In [45]:
```
!curl https://archive.ics.uci.edu/ml/machine-learning-databases/auto-mpg/auto-mpg.data -o auto-mpg.data
   #Load data online
```

```
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100 30286  100 30286    0     0   118k      0 --:--:-- --:--:-- --:--:--  119k
```

In [46]:
```
!curl https://archive.ics.uci.edu/ml/machine-learning-databases/auto-mpg/auto-mpg.names -o auto-mpg.names
      #Load data online
```

```
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100  1660  100  1660    0     0   8829      0 --:--:-- --:--:-- --:--:--  8877
```

In [47]:
```
!ls
# show all the files in this directory
```

```
auto-mpg.data  auto-mpg.ipynb  auto-mpg.names  README.md
```

In [48]:
```
!cat *.names

#show what in the names file tell what this about
```

```
1. Title: Auto-Mpg Data

2. Sources:
   (a) Origin:  This dataset was taken from the StatLib library which is
                maintained at Carnegie Mellon University. The dataset was
                used in the 1983 American Statistical Association Exposition.
   (c) Date: July 7, 1993

3. Past Usage:
    -  See 2b (above)
    -  Quinlan,R. (1993). Combining Instance-Based and Model-Based Learning.
       In Proceedings on the Tenth International Conference of Machine
       Learning, 236-243, University of Massachusetts, Amherst. Morgan
       Kaufmann.

4. Relevant Information:

   This dataset is a slightly modified version of the dataset provided in
   the StatLib library.  In line with the use by Ross Quinlan (1993) in
   predicting the attribute "mpg", 8 of the original instances were removed
   because they had unknown values for the "mpg" attribute.  The original
   dataset is available in the file "auto-mpg.data-original".

   "The data concerns city-cycle fuel consumption in miles per gallon,
    to be predicted in terms of 3 multivalued discrete and 5 continuous
    attributes." (Quinlan, 1993)

5. Number of Instances: 398

6. Number of Attributes: 9 including the class attribute

7. Attribute Information:

    1. mpg:           continuous
    2. cylinders:     multi-valued discrete
    3. displacement:  continuous
    4. horsepower:    continuous
    5. weight:        continuous
    6. acceleration:  continuous
    7. model year:    multi-valued discrete
    8. origin:        multi-valued discrete
    9. car name:      string (unique for each instance)

8. Missing Attribute Values:  horsepower has 6 missing values
```

In [49]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

#import dependencies packages
```

In [50]:
```
dataset = pd.read_csv("auto-mpg.data",delim_whitespace=True, names=['mpg', 'cylinders', 'displacement', 'horsepower', 'weight', 'acceleration', 'model_year', 'orgin', 'car_name'])
#Load the file and put name columns on top
```

In [51]:
```
dataset.head()
#show the first five data
```

Out[51]:

| | mpg | cylinders | displacement | horsepower | weight | acceleration | model_year | orgin | car_name |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 18.0 | 8 | 307.0 | 130.0 | 3504.0 | 12.0 | 70 | 1 | chevrolet chevelle malibu |
| 1 | 15.0 | 8 | 350.0 | 165.0 | 3693.0 | 11.5 | 70 | 1 | buick skylark 320 |
| 2 | 18.0 | 8 | 318.0 | 150.0 | 3436.0 | 11.0 | 70 | 1 | plymouth satellite |
| 3 | 16.0 | 8 | 304.0 | 150.0 | 3433.0 | 12.0 | 70 | 1 | amc rebel sst |
| 4 | 17.0 | 8 | 302.0 | 140.0 | 3449.0 | 10.5 | 70 | 1 | ford torino |

In [52]:
```
dataset.shape
#show the structuer of the dataset
```

Out[52]: (398, 9)

In [53]:
```
dataset.isnull().values.any()
#check if this data set has null values
```

Out[53]: False

In [54]:
```
dataset.describe()
#check dataset in more detail
```

Out[54]:

| | mpg | cylinders | displacement | weight | acceleration | model_year | orgin |
|---|---|---|---|---|---|---|---|
| count | 398.000000 | 398.000000 | 398.000000 | 398.000000 | 398.000000 | 398.000000 | 398.000000 |
| mean | 23.514573 | 5.454774 | 193.425879 | 2970.424623 | 15.568090 | 76.010050 | 1.572864 |
| std | 7.815984 | 1.701004 | 104.269838 | 846.841774 | 2.757689 | 3.697627 | 0.802055 |
| min | 9.000000 | 3.000000 | 68.000000 | 1613.000000 | 8.000000 | 70.000000 | 1.000000 |
| 25% | 17.500000 | 4.000000 | 104.250000 | 2223.750000 | 13.825000 | 73.000000 | 1.000000 |
| 50% | 23.000000 | 4.000000 | 148.500000 | 2803.500000 | 15.500000 | 76.000000 | 1.000000 |
| 75% | 29.000000 | 8.000000 | 262.000000 | 3608.000000 | 17.175000 | 79.000000 | 2.000000 |
| max | 46.600000 | 8.000000 | 455.000000 | 5140.000000 | 24.800000 | 82.000000 | 3.000000 |

In [55]:
```
dataset.dtypes
#check all the data types
```

Out[55]:
```
mpg             float64
cylinders         int64
displacement    float64
horsepower       object
weight          float64
acceleration    float64
model_year        int64
orgin             int64
```

