```
from google.colab import files
files.upload()
```

Choose Files No file chosen Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.

```
Saving Automobile_data.csv to Automobile_data.csv
{'Automobile_data.csv': b'symboling,normalized-losses,make,fuel-type,aspiration,num-of-
```

```
import pandas as pd
df = pd.read_csv('Automobile_data.csv')
df.head()
```

	symboling	normalized-losses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels	engine-location
0	3	?	alfa-romero	gas	std	two	convertible	rwd	front
1	3	?	alfa-romero	gas	std	two	convertible	rwd	front
2	1	?	alfa-romero	gas	std	two	hatchback	rwd	front
3	2	164	audi	gas	std	four	sedan	fwd	front
4	2	164	audi	gas	std	four	sedan	4wd	front

```
import numpy as np
df.replace("?", np.nan, inplace = True)
df.head()
```

	symboling	normalized-losses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels	e lo
0	3	NaN	alfa-romero	gas	std	two	convertible	rwd	
1	3	NaN	alfa-romero	gas	std	two	convertible	rwd	
2	1	NaN	alfa-romero	gas	std	two	hatchback	rwd	
3	2	164	audi	gas	std	four	sedan	fwd	
4	2	164	audi	gas	std	four	sedan	4wd	

```
# Evaluating Missing values
missing_data = df.isnull()
missing_data.head(5)
```

	symboling	normalized-losses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels	engine-locatio
0	False	True	False	False	False	False	False	False	False
1	False	True	False	False	False	False	False	False	False
2	False	True	False	False	False	False	False	False	False
3	False	False	False	False	False	False	False	False	False
4	False	False	False	False	False	False	False	False	False

```
df.dtypes
```

```
symboling              int64
normalized-losses     object
make                  object
fuel-type             object
aspiration            object
num-of-doors          object
body-style            object
drive-wheels          object
engine-location       object
wheel-base           float64
length               float64
width                float64
height               float64
curb-weight            int64
engine-type           object
num-of-cylinders      object
engine-size            int64
fuel-system           object
bore                  object
stroke                object
compression-ratio    float64
horsepower            object
peak-rpm              object
city-mpg               int64
highway-mpg            int64
price                 object
dtype: object
```

```
missing_data1 = df.notnull()
missing_data1.head(5)
```

	symboling	normalized-losses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels	engine-location
0	True	False	True	True	True	True	True	True	True
1	True	False	True	True	True	True	True	True	True
2	True	False	True	True	True	True	True	True	True
3	True	True	True	True	True	True	True	True	True
4	True	True	True	True	True	True	True	True	True

```
#Counting missing values in each column
for column in missing_data.columns.values.tolist():
    print(column)
```

```
symboling
normalized-losses
make
fuel-type
aspiration
num-of-doors
body-style
drive-wheels
engine-location
wheel-base
length
width
height
curb-weight
engine-type
num-of-cylinders
engine-size
fuel-system
bore
stroke
compression-ratio
horsepower
peak-rpm
city-mpg
highway-mpg
price
```

```
#Counting missing values in each column
for column in missing_data.columns.values.tolist():
    print(column)
    print (missing_data[column].value_counts())
    print(" ")
```

```
symboling
False    205
```

```
Name: symboling, dtype: int64

normalized-losses
False    164
True      41
Name: normalized-losses, dtype: int64

make
False    205
Name: make, dtype: int64

fuel-type
False    205
Name: fuel-type, dtype: int64

aspiration
False    205
Name: aspiration, dtype: int64

num-of-doors
False    203
True       2
Name: num-of-doors, dtype: int64

body-style
False    205
Name: body-style, dtype: int64

drive-wheels
False    205
Name: drive-wheels, dtype: int64

engine-location
False    205
Name: engine-location, dtype: int64

wheel-base
False    205
Name: wheel-base, dtype: int64

length
False    205
Name: length, dtype: int64

width
False    205
Name: width, dtype: int64

height
False    205
Name: height, dtype: int64

curb-weight
False    205
Name: curb-weight, dtype: int64
```

```
#"normalized-losses","stroke","bore","horsepower","peak-rpm"  replace by mean or median (num
avg_1 = df["normalized-losses"].astype("float").mean()
avg_1
```

```
122.0
```

```
df["normalized-losses"].replace(np.nan, avg_1, inplace = True)
df
```

	symboling	normalized-losses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels
0	3	122	alfa-romero	gas	std	two	convertible	rwd
1	3	122	alfa-romero	gas	std	two	convertible	rwd
2	1	122	alfa-romero	gas	std	two	hatchback	rwd
3	2	164	audi	gas	std	four	sedan	fwd
4	2	164	audi	gas	std	four	sedan	4wd
...	...	...	...	...	...	...	...	...
200	-1	95	volvo	gas	std	four	sedan	rwd
201	-1	95	volvo	gas	turbo	four	sedan	rwd
202	-1	95	volvo	gas	std	four	sedan	rwd
203	-1	95	volvo	diesel	turbo	four	sedan	rwd
204	-1	95	volvo	gas	turbo	four	sedan	rwd

