K-Means Clustering

In [44]:
```
# Importing the libraries
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt

# To ignore warnings
import warnings
warnings.filterwarnings("ignore")
```

In [45]:
```
# Read data into dataframe
df = pd.read_excel(r'F:\DSP\Class\Python\Basics\Mavoix\mavoix_ml_sample_dataset.xlsx', index_col = 0, header = 0)
df.head()
```

Out[45]:

Application_ID	Current City	Python (out of 3)	R Programming (out of 3)	Deep Learning (out of 3)	PHP (out of 3)	MySQL (out of 3)	HTML (out of 3)	CSS (out of 3)	JavaScript (out of 3)	Unnamed: 10	...	Node.js (out of 3)	ReactJS (out of 3)	Other skills	Degree	Stream	Current Year Of Graduation	Performance_PG	Performance_UG	Performance_12	Performance_10
ML0001	Bangalore	0	2	0	2	0	2	3	2	NaN	...	0	0	R Programming	Bachelor of Science (B.Sc)	Mathematics	2017	NaN	NaN	NaN	NaN
ML0002	Bangalore	2	0	0	2	2	2	2	2	NaN	...	0	0	Data Science, Machine Learning, Neural Network...	Bachelor of Technology (B.Tech)	Computer Science & Engineering	2019	NaN	85.50/100	92.20/92.20	96.60/96.60
ML0003	Bangalore	3	0	1	2	2	2	0	2	NaN	...	0	0	Algorithms, Data Structures, Python, C Program...	Master of Science (M.Sc)	Computer Science	2018	7.91/10	70.00/100	64.83/64.83	77.60/77.60
ML0004	Bangalore	2	0	2	1	0	2	0	0	NaN	...	0	0	CSS, Deep Learning, Embedded Systems, HTML, Ma...	Bachelor of Engineering (B.E)	Electronics and Communication	2019	NaN	6.86/10	76.00/76.00	84.32/84.32
ML0005	Bangalore	2	0	0	2	0	2	1	1	NaN	...	2	2	HTML, OpenCV, Python, SQL, C++ Programming, CS...	Bachelor of Technology (B.Tech)	Production Engineering	2018	NaN	6.38/10	65.20/65.20	68.80/68.80

5 rows × 23 columns

In [46]:
```
# Check for the shape of the dataset
print(df.shape)
print()
# Check for the missing values
print(df.isnull().sum())
```

```
(392, 23)

Current City                   0
Python (out of 3)              0
R Programming (out of 3)       0
Deep Learning (out of 3)       0
PHP (out of 3)                 0
MySQL (out of 3)               0
HTML (out of 3)                0
CSS (out of 3)                 0
JavaScript (out of 3)          0
Unnamed: 10                  392
AJAX (out of 3)                0
Bootstrap (out of 3)           0
MongoDB (out of 3)             0
Node.js (out of 3)             0
ReactJS (out of 3)             0
Other skills                  14
Degree                        12
Stream                        18
Current Year Of Graduation     0
Performance_PG               289
Performance_UG                54
Performance_12               163
Performance_10               177
dtype: int64
```

In [47]:
```
# To get the column names of the dataset
df.columns
```

Out[47]:
```
Index(['Current City', 'Python (out of 3)', 'R Programming (out of 3)',
       'Deep Learning (out of 3)', 'PHP (out of 3)', 'MySQL (out of 3)',
       'HTML (out of 3)', 'CSS (out of 3)', 'JavaScript (out of 3)',
       'Unnamed: 10', 'AJAX (out of 3)', 'Bootstrap (out of 3)',
       'MongoDB (out of 3)', 'Node.js (out of 3)', 'ReactJS (out of 3)',
       'Other skills', 'Degree', 'Stream', 'Current Year Of Graduation',
       'Performance_PG', 'Performance_UG', 'Performance_12', 'Performance_10'],
      dtype='object')
```

In [48]:
```
# We take a subset of the variables which are important for model building
data=df.drop(['Current City','Unnamed: 10','Other skills','Degree','Stream','Current Year Of Graduation','Performance_PG',
              'Performance_UG','Performance_12','Performance_10'],axis=1)
```