```
car_name        object
dtype: object
```

In [56]:
```
dataset['horsepower'].unique()
#show all the unique values
```

Out[56]:
```
array(['130.0', '165.0', '150.0', '140.0', '198.0', '220.0', '215.0',
       '225.0', '190.0', '170.0', '160.0', '95.00', '97.00', '85.00',
       '88.00', '46.00', '87.00', '90.00', '113.0', '200.0', '210.0',
       '193.0', '?', '100.0', '105.0', '175.0', '153.0', '180.0', '110.0',
       '72.00', '86.00', '70.00', '76.00', '65.00', '69.00', '60.00',
       '80.00', '54.00', '208.0', '155.0', '112.0', '92.00', '145.0',
       '137.0', '158.0', '167.0', '94.00', '107.0', '230.0', '49.00',
       '75.00', '91.00', '122.0', '67.00', '83.00', '78.00', '52.00',
       '61.00', '93.00', '148.0', '129.0', '96.00', '71.00', '98.00',
       '115.0', '53.00', '81.00', '79.00', '120.0', '152.0', '102.0',
       '108.0', '68.00', '58.00', '149.0', '89.00', '63.00', '48.00',
       '66.00', '139.0', '103.0', '125.0', '133.0', '138.0', '135.0',
       '142.0', '77.00', '62.00', '132.0', '84.00', '64.00', '74.00',
       '116.0', '82.00'], dtype=object)
```

In [57]:
```
dataset = dataset.loc[dataset['horsepower'] != '?']
#In horsepower has a value ? which should not be
```

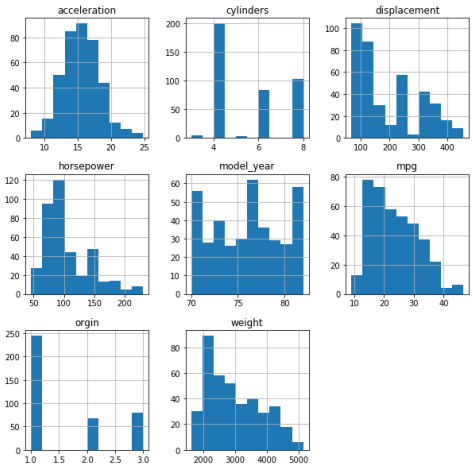
In [58]:
```
dataset['horsepower'] = dataset['horsepower'].astype(float)
# change the datatype to float
```

In [59]:
```
dataset.dtypes
#display the data type
```

Out[59]:
```
mpg             float64
cylinders         int64
displacement    float64
horsepower      float64