205 rows × 26 columns

```
avg_2 = df["bore"].astype("float").mean()
avg_2
```

```
3.3297512437810957
```

```
df["bore"].replace("np.nan",avg_2,inplace=True)
df
```

	symboling	normalized-losses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels	engin locati
0	3	122	alfa-romero	gas	std	two	convertible	rwd	fr
1	3	122	alfa-romero	gas	std	two	convertible	rwd	fr
2	1	122	alfa-romero	gas	std	two	hatchback	rwd	fr
3	2	164	audi	gas	std	four	sedan	fwd	fr
4	2	164	audi	gas	std	four	sedan	4wd	fr
...	...	...	...	...	...	...	...	...	
200	-1	95	volvo	gas	std	four	sedan	rwd	fr
201	-1	95	volvo	gas	turbo	four	sedan	rwd	fr
202	-1	95	volvo	gas	std	four	sedan	rwd	fr
203	-1	95	volvo	diesel	turbo	four	sedan	rwd	fr

```
avg_3 = df['stroke'].astype('float').mean(axis=0)
df['stroke'].replace(np.nan, avg_3, inplace = True)
df
```

	symboling	normalized-losses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels

```
avg_4=df['horsepower'].astype('float').mean(axis=0)
df['horsepower'].replace(np.nan, avg_4, inplace= True)
df
```

	symboling	normalized-losses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels
0	3	122	alfa-romero	gas	std	two	convertible	rwd
1	3	122	alfa-romero	gas	std	two	convertible	rwd
2	1	122	alfa-romero	gas	std	two	hatchback	rwd
3	2	164	audi	gas	std	four	sedan	fwd
4	2	164	audi	gas	std	four	sedan	4wd
...	...	...	...	...	...	...	...	...
200	-1	95	volvo	gas	std	four	sedan	rwd
201	-1	95	volvo	gas	turbo	four	sedan	rwd
202	-1	95	volvo	gas	std	four	sedan	rwd
203	-1	95	volvo	diesel	turbo	four	sedan	rwd
204	-1	95	volvo	gas	turbo	four	sedan	rwd

205 rows × 26 columns

```
avg_5=df['peak-rpm'].astype('float').mean(axis=0)
df['peak-rpm'].replace(np.nan, avg_5, inplace= True)
df
```

	symboling	normalized-losses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels	engin locati
0	3	122	alfa-romero	gas	std	two	convertible	rwd	fr
1	3	122	alfa-romero	gas	std	two	convertible	rwd	fr
2	1	122	alfa-romero	gas	std	two	hatchback	rwd	fr
3	2	164	audi	gas	std	four	sedan	fwd	fr
4	2	164	audi	gas	std	four	sedan	4wd	fr
...	...	...	...	...	...	...	...	...	
200	-1	95	volvo	gas	std	four	sedan	rwd	fr

```
#replace by mode or maximum occuring frequency
df['num-of-doors'].value_counts()
```

```
four    114
two      89
Name: num-of-doors, dtype: int64
```

205 rows × 26 columns

```
df['num-of-doors'].value_counts().idxmax()
```

```
'four'
```

```
#replace the missing 'num-of-doors' values by the most frequent
df['num-of-doors'].replace("np.nan","Four",inplace=True)
df.head()
```

	symboling	normalized-losses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels	engine-location
0	3	122	alfa-romero	gas	std	two	convertible	rwd	front
1	3	122	alfa-romero	gas	std	two	convertible	rwd	front
2	1	122	alfa-romero	gas	std	two	hatchback	rwd	front
3	2	164	audi	gas	std	four	sedan	fwd	front
4	2	164	audi	gas	std	four	sedan	4wd	front

```
# simply drop whole row with NaN in "price" column
df["price"].dropna( axis=0, inplace = True)

df.reset_index(drop = True, inplace = True)
df
```

	symboling	normalized-losses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels
0	3	122	alfa-romero	gas	std	two	convertible	rwd
1	3	122	alfa-romero	gas	std	two	convertible	rwd
2	1	122	alfa-romero	gas	std	two	hatchback	rwd
3	2	164	audi	gas	std	four	sedan	fwd
4	2	164	audi	gas	std	four	sedan	4wd
...	...	...	...	...	...	...	...	...
196	-1	95	volvo	gas	std	four	sedan	rwd
197	-1	95	volvo	gas	turbo	four	sedan	rwd
198	-1	95	volvo	gas	std	four	sedan	rwd
199	-1	95	volvo	diesel	turbo	four	sedan	rwd
200	-1	95	volvo	gas	turbo	four	sedan	rwd

