Lecture 6-Part 2

Matrix Plots (Heatmap)

Matrix plots allow you to plot data as color-encoded matrices and can also be used to indicate clusters within the data

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


import matplotlib.pyplot as plt
```

In [2]:
```
import seaborn as sns
```

Import Dataset

In [3]:
```
cars = pd.read_csv('Downloads/mtcars.csv')
```

Out[3]:
```
Index(['name', 'mpg', 'cyl', 'disp', 'hp', 'drat', 'wt', 'qsec', 'vs', 'am',
       'gear', 'carb'],
      dtype='object')
```

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

Out[20]:

	name	mpg	cyl	disp	hp	drat	wt	qsec	vs	am	gear	carb
0	Mazda RX4	21.0	6	160.0	110	3.90	2.620	16.46	0	1	4	4
1	Mazda RX4 Wag	21.0	6	160.0	110	3.90	2.875	17.02	0	1	4	4
2	Datsun 710	22.8	4	108.0	93	3.85	2.320	18.61	1	1	4	1
3	Hornet 4 Drive	21.4	6	258.0	110	3.08	3.215	19.44	1	0	3	1
4	Hornet Sportabout	18.7	8	360.0	175	3.15	3.440	17.02	0	0	3	2

Heatmap

In order for a heatmap to work properly, your data should already be in a matrix form, the sns.heatmap function basically just colors it in for you. For example:

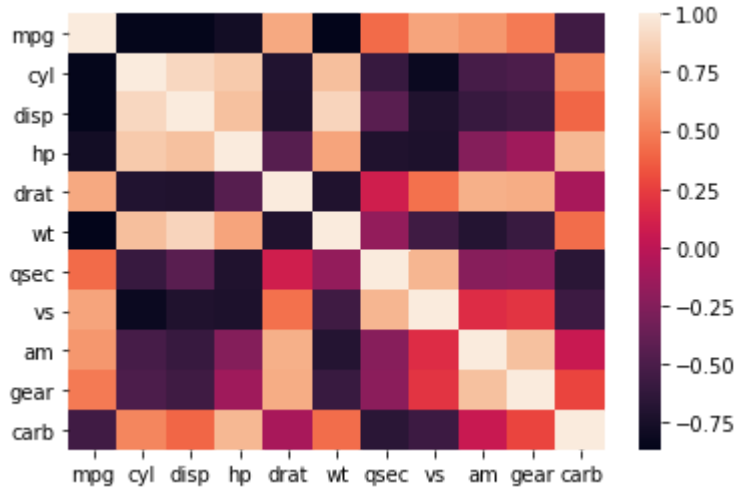
In [4]:
```
1 # correlation data
```