weight          float64
acceleration    float64
model_year        int64
orgin             int64
car_name         object
dtype: object
```

In [60]:
```
dataset.hist(figsize=(10,10))
#show all the data in graph
```

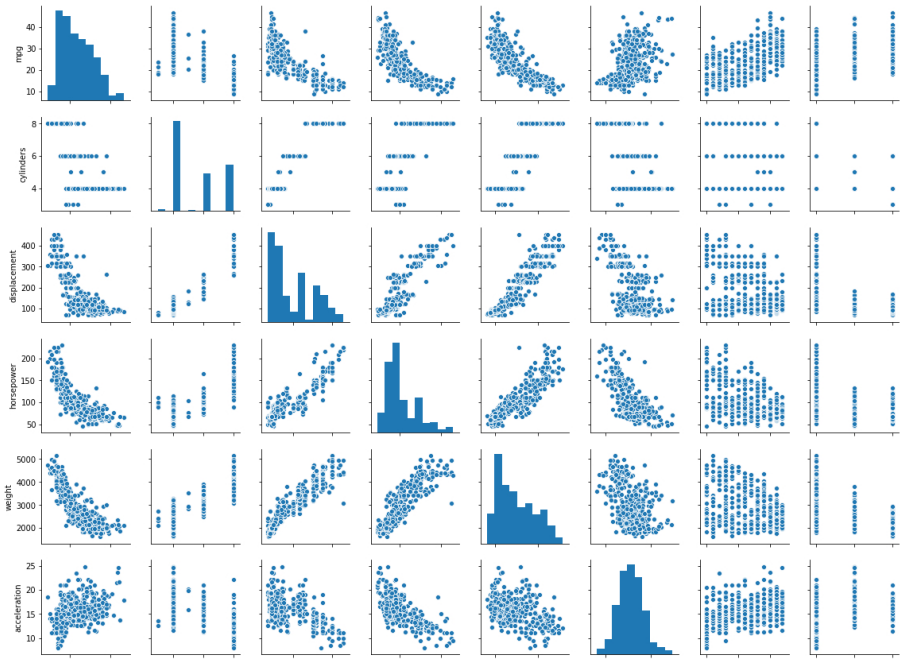
Out[60]:
```
array([[<matplotlib.axes._subplots.AxesSubplot object at 0x7f16934945c0>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x7f168632b5c0>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x7f16862ec6a0>],
       [<matplotlib.axes._subplots.AxesSubplot object at 0x7f167c3dac18>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x7f167c0ab198>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x7f167c04f710>],
       [<matplotlib.axes._subplots.AxesSubplot object at 0x7f1667fc6c88>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x7f1667ff5278>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x7f1667ff52b0>]],
      dtype=object)
```

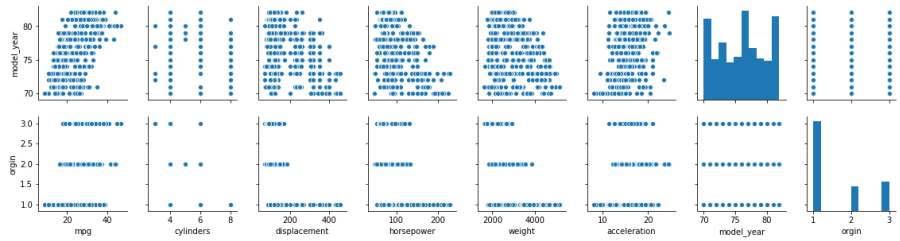



In [61]:
```
sns.pairplot(dataset, size = 2.0)
```

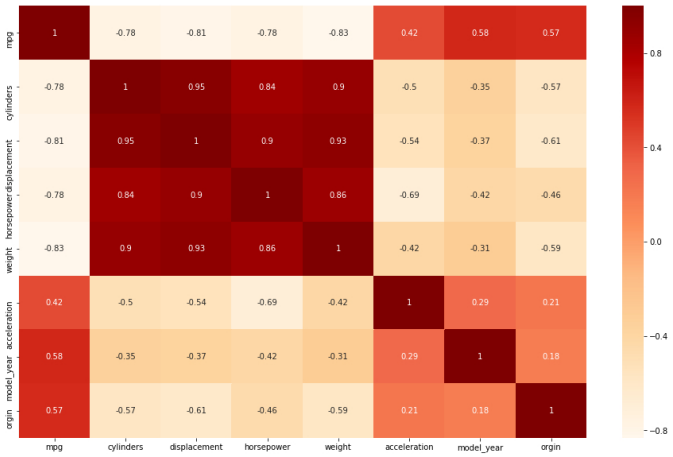
```
/home/nbuser/anaconda3_501/lib/python3.6/site-packages/seaborn/axisgrid.py:2065: UserWarning: The `size` parameter has been renamed to `height`; pleaes update your code.
  warnings.warn(msg, UserWarning)
```

Out[61]:
```
<seaborn.axisgrid.PairGrid at 0x7f16657ca320>
```





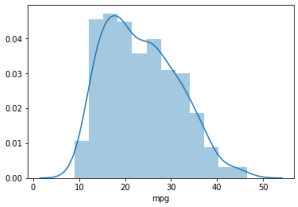

In [62]:
```
ax, fig = plt.subplots(figsize=(16,10))
correlation_matrix = dataset.corr()
sns.heatmap(correlation_matrix, annot=True, cmap="OrRd")
plt.show()

