Data Prep and Cleaning ## Deliverables: - Submit two files that has the name: **YourLastName_Exercise_0:**
1. Your **HTML** file that has your source code and output 2. Your **ipynb script** that has your source code and output ## Objectives: In this exercise you will: - Load data from csv file into a DataFrame Object - Inspect the data - Clean the data - Prepare data for analysis

Many states, counties and cities in the U.S. have web sites where they make data available. The data used for this homework was retrieved from the Los Angeles city link provided below.

https://data.lacity.org/Public-Safety/Traffic-Collision-Data-from-2010-to-Present/d5tf-ez2w

Data Dictionary - fields available in the csv file

In [1]:
```
# load libraries
import pandas as pd
import numpy as np

# set up notebook to display multiple output in one cell
from IPython.core.interactiveshell import InteractiveShell
InteractiveShell.ast_node_interactivity = "all"
```

```
/Users/ashleybrinker/anaconda3/lib/python3.7/site-packages/pandas/compat/_optional.py:138: UserWarnin
g: Pandas requires version '2.7.0' or newer of 'numexpr' (version '2.6.8' currently installed).
  warnings.warn(msg, UserWarning)
```

In [2]:
```
# ----------------------------------------------------
# read in file
# ----------------------------------------------------
df = pd.read_csv("Traffic_Collision_Data.csv")

# look at the first 5 records
df.head()
```

Out[2]:

	DR Number	Date Reported	Date Occurred	Time Occurred	Area ID	Area Name	Reporting District	Crime Code	Crime Code Description	MO Codes	Victim Age	Victim Sex	Victim Descent	Premis Cod
0	190319651	08/24/2019	08/24/2019	450	3	Southwest	356	997	TRAFFIC COLLISION	3036 3004 3026 3101 4003	22.0	M	H	101.
1	190319680	08/30/2019	08/30/2019	2320	3	Southwest	355	997	TRAFFIC COLLISION	3037 3006 3028 3030 3039 3101 4003	30.0	F	H	101.
2	190413769	08/25/2019	08/25/2019	545	4	Hollenbeck	422	997	TRAFFIC COLLISION	3101 3401 3701 3006 3030	NaN	M	X	101.
3	190127578	11/20/2019	11/20/2019	350	1	Central	128	997	TRAFFIC COLLISION	0605 3101 3401 3701 3011 3034	21.0	M	H	101.
4	190319695	08/30/2019	08/30/2019	2100	3	Southwest	374	997	TRAFFIC COLLISION	0605 4025 3037 3004 3025 3101	49.0	M	B	101.

In [3]:
```
# look at the fields and data types
df.info()

# see null count
df.isnull().sum()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 569389 entries, 0 to 569388
Data columns (total 18 columns):
 #   Column                  Non-Null Count   Dtype
---  ------                  --------------   -----
 0   DR Number               569389 non-null  int64
 1   Date Reported           569389 non-null  object
 2   Date Occurred           569389 non-null  object
 3   Time Occurred           569389 non-null  int64
 4   Area ID                 569389 non-null  int64
 5   Area Name               569389 non-null  object
 6   Reporting District      569389 non-null  int64
 7   Crime Code              569389 non-null  int64
 8   Crime Code Description  569389 non-null  object
 9   MO Codes                482030 non-null  object
 10  Victim Age              486086 non-null  float64
 11  Victim Sex              560283 non-null  object
 12  Victim Descent          559389 non-null  object
 13  Premise Code            568427 non-null  float64
 14  Premise Description     568426 non-null  object
 15  Address                 569389 non-null  object
 16  Cross Street            542236 non-null  object
 17  Location                569389 non-null  object
dtypes: float64(2), int64(5), object(11)
memory usage: 78.2+ MB
```

Out[3]:
```
DR Number                     0
Date Reported                 0
Date Occurred                 0
Time Occurred                 0
Area ID                       0
Area Name                     0
Reporting District            0
Crime Code                    0
Crime Code Description        0
MO Codes                  87359
Victim Age                83303
Victim Sex                 9106
Victim Descent            10000
Premise Code                962
Premise Description         963
Address                       0
Cross Street              27153
Location                      0
dtype: int64
```

Observations from first five records and .info()

- DR Number should be unique
- Date Reported and Date Occurred are mm/dd/yyyy - not Date fields, but Objects
- Is Crime Code all 997?
- Is Crime Code Description all TRAFFIC COLLISION?
- MO Codes are more than one in the field separated by a space. What do they mean?
- Victim age is a float and there are nulls
- Victim Descent is one character code
- Are Premise code and Premise Description all the same?
- Location has lat/long in same field separated by comma

What to do with the data?

The cleaning and prepping of any data depends on the purpose of the project. Below are some items that we want to analyze with this data:

- Has Los Angeles traffic incidents increased or decreased over time?
- With the Covid pandemic in play most of 2020 and some of 2021, is there a decrease in traffic accidents in this time?
- How do the different areas in L.A. differ in accidents?
- Does the number of traffic accidents vary by Age? By Gender? By Descent?

This week the focus is on cleaning and prepping data and in another Exercise this quarter, you will be answering these questions.