Out[4]:

	mpg	cyl	disp	hp	drat	wt	qsec	vs	
mpg	1.000000	-0.852162	-0.847551	-0.776168	0.681172	-0.867659	0.418684	0.664039	0.5998
cyl	-0.852162	1.000000	0.902033	0.832447	-0.699938	0.782496	-0.591242	-0.810812	-0.5226
disp	-0.847551	0.902033	1.000000	0.790949	-0.710214	0.887980	-0.433698	-0.710416	-0.5912
hp	-0.776168	0.832447	0.790949	1.000000	-0.448759	0.658748	-0.708223	-0.723097	-0.2432
drat	0.681172	-0.699938	-0.710214	-0.448759	1.000000	-0.712441	0.091205	0.440278	0.7127
wt	-0.867659	0.782496	0.887980	0.658748	-0.712441	1.000000	-0.174716	-0.554916	-0.6924
qsec	0.418684	-0.591242	-0.433698	-0.708223	0.091205	-0.174716	1.000000	0.744535	-0.2298
vs	0.664039	-0.810812	-0.710416	-0.723097	0.440278	-0.554916	0.744535	1.000000	0.1683
am	0.599832	-0.522607	-0.591227	-0.243204	0.712711	-0.692495	-0.229861	0.168345	1.0000
gear	0.480285	-0.492687	-0.555569	-0.125704	0.699610	-0.583287	-0.212682	0.206023	0.7940
carb	-0.550925	0.526988	0.394977	0.749812	-0.090790	0.427606	-0.656249	-0.569607	0.0575

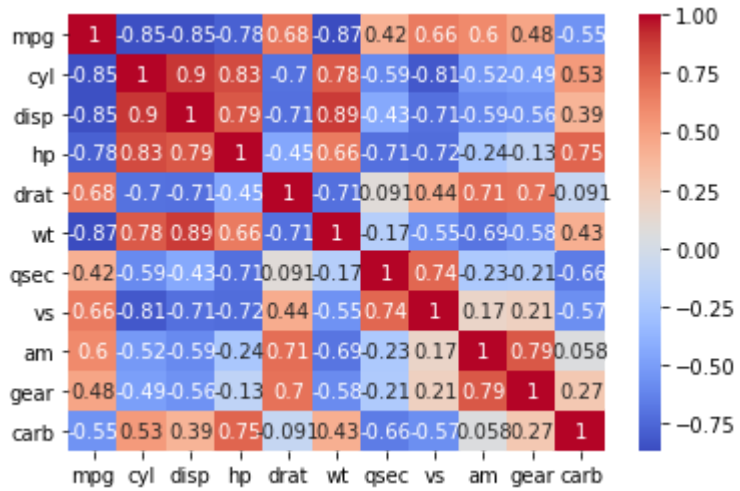
In [7]:
```
1 sns.heatmap(cars.corr())
```

Out[7]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x210394dd388>
```



