Data Profiling for the US Accidents (2016 - 2021) dataset

Doing some basic data profiling here using pandas - the main data profiling with a very elaborate data profiling report has been done as well and the report has been saved for cleansing usage

Also plotting a few graphs here using relevant libraries

In [1]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:
```
df = pd.read_csv('US_Accidents_Dec21_updated.csv')
#read the dataset
```

In [3]:
```
df.columns
#printing all column names
```

Out[3]:
```
Index(['ID', 'Severity', 'Start_Time', 'End_Time', 'Start_Lat', 'Start_Lng',
       'End_Lat', 'End_Lng', 'Distance(mi)', 'Description', 'Number', 'Street',
       'Side', 'City', 'County', 'State', 'Zipcode', 'Country', 'Timezone',
       'Airport_Code', 'Weather_Timestamp', 'Temperature(F)', 'Wind_Chill(F)',
       'Humidity(%)', 'Pressure(in)', 'Visibility(mi)', 'Wind_Direction',
       'Wind_Speed(mph)', 'Precipitation(in)', 'Weather_Condition', 'Amenity',
       'Bump', 'Crossing', 'Give_Way', 'Junction', 'No_Exit', 'Railway',
       'Roundabout', 'Station', 'Stop', 'Traffic_Calming', 'Traffic_Signal',
       'Turning_Loop', 'Sunrise_Sunset', 'Civil_Twilight', 'Nautical_Twilight',
       'Astronomical_Twilight'],
      dtype='object')
```

In [4]:
```
df.head()
```

Out[4]:

	ID	Severity	Start_Time	End_Time	Start_Lat	Start_Lng	End_Lat	End_Lng	Distance(mi)	Description	...	Roundabout	Station	Stop	Traffic_Calmir
0	A-1	3	2016-02-08 00:37:08	2016-02-08 06:37:08	40.108910	-83.092860	40.112060	-83.031870	3.230	Between Sawmill Rd/Exit 20 and OH-315/Olentang...	...	False	False	False	Fal
1	A-2	2	2016-02-08 05:56:20	2016-02-08 11:56:20	39.865420	-84.062800	39.865010	-84.048730	0.747	At OH-4/OH-235/Exit 41 - Accident.	...	False	False	False	Fal
2	A-3	2	2016-02-08 06:15:39	2016-02-08 12:15:39	39.102660	-84.524680	39.102090	-84.523960	0.055	At I-71/US-50/Exit 1 - Accident.	...	False	False	False	Fal
3	A-4	2	2016-02-08 06:51:45	2016-02-08 12:51:45	41.062130	-81.537840	41.062170	-81.535470	0.123	At Dart Ave/Exit 21 - Accident.	...	False	False	False	Fal
4	A-5	3	2016-02-08 07:53:43	2016-02-08 13:53:43	39.172393	-84.492792	39.170476	-84.501798	0.500	At Mitchell Ave/Exit 6 - Accident.	...	False	False	False	Fal

5 rows × 47 columns

In [5]:
```
df.dtypes
#checking data types of all columns, this will help in deciding strategy for filling NULL/NaN values
```

Out[5]:
```
ID                          object
Severity                     int64
Start_Time                  object
End_Time                    object
Start_Lat                  float64
Start_Lng                  float64
End_Lat                    float64
End_Lng                    float64
Distance(mi)               float64
Description                 object
Number                     float64
Street                      object
Side                        object
City                        object
County                      object
State                       object
Zipcode                     object
Country                     object
Timezone                    object
Airport_Code                object
Weather_Timestamp           object
Temperature(F)             float64
Wind_Chill(F)              float64
Humidity(%)                float64
Pressure(in)               float64
Visibility(mi)             float64
Wind_Direction              object
Wind_Speed(mph)            float64
Precipitation(in)          float64
Weather_Condition           object
Amenity                       bool
Bump                          bool
Crossing                      bool
Give_Way                      bool
Junction                      bool
No_Exit                       bool
Railway                       bool
Roundabout                    bool
Station                       bool
Stop                          bool
Traffic_Calming               bool
Traffic_Signal                bool
Turning_Loop                  bool
Sunrise_Sunset              object
Civil_Twilight              object
Nautical_Twilight           object
Astronomical_Twilight       object
dtype: object
```