In [4]:
```
# view data without a scroll bar
print(df.head())
```

```
   DR Number Date Reported Date Occurred  Time Occurred  Area ID   Area Name  \
0  190319651    08/24/2019    08/24/2019            450        3   Southwest
1  190319680    08/30/2019    08/30/2019           2320        3   Southwest
2  190413769    08/25/2019    08/25/2019            545        4  Hollenbeck
3  190127578    11/20/2019    11/20/2019            350        1     Central
4  190319695    08/30/2019    08/30/2019           2100        3   Southwest

   Reporting District  Crime Code Crime Code Description  \
0                 356         997      TRAFFIC COLLISION
1                 355         997      TRAFFIC COLLISION
2                 422         997      TRAFFIC COLLISION
3                 128         997      TRAFFIC COLLISION
4                 374         997      TRAFFIC COLLISION

                              MO Codes  Victim Age Victim Sex Victim Descent  \
0            3036 3004 3026 3101 4003        22.0          M              H
1  3037 3006 3028 3030 3039 3101 4003        30.0          F              H
2            3101 3401 3701 3006 3030         NaN          M              X
3       0605 3101 3401 3701 3011 3034        21.0          M              H
4       0605 4025 3037 3004 3025 3101        49.0          M              B

   Premise Code Premise Description                          Address  \
0         101.0              STREET  JEFFERSON                     BL
1         101.0              STREET  JEFFERSON                     BL
2         101.0              STREET                     N  BROADWAY
3         101.0              STREET                                1ST
4         101.0              STREET            MARTIN LUTHER KING JR

                          Cross Street               Location
0     NORMANDIE                     AV  (34.0255, -118.3002)
1                            W  WESTERN  (34.0256, -118.3089)
2  W  EASTLAKE                      AV  (34.0738, -118.2078)
3                              CENTRAL  (34.0492, -118.2391)
4     ARLINGTON                     AV  (34.0108, -118.3182)
```

In [5]:
```
# Are there any duplicates
df['DR Number'].nunique()

# comparing rows to each other shows there are duplicates
df.duplicated().sum()
```

Out[5]: 566747

Out[5]: 2642

Using Pandas documentation

In this notebook, you will see links to Pandas documentation. Even though you may be familiar with the code being shown, it is worth revisiting the documentation to see if there are other features availabe that could be useful.

.value_counts is very commonly used, but what parameters are available that you have not used yet?

Reference: # https://pandas.pydata.org/docs/reference/api/pandas.DataFrame.value_counts.html

In [6]:
```
# Isolate year to see what is included in the data
# Note that we are creating a new column in the dataframe
df['Year'] = pd.to_datetime(df['Date Occurred']).dt.year

# sort = False keeps the order of the item being counted
df['Year'].value_counts(sort = False)
```

Out[6]:
```
2019    56880
2020    42567
2010    45341
2012    45592
2014    47166
2015    52754
2016    56826
2017    57996
2018    57438
2013    45246
2011    45500
2021    16083
Name: Year, dtype: int64
```

In [7]:
```
# Area Name looks good - not sure about Reporting District
df['Area Name'].value_counts()

# Over 1000 different reporting districts
df['Reporting District'].nunique()
df['Reporting District'].value_counts()
```

Out[7]:
```
77th Street    37822
Southwest      33550
Wilshire       32133
N Hollywood    29997
West LA        29927
Olympic        29829
Pacific        29625
Newton         29112
Van Nuys       28373
Devonshire     27837
West Valley    27510
Hollywood      27495
Northeast      25465
Mission        24936
Southeast      24605
Topanga        24235
Central        23314
Rampart        21437
Harbor         21430
Hollenbeck     20678
Foothill       20079
Name: Area Name, dtype: int64
```

Out[7]: 1332

Out[7]:
```
645     2574
1494    2364
1309    2274
111     2228
646     2224
        ...
973        1
694        1
1697       1
962        1
2199       1
Name: Reporting District, Length: 1332, dtype: int64
```

In [8]:
```
# all the same, we can drop these columns later
df['Crime Code'].value_counts()
df['Crime Code Description'].value_counts()
```

Out[8]:
```
997    569389
Name: Crime Code, dtype: int64
```

Out[8]:
```
TRAFFIC COLLISION    569389
Name: Crime Code Description, dtype: int64
```

In [9]:
```
# 82945 null ages and there is some dirty data in ages
df['Victim Age'].value_counts(dropna = False) #will show NaN too

# ten year old driver!
df['Victim Age'].describe()

df['Victim Age'].hist()
```

Out[9]:
```
NaN     83303
30.0    16710
25.0    15309
27.0    13654
28.0    13550
        ...
10.0       50
11.0       46
96.0       45
98.0       39
97.0       35
Name: Victim Age, Length: 91, dtype: int64
```

Out[9]:
```
count    486086.000000
mean         41.227268
std          16.375172
min          10.000000
25%          28.000000
50%          38.000000
75%          51.000000
max          99.000000
Name: Victim Age, dtype: float64
```

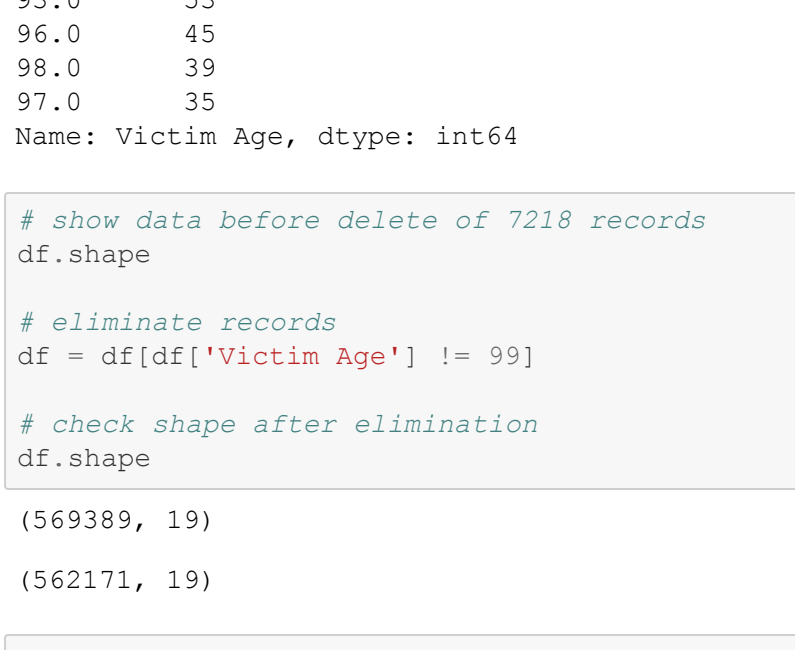
Out[9]: <matplotlib.axes._subplots.AxesSubplot at 0x1228ec0b8>