In [49]:
```
data.shape
```

Out[49]:
```
(392, 13)
```

In [50]:
```
data.columns
```

Out[50]:
```
Index(['Python (out of 3)', 'R Programming (out of 3)',
       'Deep Learning (out of 3)', 'PHP (out of 3)', 'MySQL (out of 3)',
       'HTML (out of 3)', 'CSS (out of 3)', 'JavaScript (out of 3)',
       'AJAX (out of 3)', 'Bootstrap (out of 3)', 'MongoDB (out of 3)',
       'Node.js (out of 3)', 'ReactJS (out of 3)'],
      dtype='object')
```

In [51]:
```
data.isnull().sum()
```

Out[51]:
```
Python (out of 3)           0
R Programming (out of 3)    0
Deep Learning (out of 3)    0
PHP (out of 3)              0
MySQL (out of 3)            0
HTML (out of 3)             0
CSS (out of 3)              0
JavaScript (out of 3)       0
AJAX (out of 3)             0
Bootstrap (out of 3)        0
MongoDB (out of 3)          0
Node.js (out of 3)          0
ReactJS (out of 3)          0
dtype: int64
```

In [52]:
```
data.dtypes
```

Out[52]:
```
Python (out of 3)           int64
R Programming (out of 3)    int64
Deep Learning (out of 3)    int64
PHP (out of 3)              int64
MySQL (out of 3)            int64
HTML (out of 3)             int64
CSS (out of 3)              int64
JavaScript (out of 3)       int64
AJAX (out of 3)             int64
Bootstrap (out of 3)        int64
MongoDB (out of 3)          int64
Node.js (out of 3)          int64
ReactJS (out of 3)          int64
dtype: object
```

In [53]:
```
# Created a subset of the dataset for Data Scientist Position
datax=data.drop(['PHP (out of 3)','HTML (out of 3)','CSS (out of 3)','JavaScript (out of 3)',
                 'AJAX (out of 3)', 'Bootstrap (out of 3)', 'MongoDB (out of 3)','Node.js (out of 3)', 'ReactJS (out of 3)'],
                axis=1)
```

In [54]:
```
datax
```

Out[54]:

Application_ID	Python (out of 3)	R Programming (out of 3)	Deep Learning (out of 3)	MySQL (out of 3)
ML0001	0	2	0	0
ML0002	2	0	0	2
ML0003	3	0	1	2
ML0004	2	0	2	0
ML0005	2	0	0	0
...	...	...	...	...
ML0388	2	1	0	0
ML0389	2	0	0	0
ML0390	1	0	0	0
ML0391	2	2	0	0
ML0392	2	3	0	0

392 rows × 4 columns

In [55]:
```
# Created a subset for Web Development Position
datay=data.drop(['Python (out of 3)', 'R Programming (out of 3)',
       'Deep Learning (out of 3)'],axis=1)
```

In [56]:
```
datay.head()
```

Out[56]:

Application_ID	PHP (out of 3)	MySQL (out of 3)	HTML (out of 3)	CSS (out of 3)	JavaScript (out of 3)	AJAX (out of 3)	Bootstrap (out of 3)	MongoDB (out of 3)	Node.js (out of 3)	ReactJS (out of 3)
ML0001	2	0	2	3	2	0	2	0	0	0
ML0002	2	2	2	2	2	0	0	0	0	0
ML0003	2	2	2	0	2	0	0	0	0	0
ML0004	1	0	2	0	0	0	0	0	0	0
ML0005	2	0	2	1	1	0	0	2	2	2

In [57]:
```
# Taking the total score of the different skills which a Data Scientist should possess
datax['total']=datax['Python (out of 3)']+datax['R Programming (out of 3)']+datax['Deep Learning (out of 3)']+datax['MySQL (out of 3)']
```

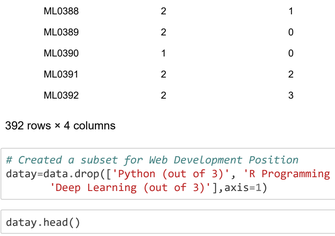
In [59]:
```
datax['grandtotal']= 12
datax.head()
```

Out[59]:

Application_ID	Python (out of 3)	R Programming (out of 3)	Deep Learning (out of 3)	MySQL (out of 3)	total	grandtotal
ML0001	0	2	0	0	2	12
ML0002	2	0	0	2	4	12
ML0003	3	0	1	2	6	12
ML0004	2	0	2	0	4	12
ML0005	2	0	0	0	2	12

In [61]:
```
# build a model with total & garndtotal
# As arrays are lighter in weight hence it will work faster than the dataframe
X=datax.values[:,[4,5]]
```

In [62]:
```
# Using the elbow method to find the optimal number of clusters
from sklearn.cluster import KMeans
wsse = []
for i in range(1, 10):
    kmeans = KMeans(n_clusters = i, random_state = 10)
    kmeans.fit(X)
    wsse.append(kmeans.inertia_)
plt.plot(range(1, 10), wsse)
plt.title('The Elbow Method')
plt.xlabel('Number of clusters')
plt.ylabel('WSSE')
plt.show()
```



In [64]:
```
# Fitting K-Means to the dataset
kmeans=KMeans(n_clusters=3,random_state=10)
Y_pred=kmeans.fit_predict(X)
```

In [65]:
```
Y_pred
# the clusters no are allocated on the dataset
# since we have selected the no of clusters = 3, hence 0,1,2
```

Out[65]:
```
array([0, 1, 2, 1, 0, 0, 0, 1, 1, 1, 0, 1, 1, 1, 0, 1, 0, 0, 0, 1, 1, 0,
       0, 1, 1, 0, 0, 1, 1, 2, 1, 0, 0, 2, 2, 0, 1, 1, 1, 0, 1, 0, 1, 1,
       0, 1, 0, 1, 0, 0, 0, 0, 1, 0, 1, 2, 0, 1, 0, 1, 2, 0, 1, 1, 1, 0,
       1, 1, 0, 0, 1, 1, 1, 0, 0, 0, 2, 0, 1, 0, 1, 1, 1, 0, 1, 0, 1, 1,
       0, 1, 2, 0, 0, 2, 1, 1, 1, 1, 0, 1, 1, 1, 1, 2, 1, 0, 1, 0, 1, 0,
       0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 1, 1, 0, 0, 2, 0, 0, 1, 0, 2, 0, 0,
       1, 0, 1, 1, 1, 1, 1, 2, 0, 0, 1, 1, 2, 1, 0, 1, 1, 0, 0, 1, 1, 0,
       2, 0, 2, 0, 2, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 2, 0, 0, 0, 2,
       1, 2, 2, 2, 1, 1, 2, 0, 1, 0, 1, 1, 0, 1, 1, 1, 1, 0, 1, 0, 0, 2,
       0, 0, 0, 1, 0, 2, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 2, 2, 0, 1, 2, 1,
       1, 0, 2, 1, 0, 1, 0, 0, 0, 0, 0, 1, 1, 1, 0, 1, 0, 0, 0, 0, 1, 0,
       0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 1, 2, 0, 0, 0, 1, 0, 0, 0, 0, 1,
       0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0,
       1, 0, 0, 0, 0, 1, 1, 0, 1, 0, 2, 0, 0, 0, 1, 0, 1, 1, 0, 1, 0, 1,
       0, 1, 1, 0, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 0, 0, 1, 0, 1,
       1, 0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 2, 0, 0, 0, 0, 2, 0, 0,
       1, 0, 1, 0, 1, 1, 1, 1, 0, 0, 0, 1, 2, 0, 0, 0, 1, 0, 0, 0, 0, 0,
       2, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1])
```

In [66]:
```
datax['clusters']=Y_pred
# we are appending the clusters column to the dataset
```

In [67]:
```
datax
```

Out[67]:

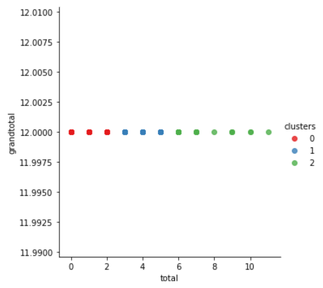
Application_ID	Python (out of 3)	R Programming (out of 3)	Deep Learning (out of 3)	MySQL (out of 3)	total	grandtotal	clusters
ML0001	0	2	0	0	2	12	0
ML0002	2	0	0	2	4	12	1
ML0003	3	0	1	2	6	12	2
ML0004	2	0	2	0	4	12	1
ML0005	2	0	0	0	2	12	0
...	...	...	...	...	...	...	...
ML0388	2	1	0	0	3	12	1
ML0389	2	0	0	0	2	12	0
ML0390	1	0	0	0	1	12	0
ML0391	2	2	0	0	4	12	1
ML0392	2	3	0	0	5	12	1

392 rows × 7 columns

In [68]:
```
# Data Visualization
import seaborn as sns

sns.lmplot( data=datax, x='total', y='grandtotal',
    fit_reg=False, # No regression line
    hue='clusters',palette="Set1")
```

Out[68]:
```
<seaborn.axisgrid.FacetGrid at 0x11806c88d48>
```



In [69]:
```
# Changing the numerical variable to categorical Variable
# in this case the cluster
datax['clusters']=datax.clusters.map({0:'Not Applicable',1:'Maybe a Data Scientist',2:'Data Scientist'})
```

In [70]:
```
# Verifying the dataset
datax
```

Out[70]:

Application_ID	Python (out of 3)	R Programming (out of 3)	Deep Learning (out of 3)	MySQL (out of 3)	total	grandtotal	clusters
ML0001	0	2	0	0	2	12	Not Applicable
ML0002	2	0	0	2	4	12	Maybe a Data Scientist
ML0003	3	0	1	2	6	12	Data Scientist
ML0004	2	0	2	0	4	12	Maybe a Data Scientist
ML0005	2	0	0	0	2	12	Not Applicable
...	...	...	...	...	...	...	...
ML0388	2	1	0	0	3	12	Maybe a Data Scientist
ML0389	2	0	0	0	2	12	Not Applicable
ML0390	1	0	0	0	1	12	Not Applicable
ML0391	2	2	0	0	4	12	Maybe a Data Scientist
ML0392	2	3	0	0	5	12	Maybe a Data Scientist

392 rows × 7 columns

In [25]:
```
# Subset data for Web Development Position
datay.head()
```

Out[25]:

Application_ID	PHP (out of 3)	MySQL (out of 3)	HTML (out of 3)	CSS (out of 3)	JavaScript (out of 3)	AJAX (out of 3)	Bootstrap (out of 3)	MongoDB (out of 3)	Node.js (out of 3)	ReactJS (out of 3)
ML0001	2	0	2	3	2	0	2	0	0	0
ML0002	2	2	2	2	2	0	0	0	0	0
ML0003	2	2	2	0	2	0	0	0	0	0
ML0004	1	0	2	0	0	0	0	0	0	0
ML0005	2	0	2	1	1	0	0	2	2	2

In [26]:
```
datay.columns
```

Out[26]:
```
Index(['PHP (out of 3)', 'MySQL (out of 3)', 'HTML (out of 3)',
       'CSS (out of 3)', 'JavaScript (out of 3)', 'AJAX (out of 3)',
       'Bootstrap (out of 3)', 'MongoDB (out of 3)', 'Node.js (out of 3)',
       'ReactJS (out of 3)'],
      dtype='object')
```

In [27]:
```
datay['total']=datay['PHP (out of 3)']+datay['MySQL (out of 3)']+datay['HTML (out of 3)']+datay['CSS (out of 3)']+datay['JavaScript (out of 3)']+datay['AJAX (out of 3)']+datay['Bootstrap (out of 3)']+datay['MongoDB (out of 3)']+datay['Node.js (out of 3)']+datay['ReactJS (out of 3)']
```

In [28]:
```
datay['grandtotal']= 30
```

In [29]:
```
datay
```

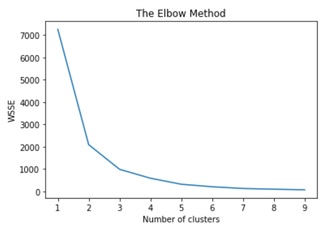
Out[29]:

Application_ID	PHP (out of 3)	MySQL (out of 3)	HTML (out of 3)	CSS (out of 3)	JavaScript (out of 3)	AJAX (out of 3)	Bootstrap (out of 3)	MongoDB (out of 3)	Node.js (out of 3)	ReactJS (out of 3)	total	grandtotal
ML0001	2	0	2	3	2	0	2	0	0	0	11	30
ML0002	2	2	2	2	2	0	0	0	0	0	10	30
ML0003	2	2	2	0	2	0	0	0	0	0	8	30
ML0004	1	0	2	0	0	0	0	0	0	0	3	30
ML0005	2	0	2	1	1	0	0	2	2	2	12	30
...	...	...	...	...	...	...	...	...	...	...	...	...
ML0388	0	0	2	0	0	0	0	0	0	0	2	30
ML0389	2	0	2	2	1	0	0	0	0	0	7	30
ML0390	0	0	2	2	1	0	0	0	0	0	5	30
ML0391	0	0	0	0	0	0	0	0	0	0	0	30
ML0392	2	0	2	2	3	0	0	0	0	0	9	30

392 rows × 12 columns

In [30]:
```
X=datay.values[:,[10,11]]
```

In [31]:
```
from sklearn.cluster import KMeans
wsse = []
for i in range(1, 10):
    kmeans = KMeans(n_clusters = i, random_state = 10)
    kmeans.fit(X)
    wsse.append(kmeans.inertia_)
plt.plot(range(1, 10), wsse)
plt.title('The Elbow Method')
plt.xlabel('Number of clusters')
plt.ylabel('WSSE')
plt.show()
```



In [32]:
```
kmeans=KMeans(n_clusters=3,random_state=10)
Y_pred=kmeans.fit_predict(X)
```

In [33]:
```
Y_pred
```

Out[33]:
```
array([1, 1, 0, 2, 1, 0, 2, 2, 0, 0, 2, 2, 0, 2, 2, 1, 0, 0, 2, 1, 1, 2,
       0, 2, 0, 2, 0, 2, 0, 0, 0, 0, 2, 0, 1, 2, 0, 0, 1, 2, 2, 1, 0, 2,
       2, 2, 1, 2, 0, 0, 2, 1, 0, 2, 0, 2, 2, 0, 2, 1, 2, 2, 2, 2, 2, 1,
       1, 2, 2, 2, 0, 1, 2, 0, 2, 0, 2, 0, 2, 2, 0, 2, 1, 2, 2, 2, 2, 2,
       1, 1, 2, 2, 2, 0, 1, 2, 0, 2, 0, 1, 0, 0, 0, 2, 0, 2, 2, 1, 0, 2,
       0, 0, 1, 2, 2, 2, 0, 2, 0, 2, 1, 0, 0, 0, 1, 2, 2, 2, 1, 2, 2, 0,
       2, 2, 1, 0, 0, 2, 1, 1, 0, 2, 0, 2, 0, 2, 0, 2, 0, 0, 0, 2, 1, 0,
       1, 2, 0, 0, 1, 2, 2, 1, 0, 2, 2, 2, 1, 2, 0, 0, 2, 1, 0, 0, 0, 0,
       2, 0, 1, 2, 0, 0, 1, 2, 2, 1, 0, 2, 2, 2, 1, 2, 0, 0, 2, 1, 0, 0,
       0, 0, 2, 0, 1, 2, 0, 0, 1, 2, 2, 1, 0, 2, 2, 2, 1, 2, 0, 0, 2, 1,
       1, 1, 0, 2, 1, 0, 2, 2, 0, 0, 2, 2, 0, 2, 2, 1, 0, 0, 2, 1, 1, 2,
       0, 2, 0, 2, 0, 2, 0, 0, 0, 0, 2, 0, 1, 2, 0, 0, 1, 2, 2, 1, 0, 2,
       2, 2, 1, 2, 0, 0, 2, 1, 0, 2, 0, 2, 2, 0, 2, 1, 2, 2, 2, 2, 2, 1,
       1, 2, 2, 2, 0, 1, 2, 0, 2, 0, 2, 0, 2, 2, 0, 2, 1, 2, 2, 2, 2, 2,
       1, 1, 2, 2, 2, 0, 1, 2, 0, 2, 0, 1, 0, 0, 0, 2, 0, 2, 2, 1, 0, 2,
       0, 0, 1, 2, 2, 2, 0, 2, 0, 2, 1, 0, 0, 0, 1, 2, 2, 2, 2, 1, 2, 0,
       2, 2, 1, 0, 0, 2, 1, 1, 0, 2, 0, 2, 0, 2, 0, 2, 0, 0, 0, 0, 2, 0,
       1, 2, 0, 0, 1, 2, 2, 1, 0, 2, 2, 2, 1, 2, 0, 0, 2, 1])
```

