In [1]:

```
#importing the libraries
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
```

In [2]:

```
#importing the mall dataset with pandas
dataset = pd.read_csv('Mall_Customers.csv')
dataset.head()
```

Out[2]:

	CustomerID	Genre	Age	Annual Income (k$)	Spending Score (1-100)
0	1	Male	19	15	39
1	2	Male	21	15	81
2	3	Female	20	16	6
3	4	Female	23	16	77
4	5	Female	31	17	40

In [3]:

```
X = dataset.iloc[:, [3,4]].values
```

In [17]:

```
X
```

Out[17]:

```
array([[ 15,  39],
       [ 15,  81],
       [ 16,   6],
       [ 16,  77],
       [ 17,  40],
       [ 17,  76],
       [ 18,   6],
       [ 18,  94],
       [ 19,   3],
       [ 19,  72],
       [ 19,  14],
       [ 19,  99],
       [ 20,  15],
       [ 20,  77],
       [ 20,  13],
       [ 20,  79],
       [ 21,  35],
       [ 21,  66],
       [ 23,  29],
       [ 23,  98],
       [ 24,  35],
       [ 24,  73],
       [ 25,   5],
       [ 25,  73],
       [ 28,  14],
       [ 28,  82],
       [ 28,  32],
       [ 28,  61],
       [ 29,  31],
       [ 29,  87],
       [ 30,   4],
       [ 30,  73],
       [ 33,   4],
       [ 33,  92],
       [ 33,  14],
       [ 33,  81],
       [ 34,  17],
       [ 34,  73],
       [ 37,  26],
       [ 37,  75],
       [ 38,  35],
       [ 38,  92],
       [ 39,  36],
       [ 39,  61],
       [ 39,  28],
       [ 39,  65],
       [ 40,  55],
       [ 40,  47],
       [ 40,  42],
       [ 40,  42],
       [ 42,  52],
       [ 42,  60],
       [ 43,  54],
       [ 43,  60],
       [ 43,  45],
       [ 43,  41],
       [ 44,  50],
       [ 44,  46],
       [ 46,  51],
```

```
       [ 46,  46],
       [ 46,  56],
       [ 46,  55],
       [ 47,  52],
       [ 47,  59],
       [ 48,  51],
       [ 48,  59],
       [ 48,  50],
       [ 48,  48],
       [ 48,  59],
       [ 48,  47],
       [ 49,  55],
       [ 49,  42],
       [ 50,  49],
       [ 50,  56],
       [ 54,  47],
       [ 54,  54],
       [ 54,  53],
       [ 54,  48],
       [ 54,  52],
       [ 54,  42],
       [ 54,  51],
       [ 54,  55],
       [ 54,  41],
       [ 54,  44],
       [ 54,  57],
       [ 54,  46],
       [ 57,  58],
       [ 57,  55],
       [ 58,  60],
       [ 58,  46],
       [ 59,  55],
       [ 59,  41],
       [ 60,  49],
       [ 60,  40],
       [ 60,  42],
       [ 60,  52],
       [ 60,  47],
       [ 60,  50],
       [ 61,  42],
       [ 61,  49],
       [ 62,  41],
       [ 62,  48],
       [ 62,  59],
       [ 62,  55],
       [ 62,  56],
       [ 62,  42],
       [ 63,  50],
       [ 63,  46],
       [ 63,  43],
       [ 63,  48],
       [ 63,  52],
       [ 63,  54],
       [ 64,  42],
       [ 64,  46],
       [ 65,  48],
       [ 65,  50],
       [ 65,  43],
       [ 65,  59],
       [ 67,  43],
       [ 67,  57],
```

```
       [ 67,  56],
       [ 67,  40],
       [ 69,  58],
       [ 69,  91],
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       [ 70,  77],
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       [ 71,  95],
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       [ 71,  75],
       [ 71,   9],
       [ 71,  75],
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       [ 73,  88],
       [ 73,   7],
       [ 73,  73],
       [ 74,  10],
       [ 74,  72],
       [ 75,   5],
       [ 75,  93],
       [ 76,  40],
       [ 76,  87],
       [ 77,  12],
       [ 77,  97],
       [ 77,  36],
       [ 77,  74],
       [ 78,  22],
       [ 78,  90],
       [ 78,  17],
       [ 78,  88],
       [ 78,  20],
       [ 78,  76],
       [ 78,  16],
       [ 78,  89],
       [ 78,   1],
       [ 78,  78],
       [ 78,   1],
       [ 78,  73],
       [ 79,  35],
       [ 79,  83],
       [ 81,   5],
       [ 81,  93],
       [ 85,  26],
       [ 85,  75],
       [ 86,  20],
       [ 86,  95],
       [ 87,  27],
       [ 87,  63],
       [ 87,  13],
       [ 87,  75],
       [ 87,  10],
       [ 87,  92],
       [ 88,  13],
       [ 88,  86],
       [ 88,  15],
       [ 88,  69],
       [ 93,  14],
       [ 93,  90],
       [ 97,  32],
```

```
       [ 97,  86],
       [ 98,  15],
       [ 98,  88],
       [ 99,  39],
       [ 99,  97],
       [101,  24],
       [101,  68],
       [103,  17],
       [103,  85],
       [103,  23],
       [103,  69],
       [113,   8],
       [113,  91],
       [120,  16],
       [120,  79],
       [126,  28],
       [126,  74],
       [137,  18],
       [137,  83]], dtype=int64)
```

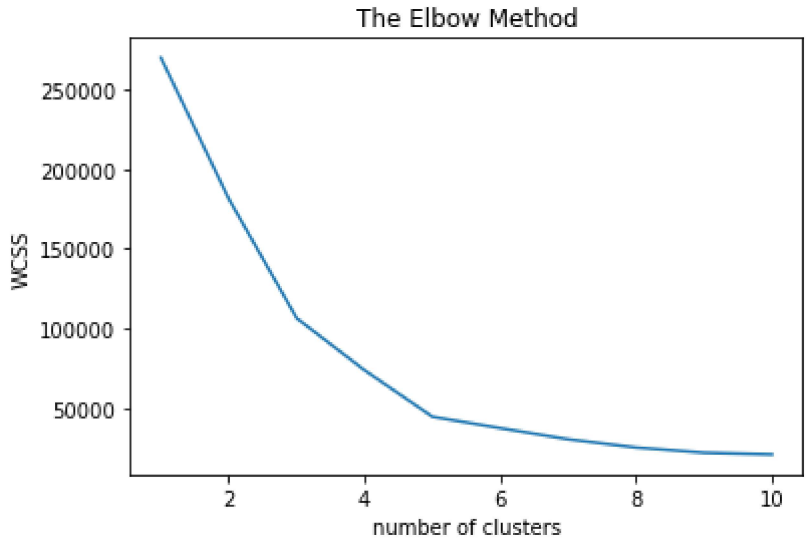
In [4]:

```
#using the elbow method find the optimal number of clusters
from sklearn.cluster import KMeans
```

In [5]:

```
wcss =[]
for i in range(1,11):
    kmeans = KMeans(n_clusters = i,init = 'k-means++',max_iter = 300,n_init = 10,random
_state = 0)
    kmeans.fit(X)
    wcss.append(kmeans.inertia_)

plt.plot(range(1, 11),wcss)
plt.title('The Elbow Method')
plt.xlabel('number of clusters')
plt.ylabel('WCSS')
plt.show()
```



In [6]:

```
# here  optimal no. of clusters is 5
```

In [7]:

```
#applying kmeans on  mall dataset
kmeans = KMeans(n_clusters = 5,init = 'k-means++',max_iter = 300,n_init = 10,random_sta
te = 0)
y_kmeans = kmeans.fit_predict(X)
```

In [8]:

```
y_kmeans
```

Out[8]:

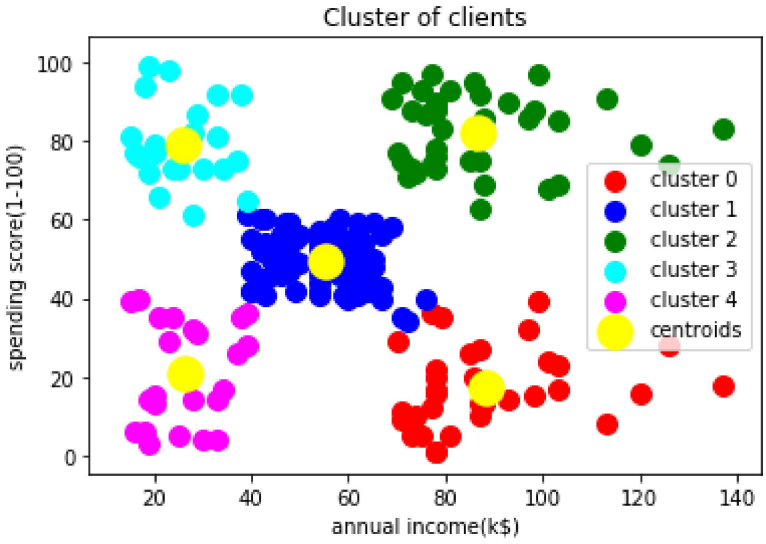
```
array([4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3,
4,
       3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 1, 4,
3,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1,
       1, 1, 1, 1,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

In [9]:

```
#here we have clusters 0,1,2,3,4
```

In [10]:

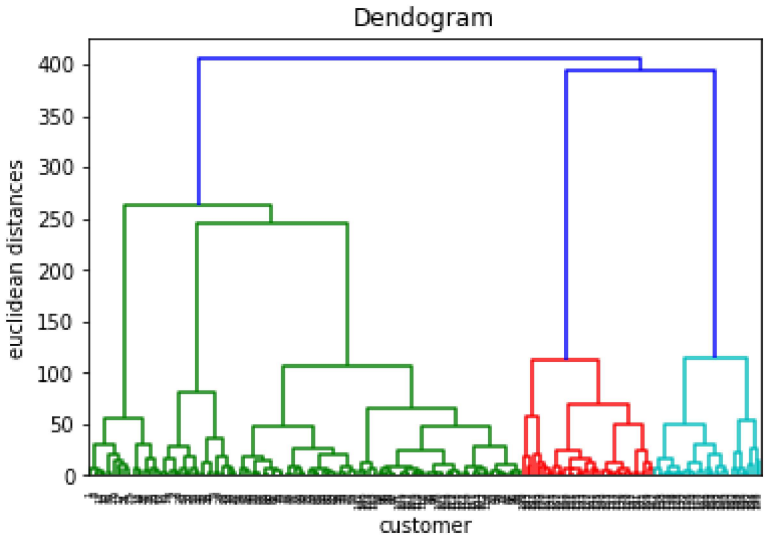
```
#visualising the clusters
plt.scatter(X[y_kmeans == 0, 0],X[y_kmeans == 0, 1], s = 100,c ='red',label = 'cluster
 0')
plt.scatter(X[y_kmeans == 1, 0],X[y_kmeans == 1, 1], s = 100,c ='blue',label = 'cluster
 1')
plt.scatter(X[y_kmeans == 2, 0],X[y_kmeans == 2, 1], s = 100,c ='green',label = 'cluste
r 2')
plt.scatter(X[y_kmeans == 3, 0],X[y_kmeans == 3, 1], s = 100,c ='cyan',label = 'cluster
 3')
plt.scatter(X[y_kmeans == 4, 0],X[y_kmeans == 4, 1], s = 100,c ='magenta',label = 'clus
ter 4')
plt.scatter(kmeans.cluster_centers_[:,0],kmeans.cluster_centers_[:, 1],s = 300, c = 'ye
llow',label =  'centroids')
plt.title('Cluster of clients')
plt.xlabel('annual income(k$)')
plt.ylabel('spending score(1-100)')
plt.legend()
plt.show()
```



Heirarchical clustering

In [12]:

```
# using the dendogram to find optimal no. of clusters
import scipy.cluster.hierarchy as sch
dendrogram = sch.dendrogram(sch.linkage(X, method = 'ward'))
plt.title('Dendogram')
plt.xlabel('customer')
plt.ylabel('euclidean distances')
plt.show()
```



In [ ]:

```
# here by above seeing the dendrogram, we find the maximum distance which should nott c
ut by horizontal line
#so here by finding it we cut it from middle and find the no of clusters. here is 5
```

In [15]:

```
# fitting the hierarchical clustering on mall dataset
from sklearn.cluster import AgglomerativeClustering
hc = AgglomerativeClustering(n_clusters = 5,affinity = 'euclidean',linkage = 'ward')
y_hc = hc.fit_predict(X)
```

In [16]:

```
#visualising the clusters
plt.scatter(X[y_hc == 0, 0],X[y_hc == 0, 1], s = 100,c ='red',label = 'cluster 0')
plt.scatter(X[y_hc == 1, 0],X[y_hc == 1, 1], s = 100,c ='blue',label = 'cluster 1')
plt.scatter(X[y_hc == 2, 0],X[y_hc == 2, 1], s = 100,c ='green',label = 'cluster 2')
plt.scatter(X[y_hc == 3, 0],X[y_hc == 3, 1], s = 100,c ='cyan',label = 'cluster 3')
plt.scatter(X[y_hc == 4, 0],X[y_hc == 4, 1], s = 100,c ='magenta',label = 'cluster 4')

plt.title('Cluster of clients')
plt.xlabel('annual income(k$)')
plt.ylabel('spending score(1-100)')
plt.legend()
plt.show()
```