Los Angeles 2020 census data

https://planning.lacity.org/resources/demographics

In [10]:
```
# visually look at data
df.boxplot(column = 'Victim Age')
```

Out[10]: <matplotlib.axes._subplots.AxesSubplot at 0x121cbf2b0>



Victim Age analysis

- The histogram shows a blip near 100
- The boxplot shows potential outliers at the higher end of age
- After running the cell below, you can see that the age of 99 appears to be dirty data. Since there are 39 people that are 98 years old, there are bound to be valid 99 years olds, but we don't know which ones, so we will eliminate 99 year olds from our data.

In [11]:
```
# create a subset of data to check out the ages
temp = df[df['Victim Age'] > 90]
len(temp)
temp['Victim Age'].value_counts()
```

Out[11]: 7693

Out[11]:
```
99.0    7218
91.0     101
92.0      90
94.0      57
95.0      55
93.0      53
96.0      45
98.0      39
97.0      35
Name: Victim Age, dtype: int64
```

In [12]:
```
# show data before delete of 7218 records
df.shape

# eliminate records
df = df[df['Victim Age'] != 99]

# check shape after elimination
df.shape
```

Out[12]: (569389, 19)

Out[12]: (562171, 19)

In [13]:
```
# look at victim gender values
df['Victim Sex'].value_counts(dropna = False)

# what is the precentage breakdown? Use normalize = True
df['Victim Sex'].value_counts(normalize = True, dropna = False)

# X is Unknown
# H and N are dirty data
```

Out[13]:
```
M      326740
F      211213
X       15258
NaN      8797
H         152
N          11
Name: Victim Sex, dtype: int64
```

Out[13]:
```
M      0.581211
F      0.375710
X      0.027141
NaN    0.015648
H      0.000270
N      0.000020
Name: Victim Sex, dtype: float64
```

Los Angeles 2020 census data

Descent Codes used in LA Traffic data

In [14]:
```
# look at descent by percent
df['Victim Descent'].value_counts(normalize = True, dropna = False)

# and by counts
df['Victim Descent'].value_counts()
```

Out[14]:
```
H      0.376154
W      0.232102
O      0.139420
B      0.133851
X      0.049316
A      0.036729
NaN    0.017214
K      0.007859
F      0.003001
C      0.001519
U      0.000683
J      0.000589
V      0.000418
P      0.000359
I      0.000315
Z      0.000279
G      0.000085
S      0.000062
D      0.000028
L      0.000012
-      0.000004
Name: Victim Descent, dtype: float64
```

Out[14]:
```
H    211463
W    130481
O     78378
B     75247
X     27724
A     20648
K      4418
F      1687
C       854
U       384
J       331
V       235
P       202
I       177
Z       157
G        48
S        35
D        16
L         7
-         2
Name: Victim Descent, dtype: int64
```

In [15]:
```
# since the majority are the same, we can drop these columns later
df['Premise Code'].value_counts()
df['Premise Description'].value_counts()
```

Out[15]:
```
101.0    535982
108.0     17565
102.0      2759
103.0       968
104.0       959
          ...
251.0         1
216.0         1
208.0         1
933.0         1
135.0         1
Name: Premise Code, Length: 120, dtype: int64
```

Out[15]:
```
STREET                          535982
PARKING LOT                      17565
SIDEWALK                          2759
ALLEY                              968
DRIVEWAY                           959
                                 ...
CHECK CASHING*                       1
AUTO SALES LOT                       1
SWAP MEET                            1
AUTO SUPPLY STORE*                   1
MTA PROPERTY OR PARKING LOT          1
Name: Premise Description, Length: 119, dtype: int64
```

In [16]:
```
# have some null locations. Lat and Long are separated by a comma.
df['Location'].value_counts()
```

Out[16]:
```
(0.0, 0.0)               668
(33.9892, -118.3089)     583
(34.2012, -118.4662)     527
(33.9601, -118.2827)     519
(34.2216, -118.4488)     510
                        ...
(34.2542, -118.4294)       1
(34.1975, -118.512)        1
(34.1776, -118.4072)       1
(33.9864, -118.4151)       1
(34.2495, -118.3707)       1
Name: Location, Length: 49248, dtype: int64
```

Requirements: Answer the homework questions below. Add cells as needed. Make sure all cells are run before you download to HTML.
NOTE that many questions have multiple steps to complete.

Requirement 1: (5 points) Drop all unneeded columns: Date Reported, Area ID, Crime Code, Crime Code Description, Premise Code, Premise Description, Address and Cross Street. You should end up with 11 columns.
Show the dataframe shape before deleting columns and after deleting columns.
Reference: https://pandas.pydata.org/docs/reference/api/pandas.DataFrame.drop.html

In [17]:
```
# show dataframe before drop
df.shape

# drop columns
df.drop(['Date Reported','Area ID', 'Crime Code', 'Crime Code Description', 'Premise Code','Premise Des
cription',
        'Address', 'Cross Street'], axis = 1, inplace = True)
#show dataframe after drop
df.shape
```

Out[17]: (562171, 19)

Out[17]: (562171, 11)

Requirement 2: (5 points) Drop the duplicates.
Show the shape of your dataframe before the drop and after the drop. Your dataframe should decrease by 2594 records. *Reference: https://pandas.pydata.org/docs/reference/api/pandas.DataFrame.drop_duplicates.html*

In [18]:
```
# show df shape before
df.shape

# drop duplicates
df = df.drop_duplicates() # could have done a new dataframe

# show df shape after
df.shape
```

Out[18]: (562171, 11)

Out[18]: (559577, 11)

Requirement 3: (5 points) Rename columns to make them more clear and to prepare them for being loaded into a SQL database:
1. Rename DR Number to DR_Number 2. Date Occurred to Date 3. Area Name to Division 4. Victim Age to Age 5. Victim Sex to Gender 6. Victim Descent to Descent 7. MO Codes to MO_Codes 8. Reporting District to Reporting_District After you have completed the rename, show your dataframe with .info() to show the changes. *Reference: https://pandas.pydata.org/docs/reference/api/pandas.DataFrame.rename.html*

In [19]:
```
df = df.rename(columns={"DR Number": "DR_Number", "Date Occurred": "Date", "Area Name": "Division", "Vi
ctim Age": "Age",
                    "Victim Sex": "Gender", "Victim Descent": "Descent", "MO Codes": "MO_Codes",
                     "Reporting District": "Reporting_District"})

df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 559577 entries, 0 to 566746
Data columns (total 11 columns):
 #   Column              Non-Null Count   Dtype
---  ------              --------------   -----
 0   DR_Number           559577 non-null  int64
 1   Date                559577 non-null  object
 2   Time Occurred       559577 non-null  int64
 3   Division            559577 non-null  object
 4   Reporting_District  559577 non-null  int64
 5   MO_Codes            473963 non-null  object
 6   Age                 476632 non-null  float64
 7   Gender              550807 non-null  object
 8   Descent             549933 non-null  object
 9   Location            559577 non-null  object
 10  Year                559577 non-null  int64
dtypes: float64(1), int64(4), object(6)
memory usage: 51.2+ MB
```

Requirement 4: (5 points) Create new columns into your dataframe:
1. Create a month field from Date field 2. Create a day field from Date field 3. Create an hour field from Time Occurred 4. Drop Time Occured field 5. We will keep the Date field as it might be useful in our analysis later. Show your dataframe with .info() to show the column headers.

In [20]:
```
df.head()

# change Date from string to timestamp
df["Date"] = pd.to_datetime(df["Date"])

# create month and day fields from timestamp
df['Month'] = df['Date'].dt.month
df['Day'] = df['Date'].dt.day
```

Out[20]:

	DR_Number	Date	Time Occurred	Division	Reporting_District	MO_Codes	Age	Gender	Descent	Location	Year
0	190319651	08/24/2019	450	Southwest	356	3036 3004 3026 3101 4003	22.0	M	H	(34.0255, -118.3002)	2019
1	190319680	08/30/2019	2320	Southwest	355	3037 3006 3028 3030 3039 3101 4003	30.0	F	H	(34.0256, -118.3089)	2019
2	190413769	08/25/2019	545	Hollenbeck	422	3101 3401 3701 3006 3030	NaN	M	X	(34.0738, -118.2078)	2019
3	190127578	11/20/2019	350	Central	128	0605 3101 3401 3701 3011 3034	21.0	M	H	(34.0492, -118.2391)	2019
4	190319695	08/30/2019	2100	Southwest	374	0605 4025 3037 3004 3025 3101	49.0	M	B	(34.0108, -118.3182)	2019

In [21]:
```
# create hour field
df['Hour'] = df['Time Occurred'].astype(str).str[:-2]

# confirm
df.head()
```

Out[21]:

	DR_Number	Date	Time Occurred	Division	Reporting_District	MO_Codes	Age	Gender	Descent	Location	Year	Month	Day	Hour
0	190319651	2019-08-24	450	Southwest	356	3036 3004 3026 3101 4003	22.0	M	H	(34.0255, -118.3002)	2019	8	24	4
1	190319680	2019-08-30	2320	Southwest	355	3037 3006 3028 3030 3039 3101 4003	30.0	F	H	(34.0256, -118.3089)	2019	8	30	23
2	190413769	2019-08-25	545	Hollenbeck	422	3101 3401 3701 3006 3030	NaN	M	X	(34.0738, -118.2078)	2019	8	25	5
3	190127578	2019-11-20	350	Central	128	0605 3101 3401 3701 3011 3034	21.0	M	H	(34.0492, -118.2391)	2019	11	20	3
4	190319695	2019-08-30	2100	Southwest	374	0605 4025 3037 3004 3025 3101	49.0	M	B	(34.0108, -118.3182)	2019	8	30	21

In [22]:
```
# drop the time occurred field
df.drop('Time Occurred', axis = 1, inplace = True)

# confirm
df.head()
```

Out[22]:

	DR_Number	Date	Division	Reporting_District	MO_Codes	Age	Gender	Descent	Location	Year	Month	Day	Hour
0	190319651	2019-08-24	Southwest	356	3036 3004 3026 3101 4003	22.0	M	H	(34.0255, -118.3002)	2019	8	24	4
1	190319680	2019-08-30	Southwest	355	3037 3006 3028 3030 3039 3101 4003	30.0	F	H	(34.0256, -118.3089)	2019	8	30	23
2	190413769	2019-08-25	Hollenbeck	422	3101 3401 3701 3006 3030	NaN	M	X	(34.0738, -118.2078)	2019	8	25	5
3	190127578	2019-11-20	Central	128	0605 3101 3401 3701 3011 3034	21.0	M	H	(34.0492, -118.2391)	2019	11	20	3
4	190319695	2019-08-30	Southwest	374	0605 4025 3037 3004 3025 3101	49.0	M	B	(34.0108, -118.3182)	2019	8	30	21

