In [1]:
```python
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
import seaborn as sns
from sklearn.preprocessing import StandardScaler,OneHotEncoder
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error,mean_absolute_error
```

In [2]:
```python
#predicitng city cycle fuel consumption in miles per gallon
```

In [3]:
```python
data=pd.read_fwf("D:\\24 - Machine_Learning\\download files\\auto-mpg.data")
```

In [4]:
```python
data
```

Out[4]:

	18.0	8	307.0	130.0	3504.	12.0	70	1	"chevrolet chevelle malibu"
0	15.0	8	350.0	165.0	3693.0	11.5	70	1	"buick skylark 320"
1	18.0	8	318.0	150.0	3436.0	11.0	70	1	"plymouth satellite"
2	16.0	8	304.0	150.0	3433.0	12.0	70	1	"amc rebel sst"
3	17.0	8	302.0	140.0	3449.0	10.5	70	1	"ford torino"
4	15.0	8	429.0	198.0	4341.0	10.0	70	1	"ford galaxie 500"
...	...	...	...	...	...	...	...	...	...
392	27.0	4	140.0	86.00	2790.0	15.6	82	1	"ford mustang gl"
393	44.0	4	97.0	52.00	2130.0	24.6	82	2	"vw pickup"
394	32.0	4	135.0	84.00	2295.0	11.6	82	1	"dodge rampage"
395	28.0	4	120.0	79.00	2625.0	18.6	82	1	"ford ranger"
396	31.0	4	119.0	82.00	2720.0	19.4	82	1	"chevy s-10"

397 rows × 9 columns

In [5]:
```python
col_names=['mpg','cylinders','displacement','horsepower','weight','acceleration','modelyear','origin','carname']
```

In [6]:
```python
data.columns=col_names
```

In [7]:
```python
data
```

Out[7]:

	mpg	cylinders	displacement	horsepower	weight	acceleration	modelyear	origin	carname
0	15.0	8	350.0	165.0	3693.0	11.5	70	1	"buick skylark 320"
1	18.0	8	318.0	150.0	3436.0	11.0	70	1	"plymouth satellite"
2	16.0	8	304.0	150.0	3433.0	12.0	70	1	"amc rebel sst"
3	17.0	8	302.0	140.0	3449.0	10.5	70	1	"ford torino"
4	15.0	8	429.0	198.0	4341.0	10.0	70	1	"ford galaxie 500"
...	...	...	...	...	...	...	...	...	...
392	27.0	4	140.0	86.00	2790.0	15.6	82	1	"ford mustang gl"
393	44.0	4	97.0	52.00	2130.0	24.6	82	2	"vw pickup"
394	32.0	4	135.0	84.00	2295.0	11.6	82	1	"dodge rampage"
395	28.0	4	120.0	79.00	2625.0	18.6	82	1	"ford ranger"
396	31.0	4	119.0	82.00	2720.0	19.4	82	1	"chevy s-10"

397 rows × 9 columns

In [8]:
```python
data.head()
```

Out[8]:

	mpg	cylinders	displacement	horsepower	weight	acceleration	modelyear	origin	carname
0	15.0	8	350.0	165.0	3693.0	11.5	70	1	"buick skylark 320"
1	18.0	8	318.0	150.0	3436.0	11.0	70	1	"plymouth satellite"
2	16.0	8	304.0	150.0	3433.0	12.0	70	1	"amc rebel sst"
3	17.0	8	302.0	140.0	3449.0	10.5	70	1	"ford torino"
4	15.0	8	429.0	198.0	4341.0	10.0	70	1	"ford galaxie 500"

In [9]:
```python
data.describe()
```

Out[9]:

	mpg	cylinders	displacement	weight	acceleration	modelyear	origin
count	397.000000	397.000000	397.000000	397.000000	397.000000	397.000000	397.000000
mean	23.528463	5.448363	193.139798	2969.080605	15.577078	76.025189	1.574307
std	7.820926	1.698329	104.244898	847.485218	2.755326	3.689922	0.802549
min	9.000000	3.000000	68.000000	1613.000000	8.000000	70.000000	1.000000
25%	17.500000	4.000000	104.000000	2223.000000	13.900000	73.000000	1.000000
50%	23.000000	4.000000	146.000000	2800.000000	15.500000	76.000000	1.000000
75%	29.000000	8.000000	262.000000	3609.000000	17.200000	79.000000	2.000000
max	46.600000	8.000000	455.000000	5140.000000	24.800000	82.000000	3.000000

In [10]:
```python
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 397 entries, 0 to 396
Data columns (total 9 columns):
 #   Column        Non-Null Count  Dtype
---  ------        --------------  -----
 0   mpg           397 non-null    float64
 1   cylinders     397 non-null    int64
 2   displacement  397 non-null    float64
 3   horsepower    397 non-null    object
 4   weight        397 non-null    float64
 5   acceleration  397 non-null    float64
 6   modelyear     397 non-null    int64
 7   origin        397 non-null    int64
 8   carname       397 non-null    object
dtypes: float64(4), int64(3), object(2)
memory usage: 28.0+ KB
```