201 rows × 26 columns

```
df
```

	symboling	normalized-losses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels	engin locati
0	3	122	alfa-romero	gas	std	two	convertible	rwd	fr
1	3	122	alfa-romero	gas	std	two	convertible	rwd	fr
2	1	122	alfa-romero	gas	std	two	hatchback	rwd	fr
3	2	164	audi	gas	std	four	sedan	fwd	fr
4	2	164	audi	gas	std	four	sedan	4wd	fr

```
#standerdazition
df["city-1/100km"]=235/df["city-mpg"]
df
```

	symboling	normalized-losses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels
0	3	122	alfa-romero	gas	std	two	convertible	rwd
1	3	122	alfa-romero	gas	std	two	convertible	rwd
2	1	122	alfa-romero	gas	std	two	hatchback	rwd
3	2	164	audi	gas	std	four	sedan	fwd
4	2	164	audi	gas	std	four	sedan	4wd
...	...	...	...	...	...	...	...	...
196	-1	95	volvo	gas	std	four	sedan	rwd
197	-1	95	volvo	gas	turbo	four	sedan	rwd
198	-1	95	volvo	gas	std	four	sedan	rwd
199	-1	95	volvo	diesel	turbo	four	sedan	rwd
200	-1	95	volvo	gas	turbo	four	sedan	rwd

201 rows × 27 columns

```
df["highway-mpg-1"]=235/df["highway-mpg"]
```

```
df
```

	symboling	normalized-losses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels
0	3	122	alfa-romero	gas	std	two	convertible	rwd
1	3	122	alfa-romero	gas	std	two	convertible	rwd
2	1	122	alfa-romero	gas	std	two	hatchback	rwd
3	2	164	audi	gas	std	four	sedan	fwd
4	2	164	audi	gas	std	four	sedan	4wd
...	...	...	...	...	...	...	...	...
196	-1	95	volvo	gas	std	four	sedan	rwd
197	-1	95	volvo	gas	turbo	four	sedan	rwd
198	-1	95	volvo	gas	std	four	sedan	rwd
199	-1	95	volvo	diesel	turbo	four	sedan	rwd
200	-1	95	volvo	gas	turbo	four	sedan	rwd

201 rows × 28 columns

```
df.rename(columns = {'price':'Price'}, inplace = True)
df
```

	symboling	normalized-losses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels
0	3	122	alfa-romero	gas	std	two	convertible	rwd
1	3	122	alfa-romero	gas	std	two	convertible	rwd

```
#Correct DataTypes
df.dtypes
```

```
    symboling              int64
    normalized-losses     object
    make                  object
    fuel-type             object
    aspiration            object
    num-of-doors          object
    body-style            object
    drive-wheels          object
    engine-location       object
    wheel-base           float64
    length               float64
    width                float64
    height               float64
    curb-weight            int64
    engine-type           object
    num-of-cylinders      object
    engine-size            int64
    fuel-system           object
    bore                  object
    stroke                object
    compression-ratio    float64
    horsepower            object
    peak-rpm              object
    city-mpg               int64
    highway-mpg            int64
    Price                 object
    city-1/100km         float64
    highway-mpg-1        float64
    dtype: object
```

```
df[["bore", "stroke"]] = df[["bore", "stroke"]].astype("float")
df[["normalized-losses"]] = df[["normalized-losses"]].astype("int")
df[["Price"]] = df[["Price"]].astype("float")
df[["peak-rpm"]] = df[["peak-rpm"]].astype("float")
df.dtypes
```

```
    symboling              int64
    normalized-losses      int64
    make                  object
    fuel-type             object
```

```
aspiration            object
num-of-doors          object
body-style            object
drive-wheels          object
engine-location       object
wheel-base           float64
length               float64
width                float64
height               float64
curb-weight            int64
engine-type           object
num-of-cylinders      object
engine-size            int64
fuel-system           object
bore                 float64
stroke               float64
compression-ratio    float64
horsepower            object
peak-rpm             float64
city-mpg               int64
highway-mpg            int64
Price                float64
city-1/100km         float64
highway-mpg-1        float64
dtype: object
```

```
#data transformation for highway-mpg into L/100 km
#data normalization :scaling within 1
df['length'] = df['length']/df['length'].max()
df['width'] = df['width']/df['width'].max()
df['height'] = df['height']/df['height'].max()
df.head(10)
```

symboling	normalized-losses	make	fuel-type	aspiration	num-of-doors	body-style	drive-wheels	engine-location
		alfa-						

```
#Binning
df["horsepower"]=df["horsepower"].astype(float)
df["horsepower"]
```

```
0      111.0
1      111.0
2      154.0
3      102.0
4      115.0
       ...
196    114.0
197    160.0
198    134.0
199    106.0
200    114.0
Name: horsepower, Length: 201, dtype: float64
```

```
binwidth = (max(df["horsepower"])-min(df["horsepower"]))/4
binwidth
```

```
53.5
```

```
bins = np.arange(min(df["horsepower"]), max(df["horsepower"]), binwidth)
bins
```

```
array([ 48. , 101.5, 155. , 208.5])
```