Requirement 5: (5 points) Fix the victim Age. Hint: do the fix to Age in the order listed below. Make sure to run the cell that creates the `imputeAge` field before you do any other changes. 1. Show your dataframe before any changes with .info() 2. Replace the nulls with the mean of Age 3. The ages should be valid driving ages of 16 and over. 4. Convert Age to an integer. 4. Show your dataframe with .info() *Reference: https://pandas.pydata.org/docs/reference/api/pandas.DataFrame.fillna.html*

In [23]:
```
# run this cell to create a new field in our dataframe that will track ages we have imputed
# change the dataframe name to match your current dataframe

# if the Age is over 9 then imputeAge will be False, otherwise it will be True
df['imputeAge'] = np.where(df['Age'] > 9, False, True)
df.head()
df.info()
```

Out[23]:

	DR_Number	Date	Division	Reporting_District	MO_Codes	Age	Gender	Descent	Location	Year	Month	Day	Hour	imputeAge
0	190319651	2019-08-24	Southwest	356	3036 3004 3026 3101 4003	22.0	M	H	(34.0255, -118.3002)	2019	8	24	4	False
1	190319680	2019-08-30	Southwest	355	3037 3006 3028 3030 3039 3101 4003	30.0	F	H	(34.0256, -118.3089)	2019	8	30	23	False
2	190413769	2019-08-25	Hollenbeck	422	3101 3401 3701 3006 3030	NaN	M	X	(34.0738, -118.2078)	2019	8	25	5	True
3	190127578	2019-11-20	Central	128	0605 3101 3401 3701 3011 3034	21.0	M	H	(34.0492, -118.2391)	2019	11	20	3	False
4	190319695	2019-08-30	Southwest	374	0605 4025 3037 3004 3025 3101	49.0	M	B	(34.0108, -118.3182)	2019	8	30	21	False

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 559577 entries, 0 to 566746
Data columns (total 14 columns):
 #   Column              Non-Null Count   Dtype
---  ------              --------------   -----
 0   DR_Number           559577 non-null  int64
 1   Date                559577 non-null  datetime64[ns]
 2   Division            559577 non-null  object
 3   Reporting_District  559577 non-null  int64
 4   MO_Codes            473963 non-null  object
 5   Age                 476632 non-null  float64
 6   Gender              550807 non-null  object
 7   Descent             549933 non-null  object
 8   Location            559577 non-null  object
 9   Year                559577 non-null  int64
 10  Month               559577 non-null  int64
 11  Day                 559577 non-null  int64
 12  Hour                559577 non-null  object
 13  imputeAge           559577 non-null  bool
dtypes: bool(1), datetime64[ns](1), float64(1), int64(5), object(6)
memory usage: 60.3+ MB
```

In [24]:
```
# compute mean age
mean_age = df['Age'].mean(axis='index')

# replace na with mean age
df['Age'] = df['Age'].fillna(mean_age)

# show after
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 559577 entries, 0 to 566746
Data columns (total 14 columns):
 #   Column              Non-Null Count   Dtype
---  ------              --------------   -----
 0   DR_Number           559577 non-null  int64
 1   Date                559577 non-null  datetime64[ns]
 2   Division            559577 non-null  object
 3   Reporting_District  559577 non-null  int64
 4   MO_Codes            473963 non-null  object
 5   Age                 559577 non-null  float64
 6   Gender              550807 non-null  object
 7   Descent             549933 non-null  object
 8   Location            559577 non-null  object
 9   Year                559577 non-null  int64
 10  Month               559577 non-null  int64
 11  Day                 559577 non-null  int64
 12  Hour                559577 non-null  object
 13  imputeAge           559577 non-null  bool
dtypes: bool(1), datetime64[ns](1), float64(1), int64(5), object(6)
memory usage: 60.3+ MB
```

In [25]:
```
# remove instances with age < 16
df = df.drop(df[df.Age < 16].index)

# show after
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 559129 entries, 0 to 566746
Data columns (total 14 columns):
 #   Column              Non-Null Count   Dtype
---  ------              --------------   -----
 0   DR_Number           559129 non-null  int64
 1   Date                559129 non-null  datetime64[ns]
 2   Division            559129 non-null  object
 3   Reporting_District  559129 non-null  int64
 4   MO_Codes            473522 non-null  object
 5   Age                 559129 non-null  float64
 6   Gender              550363 non-null  object
 7   Descent             549489 non-null  object
 8   Location            559129 non-null  object
 9   Year                559129 non-null  int64
 10  Month               559129 non-null  int64
 11  Day                 559129 non-null  int64
 12  Hour                559129 non-null  object
 13  imputeAge           559129 non-null  bool
dtypes: bool(1), datetime64[ns](1), float64(1), int64(5), object(6)
memory usage: 60.3+ MB
```

In [26]:
```
# confirm float type before
type(df['Age'][0])

# convert age to integer
df['Age'] = df['Age'].astype(int)

# confirm int type after
type(df['Age'][0])

# show after
df.info()
```

Out[26]: numpy.float64

Out[26]: numpy.int64

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 559129 entries, 0 to 566746
Data columns (total 14 columns):
 #   Column              Non-Null Count   Dtype
---  ------              --------------   -----
 0   DR_Number           559129 non-null  int64
 1   Date                559129 non-null  datetime64[ns]
 2   Division            559129 non-null  object
 3   Reporting_District  559129 non-null  int64
 4   MO_Codes            473522 non-null  object
 5   Age                 559129 non-null  int64
 6   Gender              550363 non-null  object
 7   Descent             549489 non-null  object
 8   Location            559129 non-null  object
 9   Year                559129 non-null  int64
 10  Month               559129 non-null  int64
 11  Day                 559129 non-null  int64
 12  Hour                559129 non-null  object
 13  imputeAge           559129 non-null  bool
dtypes: bool(1), datetime64[ns](1), int64(6), object(6)
memory usage: 76.4+ MB
```

