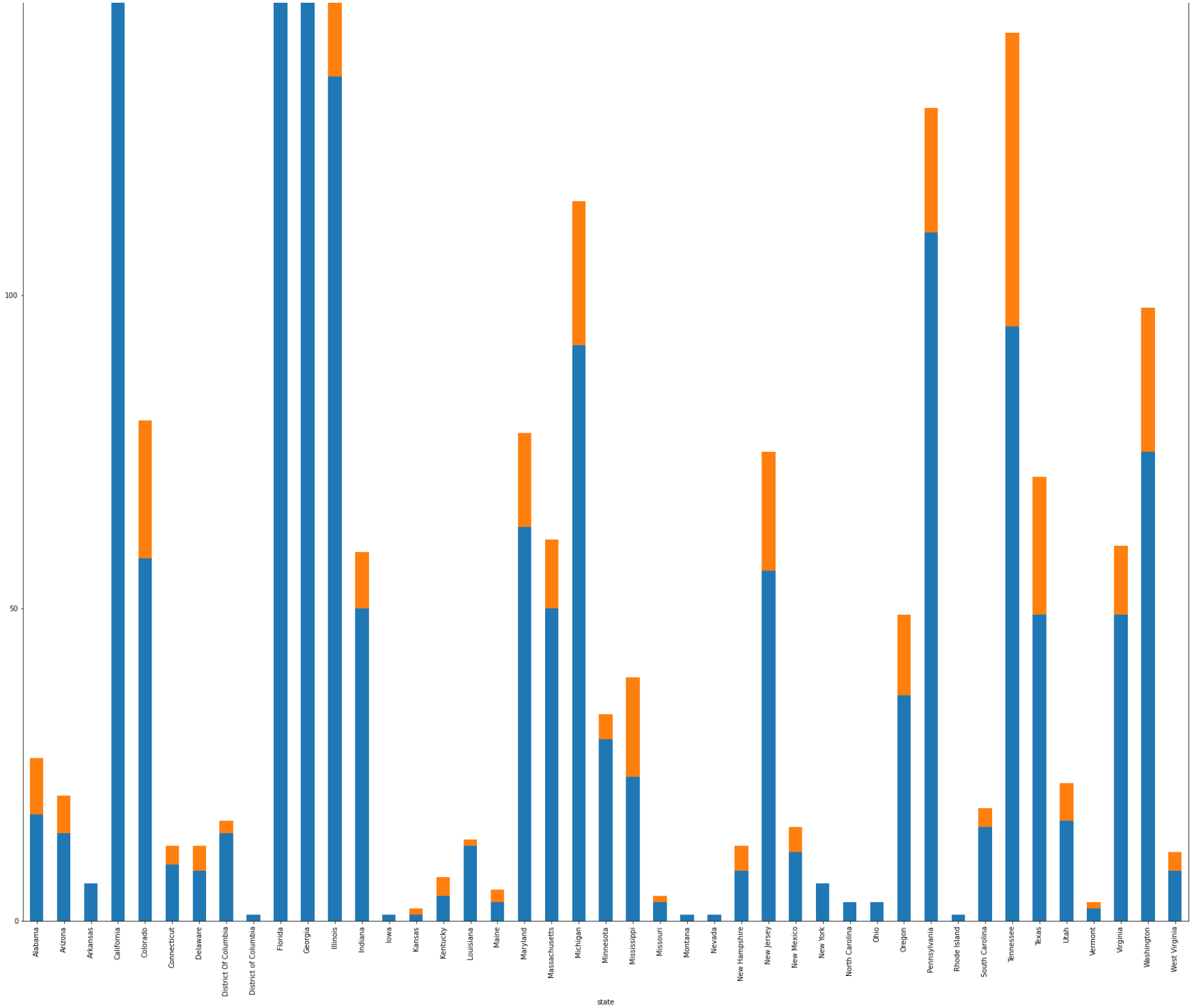
14. state wise status of complaints using a stacked bar chart