In [11]:
```python
data.shape
```

Out[11]:
```
(397, 9)
```

In [12]:
```python
data.isnull()
```

Out[12]:

	mpg	cylinders	displacement	horsepower	weight	acceleration	modelyear	origin	carname
0	False	False	False	False	False	False	False	False	False
1	False	False	False	False	False	False	False	False	False
2	False	False	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
...	...	...	...	...	...	...	...	...	...
392	False	False	False	False	False	False	False	False	False
393	False	False	False	False	False	False	False	False	False
394	False	False	False	False	False	False	False	False	False
395	False	False	False	False	False	False	False	False	False
396	False	False	False	False	False	False	False	False	False

397 rows × 9 columns

In [13]:
```python
data['carname'].value_counts()
```

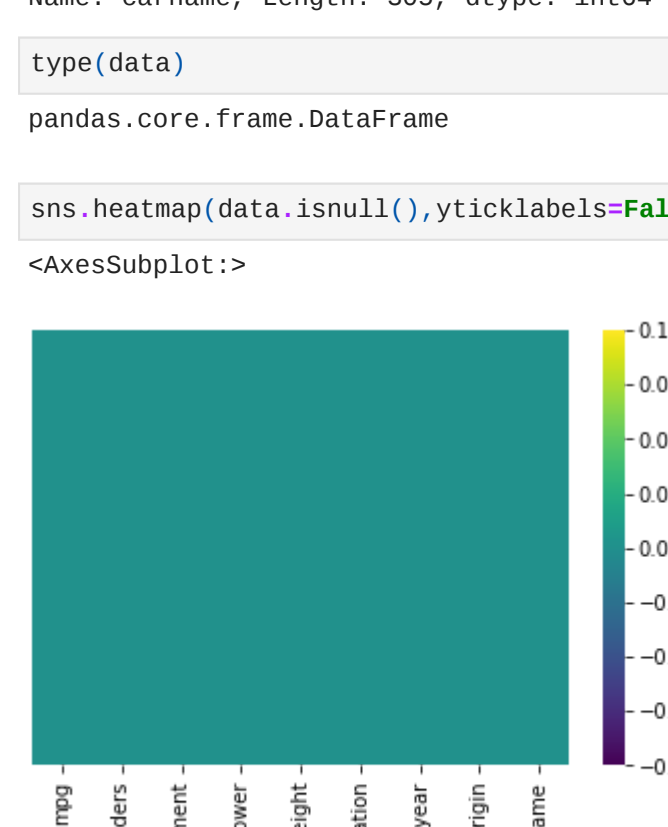
Out[13]:
```
"ford pinto"             6
"amc matador"            5
"toyota corolla"         5
"ford maverick"          5
"amc hornet"             4
                        ..
"chevrolet monza 2+2"    1
"ford mustang ii"        1
"pontiac astro"          1
"amc pacer"              1
"chevy s-10"             1
Name: carname, Length: 305, dtype: int64
```

In [14]:
```python
type(data)
```

Out[14]:
```
pandas.core.frame.DataFrame
```

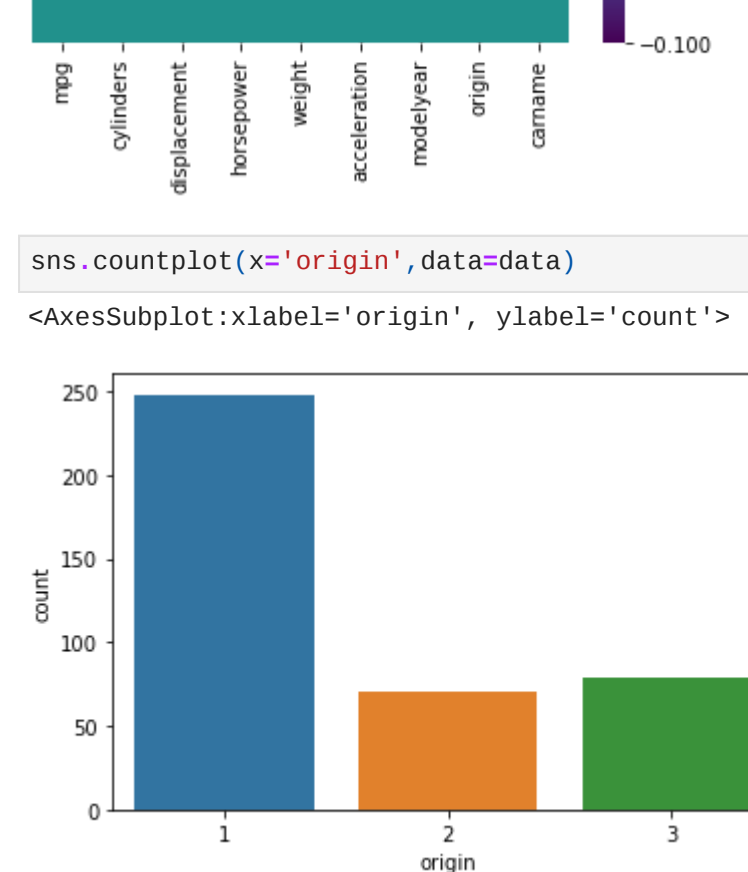
In [15]:
```python
sns.heatmap(data.isnull(),yticklabels=False,cbar=True,cmap='viridis')
```