Requirement 6: (5 points) Fix the Gender field. 1. The values should be M, F and X so drop the rows with H, N and null values. 2. Rename M to Male, F to Female and X to Other. 3. Show value counts for Gender column after the data has been cleaned. *Reference: https://pandas.pydata.org/docs/reference/api/pandas.DataFrame.replace.html*

In [27]:
```
# show before
df.info()

# remove instances with gender = H, N, Null
df = df.drop(df[df.Gender == 'H'].index)
df = df.drop(df[df.Gender == 'N'].index)
df = df.dropna(subset=['Gender'])

# show after
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 559129 entries, 0 to 566746
Data columns (total 14 columns):
 #   Column              Non-Null Count   Dtype
---  ------              --------------   -----
 0   DR_Number           559129 non-null  int64
 1   Date                559129 non-null  datetime64[ns]
 2   Division            559129 non-null  object
 3   Reporting_District  559129 non-null  int64
 4   MO_Codes            473522 non-null  object
 5   Age                 559129 non-null  int64
 6   Gender              550363 non-null  object
 7   Descent             549489 non-null  object
 8   Location            559129 non-null  object
 9   Year                559129 non-null  int64
 10  Month               559129 non-null  int64
 11  Day                 559129 non-null  int64
 12  Hour                559129 non-null  object
 13  imputeAge           559129 non-null  bool
dtypes: bool(1), datetime64[ns](1), int64(6), object(6)
memory usage: 76.4+ MB
<class 'pandas.core.frame.DataFrame'>
Int64Index: 550202 entries, 0 to 566746
Data columns (total 14 columns):
 #   Column              Non-Null Count   Dtype
---  ------              --------------   -----
 0   DR_Number           550202 non-null  int64
 1   Date                550202 non-null  datetime64[ns]
 2   Division            550202 non-null  object
 3   Reporting_District  550202 non-null  int64
 4   MO_Codes            465652 non-null  object
 5   Age                 550202 non-null  int64
 6   Gender              550202 non-null  object
 7   Descent             549317 non-null  object
 8   Location            550202 non-null  object
 9   Year                550202 non-null  int64
 10  Month               550202 non-null  int64
 11  Day                 550202 non-null  int64
 12  Hour                550202 non-null  object
 13  imputeAge           550202 non-null  bool
dtypes: bool(1), datetime64[ns](1), int64(6), object(6)
memory usage: 59.3+ MB
```

In [28]:
```
# change MFX to male, female, other
df['Gender'].replace(['M', 'F', 'X'], ['Male', 'Female', 'Other'], inplace = True)

# show after
df.head()

# show value counts for gender
df['Gender'].value_counts()
```

Out[28]:

	DR_Number	Date	Division	Reporting_District	MO_Codes	Age	Gender	Descent	Location	Year	Month	Day	Hour	imputeAge
0	190319651	2019-08-24	Southwest	356	3036 3004 3026 3101 4003	22	Male	H	(34.0255, -118.3002)	2019	8	24	4	False
1	190319680	2019-08-30	Southwest	355	3037 3006 3028 3030 3039 3101 4003	30	Female	H	(34.0256, -118.3089)	2019	8	30	23	False
2	190413769	2019-08-25	Hollenbeck	422	3101 3401 3701 3006 3030	40	Male	X	(34.0738, -118.2078)	2019	8	25	5	True
3	190127578	2019-11-20	Central	128	0605 3101 3401 3701 3011 3034	21	Male	H	(34.0492, -118.2391)	2019	11	20	3	False
4	190319695	2019-08-30	Southwest	374	0605 4025 3037 3004 3025 3101	49	Male	B	(34.0108, -118.3182)	2019	8	30	21	False

Out[28]:
```
Male      324885
Female    210125
Other      15192
Name: Gender, dtype: int64
```

Requirement 7: (5 points) For cleaning the Victim Descent, we will follow the guidelines of Pew Research. 1. Change C (Chinese), Z (Asian Indian), F (Filipino), V (Vietnamese), K (Korean), J (Japanese), D (Cambodian), L (Laotion) into A (Asian) 2. Change the I, U, G, S, and P into O (Other) 3. Change the - (2 records with a dash) and the NaN into X (Unknown) 4. Rename the values in this column: H is Hispanic, W is White, O is Other, B is Black, X is Unknown and A is Asian 5. Do a values_count() on the Descent field to show the new breakdown. ![image.png](
iVBORw0KGgoAAAANSUhEUgAAAPgAAABNCAYAAACL1qnNAAAgAEIEQVR4nOy9d7wdxXnw/53dPef2pIskXfXeO0gClRAdATZgMBjb4Ap
Reference: https://www.pewresearch.org/fact-tank/2021/04/29/key-facts-about-asian-origin-groups-in-the-u-s/

In [29]:
```
df.head()

# change descent values
df['Descent'].replace(['C', 'Z', 'F', 'V', 'K', 'J', 'D', 'L', 'A'], 'Asian', inplace=True)
df['Descent'].replace(['I', 'U', 'G', 'S', 'P', 'O'], 'Other', inplace=True)
df['Descent'].replace(['-', 'NaN', 'X'], 'Unknown', inplace=True)
df['Descent'].replace('H', 'Hispanic', inplace=True)
df['Descent'].replace('W', 'White', inplace=True)
df['Descent'].replace('B', 'Black', inplace=True)

df.head()
```

Out[29]:

	DR_Number	Date	Division	Reporting_District	MO_Codes	Age	Gender	Descent	Location	Year	Month	Day	Hour	imputeAge
0	190319651	2019-08-24	Southwest	356	3036 3004 3026 3101 4003	22	Male	H	(34.0255, -118.3002)	2019	8	24	4	False
1	190319680	2019-08-30	Southwest	355	3037 3006 3028 3030 3039 3101 4003	30	Female	H	(34.0256, -118.3089)	2019	8	30	23	False
2	190413769	2019-08-25	Hollenbeck	422	3101 3401 3701 3006 3030	40	Male	X	(34.0738, -118.2078)	2019	8	25	5	True
3	190127578	2019-11-20	Central	128	0605 3101 3401 3701 3011 3034	21	Male	H	(34.0492, -118.2391)	2019	11	20	3	False
4	190319695	2019-08-30	Southwest	374	0605 4025 3037 3004 3025 3101	49	Male	B	(34.0108, -118.3182)	2019	8	30	21	False