Q:Provide state wise status of complaints in a stacked bar chart. Use the categorized variable from Q3

In [ ]:
```
complaint_status.plot(kind="bar", figsize=(30,50), stacked=True)
```

Out[ ]: <AxesSubplot:xlabel='state'>




100
50
0
Alabama
Arizona
Arkansas
California
Colorado
Connecticut
Delaware
District Of Columbia
District of Columbia
Florida
Georgia
Illinois
Indiana
Iowa
Kansas
Kentucky
Louisiana
Maine
Maryland
Massachusetts
Michigan
Minnesota
Mississippi
Missouri
Montana
Nevada
New Hampshire
New Jersey
New Mexico
New York
North Carolina
Ohio
Oregon
Pennsylvania
Rhode Island
South Carolina
Tennessee
Texas
Utah
Vermont
Virginia
Washington
West Virginia
state

15. state wise all complaint percentages

In [ ]:
```
state_sorted['cumulative_sum'] = state_sorted['count'].cumsum()
state_sorted['percent_contribution']=100*state_sorted['count'].round(1)/state_sorted['cumulative_sum'].max()
state_sorted
```

Out[ ]:

	state	count	cumulative_sum	percent_contribution
0	Georgia	288	288	12.955466
1	Florida	240	528	10.796221
2	California	220	748	9.896536
3	Illinois	164	912	7.377418
4	Tennessee	142	1054	6.387764
5	Pennsylvania	130	1184	5.847953
6	Michigan	115	1299	5.173189
7	Washington	98	1397	4.408457
8	Colorado	80	1477	3.598740
9	Maryland	78	1555	3.508772
10	New Jersey	75	1630	3.373819
11	Texas	71	1701	3.193882
12	Massachusetts	61	1762	2.744040
13	Virginia	60	1822	2.699055
14	Indiana	59	1881	2.654071
15	Oregon	49	1930	2.204229
16	Mississippi	39	1969	1.754386
17	Minnesota	33	2002	1.484480
18	Alabama	26	2028	1.169591
19	Utah	22	2050	0.989654

	state	count	cumulative_sum	percent_contribution
20	Arizona	20	2070	0.899685
21	South Carolina	18	2088	0.809717
22	District Of Columbia	16	2104	0.719748
23	New Mexico	15	2119	0.674764
24	Louisiana	13	2132	0.584795
25	New Hampshire	12	2144	0.539811
26	Connecticut	12	2156	0.539811
27	Delaware	12	2168	0.539811
28	West Virginia	11	2179	0.494827
29	Kentucky	7	2186	0.314890
30	New York	6	2192	0.269906
31	Arkansas	6	2198	0.269906
32	Maine	5	2203	0.224921
33	Missouri	4	2207	0.179937
34	North Carolina	3	2210	0.134953
35	Vermont	3	2213	0.134953
36	Ohio	3	2216	0.134953
37	Kansas	2	2218	0.089969
38	District of Columbia	1	2219	0.044984
39	Rhode Island	1	2220	0.044984
40	Montana	1	2221	0.044984
41	Iowa	1	2222	0.044984
42	Nevada	1	2223	0.044984

16. state wise open complaint percentages

In [ ]:
```
status_summary=updated_data_set.groupby(["state","new_status"]).size().unstack().fillna(0)
total_open_complaints=status_summary['Open'].sum()
```

Analysis comment

In [ ]:
```
print('Total open complaints',total_open_complaints)
```

```
Total open complaints 517.0
```

In [ ]:
```
complaint_status['percent_open_complaints']=(100*complaint_status['Open']/total_open_complaints).round(1)
complaint_status
```