Out[15]:
```
<AxesSubplot:>
```



In [16]:
```python
sns.countplot(x='origin',data=data)
```

Out[16]:
```
<AxesSubplot:xlabel='origin', ylabel='count'>
```



In [17]:
```python
data['carname'].unique()
```

Out[17]:
```
array(['"buick skylark 320"', '"plymouth satellite"', '"amc rebel sst"',
       '"ford torino"', '"ford galaxie 500"', '"chevrolet impala"',
       '"plymouth fury iii"', '"pontiac catalina"',
       '"amc ambassador dpl"', '"dodge challenger se"',
       '"plymouth \'cuda 340"', '"chevrolet monte carlo"',
       '"buick estate wagon (sw)"', '"toyota corona mark ii"',
       '"plymouth duster"', '"amc hornet"', '"ford maverick"',
       '"datsun pl510"', '"volkswagen 1131 deluxe sedan"',
       '"peugeot 504"', '"audi 100 ls"', '"saab 99e"', '"bmw 2002"',
       '"amc gremlin"', '"ford f250"', '"chevy c20"', '"dodge d200"',
       '"hi 1200d"', '"chevrolet vega 2300"', '"toyota corona"',
       '"ford pinto"', '"plymouth satellite custom"',
       '"chevrolet chevelle malibu"', '"ford torino 500"',
       '"amc matador"', '"pontiac catalina brougham"',
       '"dodge monaco (sw)"', '"ford country squire (sw)"',
       '"pontiac safari (sw)"', '"amc hornet sportabout (sw)"',
       '"chevrolet vega (sw)"', '"pontiac firebird"', '"ford mustang"',
       '"mercury capri 2000"', '"opel 1900"', '"peugeot 304"',
       '"fiat 124b"', '"toyota corolla 1200"', '"datsun 1200"',
       '"volkswagen model 111"', '"plymouth cricket"',
       '"toyota corona hardtop"', '"dodge colt hardtop"',
       '"volkswagen type 3"', '"chevrolet vega"', '"ford pinto runabout"',
       '"amc ambassador sst"', '"mercury marquis"',
       '"buick lesabre custom"', '"oldsmobile delta 88 royale"',
       '"chrysler newport royal"', '"mazda rx2 coupe"',
       '"amc matador (sw)"', '"chevrolet chevelle concours (sw)"',
       '"ford gran torino (sw)"', '"plymouth satellite custom (sw)"',
       '"volvo 145e (sw)"', '"volkswagen 411 (sw)"', '"peugeot 504 (sw)"',
       '"renault 12 (sw)"', '"ford pinto (sw)"', '"datsun 510 (sw)"',
       '"toyouta corona mark ii (sw)"', '"dodge colt (sw)"',
       '"toyota corolla 1600 (sw)"', '"buick century 350"',
       '"chevrolet malibu"', '"ford gran torino"',
       '"dodge coronet custom"', '"mercury marquis brougham"',
       '"chevrolet caprice classic"', '"ford ltd"',
       '"plymouth fury gran sedan"', '"chrysler new yorker brougham"',
       '"buick electra 225 custom"', '"amc ambassador brougham"',
       '"plymouth valiant"', '"chevrolet nova custom"',
       '"volkswagen super beetle"', '"ford country"',
       '"plymouth custom suburb"', '"oldsmobile vista cruiser"',
       '"toyota carina"', '"datsun 610"', '"maxda rx3"',
       '"mercury capri v6"', '"fiat 124 sport coupe"',
       '"chevrolet monte carlo s"', '"pontiac grand prix"', '"fiat 128"',
       '"opel manta"', '"audi 100ls"', '"volvo 144ea"',
       '"dodge dart custom"', '"saab 99le"', '"toyota mark ii"',
       '"oldsmobile omega"', '"chevrolet nova"', '"datsun b210"',
       '"chevrolet chevelle malibu classic"',
       '"plymouth satellite sebring"', '"buick century luxus (sw)"',
       '"dodge coronet custom (sw)"', '"audi fox"', '"volkswagen dasher"',
       '"datsun 710"', '"dodge colt"', '"fiat 124 tc"', '"honda civic"',
       '"subaru"', '"fiat x1.9"', '"plymouth valiant custom"',
       '"mercury monarch"', '"chevrolet bel air"',
       '"plymouth grand fury"', '"buick century"',
       '"chevroelt chevelle malibu"', '"plymouth fury"',
       '"buick skyhawk"', '"chevrolet monza 2+2"', '"ford mustang ii"',
       '"toyota corolla"', '"pontiac astro"', '"volkswagen rabbit"',
       '"amc pacer"', '"volvo 244dl"', '"honda civic cvcc"', '"fiat 131"',
       '"capri ii"', '"renault 12tl"', '"dodge coronet brougham"',
       '"chevrolet chevette"', '"chevrolet woody"', '"vw rabbit"',
       '"dodge aspen se"', '"ford granada ghia"', '"pontiac ventura sj"',
       '"amc pacer d/l"', '"datsun b-210"', '"volvo 245"',
       '"plymouth volare premier v8"', '"mercedes-benz 280s"',
       '"cadillac seville"', '"chevy c10"', '"ford f108"', '"dodge d100"',
       '"honda accord cvcc"', '"buick opel isuzu deluxe"',
       '"renault 5 gtl"', '"plymouth arrow gs"',
       '"datsun f-10 hatchback"', '"oldsmobile cutlass supreme"',
       '"dodge monaco brougham"', '"mercury cougar brougham"',
       '"chevrolet concours"', '"buick skylark"',
       '"plymouth volare custom"', '"ford granada"',
       '"pontiac grand prix lj"', '"chevrolet monte carlo landau"',
       '"chrysler cordoba"', '"ford thunderbird"',
       '"volkswagen rabbit custom"', '"pontiac sunbird coupe"',
       '"toyota corolla liftback"', '"ford mustang ii 2+2"',
       '"dodge colt m/m"', '"subaru dl"', '"datsun 810"', '"bmw 320i"',
       '"mazda rx-4"', '"volkswagen rabbit custom diesel"',
       '"ford fiesta"', '"mazda glc deluxe"', '"datsun b210 gx"',
       '"oldsmobile cutlass salon brougham"', '"dodge diplomat"',
       '"mercury monarch ghia"', '"pontiac phoenix lj"',
       '"ford fairmont (auto)"', '"ford fairmont (man)"',
       '"plymouth volare"', '"amc concord"', '"buick century special"',
       '"mercury zephyr"', '"dodge aspen"', '"amc concord d/l"',
       '"buick regal sport coupe (turbo)"', '"ford futura"',
       '"dodge magnum xe"', '"datsun 510"', '"dodge omni"',
       '"toyota celica gt liftback"', '"plymouth sapporo"',
       '"oldsmobile starfire sx"', '"datsun 200-sx"', '"audi 5000"',
       '"volvo 264gl"', '"saab 99gle"', '"peugeot 604sl"',
       '"volkswagen scirocco"', '"honda accord lx"',
       '"pontiac lemans v6"', '"mercury zephyr 6"', '"ford fairmont 4"',
       '"amc concord dl 6"', '"dodge aspen 6"', '"ford ltd landau"',
       '"mercury grand marquis"', '"dodge st. regis"',
       '"chevrolet malibu classic (sw)"',
       '"chrysler lebaron town @ country (sw)"', '"vw rabbit custom"',
       '"maxda glc deluxe"', '"dodge colt hatchback custom"',
       '"amc spirit dl"', '"mercedes benz 300d"', '"cadillac eldorado"',
       '"plymouth horizon"', '"plymouth horizon tc3"', '"datsun 210"',
       '"fiat strada custom"', '"buick skylark limited"',
       '"chevrolet citation"', '"oldsmobile omega brougham"',
       '"pontiac phoenix"', '"toyota corolla tercel"', '"datsun 310"',
       '"ford fairmont"', '"audi 4000"', '"toyota corona liftback"',
       '"mazda 626"', '"datsun 510 hatchback"', '"mazda glc"',
       '"vw rabbit c (diesel)"', '"vw dasher (diesel)"',
       '"audi 5000s (diesel)"', '"mercedes-benz 240d"',
       '"honda civic 1500 gl"', '"renault lecar deluxe"',
       '"vokswagen rabbit"', '"datsun 280-zx"', '"mazda rx-7 gs"',
       '"triumph tr7 coupe"', '"ford mustang cobra"', '"honda accord"',
       '"plymouth reliant"', '"dodge aries wagon (sw)"',
       '"toyota starlet"', '"plymouth champ"', '"honda civic 1300"',
       '"datsun 210 mpg"', '"toyota tercel"', '"mazda glc 4"',
       '"plymouth horizon 4"', '"ford escort 4w"', '"ford escort 2h"',
       '"volkswagen jetta"', '"renault 18i"', '"honda prelude"',
       '"datsun 200sx"', '"peugeot 505s turbo diesel"', '"volvo diesel"',
       '"toyota cressida"', '"datsun 810 maxima"',
       '"oldsmobile cutlass ls"', '"ford granada gl"',
       '"chrysler lebaron salon"', '"chevrolet cavalier"',
       '"chevrolet cavalier wagon"', '"chevrolet cavalier 2-door"',
       '"pontiac j2000 se hatchback"', '"dodge aries se"',
       '"ford fairmont futura"', '"amc concord dl"',
       '"volkswagen rabbit l"', '"mazda glc custom l"',
       '"mazda glc custom"', '"plymouth horizon miser"',
       '"mercury lynx l"', '"nissan stanza xe"', '"honda civic (auto)"',
       '"datsun 310 gx"', '"buick century limited"',
       '"oldsmobile cutlass ciera (diesel)"',
       '"chrysler lebaron medallion"', '"ford granada l"',
       '"toyota celica gt"', '"dodge charger 2.2"', '"chevrolet camaro"',
       '"ford mustang gl"', '"vw pickup"', '"dodge rampage"',
       '"ford ranger"', '"chevy s-10"'], dtype=object)
```

In [18]:
```python
data['carname']=[i[0] for i in data['carname'].str.split(' ')]
```

In [19]:
```python
data['carname'].unique()
```

Out[19]:
```
array(['"buick', '"plymouth', '"amc', '"ford', '"chevrolet', '"pontiac',
       '"dodge', '"toyota', '"datsun', '"volkswagen', '"peugeot', '"audi',
       '"saab', '"bmw', '"chevy', '"hi', '"mercury', '"opel', '"fiat',
       '"oldsmobile', '"chrysler', '"mazda', '"volvo', '"renault',
       '"toyouta', '"maxda', '"honda', '"subaru', '"chevroelt', '"capri',
       '"vw', '"mercedes-benz', '"cadillac', '"mercedes', '"subaru"',
       '"vokswagen', '"triumph', '"nissan'], dtype=object)
```

In [20]:
```python
data['carname']=data['carname'].replace(['chevy','chevrolet'],'chevrolet')
data['carname']=data['carname'].replace(['vw','vokswagen','volkswagen'],'volkswagen')
data['carname']=data['carname'].replace(['maxda','mazda'],'mazda')
data['carname']=data['carname'].replace(['toyouta','toyota'],'toyota')
data['carname']=data['carname'].replace(['mercedes','mercedes-benz'],'mercedes-benz')
data['carname']=data['carname'].replace(['nissan','datsun'],'datsun')
data['carname']=data['carname'].replace(['capri','ford'],'ford')
```

In [21]:
```python
data['carname'].unique()
```

Out[21]:
```
array(['"buick', '"plymouth', '"amc', '"ford', '"chevrolet', '"pontiac',
       '"dodge', '"toyota', '"datsun', '"volkswagen', '"peugeot', '"audi',
       '"saab', '"bmw', '"chevy', '"hi', '"mercury', '"opel', '"fiat',
       '"oldsmobile', '"chrysler', '"mazda', '"volvo', '"renault',
       '"toyouta', '"maxda', '"honda', '"subaru', '"chevroelt', '"capri',
       '"vw', '"mercedes-benz', '"cadillac', '"mercedes', '"subaru"',
       '"vokswagen', '"triumph', '"nissan'], dtype=object)
```

In [22]:
```python
data
```

Out[22]:

	mpg	cylinders	displacement	horsepower	weight	acceleration	modelyear	origin	carname
0	15.0	8	350.0	165.0	3693.0	11.5	70	1	"buick
1	18.0	8	318.0	150.0	3436.0	11.0	70	1	"plymouth
2	16.0	8	304.0	150.0	3433.0	12.0	70	1	"amc
3	17.0	8	302.0	140.0	3449.0	10.5	70	1	"ford
4	15.0	8	429.0	198.0	4341.0	10.0	70	1	"ford
...	...	...	...	...	...	...	...	...	...
392	27.0	4	140.0	86.00	2790.0	15.6	82	1	"ford
393	44.0	4	97.0	52.00	2130.0	24.6	82	2	"vw
394	32.0	4	135.0	84.00	2295.0	11.6	82	1	"dodge
395	28.0	4	120.0	79.00	2625.0	18.6	82	1	"ford
396	31.0	4	119.0	82.00	2720.0	19.4	82	1	"chevy

397 rows × 9 columns

In [23]:
```python
org=pd.get_dummies(data.origin,prefix='org')
```

In [24]:
```python
org
```

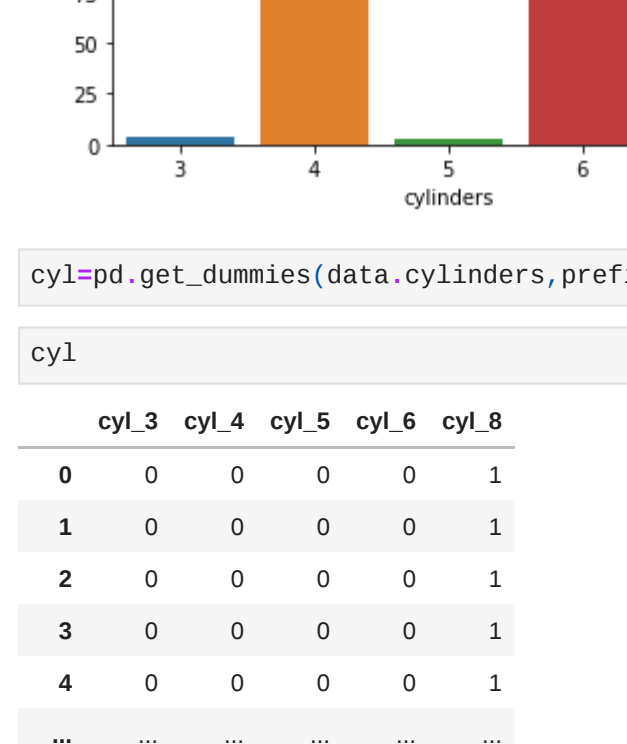
Out[24]:

	org_1	org_2	org_3
0	1	0	0
1	1	0	0
2	1	0	0
3	1	0	0
4	1	0	0
...	...	...	...
392	1	0	0
393	0	1	0
394	1	0	0
395	1	0	0
396	1	0	0