Out[29]:

	DR_Number	Date	Division	Reporting_District	MO_Codes	Age	Gender	Descent	Location	Year	Month	Day	Hour	imputeAge
0	190319651	2019-08-24	Southwest	356	3036 3004 3026 3101 4003	22	Male	Hispanic	(34.0255, -118.3002)	2019	8	24	4	False
1	190319680	2019-08-30	Southwest	355	3037 3006 3028 3030 3039 3101 4003	30	Female	Hispanic	(34.0256, -118.3089)	2019	8	30	23	False
2	190413769	2019-08-25	Hollenbeck	422	3101 3401 3701 3006 3030	40	Male	Unknown	(34.0738, -118.2078)	2019	8	25	5	True
3	190127578	2019-11-20	Central	128	0605 3101 3401 3701 3011 3034	21	Male	Hispanic	(34.0492, -118.2391)	2019	11	20	3	False
4	190319695	2019-08-30	Southwest	374	0605 4025 3037 3004 3025 3101	49	Male	Black	(34.0108, -118.3182)	2019	8	30	21	False

In [30]:
```
# show a value count for descent
df['Descent'].value_counts()
```

Out[30]:
```
Hispanic    210118
White       129838
Other        78796
Black        74787
Asian        28184
Unknown      27594
Name: Descent, dtype: int64
```

Requirement 8: (5 points) The Location field contains Latitude and Longitude separated by a comma. 1. Create two new fields in the your dataframe - one for Latitude and one for Longitude. Neither of these fields should contain a parenthesis or comma from the original field. 2. Once you have these two new columns, drop the Location field. 3. Drop the rows that have 0.00 for both Latitude and Longitudes. You can do this before or after you split the field. 3. Show your dataframe with .info to show the new columns. *Reference: https://docs.python.org/2.5/lib/string-methods.html*

In [31]:
```
df.head()

# create lat and lon fields
df['Latitude'] = df.Location.str.strip('()').str.split(',').str[0]
df['Longitude'] = df.Location.str.strip('()').str.split(',').str[1]

df.head()
```

Out[31]:

	DR_Number	Date	Division	Reporting_District	MO_Codes	Age	Gender	Descent	Location	Year	Month	Day	Hour	imputeAge
0	190319651	2019-08-24	Southwest	356	3036 3004 3026 3101 4003	22	Male	Hispanic	(34.0255, -118.3002)	2019	8	24	4	False
1	190319680	2019-08-30	Southwest	355	3037 3006 3028 3030 3039 3101 4003	30	Female	Hispanic	(34.0256, -118.3089)	2019	8	30	23	False
2	190413769	2019-08-25	Hollenbeck	422	3101 3401 3701 3006 3030	40	Male	Unknown	(34.0738, -118.2078)	2019	8	25	5	True
3	190127578	2019-11-20	Central	128	0605 3101 3401 3701 3011 3034	21	Male	Hispanic	(34.0492, -118.2391)	2019	11	20	3	False
4	190319695	2019-08-30	Southwest	374	0605 4025 3037 3004 3025 3101	49	Male	Black	(34.0108, -118.3182)	2019	8	30	21	False

Out[31]:

	DR_Number	Date	Division	Reporting_District	MO_Codes	Age	Gender	Descent	Location	Year	Month	Day	Hour	imputeAge
0	190319651	2019-08-24	Southwest	356	3036 3004 3026 3101 4003	22	Male	Hispanic	(34.0255, -118.3002)	2019	8	24	4	False
1	190319680	2019-08-30	Southwest	355	3037 3006 3028 3030 3039 3101 4003	30	Female	Hispanic	(34.0256, -118.3089)	2019	8	30	23	False
2	190413769	2019-08-25	Hollenbeck	422	3101 3401 3701 3006 3030	40	Male	Unknown	(34.0738, -118.2078)	2019	8	25	5	True
3	190127578	2019-11-20	Central	128	0605 3101 3401 3701 3011 3034	21	Male	Hispanic	(34.0492, -118.2391)	2019	11	20	3	False
4	190319695	2019-08-30	Southwest	374	0605 4025 3037 3004 3025 3101	49	Male	Black	(34.0108, -118.3182)	2019	8	30	21	False

In [32]:
```
# drop location field
df.drop('Location', axis = 1, inplace = True)

df.head()
```

Out[32]:

	DR_Number	Date	Division	Reporting_District	MO_Codes	Age	Gender	Descent	Year	Month	Day	Hour	imputeAge	Latitude
0	190319651	2019-08-24	Southwest	356	3036 3004 3026 3101 4003	22	Male	Hispanic	2019	8	24	4	False	34.0255
1	190319680	2019-08-30	Southwest	355	3037 3006 3028 3030 3039 3101 4003	30	Female	Hispanic	2019	8	30	23	False	34.0256
2	190413769	2019-08-25	Hollenbeck	422	3101 3401 3701 3006 3030	40	Male	Unknown	2019	8	25	5	True	34.0738
3	190127578	2019-11-20	Central	128	0605 3101 3401 3701 3011 3034	21	Male	Hispanic	2019	11	20	3	False	34.0492
4	190319695	2019-08-30	Southwest	374	0605 4025 3037 3004 3025 3101	49	Male	Black	2019	8	30	21	False	34.0108