Out[ ]:

new_status state	Closed	Open	percent_open_complaints
Alabama	17.0	9.0	1.7
Arizona	14.0	6.0	1.2
Arkansas	6.0	0.0	0.0
California	159.0	61.0	11.8
Colorado	58.0	22.0	4.3
Connecticut	9.0	3.0	0.6
Delaware	8.0	4.0	0.8
District Of Columbia	14.0	2.0	0.4
District of Columbia	1.0	0.0	0.0
Florida	201.0	39.0	7.5
Georgia	208.0	80.0	15.5
Illinois	135.0	29.0	5.6
Indiana	50.0	9.0	1.7
Iowa	1.0	0.0	0.0

new_status	Closed	Open	percent_open_complaints
state			
Kansas	1.0	1.0	0.2
Kentucky	4.0	3.0	0.6
Louisiana	12.0	1.0	0.2
Maine	3.0	2.0	0.4
Maryland	63.0	15.0	2.9
Massachusetts	50.0	11.0	2.1
Michigan	92.0	23.0	4.4
Minnesota	29.0	4.0	0.8
Mississippi	23.0	16.0	3.1
Missouri	3.0	1.0	0.2
Montana	1.0	0.0	0.0
Nevada	1.0	0.0	0.0
New Hampshire	8.0	4.0	0.8
New Jersey	56.0	19.0	3.7
New Mexico	11.0	4.0	0.8
New York	6.0	0.0	0.0
North Carolina	3.0	0.0	0.0
Ohio	3.0	0.0	0.0
Oregon	36.0	13.0	2.5
Pennsylvania	110.0	20.0	3.9
Rhode Island	1.0	0.0	0.0
South Carolina	15.0	3.0	0.6
Tennessee	95.0	47.0	9.1
Texas	49.0	22.0	4.3

new_status	Closed	Open	percent_open_complaints
state			
Utah	16.0	6.0	1.2
Vermont	2.0	1.0	0.2
Virginia	49.0	11.0	2.1
Washington	75.0	23.0	4.4
West Virginia	8.0	3.0	0.6

17. Top 3 states with open complaint %

Q:Which state has the highest percentage of unresolved complaints

In [ ]:
```
complaint_status.sort_values(by='percent_open_complaints',ascending=False,inplace=True)
complaint_status.head(3)
```

Out[ ]:

new_status	Closed	Open	percent_open_complaints
state			
Georgia	208.0	80.0	15.5
California	159.0	61.0	11.8
Tennessee	95.0	47.0	9.1

Analysis comment

In [ ]:
```
print('State ',complaint_status.iloc[0].name, ' has maximum open cases of ',complaint_status.iloc[0]['Open'])
```

```
State  Georgia  has maximum open cases of  80.0
```

17.Percentage of complaints resolved till date, which were received through the Internet and customer care calls.

Q:Provide the percentage of complaints resolved till date, which were received through the Internet and customer care calls

In [ ]:
```
recieved_via_call_or_internet = updated_data_set.groupby(['received_via','new_status']).size().unstack().fillna(0)
total_closed=recieved_via_call_or_internet['Closed'].sum()
recieved_via_call_or_internet['percentage_closed']=(100*recieved_via_call_or_internet['Closed']/total_closed).round(1)
recieved_via_call_or_internet
```

Out[ ]:

new_status	Closed	Open	percentage_closed
received_via			
Customer Care Call	863	255	50.6
Internet	843	262	49.4

Analysis comment

In [ ]:
```
print('Complaints recieved by ',recieved_via_call_or_internet.iloc[0].name, ' has maximum closed percentage of ',recieved
```

```
Complaints recieved by  Customer Care Call  has maximum closed percentage of  50.6
```

18. new categorical variable: Complaint type

Q:Provide a table with the frequency of complaint types.

