K Means Clustering with Python

In [1]:
```
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
```

In [2]:
```
#Since it is unsupervised learning, it means we are not trying to predict any outcome
# or even patterns in the data. We just specify the number of clusters we want our data in
```

In [3]:
```
from sklearn.datasets import make_blobs
```

In [5]:
```
#Pressing shift + tab on 'make_blobs' will give you numerous depictions of what you can do
# make_blobs can take the following arguments (n_samples, n_features, centers, cluster_std,
#center_box, shuffle, random_state, return_centers etc.

# Let's use it to make data

data = make_blobs(n_samples=200,n_features=2,centers=4,cluster_std=1.8,random_state=101)
```

In [6]:
```
#Let's check the format

data[0]
```

Out[6]:
```
array([[-6.42884095e+00,  1.01411174e+01],
       [ 5.86867888e+00,  5.20110356e+00],
       [-3.76109375e-01,  3.26427943e+00],
       [ 2.16679181e+00,  9.56300522e+00],
       [ 5.09508570e+00,  7.20752718e+00],
       [-1.08788882e+01, -6.11318040e+00],
       [ 2.03405554e+00,  9.76664755e+00],
       [-1.71798771e+00,  1.41401140e+00],
       [ 1.16911341e+00,  8.24556988e+00],
       [-1.35185444e+00,  3.13245345e+00],
       [-6.18548214e+00,  9.67406555e+00],
       [-1.19856602e+00,  2.50408937e+00],
       [ 2.90296863e+00,  7.91251003e+00],
       [ 2.39250023e+00,  5.38173971e+00],
       [-5.27545147e+00,  9.63836659e+00],
       [-5.66814687e-01,  5.60262755e-02],
       [ 5.97336628e+00,  5.87172022e+00],
       [-2.31355268e+00,  5.23980092e-01],
       [-1.01344756e+01, -3.43130837e+00],
       [-4.54082629e+00,  1.13920174e+01],
       [-1.04155833e+01, -5.67545836e+00],
       [ 6.64796693e-01,  9.42304718e-02],
       [ 2.11460477e+00,  3.55938488e+00],
       [-1.11790221e+01, -9.30976605e+00],
       [-6.63698251e+00,  6.39426436e+00],
       [-7.67422005e+00, -7.26839654e+00],
       [-7.98668260e+00, -9.57113308e+00],
       [ 1.27983684e+00,  3.53150777e-01],
       [ 3.54480244e+00,  7.93535678e+00],
       [ 4.03940181e+00,  4.88870433e+00],
       [-2.88118898e+00,  9.12919391e+00],
       [-9.11009911e+00, -7.69781660e+00],
       [ 5.26001172e+00,  4.74007434e+00],
       [ 2.05859724e+00, -2.44083039e+00],
       [-1.71289834e+00,  2.51221197e+00],
       [-5.40562319e+00,  7.47228315e+00],
       [-1.11995123e+01, -2.55276744e+00],
       [-1.13753641e+01, -4.94525091e+00],
       [-1.17821836e+01, -9.50883007e+00],
       [ 1.74815503e+00,  2.05595679e+00],
       [-9.00392334e+00, -6.20816203e+00],
       [-2.86564584e+00,  7.52934153e+00],
       [-1.42742293e+00,  8.33519078e+00],
       [-3.10933432e+00,  1.01641464e+01],
       [ 2.71130095e-01,  2.58303824e+00],
       [ 8.21556561e-01,  6.76966806e+00],
       [-4.11495481e+00,  8.02621345e+00],
       [ 1.55414928e+00,  3.27657687e+00],
       [-1.16546211e+01, -8.00673720e+00],
       [-1.22009637e+00,  4.90466211e+00],
       [ 3.22017630e+00, -5.94926204e-01],
       [-5.40452892e+00,  7.19997027e+00],
       [ 6.02795351e+00,  4.01696240e+00],
       [ 4.02600451e-01,  6.73452012e-01],
       [-7.38985009e+00, -5.61883075e+00],
       [-1.60537707e+00,  5.98523639e+00],
       [ 8.72770362e-01,  4.46205300e+00],
       [ 1.03445241e+00,  1.81203497e+00],
       [-3.88943018e+00,  5.29262653e+00],
       [ 3.16835529e+00,  6.73039191e+00],
```

```
[-8.07309689e+00, -7.95924003e+00],
[ 9.16131646e-01,  7.46139251e+00],
[-7.39648298e+00, -4.95353352e+00],
[-1.71632701e+00,  8.48540300e+00],
[ 2.71396283e+00,  8.37361821e+00],
[-2.16570885e+00, -9.80036369e-01],
[-1.19474369e+01, -6.96432616e+00],
[ 4.89539219e+00,  6.07867981e+00],
[ 2.86177832e+00,  8.22611192e+00],
[-9.15392597e+00, -6.26781804e+00],
[ 2.03477094e+00,  8.20236427e+00],
[ 7.56601080e-01,  5.00732585e+00],
[-8.84039494e+00, -5.35549354e+00],
[-3.02650610e+00,  3.90066592e+00],
[-8.88037875e+00, -6.13184717e+00],
[ 5.20737777e+00,  6.42515996e+00],
[ 3.19207745e+00,  1.04409077e+01],
[ 3.54100315e-02,  2.28780746e+00],
[-6.94760830e+00,  1.03023440e+01],
[-3.30473029e+00,  2.74557144e+00],
[-6.95473895e-01,  3.94656058e+00],
[-8.33457235e+00, -6.05391550e+00],
[ 5.51284070e+00,  8.53538580e+00],
[-6.27688951e+00, -5.31758277e+00],
[ 6.67624111e-01,  4.73820362e-02],
[-1.03161306e+00,  7.89798431e-01],
[-1.48136390e+00,  7.81302690e-02],
[-5.35676677e+00,  6.98316723e+00],
[ 1.85230075e+00,  3.93319729e+00],
[-1.03889624e+01, -2.75765759e+00],
[-8.37419034e+00, -9.48799296e+00],
[-8.21095227e+00, -6.52257701e+00],
[-9.80094161e+00, -2.08038454e+00],
[-6.22493829e-01,  5.50912500e+00],
[ 2.71883687e-01,  4.90522990e+00],
[-8.72228610e+00, -7.70447881e+00],
[ 5.36248494e+00,  9.10638480e+00],
[-3.95284076e+00,  7.08183115e+00],
[-8.26204953e+00, -5.92347393e+00],
[ 7.60329764e+00,  4.39690494e+00],
[-1.55623061e+00,  3.74032798e+00],
[-1.08189070e+01, -6.37070754e+00],
[ 1.33375749e+00,  3.25801024e+00],
[-3.22271663e+00, -1.47041326e-01],
[ 1.09263748e-02,  6.37797424e+00],
[-1.21138032e+00,  4.18893447e+00],
[-9.49249242e+00, -5.33043171e+00],
[ 8.71855704e+00,  9.42068808e+00],
[-9.28377343e+00, -7.31691088e+00],
[-9.51273313e+00, -6.54720909e+00],
[ 5.01871366e+00,  2.64366773e+00],
[-2.69943732e+00,  7.33651484e+00],
[-4.21294044e+00,  6.69844656e+00],
[ 2.32686550e+00,  8.41007576e+00],
[-9.33392485e+00, -1.03767705e+01],
[ 4.09116118e+00,  6.24501935e+00],
[-3.44377911e+00,  8.15200300e+00],
[-6.56254983e+00,  9.77730406e+00],
[ 1.20080532e+00,  6.94341290e+00],
[-1.14313099e+00,  8.18669136e+00],
[ 1.02282712e+00,  5.16458509e+00],
[-4.41592469e+00,  6.35654190e+00],
[-1.45990175e+00,  1.76759085e+00],
[-6.01113440e+00,  7.61084526e+00],
[-3.49761061e-01,  1.82795716e+00],
[ 5.33062618e+00,  5.70970077e+00],
[-6.16705213e+00,  1.01703782e+01],
[-2.74298212e+00, -6.73063211e-01],
[-9.88392998e+00, -7.61018334e+00],
[-2.30611367e+00,  6.56412841e+00],
[-4.18810225e+00,  6.78643776e+00],
[-3.63372128e+00,  8.71114106e+00],
[ 6.28400899e-01,  1.74545508e+00],
[-8.83495735e+00, -8.48305488e+00],
[-1.43571057e+01, -3.82895508e+00],
[-4.10513812e+00,  6.59306099e+00],
[ 3.46810859e+00,  4.27477213e+00],
[-3.83634067e+00,  3.99058382e+00],
[ 3.86879737e+00,  9.05702488e+00],
[ 1.52734733e+00,  4.44529411e-01],
[-1.01203801e+01, -7.30634015e+00],
[ 5.30579523e+00,  3.36726770e+00],
[-9.74381724e+00, -5.16531539e+00],
[-5.21734714e-01,  8.77631220e+00],
[-1.32773569e+00,  7.98200905e+00],
[ 2.26042193e+00,  6.22167436e+00],
[-1.33860111e+00,  4.76650719e+00],
[-8.11827275e+00, -8.12313116e+00],
[-3.80021292e+00,  7.47588731e+00],
```

```
       [-5.33110685e+00,  8.09237748e+00],
       [-2.50033965e+00,  1.10368807e+01],
       [-2.16845912e+00,  9.21545979e+00],
       [ 8.52592570e-02,  2.11630185e+00],
       [ 3.42604328e+00,  4.85412683e+00],
       [ 1.62539023e+00, -7.88195931e-01],
       [-8.45546407e+00,  7.81479304e+00],
       [ 1.94991080e+00,  4.77920618e+00],
       [ 2.66085026e+00,  8.85418636e+00],
       [ 3.30975285e+00,  7.20496849e+00],
       [ 1.48322247e+00, -2.15828086e-01],
       [ 4.18471184e+00,  7.42058154e+00],
       [ 1.78184320e+00,  1.54467915e+00],
       [-2.16128362e+00,  4.08184363e+00],
       [-6.73918279e+00,  4.14835615e+00],
       [-1.24514261e+01, -5.96841529e+00],
       [-6.08197913e+00,  6.17032027e+00],
       [-1.37015897e+00,  2.28590470e+00],
       [ 5.51872307e+00,  7.27154783e+00],
       [-3.03385808e+00,  8.92618442e+00],
       [ 4.20669615e+00,  3.14885797e-01],
       [ 4.11969631e+00,  7.79152164e+00],
       [ 1.47778918e+00,  2.00671508e+00],
       [-4.75152705e+00,  8.00144754e+00],
       [-1.07466987e-01,  7.34698260e+00],
       [ 1.17780584e-01,  4.83651037e+00],
       [-7.25153130e+00,  5.50680568e+00],
       [ 3.92000057e+00,  7.87622351e+00],
       [ 1.14783058e+00,  7.25692451e+00],
       [-5.77733594e+00, -8.45301197e+00],
       [ 1.75952674e+00,  6.67729832e+00],
       [-3.30799302e+00,  8.82613007e+00],
       [-7.87501869e+00, -9.37924348e+00],
       [-8.02054658e+00, -7.84568360e+00],
       [-8.56456002e-01,  1.05365275e+01],
       [-9.13930933e+00, -5.07011409e+00],
       [-1.01147018e+01, -9.56847340e+00],
       [-9.07497230e+00, -2.42418980e+00],
       [-9.65620091e+00, -8.27162550e+00],
       [-1.14063629e+01, -1.00039828e+01],
       [ 5.92620742e-01,  5.50345267e-01],
       [-9.93363386e+00, -4.65668813e+00],
       [ 5.48533076e+00,  7.60283616e+00],
       [ 4.43919524e+00,  8.13205419e+00],
       [-3.65443003e+00,  7.20898410e+00],
       [-8.81214493e+00, -6.21627131e+00],
       [ 6.71402334e-01,  4.97511492e+00],
       [ 6.56000194e+00,  8.35132137e+00],
       [ 5.13497095e+00,  9.12541881e+00],
       [-9.26198510e+00, -4.33610417e+00],
       [ 2.17474403e+00,  1.13147551e+00]])
```

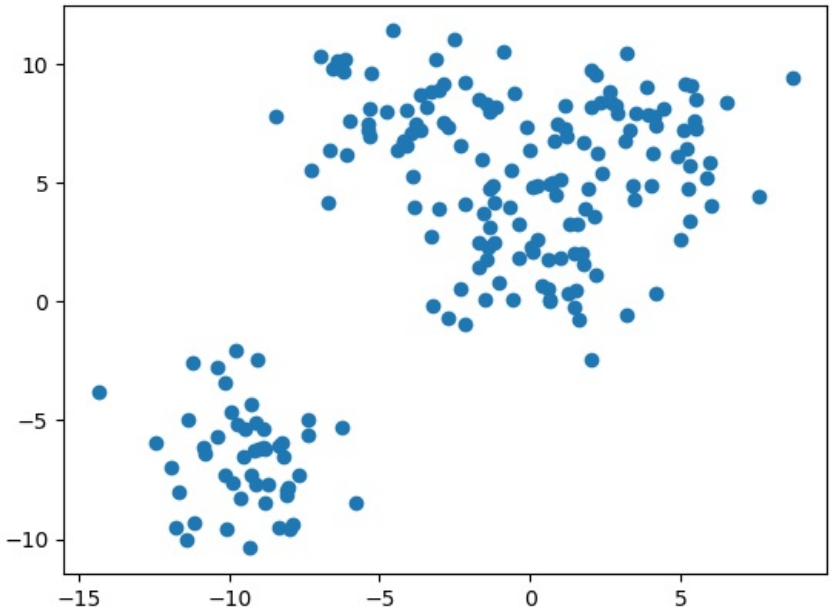
In [7]:
```
data[0].shape # 200 Samples and their 2 features
```

Out[7]:
```
(200, 2)
```

In [8]:
```
#Let's plot it - Take all the rows in the first and second column(2 features)
# Plus all rows for having all the data

plt.scatter(data[0][:,0],data[0][:,1]) # So there are 2 blobs
```

Out[8]:
```
<matplotlib.collections.PathCollection at 0x1cb65a51580>
```



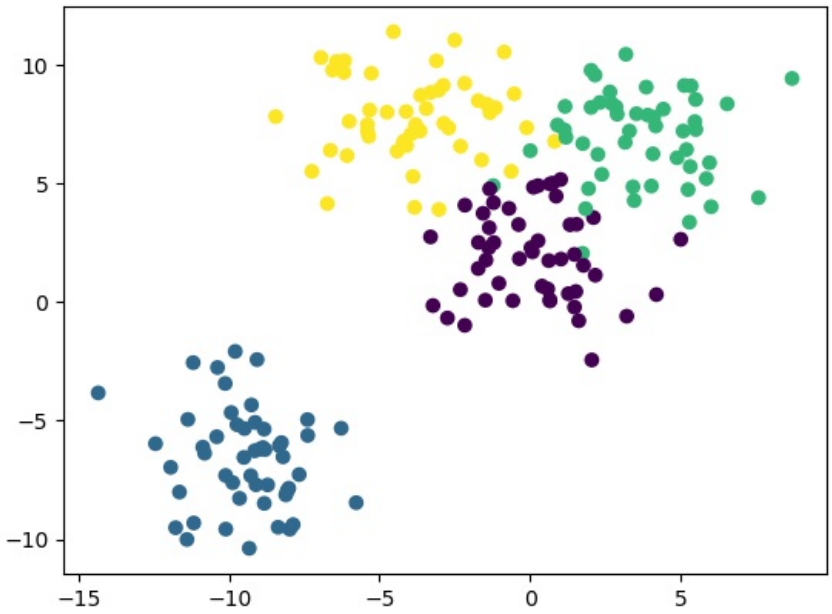
In [9]:
```
# Let's check the second item in the tupple

data[1] # Data shows that there are 4 variables. I mean there are 4 centers so let's replot this
```

Out[9]:
```
array([3, 2, 0, 2, 2, 1, 2, 0, 2, 0, 3, 0, 2, 2, 3, 0, 2, 0, 1, 3, 1, 0,
       0, 1, 3, 1, 1, 0, 2, 2, 3, 1, 2, 0, 0, 3, 1, 1, 1, 2, 1, 3, 3, 3,
       0, 3, 3, 0, 1, 2, 0, 3, 2, 0, 1, 3, 0, 0, 3, 2, 1, 2, 1, 3, 2, 0,
       1, 2, 2, 1, 2, 0, 1, 3, 1, 2, 2, 0, 3, 0, 0, 1, 2, 1, 0, 0, 0, 3,
       2, 1, 1, 1, 1, 3, 0, 1, 2, 3, 1, 2, 0, 1, 0, 0, 2, 0, 1, 2, 1, 1,
       0, 3, 3, 2, 1, 2, 3, 3, 2, 3, 0, 3, 0, 3, 0, 2, 3, 0, 1, 3, 3, 3,
       0, 1, 1, 3, 2, 3, 2, 0, 1, 2, 1, 3, 3, 2, 0, 1, 3, 3, 3, 3, 0, 2,
       0, 3, 2, 2, 2, 0, 2, 0, 0, 3, 1, 3, 0, 2, 3, 0, 2, 0, 3, 3, 0, 3,
       2, 2, 1, 2, 3, 1, 1, 3, 1, 1, 1, 1, 1, 0, 1, 2, 2, 3, 1, 0, 2, 2,
       1, 0])
```