In [33]:
```
df.info()

# drop lat and lon of (0,0)
df = df.drop(df[(df.Latitude == '0.00') & (df.Longitude == '0.00')].index)

df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 550202 entries, 0 to 566746
Data columns (total 15 columns):
 #   Column              Non-Null Count   Dtype
---  ------              --------------   -----
 0   DR_Number           550202 non-null  int64
 1   Date                550202 non-null  datetime64[ns]
 2   Division            550202 non-null  object
 3   Reporting_District  550202 non-null  int64
 4   MO_Codes            465652 non-null  object
 5   Age                 550202 non-null  int64
 6   Gender              550202 non-null  object
 7   Descent             549317 non-null  object
 8   Year                550202 non-null  int64
 9   Month               550202 non-null  int64
 10  Day                 550202 non-null  int64
 11  Hour                550202 non-null  object
 12  imputeAge           550202 non-null  bool
 13  Latitude            550202 non-null  object
 14  Longitude           550202 non-null  object
dtypes: bool(1), datetime64[ns](1), int64(6), object(7)
memory usage: 63.5+ MB
<class 'pandas.core.frame.DataFrame'>
Int64Index: 550202 entries, 0 to 566746
Data columns (total 15 columns):
 #   Column              Non-Null Count   Dtype
---  ------              --------------   -----
 0   DR_Number           550202 non-null  int64
 1   Date                550202 non-null  datetime64[ns]
 2   Division            550202 non-null  object
 3   Reporting_District  550202 non-null  int64
 4   MO_Codes            465652 non-null  object
 5   Age                 550202 non-null  int64
 6   Gender              550202 non-null  object
 7   Descent             549317 non-null  object
 8   Year                550202 non-null  int64
 9   Month               550202 non-null  int64
 10  Day                 550202 non-null  int64
 11  Hour                550202 non-null  object
 12  imputeAge           550202 non-null  bool
 13  Latitude            550202 non-null  object
 14  Longitude           550202 non-null  object
dtypes: bool(1), datetime64[ns](1), int64(6), object(7)
memory usage: 79.6+ MB
```

Last thing to do:

Split out the MO_Codes into its own dataframe with only two fields: DR_Number and MO_Codes. The code has been provided to you and all you have to do is run the cells.

Note - this code uses a dataframe called df_new. You can change it to match your dataframe name.

In [34]:
```
# looking at MO codes shows many codes per incident
# let's separate these out and put into a separate dataframe for later use
df['MO_Codes'].head(10)
```

Out[34]:
```
0              3036 3004 3026 3101 4003
1    3037 3006 3028 3030 3039 3101 4003
2              3101 3401 3701 3006 3030
3         0605 3101 3401 3701 3011 3034
4         0605 4025 3037 3004 3025 3101
5         3101 3401 3701 3003 3025 3029
6         0605 3037 3003 3026 3029 3101
7                   4025 3037 3002 3028
8              3036 4025 3004 3026 3101
9              3101 3401 3701 3006 3030
Name: MO_Codes, dtype: object
```

In [35]:
```
# let's use pandas explode to separate field:
# https://pandas.pydata.org/docs/reference/api/pandas.DataFrame.explode.html
mo = df[['DR_Number','MO_Codes']]
mo.shape
mo = mo.dropna()
mo.shape

mo["MO_Codes"] = mo["MO_Codes"].str.split()
mo_df = mo.explode("MO_Codes")
mo_df.head(10)
mo_df["MO_Codes"].value_counts()
mo_df.info()
```

Out[35]: (550202, 2)

Out[35]: (465652, 2)

Out[35]:

	DR_Number	MO_Codes
0	190319651	3036
0	190319651	3004
0	190319651	3026
0	190319651	3101
0	190319651	4003
1	190319680	3037
1	190319680	3006
1	190319680	3028
1	190319680	3030
1	190319680	3039

Out[35]:
```
3101    402960
3701    328080
3401    328022
3004    243174
3037    212564
         ...
0446         1
1207         1
1214         1
0371         1
0450         1
Name: MO_Codes, Length: 330, dtype: int64

<class 'pandas.core.frame.DataFrame'>
Int64Index: 3036665 entries, 0 to 566746
Data columns (total 2 columns):
 #   Column     Dtype
---  ------     -----
 0   DR_Number  int64
 1   MO_Codes   object
dtypes: int64(1), object(1)
memory usage: 69.5+ MB
```

Now that MO_Codes is parsed out into its own dataframe, drop MO_Codes from the original dataframe. Show the final main dataframe with .info().

In [36]:
```
df.drop(columns = ['MO_Codes'], inplace = True)
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 550202 entries, 0 to 566746
Data columns (total 14 columns):
 #   Column              Non-Null Count   Dtype
---  ------              --------------   -----
 0   DR_Number           550202 non-null  int64
 1   Date                550202 non-null  datetime64[ns]
 2   Division            550202 non-null  object
 3   Reporting_District  550202 non-null  int64
 4   Age                 550202 non-null  int64
 5   Gender              550202 non-null  object
 6   Descent             549317 non-null  object
 7   Year                550202 non-null  int64
 8   Month               550202 non-null  int64
 9   Day                 550202 non-null  int64
 10  Hour                550202 non-null  object
 11  imputeAge           550202 non-null  bool
 12  Latitude            550202 non-null  object
 13  Longitude           550202 non-null  object
dtypes: bool(1), datetime64[ns](1), int64(6), object(6)
memory usage: 75.4+ MB
```

Save clean files to new csv files for later use

Note - change this code to match your dataframe name

In [37]:
```
# write out the clean file to be used in Ex 2 Introduction to SQL
df.to_csv('Final Traffic.csv', index = False)
```

In [38]:
```
# write out the clean file to be used in Ex 2 Introduction to SQL
mo.to_csv('MO per accident.csv', index = False)
```