397 rows × 3 columns

In [25]:
```python
sns.countplot(x='cylinders',data=data)
```

Out[25]:
```
<AxesSubplot:xlabel='cylinders', ylabel='count'>
```



In [26]:
```python
cyl=pd.get_dummies(data.cylinders,prefix='cyl')
```

In [27]:
```python
cyl
```

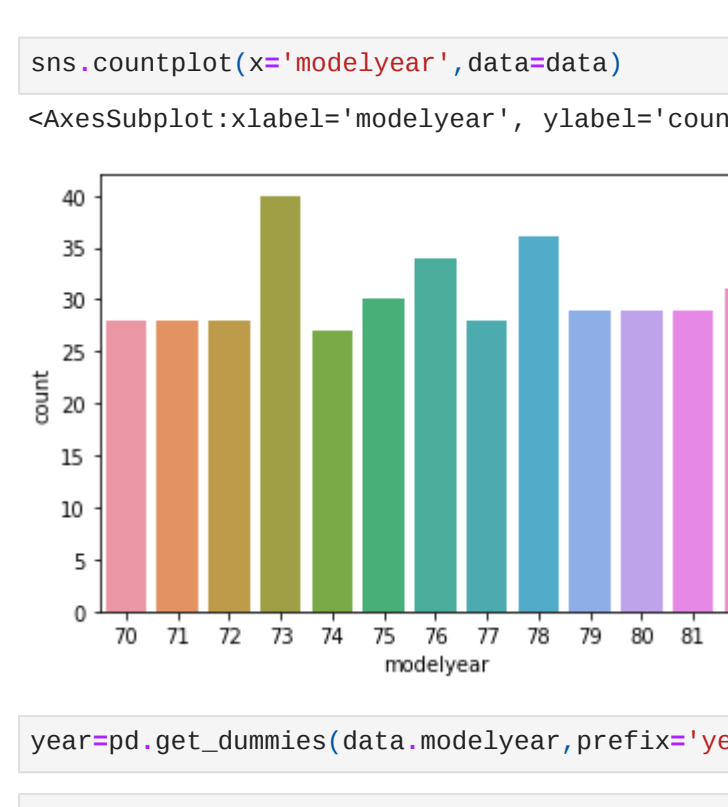
Out[27]:

	cyl_3	cyl_4	cyl_5	cyl_6	cyl_8
0	0	0	0	0	1
1	0	0	0	0	1
2	0	0	0	0	1
3	0	0	0	0	1
4	0	0	0	0	1
...	...	...	...	...	...
392	0	1	0	0	0
393	0	1	0	0	0
394	0	1	0	0	0
395	0	1	0	0	0
396	0	1	0	0	0

397 rows × 5 columns

In [28]:
```python
sns.countplot(x='modelyear',data=data)
```

Out[28]:
```
<AxesSubplot:xlabel='modelyear', ylabel='count'>
```



In [29]:
```python
year=pd.get_dummies(data.modelyear,prefix='year')
```

In [30]:
```python
year
```

Out[30]:

	year_70	year_71	year_72	year_73	year_74	year_75	year_76	year_77	year_78	year_79	year_80	year_81	year_82
0	1	0	0	0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	0	0	0	0	0
2	1	0	0	0	0	0	0	0	0	0	0	0	0
3	1	0	0	0	0	0	0	0	0	0	0	0	0
4	1	0	0	0	0	0	0	0	0	0	0	0	0
...	...	...	...	...	...	...	...	...	...	...	...	...	...
392	0	0	0	0	0	0	0	0	0	0	0	0	1
393	0	0	0	0	0	0	0	0	0	0	0	0	1
394	0	0	0	0	0	0	0	0	0	0	0	0	1
395	0	0	0	0	0	0	0	0	0	0	0	0	1
396	0	0	0	0	0	0	0	0	0	0	0	0	1

397 rows × 13 columns

In [31]:
```python
cn=pd.get_dummies(data.carname,prefix='')
```

In [32]:
```python
cn
```

Out[32]:

	_"amc	_"audi	_"bmw	_"buick	_"cadillac	_"capri	_"chevroelt	_"chevrolet	_"chevy	_"chrysler	...	_"saab	_"subaru	_"subaru"	_"toyota	_"toyouta
0	0	0	0	1	0	0	0	0	0	0	...	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
2	1	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
392	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
393	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
394	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
395	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
396	0	0	0	0	0	0	0	0	1	0	...	0	0	0	0	0

397 rows × 38 columns

In [33]:
```python
data.drop(['origin','cylinders','modelyear','carname'],axis=1,inplace=True)
```

In [34]:
```python
data
```

Out[34]:

	mpg	displacement	horsepower	weight	acceleration
0	15.0	350.0	165.0	3693.0	11.5
1	18.0	318.0	150.0	3436.0	11.0
2	16.0	304.0	150.0	3433.0	12.0
3	17.0	302.0	140.0	3449.0	10.5
4	15.0	429.0	198.0	4341.0	10.0
...	...	...	...	...	...
392	27.0	140.0	86.00	2790.0	15.6
393	44.0	97.0	52.00	2130.0	24.6
394	32.0	135.0	84.00	2295.0	11.6
395	28.0	120.0	79.00	2625.0	18.6
396	31.0	119.0	82.00	2720.0	19.4