In [6]:
```
df.describe()
```

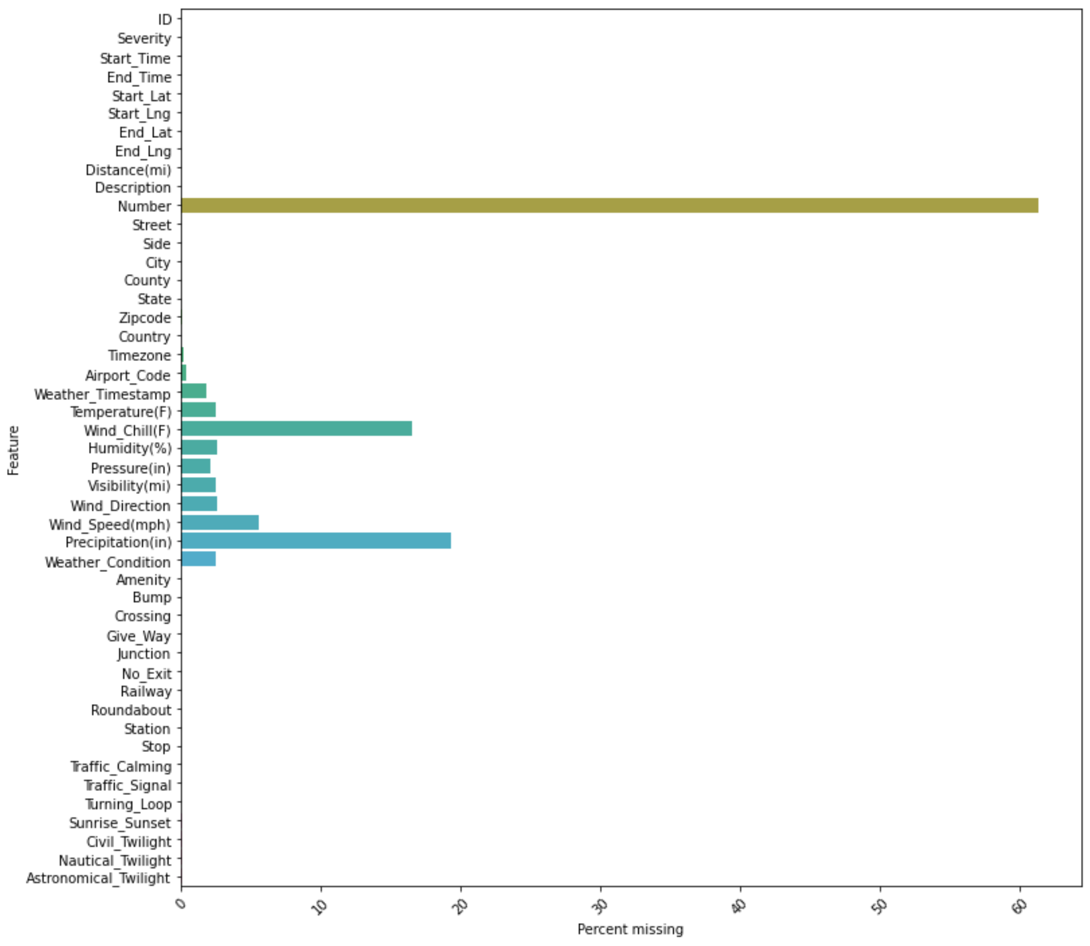
Out[6]:

	Severity	Start_Lat	Start_Lng	End_Lat	End_Lng	Distance(mi)	Number	Temperature(F)	Wind_Chill(F)	Humidity(%)	Pr
count	2.845342e+06	2.845342e+06	2.845342e+06	2.845342e+06	2.845342e+06	2.845342e+06	1.101431e+06	2.776068e+06	2.375699e+06	2.772250e+06	2.78
mean	2.137572e+00	3.624520e+01	-9.711463e+01	3.624532e+01	-9.711439e+01	7.026779e-01	8.089408e+03	6.179356e+01	5.965823e+01	6.436545e+01	2.94
std	4.787216e-01	5.363797e+00	1.831782e+01	5.363873e+00	1.831763e+01	1.560361e+00	1.836009e+04	1.862263e+01	2.116097e+01	2.287457e+01	1.04
min	1.000000e+00	2.456603e+01	-1.245481e+02	2.456601e+01	-1.245457e+02	0.000000e+00	0.000000e+00	-8.900000e+01	-8.900000e+01	1.000000e+00	0.00
25%	2.000000e+00	3.344517e+01	-1.180331e+02	3.344628e+01	-1.180333e+02	5.200000e-02	1.270000e+03	5.000000e+01	4.600000e+01	4.800000e+01	2.93
50%	2.000000e+00	3.609861e+01	-9.241808e+01	3.609799e+01	-9.241772e+01	2.440000e-01	4.007000e+03	6.400000e+01	6.300000e+01	6.700000e+01	2.98
75%	2.000000e+00	4.016024e+01	-8.037243e+01	4.016105e+01	-8.037338e+01	7.640000e-01	9.567000e+03	7.600000e+01	7.600000e+01	8.300000e+01	3.00
max	4.000000e+00	4.900058e+01	-6.711317e+01	4.907500e+01	-6.710924e+01	1.551860e+02	9.999997e+06	1.960000e+02	1.960000e+02	1.000000e+02	5.89