In [ ]:
```
updated_data_set.customer_complaint=updated_data_set.customer_complaint.str.lower()
wordcounts=updated_data_set.customer_complaint.str.split(expand=True).stack().value_counts()
wordcounts
```

Out[ ]:
```
comcast        1160
internet        508
service         411
and             277
billing         273
               ...
1mbps             1
failures          1
```

```
west              1
throttled.        1
complaints.       1
Length: 1806, dtype: int64
```

adding new complaint type

In [ ]:

```
word_counts = dict()


def categorize(wordArr):
    internet_array=['internet','speed','speeds','data','wifi','disconnect','slow']
    billing_array=['billing','bill', '$','payment','amount','cost','price','fee','prices','rate','rates','pricing','charg
    service_array=['customer','service']

    wordsArr=wordArr.lower().split(' ')
    if (any(item in internet_array for item in wordsArr)):
        return 'internet_related'
    elif (any(item in billing_array for item in wordsArr)):
        return 'billing_related'
    elif 'network' in wordsArr:
        return 'network_related'
    elif (any(item in service_array for item in wordsArr)):
        return 'service_related'
    else:
        return 'misc'

updated_data_set['complaint_type']=(updated_data_set.apply(lambda x: categorize(x['customer_complaint']),axis=1))
updated_data_set
```

Out[ ]:

full_date	ticketNo	customer_complaint	date	date_month_year	time	received_via	city	state	zip_code	status	filing_on_behal
2015-04-22 15:53:50	250635	comcast cable internet speeds	22-04-15	2015-04-22	3:53:50 PM	Customer Care Call	Abingdon	Maryland	21009	Closed	
2015-08-04 10:22:56	223441	payment disappear - service got disconnected	04-08-15	2015-08-04	10:22:56 AM	Internet	Acworth	Georgia	30102	Closed	

full_date	ticketNo	customer_complaint	date	date_month_year	time	received_via	city	state	zip_code	status	filing_on_behal
2015-04-18 09:55:47	242732	speed and service	18-04-15	2015-04-18	9:55:47 AM	Internet	Acworth	Georgia	30101	Closed	
2015-07-05 11:59:35	277946	comcast imposed a new usage cap of 300gb that ...	05-07-15	2015-07-05	11:59:35 AM	Internet	Acworth	Georgia	30101	Open	
2015-05-26 13:25:26	307175	comcast not working and no service to boot	26-05-15	2015-05-26	1:25:26 PM	Internet	Acworth	Georgia	30101	Solved	
...	...	...	...	...	...	...	...	...	...	...	
2015-02-04 09:13:18	213550	service availability	04-02-15	2015-02-04	9:13:18 AM	Customer Care Call	Youngstown	Florida	32466	Closed	
2015-02-06 13:24:39	318775	comcast monthly billing for returned modem	06-02-15	2015-02-06	1:24:39 PM	Customer Care Call	Ypsilanti	Michigan	48197	Solved	
2015-09-06 17:28:41	331188	complaint about comcast	06-09-15	2015-09-06	5:28:41 PM	Internet	Ypsilanti	Michigan	48197	Solved	
2015-06-23 23:13:30	360489	extremely unsatisfied comcast customer	23-06-15	2015-06-23	11:13:30 PM	Customer Care Call	Ypsilanti	Michigan	48197	Solved	
2015-06-24 22:28:33	363614	comcast, ypsilanti mi internet speed	24-06-15	2015-06-24	10:28:33 PM	Customer Care Call	Ypsilanti	Michigan	48198	Open	

2223 rows × 14 columns

In [ ]:
```
updated_data_set.to_csv('data.csv')
```

In [ ]:
```
ctype_sorted=updated_data_set.groupby(["complaint_type"]).size().sort_values(ascending=False)
```

```
ctype_sorted=ctype_sorted.reset_index()
ctype_sorted=ctype_sorted.rename({0: "count"}, axis=1)
ctype_sorted
```

Out[ ]:

	complaint_type	count
0	internet_related	793
1	misc	743
2	billing_related	449
3	service_related	237
4	network_related	1

Analysis

In [ ]:

```
print('Comcast needs to focus on complaints that are\"',ctype_sorted.loc[0]['complaint_type'],'\"as there are \"',ctype_s
```

```
Comcast needs to focus on complaints that are" internet_related "as there are " 793 " incidents around it
```