In [10]:
```
plt.scatter(data[0][:,0],data[0][:,1],c=data[1])
```

Out[10]:
```
<matplotlib.collections.PathCollection at 0x1cb66121e20>
```



In [ ]:

```
```

In [13]:

```
#1 of the 4 is clearly out of the loop. The 3 others have a lot of noise
#Let's create a K Means

from sklearn.cluster import KMeans #unsupervised
```

In [20]:

```
kmeans = KMeans(n_clusters = 6) #We know that because we created the question
#The original value was 4. I just switched it up to see what K means can do.

#We can keep running and change this code from 4 to 2 to 3 or to even 8.
# The K means graph is going to section it up for us.
```

In [21]:

```
kmeans.fit(data[0])
```

Out[21]:

```
KMeans(n_clusters=6)
```

In [22]:

```
kmeans.cluster_centers_
```

Out[22]:

```
array([[ 4.41931683,  7.10852626],
       [-9.67203831, -5.13061964],
       [ 0.14363806,  1.2030127 ],
       [-4.54801232,  8.00124409],
       [-9.18960987, -8.53584776],
       [-0.0336487 ,  5.86293921]])
```

In [23]:

```
kmeans.labels_ #If we did not have the labels we'd be done at this point

#Those are predicted labels
```

Out[23]:

```
array([3, 0, 2, 0, 0, 1, 0, 2, 5, 2, 3, 2, 0, 5, 3, 2, 0, 2, 1, 3, 1, 2,
       2, 4, 3, 4, 4, 2, 0, 0, 3, 4, 0, 2, 2, 3, 1, 1, 4, 2, 1, 3, 5, 3,
       2, 5, 3, 2, 4, 5, 2, 3, 0, 2, 1, 5, 5, 2, 3, 0, 4, 5, 1, 3, 0, 2,
       1, 0, 0, 1, 0, 5, 1, 5, 1, 0, 0, 2, 3, 2, 5, 1, 0, 1, 2, 2, 2, 3,
       5, 1, 4, 1, 1, 5, 5, 4, 0, 3, 1, 0, 5, 1, 2, 2, 5, 5, 1, 0, 4, 1,
       0, 3, 3, 0, 4, 0, 3, 3, 5, 5, 5, 3, 2, 3, 2, 0, 3, 2, 4, 5, 3, 3,
       2, 4, 1, 3, 0, 3, 0, 2, 4, 0, 1, 5, 5, 5, 5, 4, 3, 3, 3, 3, 2, 0,
       2, 3, 5, 0, 0, 2, 0, 2, 5, 3, 1, 3, 2, 0, 3, 2, 0, 2, 3, 5, 5, 3,
       0, 5, 4, 5, 3, 4, 4, 3, 1, 4, 1, 4, 4, 2, 1, 0, 0, 3, 1, 5, 0, 0,
       1, 2])
```

In [24]:

```
#So how does the K means compare to the original
```

```
fig, (ax1,ax2) = plt.subplots(1,2, sharey= True, figsize= (10,6))

ax1.set_title('K Means')
ax1.scatter(data[0][:,0],data[0][:,1],c=kmeans.labels_,cmap='rainbow')

ax2.set_title('Original')
ax2.scatter(data[0][:,0],data[0][:,1],c=data[1],cmap='rainbow')

#The colors are meaningless if both are 4 and 4. The colors just group them
#The position of points are important though

#Normally we wouldn't have the labels. Only have the k means predicted ones
# We just have those labels because we created them just to compare and
#  help in the understanding of k means.
```

Out[24]: <matplotlib.collections.PathCollection at 0x1cb66d95be0>