In [8]:
```
1 sns.heatmap(cars.corr(),cmap='coolwarm',annot=True)
```

Out[8]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x21039ce7b88>
```

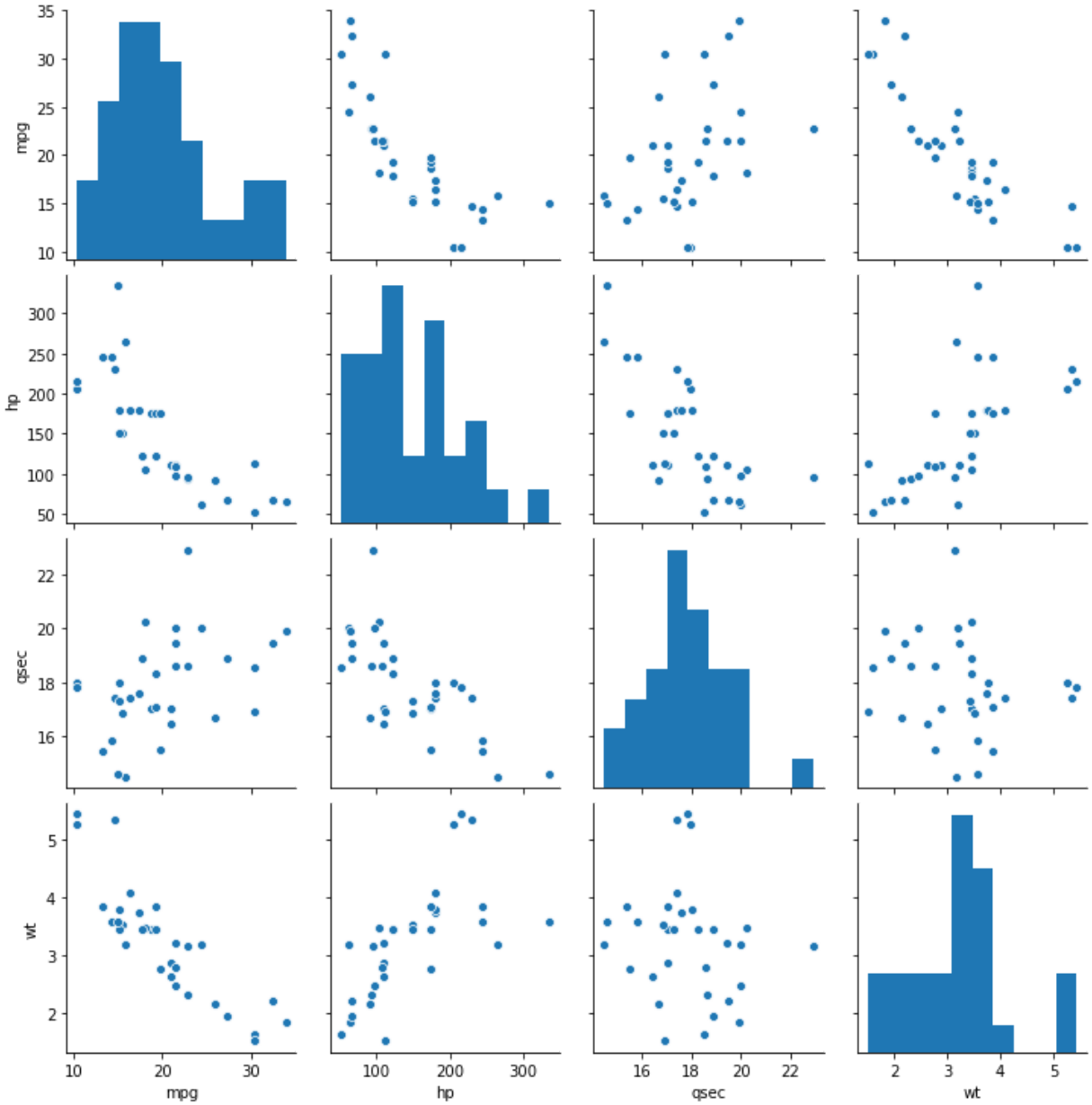


In [26]:
```
1 import scipy
2 from scipy.stats.stats import pearsonr
3 from scipy.stats.stats import spearmanr
```

The Pearson Correlation

In [12]:
```
1 X = cars[['mpg', 'hp', 'qsec', 'wt']]
```

Out[12]: <seaborn.axisgrid.PairGrid at 0x21039f58e08>



Here, we will calculate the Pearson correlation between different variables.

In [22]:
```
mpg = cars['mpg']
hp = cars['hp']
qsec = cars['qsec']
```

In [23]:
```
pearsonr_coefficient, p_value = pearsonr(mpg, hp)
```

```
PeasonR Correlation Coefficient -0.776
```

In [ ]:
```
#### Example1: Please use the empty code cells below to calculate the pearso

    1- (mpg, qsec)
    2- (mpg, wt)
```

Using pandas to calculate the Pearson correlation coefficient

In [24]:
```
corr = X.corr()
```

Out[24]:

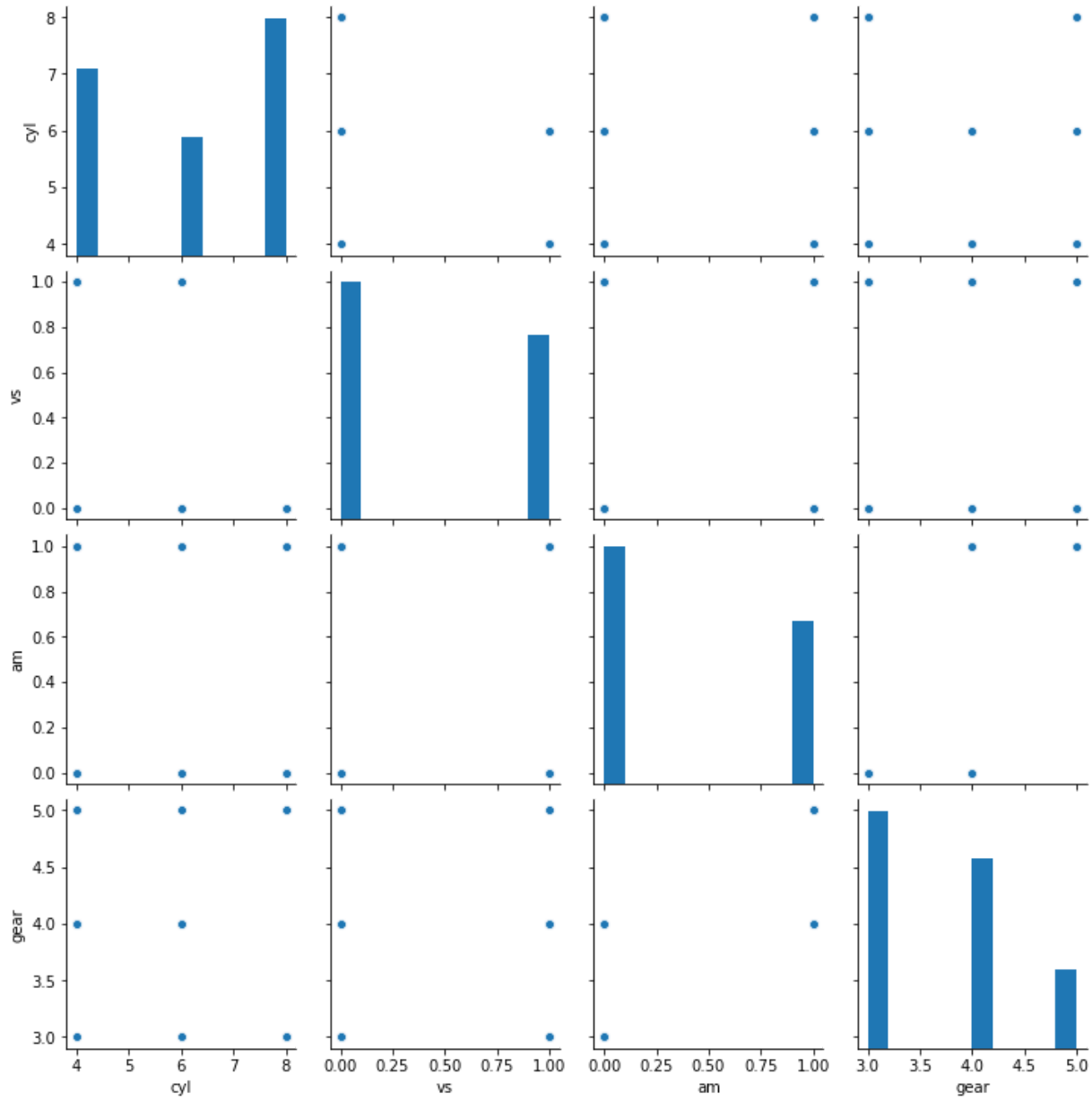
	mpg	hp	qsec	wt
mpg	1.000000	-0.776168	0.418684	-0.867659
hp	-0.776168	1.000000	-0.708223	0.658748
qsec	0.418684	-0.708223	1.000000	-0.174716
wt	-0.867659	0.658748	-0.174716	1.000000

In [ ]:
```
#### Example 2: What do the dark (black) shades and light (white) shades ind
```

The Spearman Rank Correlation

In [28]:
```
X = cars[['cyl', 'vs', 'am', 'gear']]
sns.pairplot(X)
```

Out[28]: <seaborn.axisgrid.PairGrid at 0x2103a854388>



In [32]:
```
cyl = cars['cyl']
vs = cars['vs']
am = cars['am']
gear = cars['gear']
spearmanr_coefficient, p_value = spearmanr(cyl, vs)
print('Spearman Rank Correlation Coefficient %0.3f' % (spearmanr coefficient
```

```
Spearman Rank Correlation Coefficient -0.814
```

Chi-square test for independence

In [33]:
```
table = pd.crosstab(cyl, am)
from scipy.stats import chi2_contingency
chi2, p, dof, expected = chi2_contingency(table.values)
```