397 rows × 5 columns

In [35]:
```python
data=pd.concat([org,data,cyl,year,cn],axis=1)
```

In [36]:
```python
data.shape
```

Out[36]:
```
(397, 64)
```

In [43]:
```python
data[['displacement','horsepower','weight','acceleration']]=StandardScaler().fit_transform(data[['displacement','horsepow
```

In [38]:
```python
sum(data.acceleration=='?')
```

Out[38]:
```
0
```

In [39]:
```python
sum(data.displacement=='?')
```

Out[39]:
```
0
```

In [40]:
```python
sum(data.horsepower=='?')
```

Out[40]:
```
6
```

In [41]:
```python
data=data[data.horsepower!='?']
```

In [42]:
```python
data
```

Out[42]:

	org_1	org_2	org_3	mpg	displacement	horsepower	weight	acceleration	cyl_3	cyl_4	...	_"saab	_"subaru	_"subaru"	_"toyota	_"toyouta
0	1	0	0	15.0	350.0	165.0	3693.0	11.5	0	0	...	0	0	0	0	0
1	1	0	0	18.0	318.0	150.0	3436.0	11.0	0	0	...	0	0	0	0	0
2	1	0	0	16.0	304.0	150.0	3433.0	12.0	0	0	...	0	0	0	0	0
3	1	0	0	17.0	302.0	140.0	3449.0	10.5	0	0	...	0	0	0	0	0
4	1	0	0	15.0	429.0	198.0	4341.0	10.0	0	0	...	0	0	0	0	0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
392	1	0	0	27.0	140.0	86.00	2790.0	15.6	0	1	...	0	0	0	0	0
393	0	1	0	44.0	97.0	52.00	2130.0	24.6	0	1	...	0	0	0	0	0
394	1	0	0	32.0	135.0	84.00	2295.0	11.6	0	1	...	0	0	0	0	0
395	1	0	0	28.0	120.0	79.00	2625.0	18.6	0	1	...	0	0	0	0	0
396	1	0	0	31.0	119.0	82.00	2720.0	19.4	0	1	...	0	0	0	0	0

391 rows × 64 columns

In [44]:
```python
Y=data.pop('mpg')
```

In [45]:
```python
Y
```

Out[45]:
```
0      15.0
1      18.0
2      16.0
3      17.0
4      15.0
       ...
392    27.0
393    44.0
394    32.0
395    28.0
396    31.0
Name: mpg, Length: 391, dtype: float64
```

In [46]:
```python
X=data
```

In [47]:
```python
X.head(296)
```

Out[47]:

	org_1	org_2	org_3	displacement	horsepower	weight	acceleration	cyl_3	cyl_4	cyl_5	...	_"saab	_"subaru	_"subaru"	_"toyota	_"toyouta
0	1	0	0	1.491799	1.575170	0.844259	-1.471246	0	0	0	...	0	0	0	0	0
1	1	0	0	1.185545	1.185250	0.541544	-1.652864	0	0	0	...	0	0	0	0	0
2	1	0	0	1.051559	1.185250	0.538010	-1.289628	0	0	0	...	0	0	0	0	0
3	1	0	0	1.032419	0.925303	0.556856	-1.834482	0	0	0	...	0	0	0	0	0
4	1	0	0	2.247862	2.432994	1.607524	-2.016100	0	0	0	...	0	0	0	0	0
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
293	0	0	1	-1.034793	-1.024296	-1.179336	-0.127272	0	1	0	...	0	0	0	0	0
294	1	0	0	-0.919948	-0.634376	-1.250009	-0.417861	0	1	0	...	0	0	0	0	0
295	1	0	0	-0.699828	-0.634376	-0.360711	-0.199919	0	1	0	...	0	0	0	0	0
296	0	1	0	-0.106462	-0.712360	0.652264	1.652585	0	0	1	...	0	0	0	0	0
297	1	0	0	1.491799	0.535384	1.088079	0.671847	0	0	0	...	0	0	0	0	0

296 rows × 63 columns

In [48]:
```python
X_train,X_test,Y_train,Y_test=train_test_split(X,Y,test_size=0.2,random_state=40)
```

In [49]:
```python
X_train.shape
```

Out[49]:
```
(312, 63)
```

In [50]:
```python
X_test.shape
```

Out[50]:
```
(79, 63)
```

In [51]:
```python
LR=LinearRegression()
```

In [52]:
```python
LR.fit(X_train,Y_train)
```

Out[52]:
```
LinearRegression()
```

In [53]:
```python
y_pred=LR.predict(X_test)
```

In [54]:
```python
Y_test
```

Out[54]:
```
277    31.5
387    26.0
280    19.8
336    32.4
305    28.8
       ...
205    26.5
0      15.0
142    26.0
260    18.1
346    37.0
Name: mpg, Length: 79, dtype: float64
```