In [34]:
```
datay['clusters']=Y_pred
```

In [35]:
```
datay
```

Out[35]:

Application_ID	PHP (out of 3)	MySQL (out of 3)	HTML (out of 3)	CSS (out of 3)	JavaScript (out of 3)	AJAX (out of 3)	Bootstrap (out of 3)	MongoDB (out of 3)	Node.js (out of 3)	ReactJS (out of 3)	total	grandtotal	clusters
ML0001	2	0	2	3	2	0	2	0	0	0	11	30	1
ML0002	2	2	2	2	2	0	0	0	0	0	10	30	1
ML0003	2	2	2	0	2	0	0	0	0	0	8	30	0
ML0004	1	0	2	0	0	0	0	0	0	0	3	30	2
ML0005	2	0	2	1	1	0	0	2	2	2	12	30	1
...	...	...	...	...	...	...	...	...	...	...	...	...	...
ML0388	0	0	2	0	0	0	0	0	0	0	2	30	2
ML0389	2	0	2	2	1	0	0	0	0	0	7	30	0
ML0390	0	0	2	2	1	0	0	0	0	0	5	30	0
ML0391	0	0	0	0	0	0	0	0	0	0	0	30	2
ML0392	2	0	2	2	3	0	0	0	0	0	9	30	1

392 rows × 13 columns

In [36]:
```
import seaborn as sns

sns.lmplot( data=datay, x='total', y='grandtotal',
    fit_reg=False, # No regression line
    hue='clusters',palette="Set1")
```

Out[36]: <seaborn.axisgrid.FacetGrid at 0x11806afae08>

In [37]:
```
datay['clusters']=datay.clusters.map({0:'Not Applicable',1:'May be in Web Development',2:'Web Development'})
```

In [38]:
```
datay.head()
```

Out[38]:

Application_ID	PHP (out of 3)	MySQL (out of 3)	HTML (out of 3)	CSS (out of 3)	JavaScript (out of 3)	AJAX (out of 3)	Bootstrap (out of 3)	MongoDB (out of 3)	Node.js (out of 3)	ReactJS (out of 3)	total	grandtotal	clusters
ML0001	2	0	2	3	2	0	2	0	0	0	11	30	May be in Web Development
ML0002	2	2	2	2	2	0	0	0	0	0	10	30	May be in Web Development
ML0003	2	2	2	0	2	0	0	0	0	0	8	30	Not Applicable
ML0004	1	0	2	0	0	0	0	0	0	0	3	30	Web Development
ML0005	2	0	2	1	1	0	0	2	2	2	12	30	May be in Web Development

In [41]:
```
# Merging the Data Scientist & Web Development DataFrame
jd = pd.merge(datax, datay, on = 'Application_ID', how = 'inner', indicator = False)
jd.head()
```

Out[41]:

Application_ID	Python (out of 3)	R Programming (out of 3)	Deep Learning (out of 3)	MySQL (out of 3)_x	total_x	grandtotal_x	clusters_x	PHP (out of 3)	MySQL (out of 3)_y	HTML (out of 3)	CSS (out of 3)	JavaScript (out of 3)	AJAX (out of 3)	Bootstrap (out of 3)	MongoDB (out of 3)	Node.js (out of 3)	ReactJS (out of 3)	total_y	grandtotal_y	clusters_y
ML0001	0	2	0	0	2	12	Not Applicable	2	0	2	3	2	0	2	0	0	0	11	30	May be in Web Development
ML0002	2	0	0	2	4	12	Maybe a Data Scientist	2	2	2	2	2	0	0	0	0	0	10	30	May be in Web Development
ML0003	3	0	1	2	6	12	Data Scientist	2	2	2	0	2	0	0	0	0	0	8	30	Not Applicable
ML0004	2	0	2	0	4	12	Maybe a Data Scientist	1	0	2	0	0	0	0	0	0	0	3	30	Web Development
ML0005	2	0	0	0	2	12	Not Applicable	2	0	2	1	1	0	0	2	2	2	12	30	May be in Web Development

In [71]:
```
# Saving df to a file
df.to_csv(r'F:\DSP\Class\Python\Basics\Mavoix\JobRole.csv',
          index = True, header = True)
```