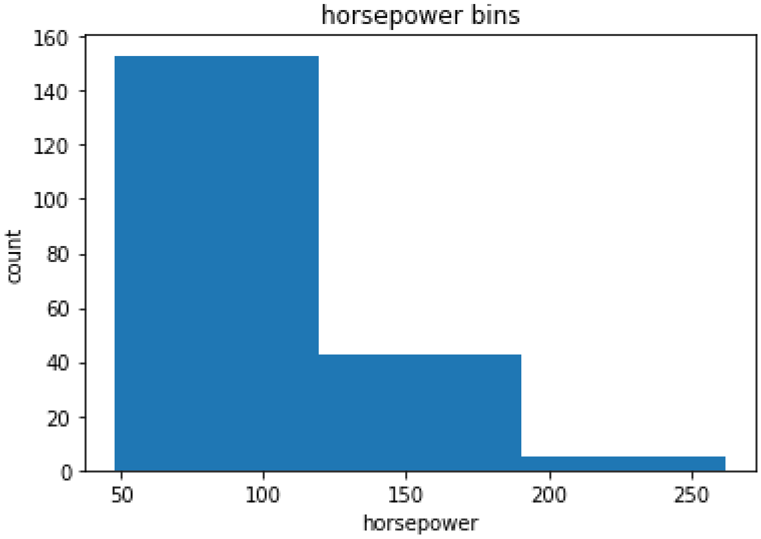
```
group_names = ['Low', 'Medium', 'High']
```

```
df['horsepower-binned'] = pd.cut(df['horsepower'], bins, labels=group_names,include_lowest=Tr
df[['horsepower','horsepower-binned']].head(20)
```

	horsepower	horsepower-binned
0	111.0	Medium
1	111.0	Medium
2	154.0	Medium
3	102.0	Medium
4	115.0	Medium
5	110.0	Medium
6	110.0	Medium
7	110.0	Medium
8	140.0	Medium
9	101.0	Low
10	101.0	Low
11	121.0	Medium
12	121.0	Medium
13	121.0	Medium

```
from matplotlib import pyplot as plt
plt.hist(df["horsepower"], bins = 3)
plt.xlabel("horsepower")
plt.ylabel("count")
plt.title("horsepower bins")
```

```
Text(0.5, 1.0, 'horsepower bins')
```



```
#dummy variable
dummy_variable_1 = pd.get_dummies(df["fuel-type"])
df["fuel-type"].value_counts()
```

```
gas       181
diesel     20
Name: fuel-type, dtype: int64
```

```
dummy_variable_1.rename(columns={'fuel-type-diesel':'gas', 'fuel-type-diesel':'diesel'}, inpl
dummy_variable_1.head()
```

	diesel	gas
0	0	1
1	0	1
2	0	1
3	0	1
4	0	1

```
df = pd.concat([df, dummy_variable_1], axis=1)
df.drop("fuel-type", axis = 1, inplace=True)
df
```

	symboling	normalized-losses	make	aspiration	num-of-doors	body-style	drive-wheels	engine locatio
0	3	122	alfa-romero	std	two	convertible	rwd	fror
1	3	122	alfa-romero	std	two	convertible	rwd	fror
2	1	122	alfa-romero	std	two	hatchback	rwd	fror
3	2	164	audi	std	four	sedan	fwd	fror
4	2	164	audi	std	four	sedan	4wd	fror
...	...	...	...	...	...	...	...	.
196	-1	95	volvo	std	four	sedan	rwd	fror
197	-1	95	volvo	turbo	four	sedan	rwd	fror
198	-1	95	volvo	std	four	sedan	rwd	fror
199	-1	95	volvo	turbo	four	sedan	rwd	fror
200	-1	95	volvo	turbo	four	sedan	rwd	fror

201 rows × 30 columns

```
dummy_variable_2 = pd.get_dummies(df['aspiration'])
dummy_variable_2.rename(columns={'std':'aspiration-std', 'turbo': 'aspiration-turbo'}, inplac
dummy_variable_2.head()
```

	aspiration-std	aspiration-turbo
0	1	0
1	1	0
2	1	0
3	1	0
4	1	0

```
df = pd.concat([df, dummy_variable_2], axis=1)
df.drop('aspiration', axis = 1, inplace=True)
```

```
df.to_csv('clean_df.csv')
```