In [55]:
```python
y_pred
```

Out[55]:
```
array([30.60742188, 30.35400391, 23.12939453, 37.35839844, 22.96582031,
       25.75683594, 17.08544922, 29.4296875 , 18.11816406, 30.71875   ,
       29.67382812, 14.33886719, 27.99951172, 25.27392578, 14.10009766,
       11.81445312, 22.57714844, 13.91601562, 10.68066406, 33.55566406,
       28.95410156, 10.86083984, 22.81982422, 24.90332031, 18.46972656,
       22.77832031, 12.43164062, 33.56445312, 29.95263672, 24.47412109,
       30.31738281, 27.64306641, 31.74755859, 24.39746094, 36.11328125,
       30.79101562, 19.83056641, 20.1171875 , 21.32373047, 29.12353516,
       15.04248047, 12.77197266, 18.62939453, 18.08105469, 29.37939453,
       19.7265625 , 12.98876953,  8.75      , 37.44921875, 30.88183594,
       19.13378906, 25.53027344, 24.00341797, 29.28125   , 25.71289062,
       24.56445312, 34.38574219,  9.13378906, 18.44189453, 20.02050781,
       13.296875  , 21.70361328, 24.28857422, 15.4921875 , 30.88964844,
       20.30957031, 13.93603516, 36.21484375, 19.76074219, 17.19433594,
       17.44287109, 31.53515625, 29.05078125, 21.37011719, 23.41455078,
       17.4296875 , 24.4140625 , 18.13427734, 35.52539062])
```

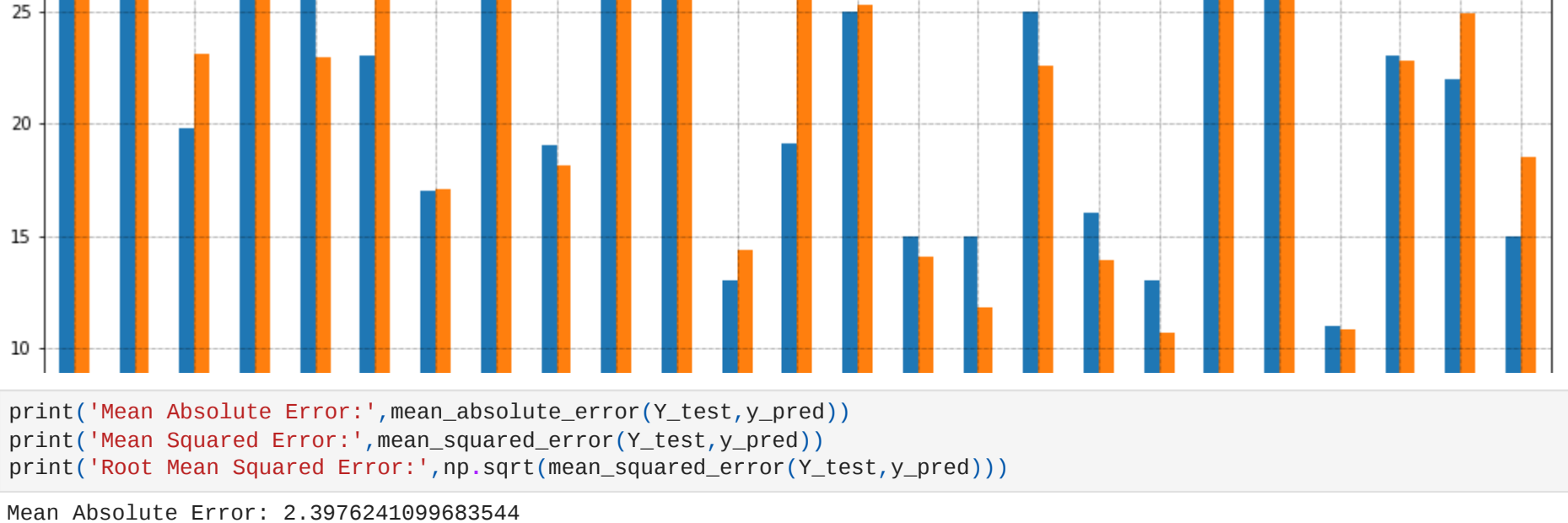
In [56]:
```python
df=pd.DataFrame({'Actual': Y_test,'Predicted': y_pred})
df
```

Out[56]:

	Actual	Predicted
277	31.5	30.607422
387	26.0	30.354004
280	19.8	23.129395
336	32.4	37.358398
305	28.8	22.965820
...	...	...
205	26.5	23.414551
0	15.0	17.429688
142	26.0	24.414062
260	18.1	18.134277
346	37.0	35.525391

79 rows × 2 columns

In [57]:
```python
df1=df.head(25)
df1.plot(kind='bar',figsize=(16,10))
plt.grid(which='major',linestyle='-',linewidth='0.5',color='green')
plt.grid(which='major',linestyle=':',linewidth='0.5',color='black')
plt.show()
```



In [58]:
```python
print('Mean Absolute Error:',mean_absolute_error(Y_test,y_pred))
print('Mean Squared Error:',mean_squared_error(Y_test,y_pred))
print('Root Mean Squared Error:',np.sqrt(mean_squared_error(Y_test,y_pred)))
```

```
Mean Absolute Error: 2.3976241099683544
Mean Squared Error: 9.267210604993602
Root Mean Squared Error: 3.0442093563015016
```