```
Chi-square statistic 8.741 p_value 0.013
```

Math and Statistics

In [34]:
```
cars = pd.read_csv('Downloads/mtcars.csv')
```

Out[34]:
```
Index(['name', 'mpg', 'cyl', 'disp', 'hp', 'drat', 'wt', 'qsec', 'vs', 'am',
       'gear', 'carb'],
      dtype='object')
```

Looking at summary statistics that decribe a variable's numeric values

In [35]:
```
cars.sum()
```

Out[35]:
```
name    Mazda RX4Mazda RX4 WagDatsun 710Hornet 4 Drive...
mpg                                                642.9
cyl                                                  198
disp                                              7383.1
hp                                                  4694
drat                                              115.09
wt                                               102.952
qsec                                              571.16
vs                                                    14
am                                                    13
gear                                                 118
carb                                                  90
dtype: object
```

In [36]:
```
1 cars.sum(axis=1)
```

Out[36]:
```
0     328.980
1     329.795
2     259.580
3     426.135
4     590.310
5     385.540
6     656.920
7     270.980
8     299.570
9     350.460
10    349.660
11    510.740
12    511.500
13    509.850
14    728.560
15    726.644
16    725.695
17    213.850
18    195.165
19    206.955
20    273.775
21    519.650
22    506.085
23    646.280
24    631.175
25    208.215
26    272.570
27    273.683
28    670.690
29    379.590
30    694.710
31    288.890
dtype: float64
```

In [ ]:
```
1 #Example: what is a different of cars.sum() and cars.sum(axis=1)?
```

In [37]:
```
1 cars.median()
```

Out[37]:
```
mpg      19.200
cyl       6.000
disp    196.300
hp      123.000
drat      3.695
wt        3.325
qsec     17.710
vs        0.000
am        0.000
gear      4.000
carb      2.000
dtype: float64
```

In [38]:
```
1 cars.mean()
```

Out[38]:
```
mpg      20.090625
cyl       6.187500
disp    230.721875
hp      146.687500
drat      3.596563
wt        3.217250
qsec     17.848750
vs        0.437500
am        0.406250
gear      3.687500
carb      2.812500
dtype: float64
```

In [ ]:
```
1 #Example:mwhat is value of median and mean parameter for gear variable?
```

In [39]:
```
1 cars.max()
```

Out[39]:
```
name    Volvo 142E
mpg           33.9
cyl              8
disp           472
hp             335
drat          4.93
wt           5.424
qsec          22.9
vs               1
am               1
gear             5
carb             8
dtype: object
```

Looking at summary statistics that describe variable distribution

we will calculate standard deviation and variance for car dataset.

In [41]:
```
1 cars.std()
```

Out[41]:
```
mpg       6.026948
cyl       1.785922
disp    123.938694
hp       68.562868
drat      0.534679
wt        0.978457
qsec      1.786943
vs        0.504016
am        0.498991
gear      0.737804
carb      1.615200
dtype: float64
```

In [42]:
```
1 cars.var()
```

Out[42]:
```
mpg        36.324103
cyl         3.189516
disp    15360.799829
hp       4700.866935
drat        0.285881
wt          0.957379
qsec        3.193166
vs          0.254032
am          0.248992
gear        0.544355
carb        2.608871
dtype: float64
```

In [43]:
```
1 cars.describe()
```

Out[43]:

	mpg	cyl	disp	hp	drat	wt	qsec	vs
count	32.000000	32.000000	32.000000	32.000000	32.000000	32.000000	32.000000	32.000000
mean	20.090625	6.187500	230.721875	146.687500	3.596563	3.217250	17.848750	0.437500
std	6.026948	1.785922	123.938694	68.562868	0.534679	0.978457	1.786943	0.504016
min	10.400000	4.000000	71.100000	52.000000	2.760000	1.513000	14.500000	0.000000
25%	15.425000	4.000000	120.825000	96.500000	3.080000	2.581250	16.892500	0.000000
50%	19.200000	6.000000	196.300000	123.000000	3.695000	3.325000	17.710000	0.000000
75%	22.800000	8.000000	326.000000	180.000000	3.920000	3.610000	18.900000	1.000000
max	33.900000	8.000000	472.000000	335.000000	4.930000	5.424000	22.900000	1.000000

In [ ]:
```
1
```