Calculate & visualize the percentage NULL values for each column or feature

In [7]:
```
null_vals = df.isna().sum()/len(df)*100
df_null_vals = pd.DataFrame(null_vals)
df_null_vals.reset_index(inplace = True)
df_null_vals.columns = ["Feature","Percent missing"]
plt.figure(figsize = (12,12))
plt.xticks(rotation = 45)
sns.barplot(x = "Percent missing", y ="Feature", data = df_null_vals, orient = "h")
```

Out[7]:
```
<AxesSubplot:xlabel='Percent missing', ylabel='Feature'>
```



Print out the number of NaN/NULL values in each column

In [8]:
```
df.isna().sum()
```

Out[8]:
```
ID                         0
Severity                   0
Start_Time                 0
End_Time                   0
Start_Lat                  0
Start_Lng                  0
End_Lat                    0
End_Lng                    0
Distance(mi)               0
Description                0
Number               1743911
Street                     2
Side                       0
City                     137
County                     0
State                      0
Zipcode                 1319
Country                    0
Timezone                3659
```

In [9]:
```
df_all_nulls = df[df.isna().any(axis=1)]
df_all_nulls
#printing all the rows which have a NULL value for any of the columns
```

Out[9]:

	ID	Severity	Start_Time	End_Time	Start_Lat	Start_Lng	End_Lat	End_Lng	Distance(mi)	Description	...	Roundabout	Station	Stop
0	A-1	3	2016-02-08 00:37:08	2016-02-08 06:37:08	40.108910	-83.092860	40.112060	-83.031870	3.230	Between Sawmill Rd/Exit 20 and OH-315/Olentang...	...	False	False	False
1	A-2	2	2016-02-08 05:56:20	2016-02-08 11:56:20	39.865420	-84.062800	39.865010	-84.048730	0.747	At OH-4/OH-235/Exit 41 - Accident.	...	False	False	False
2	A-3	2	2016-02-08 06:15:39	2016-02-08 12:15:39	39.102660	-84.524680	39.102090	-84.523960	0.055	At I-71/US-50/Exit 1 - Accident.	...	False	False	False
3	A-4	2	2016-02-08 06:51:45	2016-02-08 12:51:45	41.062130	-81.537840	41.062170	-81.535470	0.123	At Dart Ave/Exit 21 - Accident.	...	False	False	False
4	A-5	3	2016-02-08 07:53:43	2016-02-08 13:53:43	39.172393	-84.492792	39.170476	-84.501798	0.500	At Mitchell Ave/Exit 6 - Accident.	...	False	False	False
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2845337	A-2845338	2	2019-08-23 18:03:25	2019-08-23 18:32:01	34.002480	-117.379360	33.998880	-117.370940	0.543	At Market St - Accident.	...	False	False	False
2845338	A-2845339	2	2019-08-23 19:11:30	2019-08-23 19:38:23	32.766960	-117.148060	32.765550	-117.153630	0.338	At Camino Del Rio/Mission Center Rd - Accident.	...	False	False	False
2845339	A-2845340	2	2019-08-23 19:00:21	2019-08-23 19:28:49	33.775450	-117.847790	33.777400	-117.857270	0.561	At Glassell St/Grand Ave - Accident. in the ri...	...	False	False	False
2845340	A-2845341	2	2019-08-23 19:00:21	2019-08-23 19:29:42	33.992460	-118.403020	33.983110	-118.395650	0.772	At CA-90/Marina Fwy/Jefferson Blvd - Accident.	...	False	False	False
2845341	A-2845342	2	2019-08-23 18:52:06	2019-08-23 19:21:31	34.133930	-117.230920	34.137360	-117.239340	0.537	At Highland Ave/Arden Ave - Accident.	...	False	False	False

1902024 rows × 47 columns

In [10]:
```
df[df['Sunrise_Sunset'].isna()]
#printing rows which have NULL/NaN value for Sunrise_Sunset column
```

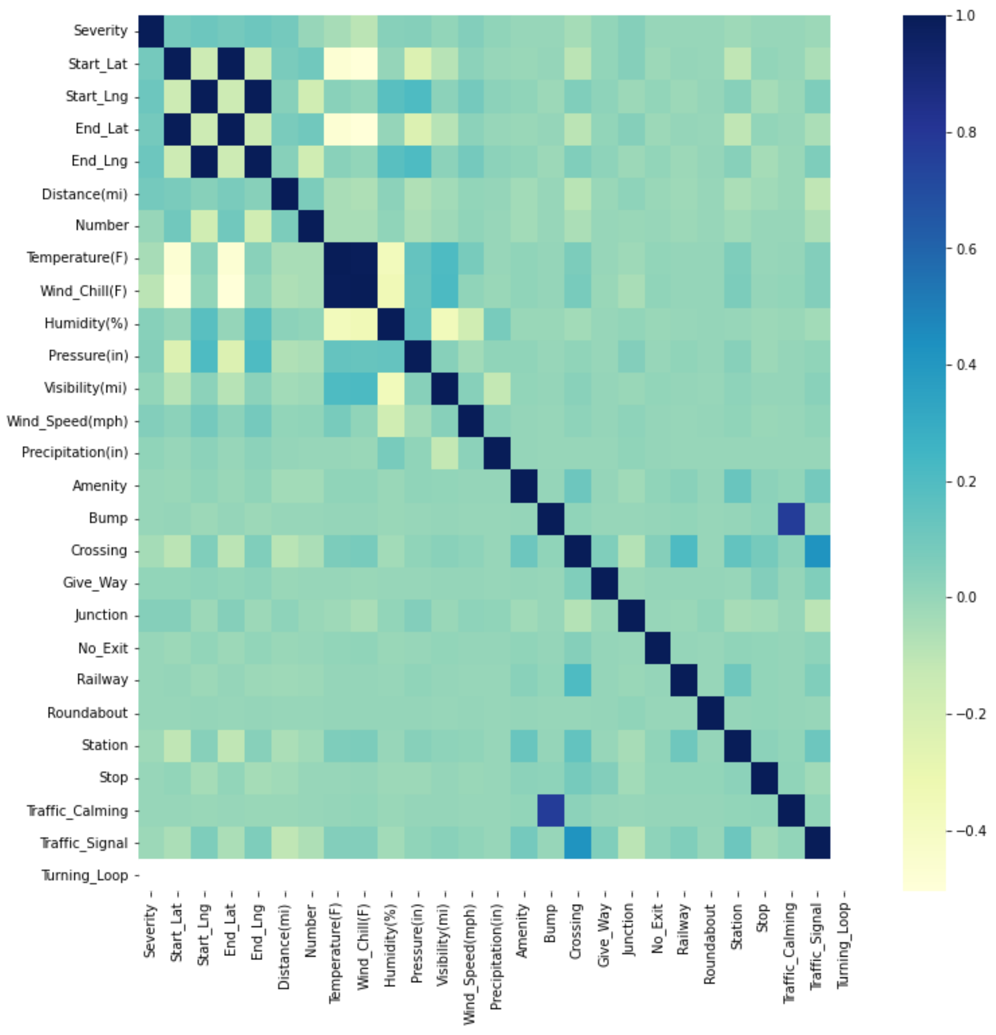
Out[10]:

	ID	Severity	Start_Time	End_Time	Start_Lat	Start_Lng	End_Lat	End_Lng	Distance(mi)	Description	...	Roundabout	Station	Stop	Traffic
34903	A-34904	4	2016-12-11 16:33:08	2016-12-11 22:33:08	41.03674	-73.67549	41.083450	-73.665300	3.271	Closed between CT-120A/King St/Exit 27 and Rou...	...	False	False	False	
43106	A-43107	4	2017-01-10 04:51:19	2017-01-10 10:51:19	40.84309	-84.80236	40.844250	-84.784350	0.945	Closed between State Line Rd and Kings Church ...	...	False	False	False	
43114	A-43115	4	2017-01-10 06:13:46	2017-01-10 12:13:46	40.84309	-84.80236	40.844250	-84.784350	0.945	Closed between State Line Rd and Kings Church ...	...	False	False	False	
										Closed between					

Visualizing the correlation between each column as a heatmap

```
In [11]: corr_matrix = df.corr()
         plt.figure(figsize = (12,12))
         sns.heatmap(corr_matrix, cmap = "YlGnBu")
```

```
Out[11]: <AxesSubplot:>
```



The following 3 cells are used to generate the data profiling report

The cells have been commented out since this has already ran before. The report is saved as a HTML document. In order to avoid running this again and using up a lot of time and memory, it has now been commented out

```
In [12]: #from pandas_profiling import ProfileReport
```

```
In [13]: #us_accidents_report = ProfileReport(df, title = "US Accidents Profile Report")
```

```
In [14]: #us_accidents_report.to_file("US_Accidents_Data_Profile_Group5.html")
```

Data Cleansing for the US Accidents (2016 - 2021) dataset

Changing the column name to exclude _ and make everything CamelCase

For columns which has units in them adding a _ to differentiate

```
In [15]: df.columns = df.columns.str.replace("[_,)]", "", regex = True)
         df.columns = df.columns.str.replace("(", "_", regex = False)
         df.columns = df.columns.str.replace('Humidity_%', 'Humidity_Perc')
```

```
In [16]: df.columns
```

```
Out[16]: Index(['ID', 'Severity', 'StartTime', 'EndTime', 'StartLat', 'StartLng',
               'EndLat', 'EndLng', 'Distance_mi', 'Description', 'Number', 'Street',
               'Side', 'City', 'County', 'State', 'Zipcode', 'Country', 'Timezone',
               'AirportCode', 'WeatherTimestamp', 'Temperature_F', 'WindChill_F',
               'Humidity_Perc', 'Pressure_in', 'Visibility_mi', 'WindDirection',
               'WindSpeed_mph', 'Precipitation_in', 'WeatherCondition', 'Amenity',
               'Bump', 'Crossing', 'GiveWay', 'Junction', 'NoExit', 'Railway',
               'Roundabout', 'Station', 'Stop', 'TrafficCalming', 'TrafficSignal',
               'TurningLoop', 'SunriseSunset', 'CivilTwilight', 'NauticalTwilight',
               'AstronomicalTwilight'],
              dtype='object')
```

Change data type of timestamp columns to DateTime

```
In [17]: df[['StartTime', 'EndTime']] = df[['StartTime', 'EndTime']].apply(pd.to_datetime)
         # doubt: can we change the column name/naming convention? Renamethis column to: StartTime and EndTime
```

The Weather_Timestamp column is also a timestamp column but it has NaN values. Replaces these NaN values with the maximum possible timestamp in Pandas, which is 2262-04-11 00:00:00

```
In [18]: df['WeatherTimestamp'] = df['WeatherTimestamp'].fillna('2262-04-11 00:00:00')
         df['WeatherTimestamp'] = df['WeatherTimestamp'].apply(pd.to_datetime)
```

Creating a new 'AccidentYear' column which will be of help while doing visualization

```
In [19]: df['AccidentYear'] = df['StartTime'].dt.year
```

```
In [20]: df['AccidentYear'].value_counts()
```

```
Out[20]: 2021    1511745
         2020     625864
         2019     258615
         2017     163918
         2018     163176
         2016     122024
         Name: AccidentYear, dtype: int64
```

Filling all the NULL values in various column with placeholder respective placeholders

For all string columns, fill NULLs with 'Not listed'

```
In [21]: string_type_columns = ['Street', 'City', 'Zipcode', 'Timezone', 'AirportCode', 'WindDirection', 'WeatherCondition',
                                'SunriseSunset', 'CivilTwilight', 'NauticalTwilight', 'AstronomicalTwilight']
         #first making a list of column names which are of string type and have NULL values
```

```
In [22]: df[string_type_columns] = df[string_type_columns].fillna('Not listed')
```

For all int/float columns, fill NULLs with -99

```
In [23]: integer_type_columns = ['Number', 'Temperature_F', 'WindChill_F', 'Humidity_Perc', 'Pressure_in', 'Visibility_mi',
                                 'WindSpeed_mph', 'Precipitation_in']
```

```
In [24]: df[integer_type_columns] = df[integer_type_columns].fillna(-99)
```

No NULLs in the 'Side' column, but only one value is N. Replace it with the most frequent occuring value which is R

```
In [25]: df['Side'] = df['Side'].replace(['N'], 'R')
```

```
In [26]: df['Side'].value_counts() #just to verify that 'N' is replaced
```

```
Out[26]: R    2353310
         L     492032
         Name: Side, dtype: int64
```

In [27]:
```
df.dtypes
```

Out[27]:
```
ID                           object
Severity                      int64
StartTime            datetime64[ns]
EndTime              datetime64[ns]
StartLat                    float64
StartLng                    float64
EndLat                      float64
EndLng                      float64
Distance_mi                 float64
Description                  object
Number                      float64
Street                       object
Side                         object
City                         object
County                       object
State                        object
Zipcode                      object
Country                      object
Timezone                     object
```

In [28]:
```
df.isna().sum()
```

Out[28]:
```
ID                       0
Severity                 0
StartTime                0
EndTime                  0
StartLat                 0
StartLng                 0
EndLat                   0
EndLng                   0
Distance_mi              0
Description              0
Number                   0
Street                   0
Side                     0
City                     0
County                   0
State                    0
Zipcode                  0
Country                  0
Timezone                 0
AirportCode              0
WeatherTimestamp         0
Temperature_F            0
WindChill_F              0
Humidity_Perc            0
Pressure_in              0
Visibility_mi            0
WindDirection            0
WindSpeed_mph            0
Precipitation_in         0
WeatherCondition         0
Amenity                  0
Bump                     0
Crossing                 0
GiveWay                  0
Junction                 0
NoExit                   0
Railway                  0
Roundabout               0
Station                  0
Stop                     0
TrafficCalming           0
TrafficSignal            0
TurningLoop              0
SunriseSunset            0
CivilTwilight            0
NauticalTwilight         0
AstronomicalTwilight     0
AccidentYear             0
dtype: int64
```

The following 2 new columns that are created in the 2 cells below are done for the data mapping purpose where we need a unique key value.

These 2 cells are only used for data loading into Neo4j and not important in terms of business

In [29]:
```
#for Neo4j scripting purpose
df['TrafficCoordinates'] = df['StartLat'].astype(str) + ", " + df['StartLng'].astype(str) + ", " + df['EndLat'].astype
```

In [30]:
```
df['TrafficDuration'] = df['StartTime'].astype(str) + ", " + df['EndTime'].astype(str)
```

No NaNs/NULLs remain in any column of the dataset. The dataset is cleaned!

In [31]:
```
df.to_csv('US_Accidents_cleaned.csv', index=False)
#saving the cleaned data frame as a new CSV
```

In [2]:
```
df = pd.read_csv('US_Accidents_cleaned.csv')
#read the dataset
```

In [3]:
```
df
```

Out[3]:

	ID	Severity	StartTime	EndTime	StartLat	StartLng	EndLat	EndLng	Distance_mi	Description	...	TrafficCalming	TrafficSignal
0	A-1	3	2016-02-08 00:37:08	2016-02-08 06:37:08	40.108910	-83.092860	40.112060	-83.031870	3.230	Between Sawmill Rd/Exit 20 and OH-315/Olentang...	...	False	False
1	A-2	2	2016-02-08 05:56:20	2016-02-08 11:56:20	39.865420	-84.062800	39.865010	-84.048730	0.747	At OH-4/OH-235/Exit 41 - Accident.	...	False	False
2	A-3	2	2016-02-08 06:15:39	2016-02-08 12:15:39	39.102660	-84.524680	39.102090	-84.523960	0.055	At I-71/US-50/Exit 1 - Accident.	...	False	False
3	A-4	2	2016-02-08 06:51:45	2016-02-08 12:51:45	41.062130	-81.537840	41.062170	-81.535470	0.123	At Dart Ave/Exit 21 - Accident.	...	False	False
4	A-5	3	2016-02-08 07:53:43	2016-02-08 13:53:43	39.172393	-84.492792	39.170476	-84.501798	0.500	At Mitchell Ave/Exit 6 - Accident.	...	False	False
...	...	...	...	...	...	...	...	...	...	...	...	...	...
2845337	A-2845338	2	2019-08-23 18:03:25	2019-08-23 18:32:01	34.002480	-117.379360	33.998880	-117.370940	0.543	At Market St - Accident.	...	False	False
2845338	A-2845339	2	2019-08-23 19:11:30	2019-08-23 19:38:23	32.766960	-117.148060	32.765550	-117.153630	0.338	At Camino Del Rio/Mission Center Rd - Accident.	...	False	False
2845339	A-2845340	2	2019-08-23 19:00:21	2019-08-23 19:28:49	33.775450	-117.847790	33.777400	-117.857270	0.561	At Glassell St/Grand Ave - Accident. in the ri...	...	False	False
2845340	A-2845341	2	2019-08-23 19:00:21	2019-08-23 19:29:42	33.992460	-118.403020	33.983110	-118.395650	0.772	At CA-90/Marina Fwy/Jefferson Blvd - Accident.	...	False	False
2845341	A-2845342	2	2019-08-23 18:52:06	2019-08-23 19:21:31	34.133930	-117.230920	34.137360	-117.239340	0.537	At Highland Ave/Arden Ave - Accident.	...	False	False

2845342 rows × 50 columns

In [4]:
```
df['AccidentYear'].value_counts()
```

Out[4]:
```
2021    1511745
2020     625864
2019     258615
2017     163918
2018     163176
2016     122024
Name: AccidentYear, dtype: int64
```

In [7]:
```
df_sampled = df.sample(frac =.01, ignore_index = True)
```

In [8]:
```
df_sampled
```

Out[8]:

	ID	Severity	StartTime	EndTime	StartLat	StartLng	EndLat	EndLng	Distance_mi	Description	...	TrafficCalming
0	A-408764	2	2021-11-18 01:07:00.000000000	2021-11-18 02:22:09.000000000	30.442862	-85.874004	30.443136	-85.874010	0.019	Incident on DOG TRACK RD near CAPTAIN FRITZ RD...	...	False
1	A-645069	2	2021-11-12 06:14:30	2021-11-12 07:33:18	38.269060	-77.945498	38.269320	-77.928368	0.929	On VA-20 in the County of Orange in the vicini...	...	False
2	A-600734	2	2021-09-23 16:37:31	2021-09-23 17:54:19	34.284416	-79.909065	34.285379	-79.910967	0.127	Incident on ROGERS RD near INDIAN BRANCH RD Ex...	...	False
3	A-1950772	2	2020-12-07 12:23:30	2020-12-08 04:06:01	28.428795	-81.407121	28.428975	-81.404630	0.152	Slow traffic on US-92 E - US-17 N - US-441 N f...	...	False
4	A-388339	2	2021-11-09 18:59:00	2021-11-09 20:22:38	33.638815	-117.344412	33.638426	-117.343770	0.046	Incident on GRAND AVE near HOUSE 17671 Right s...	...	False
...	...	...	...	...	...	...	...	...	...	...	...	...
28448	A-109926	2	2017-01-10 13:53:17	2017-01-10 19:53:17	37.560820	-122.302940	37.563630	-122.306010	0.257	At Kehoe Ave/Exit 415 - Accident.	...	False
28449	A-1344523	2	2021-06-28 19:55:00	2021-06-28 20:52:30	34.140763	-117.248329	34.135979	-117.236718	0.742	Slow traffic on CA-210 E from Del Rosa Ave (CA...	...	False
28450	A-2419578	2	2019-10-16 10:58:00	2019-10-16 12:15:00	40.388240	-111.835720	40.388240	-111.835380	0.018	At I-15 - Accident.	...	False
28451	A-971142	2	2021-10-26 15:31:04	2021-10-26 15:51:31	25.857208	-80.209463	25.861819	-80.209631	0.319	Stationary traffic on US-441 N from FL-934/81s...	...	False
28452	A-743597	2	2021-12-08 15:10:30	2021-12-08 19:17:00	33.715089	-117.845076	33.722496	-117.837676	0.665	Slow traffic on CA-55 N - Costa Mesa Fwy N fro...	...	False

28453 rows × 50 columns

In [9]:
```
df_sampled['AccidentYear'].value_counts()
```

Out[9]:
```
2021    15106
2020     6289
2019     2624
2018     1705
2017     1602
2016     1127
Name: AccidentYear, dtype: int64
```

In [10]:
```
df_sampled.to_csv('US_Accidents_sampled.csv', index=False)
#saving the cleaned data frame as a new CSV
```

In [ ]:
```
```