#make the graph with correlation
```




In [63]:
```
sns.distplot(dataset['mpg'])
#use sns to display the graph
```

```
/home/nbuser/anaconda3_501/lib/python3.6/site-packages/scipy/stats/stats.py:1713: FutureWarning: Using a non-tuple sequence for multidimensional indexing is deprecated; use `arr[tuple(seq)]` instead of `arr[seq]`. In the future this will be interpreted as an array index, `arr[np.array(seq)]`, which will result either in an error or a different result.
  return np.add.reduce(sorted[indexer] * weights, axis=axis) / sumval
```

Out[63]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f165fb53c50>
```




In [64]:
```
from sklearn.model_selection import train_test_split
#import to split the data

x=dataset.drop(['mpg', 'car_name'],axis=1)
#drop the data with car name
x.head()
```

Out[64]:

| | cylinders | displacement | horsepower | weight | acceleration | model_year | orgin |
|---|---|---|---|---|---|---|---|
| **0** | 8 | 307.0 | 130.0 | 3504.0 | 12.0 | 70 | 1 |
| **1** | 8 | 350.0 | 165.0 | 3693.0 | 11.5 | 70 | 1 |
| **2** | 8 | 318.0 | 150.0 | 3436.0 | 11.0 | 70 | 1 |
| **3** | 8 | 304.0 | 150.0 | 3433.0 | 12.0 | 70 | 1 |
| **4** | 8 | 302.0 | 140.0 | 3449.0 | 10.5 | 70 | 1 |

In [65]:
```
y = dataset['mpg']
y.head()
#show the first five data with mpg dataset
```

Out[65]:
```
0    18.0
1    15.0
2    18.0
3    16.0
4    17.0
Name: mpg, dtype: float64
```

In [66]:
```
train_x, test_x, train_y, test_y = train_test_split(x,y,test_size=0.2,random_state=42)
#split data into 2-8 and 2 for test 8 for train
```

In [67]:
```
from sklearn.linear_model import LinearRegression
model = LinearRegression()
#import linerRegression method
```

In [ ]:

In [68]:
```
model.fit(train_x,train_y)
#fit the train ing in model
```

Out[68]:
```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None,
         normalize=False)
```

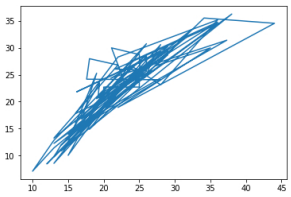
In [69]:
```
model.coef_
#show in an array
```

Out[69]:
```
array([-0.34578883,  0.01510871, -0.02130175, -0.00614163,  0.03795001,
        0.76774258,  1.61345707])
```

In [70]:
```
predicted = model.predict(test_x)
```

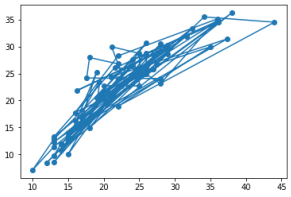
In [71]:
```
plt.plot(test_y,predicted)
#a graph displaying the prediction
```

Out[71]:
```
[<matplotlib.lines.Line2D at 0x7f165fa559b0>]
```




In [72]:
```
plt.scatter(test_y,predicted)
plt.plot(test_y,predicted)
```

Out[72]: [<matplotlib.lines.Line2D at 0x7f165fb3d9e8>]




In [73]:
```
model.score(test_x,test_y)
```

Out[73]: 0.7901500386760352

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]: