In [15]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

In [16]:
```
data = pd.read_csv('Mall_Customers.csv')
```

In [11]:
```
data.head()
```

Out[11]:

	CustomerID	Gender	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 [17]:
```
data.shape
```

Out[17]:
```
(200, 5)
```

In [18]:
```
data.tail()
```

Out[18]:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
195	196	Female	35	120	79
196	197	Female	45	126	28
197	198	Male	32	126	74
198	199	Male	32	137	18
199	200	Male	30	137	83

In [19]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 5 columns):
 #   Column                  Non-Null Count  Dtype
---  ------                  --------------  -----
 0   CustomerID              200 non-null    int64
 1   Gender                  200 non-null    object
 2   Age                     200 non-null    int64
 3   Annual Income (k$)      200 non-null    int64
 4   Spending Score (1-100)  200 non-null    int64
dtypes: int64(4), object(1)
memory usage: 7.9+ KB
```

In [20]:
```
data.describe()
```

Out[20]:

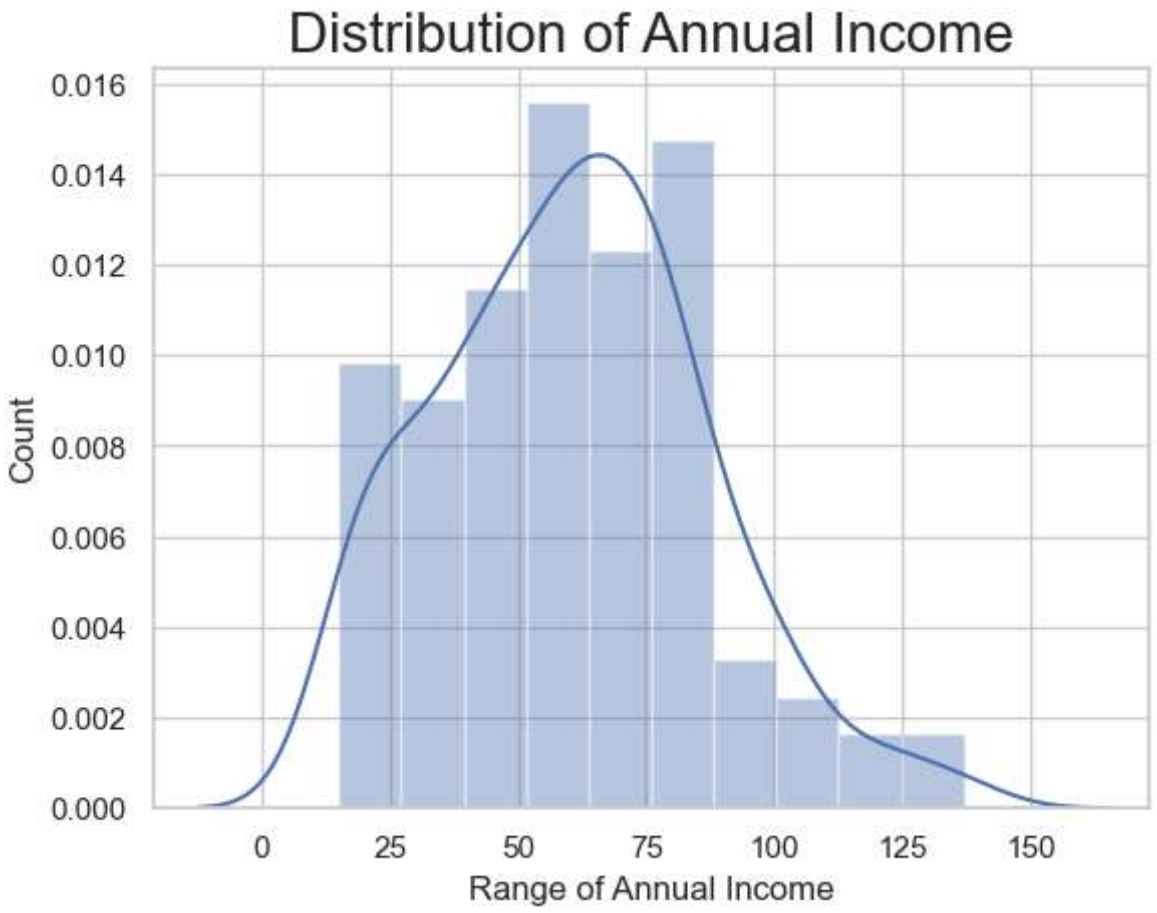
	CustomerID	Age	Annual Income (k$)	Spending Score (1-100)
count	200.000000	200.000000	200.000000	200.000000
mean	100.500000	38.850000	60.560000	50.200000
std	57.879185	13.969007	26.264721	25.823522
min	1.000000	18.000000	15.000000	1.000000
25%	50.750000	28.750000	41.500000	34.750000
50%	100.500000	36.000000	61.500000	50.000000
75%	150.250000	49.000000	78.000000	73.000000
max	200.000000	70.000000	137.000000	99.000000

In [21]:
```
data.isnull().any()
```

Out[21]:
```
CustomerID              False
Gender                  False
Age                     False
Annual Income (k$)      False
Spending Score (1-100)  False
dtype: bool
```

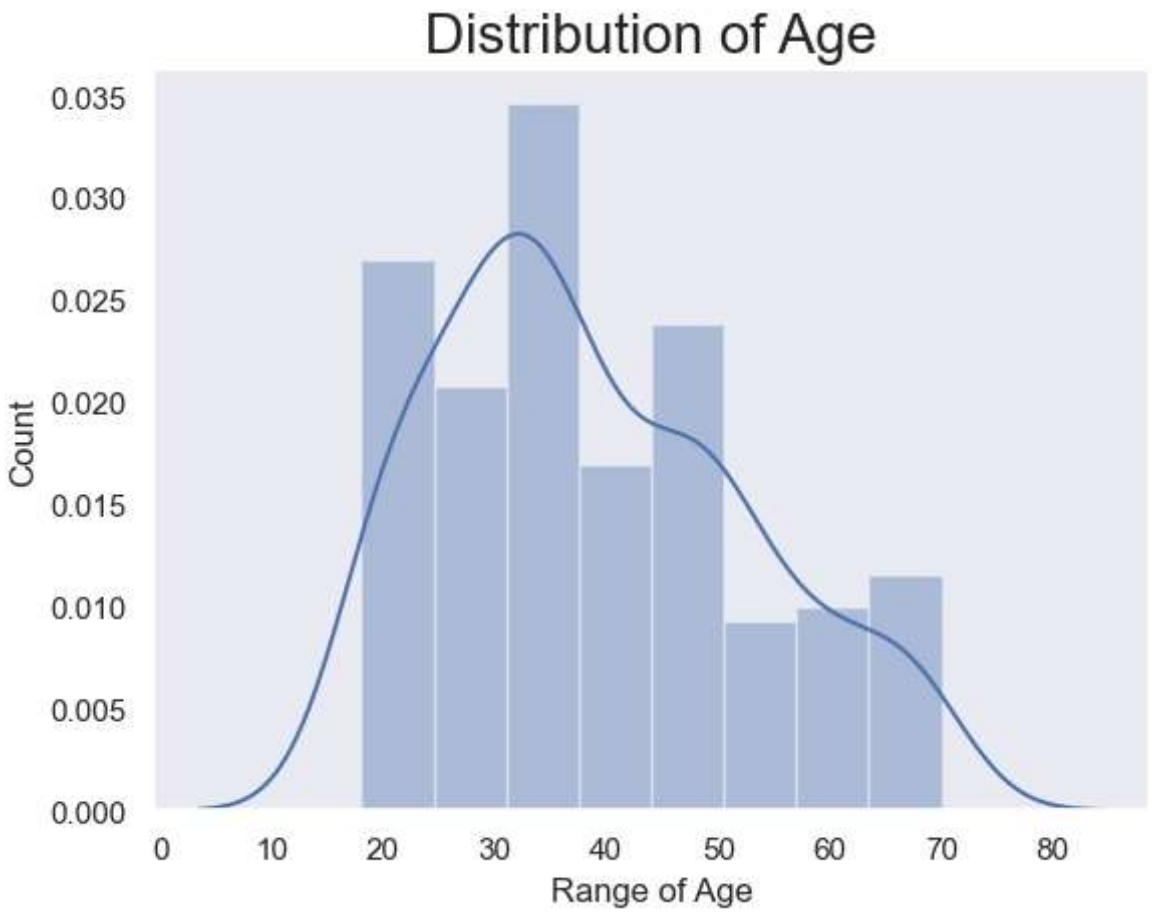
In [22]:
```
sns.set(style = 'whitegrid')
sns.distplot(data['Annual Income (k$)'])
plt.title('Distribution of Annual Income', fontsize = 20)
plt.xlabel('Range of Annual Income')
plt.ylabel('Count')
plt.show()
```

```
C:\Users\LENOVO\anaconda3\lib\site-packages\seaborn\distributions.py:2619: Fu
tureWarning: `distplot` is a deprecated function and will be removed in a fut
ure version. Please adapt your code to use either `displot` (a figure-level f
unction with similar flexibility) or `histplot` (an axes-level function for h
istograms).
  warnings.warn(msg, FutureWarning)
```



In [23]:
```
sns.set(style = 'dark')
sns.distplot(data['Age'])
plt.title('Distribution of Age', fontsize = 20)
plt.xlabel('Range of Age')
plt.ylabel('Count')
plt.show()
```

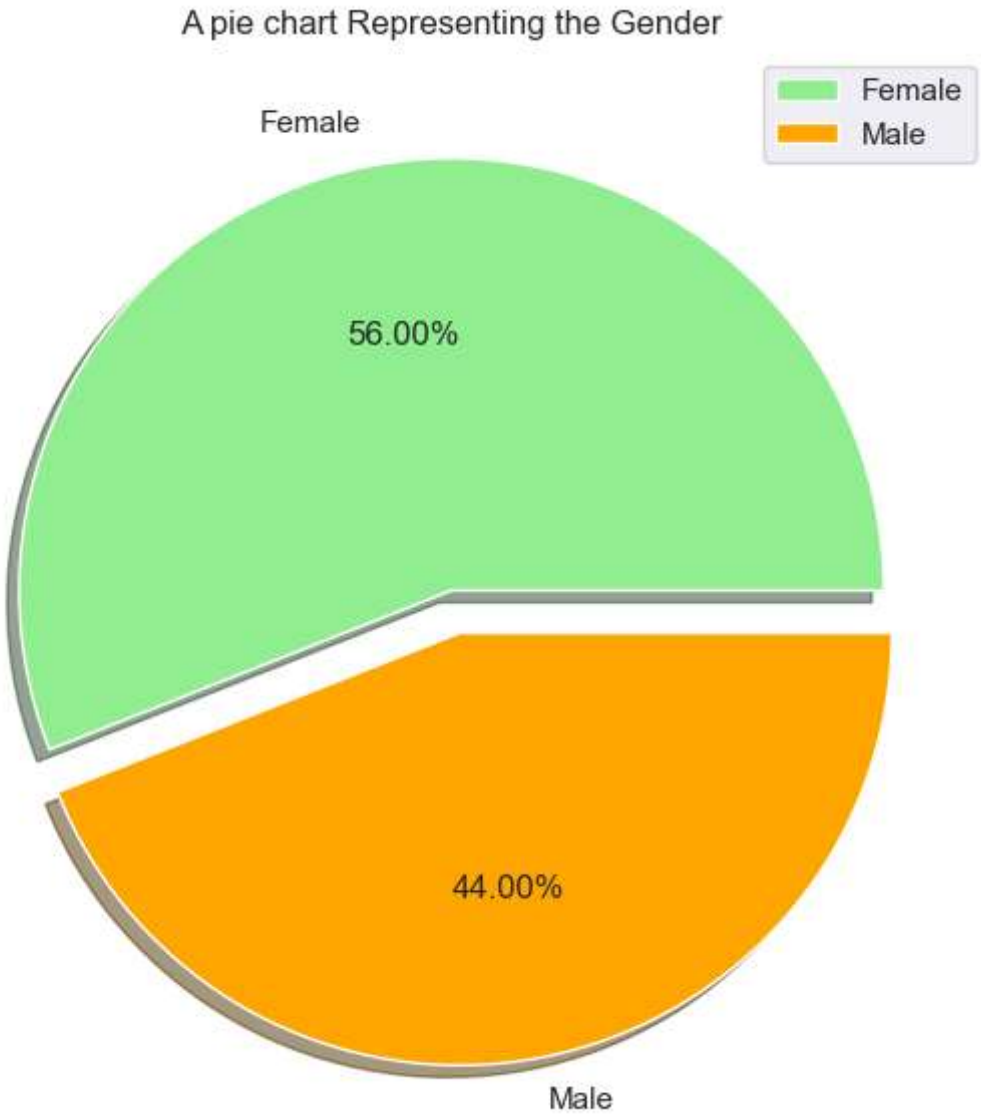
```
C:\Users\LENOVO\anaconda3\lib\site-packages\seaborn\distributions.py:2619: Fu
tureWarning: `distplot` is a deprecated function and will be removed in a fut
ure version. Please adapt your code to use either `displot` (a figure-level f
unction with similar flexibility) or `histplot` (an axes-level function for h
istograms).
  warnings.warn(msg, FutureWarning)
```



In [24]:
```
data['Gender'].value_counts()
```

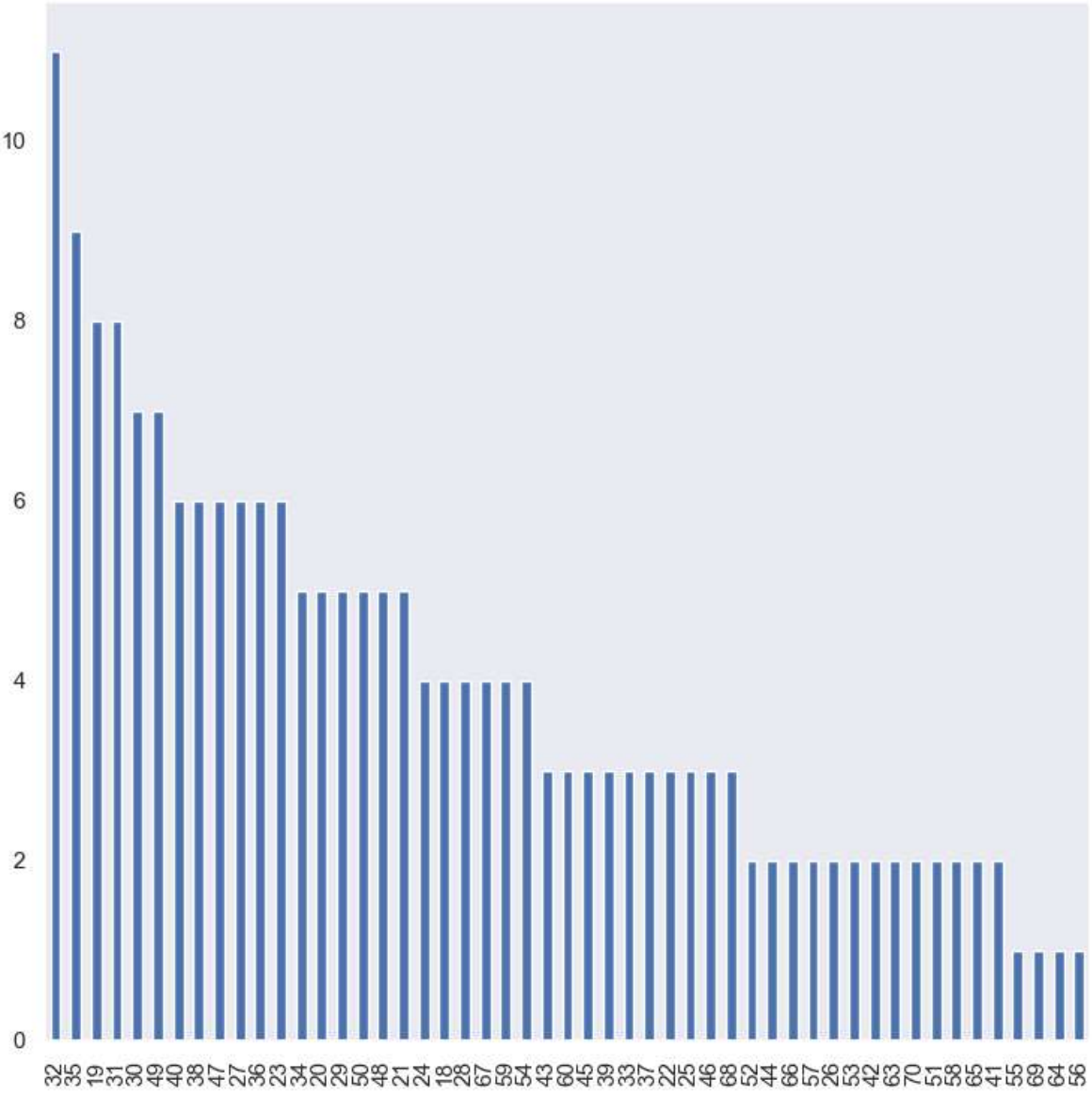
Out[24]:
```
Female    112
Male       88
Name: Gender, dtype: int64
```

In [25]:
```
labels = ['Female', 'Male']
size = [112, 88]
colors = ['lightgreen', 'orange']
explode = [0, 0.1]

plt.rcParams['figure.figsize'] = (7, 7)
plt.pie(size, colors = colors, explode = explode, labels = labels, shadow = Tr
plt.title('A pie chart Representing the Gender')
plt.axis('off')
plt.legend()
plt.show()
```



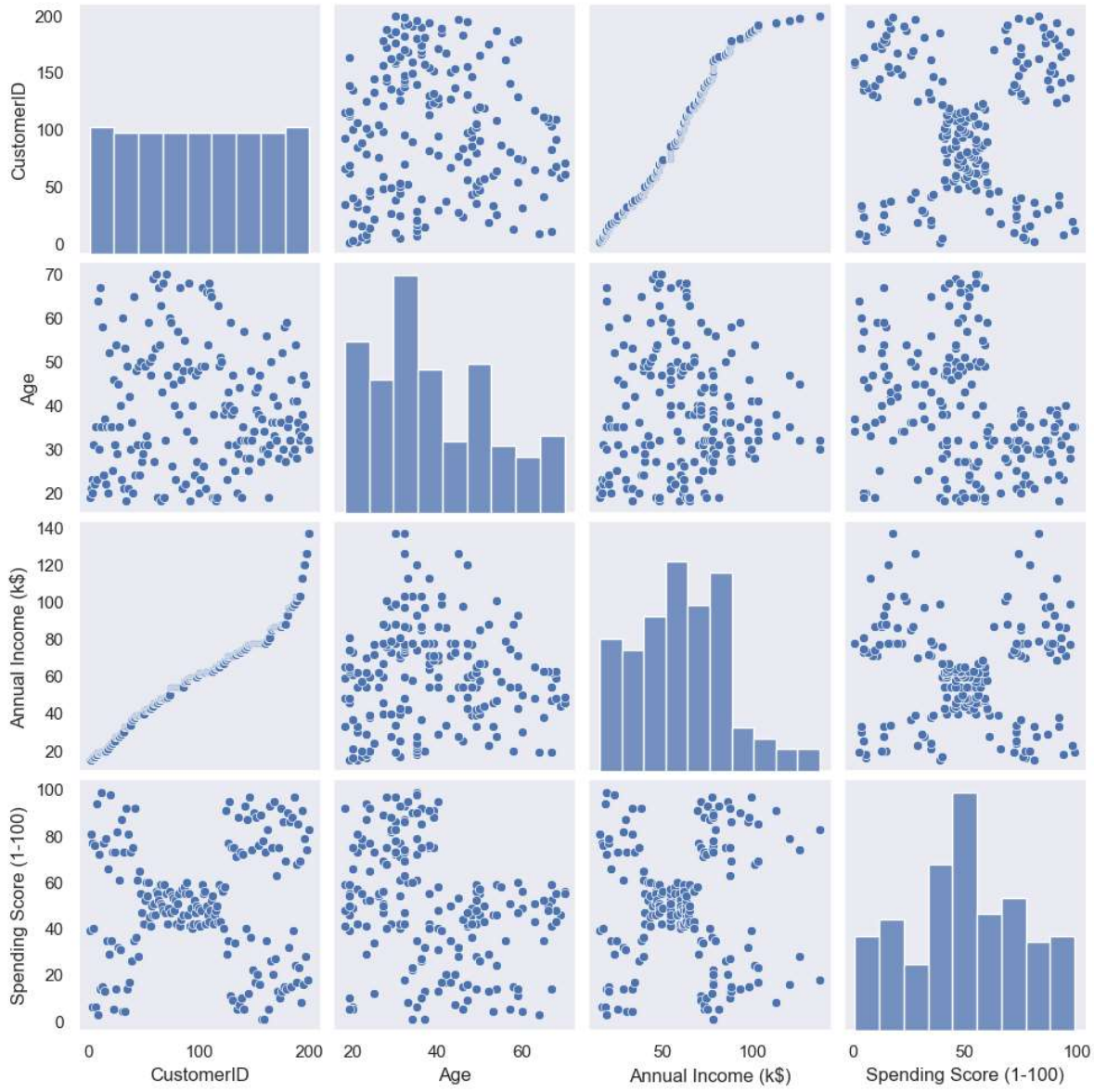
In [26]:
```
data['Age'].value_counts().plot.bar(figsize = (9, 9))
```

Out[26]: <AxesSubplot:>



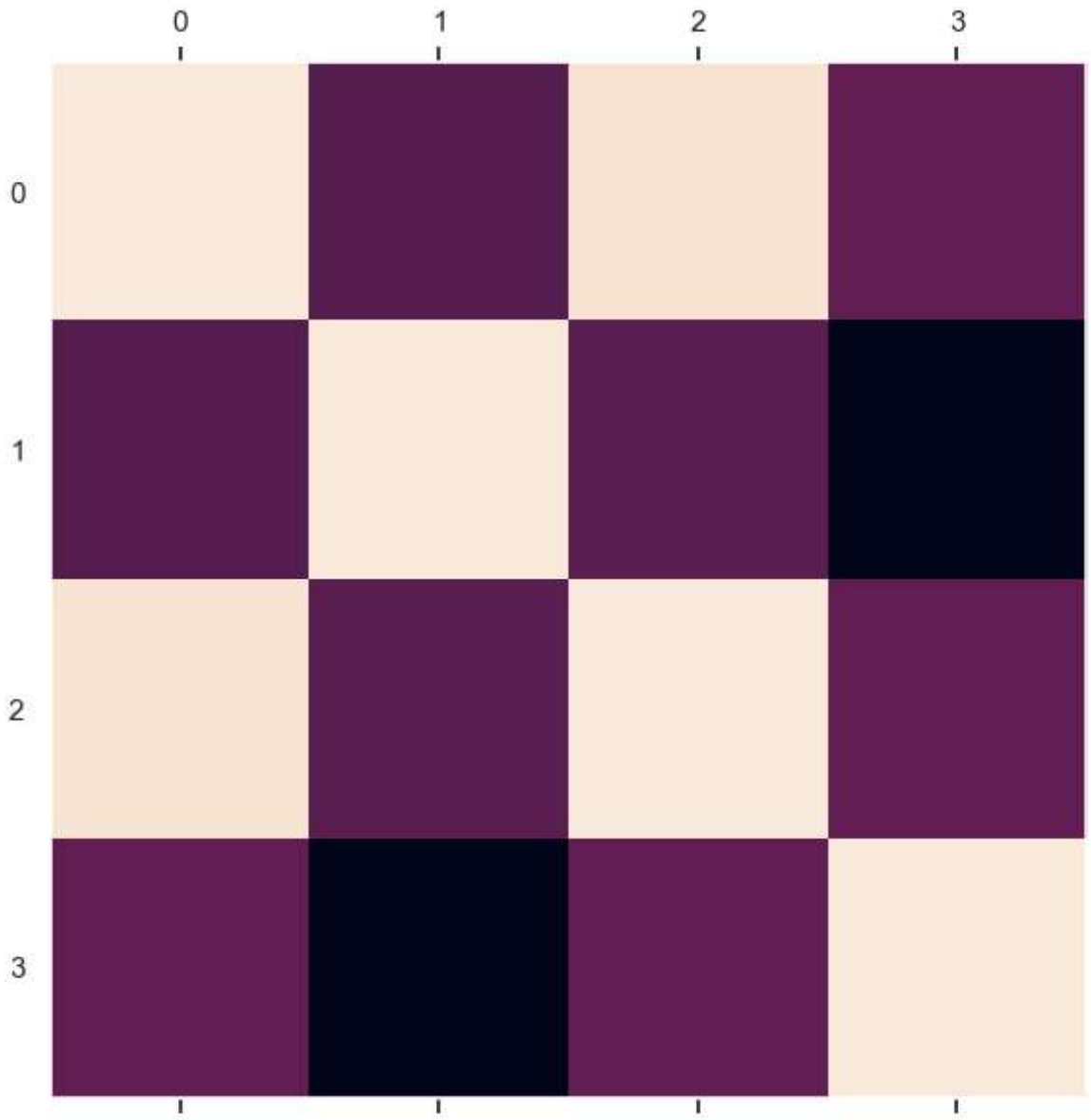
In [27]:
```
sns.pairplot(data)
```

Out[27]: <seaborn.axisgrid.PairGrid at 0x14a0038cd90>



In [28]:
```
plt.matshow(data.corr())
```

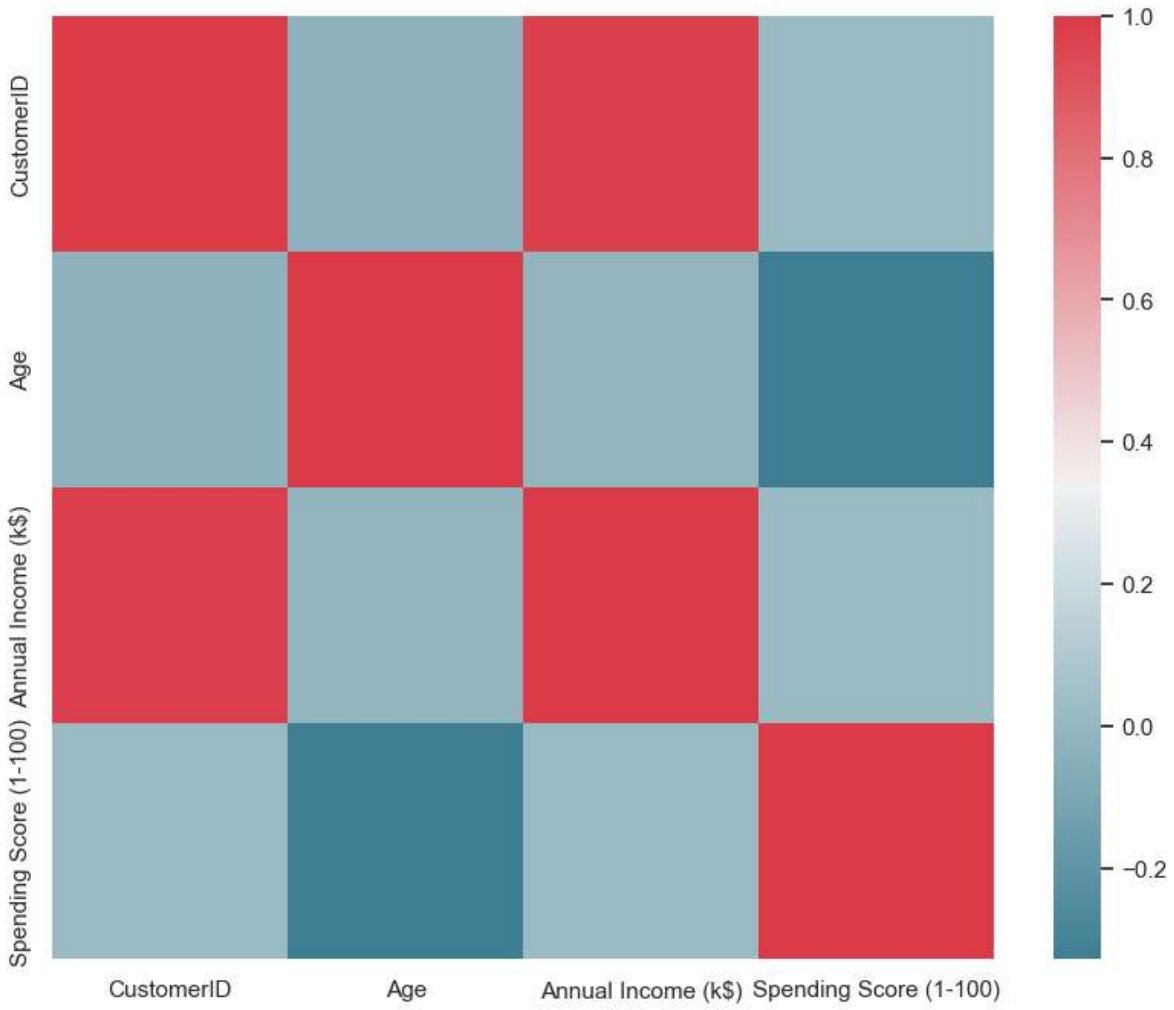
Out[28]:
```
<matplotlib.image.AxesImage at 0x14a00663be0>
```



In [30]:
```
fig, axis = plt.subplots(figsize=(10, 8))
corr = data.corr()
sns.heatmap(corr, mask = np.zeros_like(corr, dtype = np.bool), cmap = sns.dive
            square = True, ax = axis)
```

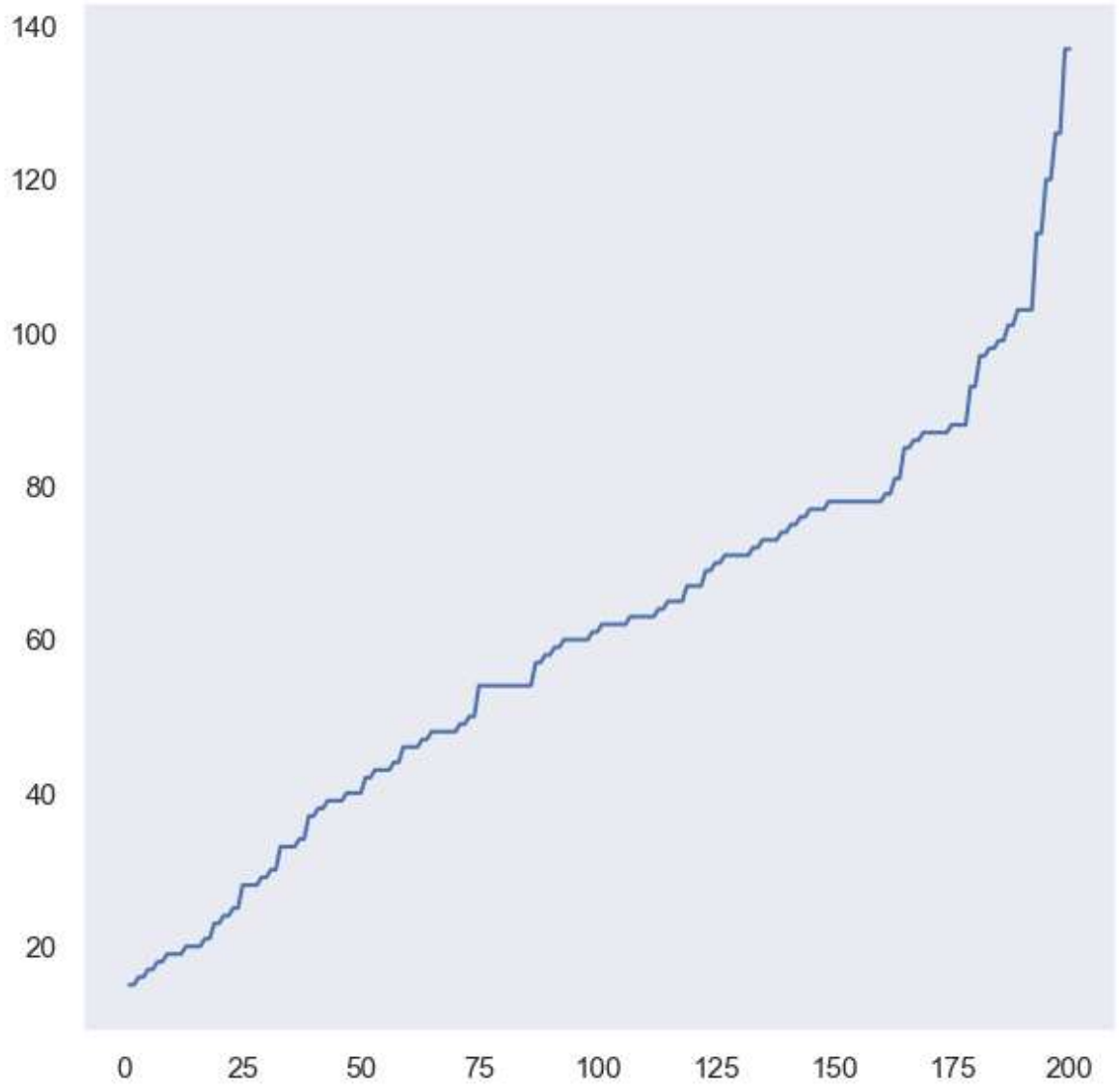
```
C:\Users\LENOVO\AppData\Local\Temp\ipykernel_6436\408083941.py:3: Deprecation
Warning: `np.bool` is a deprecated alias for the builtin `bool`. To silence t
his warning, use `bool` by itself. Doing this will not modify any behavior an
d is safe. If you specifically wanted the numpy scalar type, use `np.bool_` h
ere.
Deprecated in NumPy 1.20; for more details and guidance: https://numpy.org/de
vdocs/release/1.20.0-notes.html#deprecations (https://numpy.org/devdocs/relea
se/1.20.0-notes.html#deprecations)
  sns.heatmap(corr, mask = np.zeros_like(corr, dtype = np.bool), cmap = sns.d
iverging_palette(220, 10, as_cmap = True),
```

Out[30]: <AxesSubplot:>

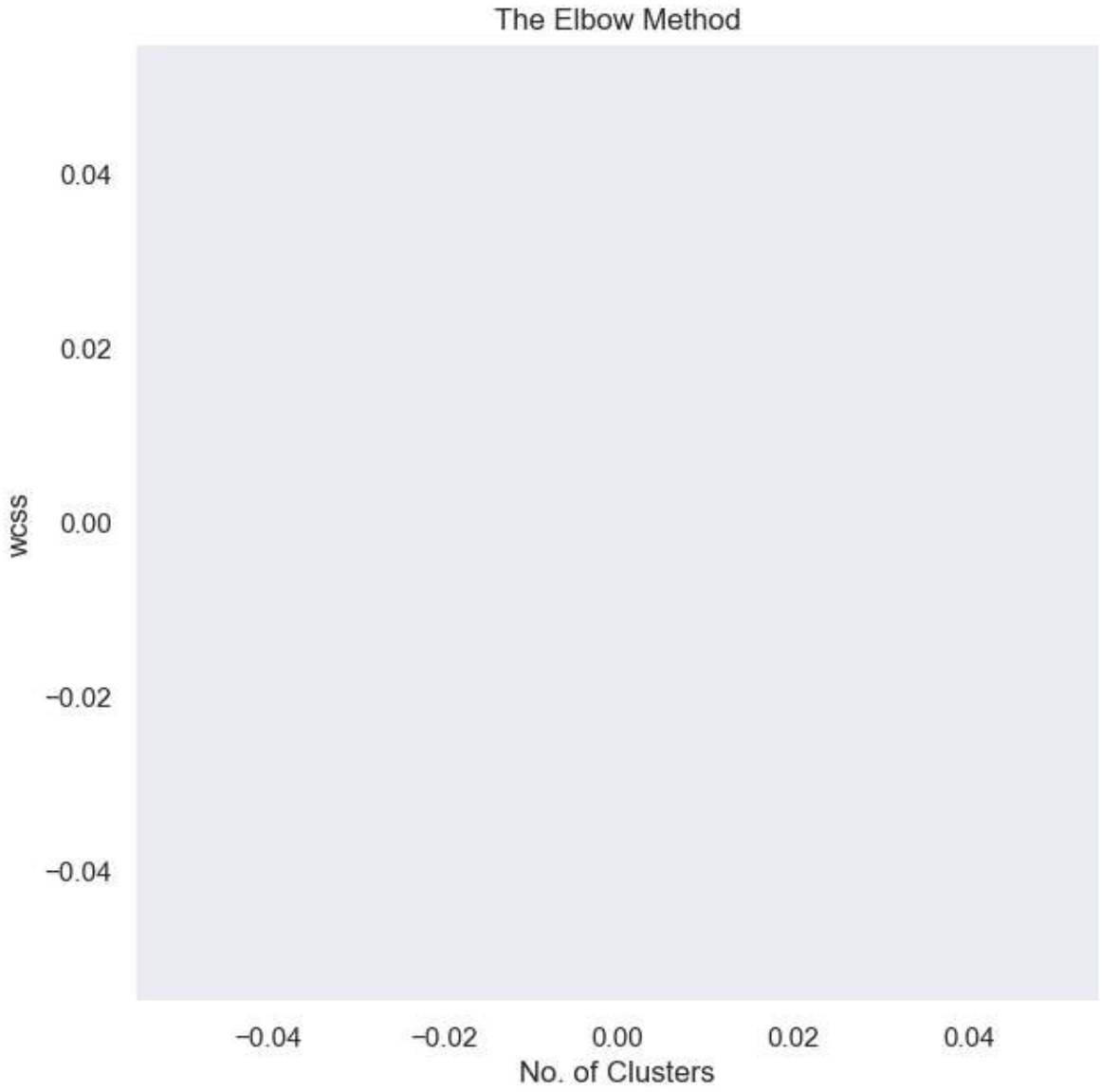


In [31]:
```
x = data['CustomerID']
y = data['Annual Income (k$)']

plt.plot(x, y)
```

Out[31]:
```
[<matplotlib.lines.Line2D at 0x14a023b61f0>]
```



In [38]:
```
from sklearn.cluster import KMeans

wcss = []
for i in range(1,1):
  km = KMeans(n_clusters = i, init = 'k-means++', max_iter = 300, n_init = 10,
  km.fit(x)
  wcss.append(km.inertia_)

plt.plot(range(1,1), wcss)
plt.title('The Elbow Method')
plt.xlabel('No. of Clusters')
plt.ylabel('wcss')
plt.show()
```



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

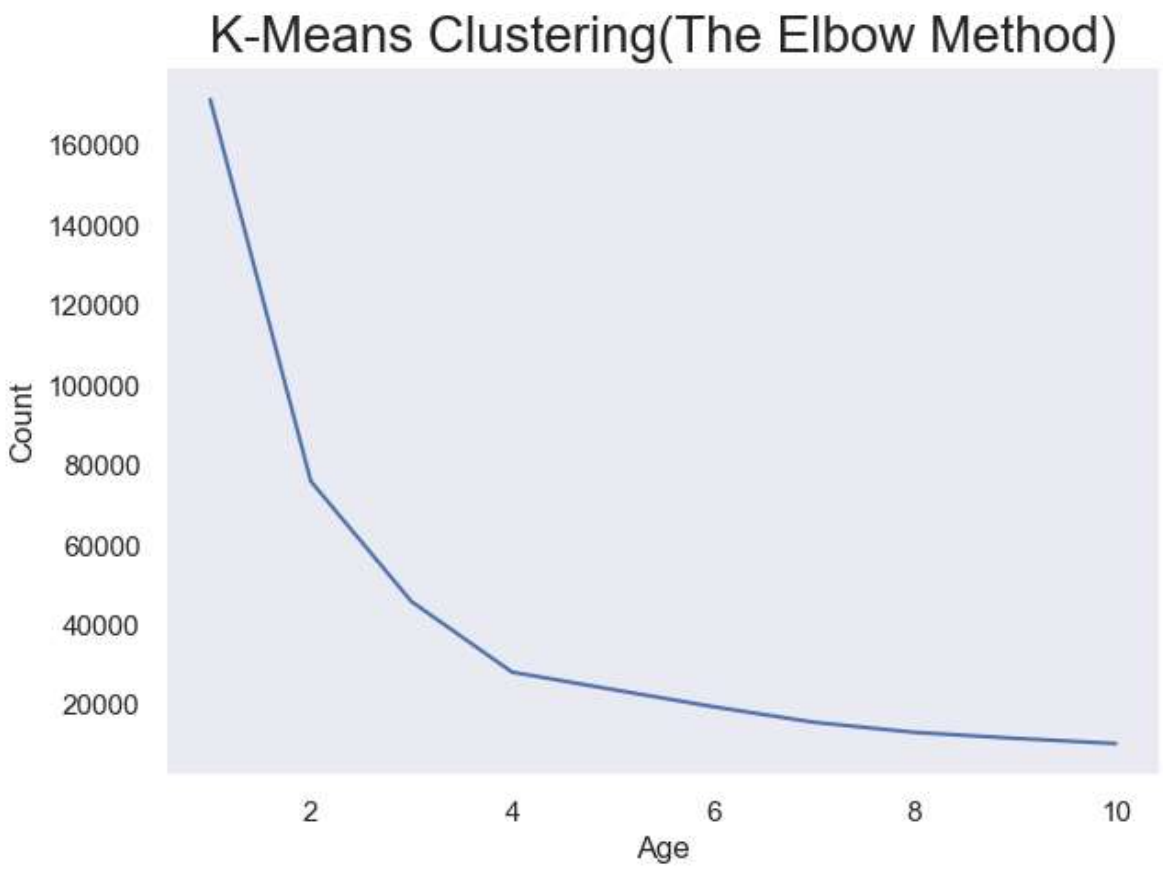
Out[50]:
```
Index(['CustomerID', 'Gender', 'Age', 'Annual Income (k$)',
       'Spending Score (1-100)'],
      dtype='object')
```

In [51]:
```
x = data.iloc[:, [2, 4]].values
x.shape
```

Out[51]:
```
(200, 2)
```

In [52]:
```
from sklearn.cluster import KMeans

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

plt.rcParams['figure.figsize'] = (7, 5)
plt.plot(range(1, 11), wcss)
plt.title('K-Means Clustering(The Elbow Method)', fontsize = 20)
plt.xlabel('Age')
plt.ylabel('Count')
plt.show()
```

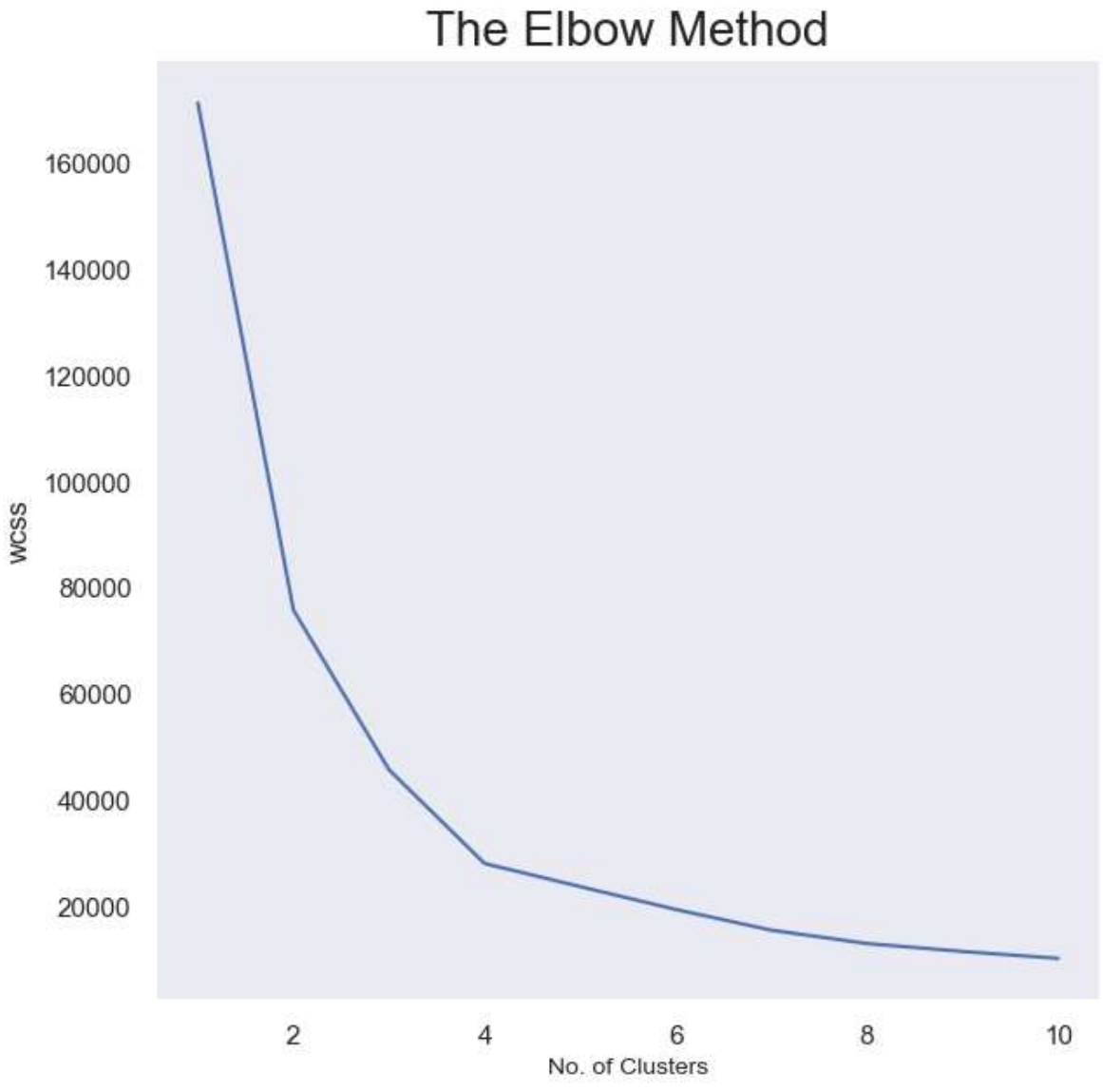
```
C:\Users\LENOVO\anaconda3\lib\site-packages\sklearn\cluster\_kmeans.py:1036:
UserWarning: KMeans is known to have a memory leak on Windows with MKL, when
there are less chunks than available threads. You can avoid it by setting the
environment variable OMP_NUM_THREADS=1.
  warnings.warn(
```



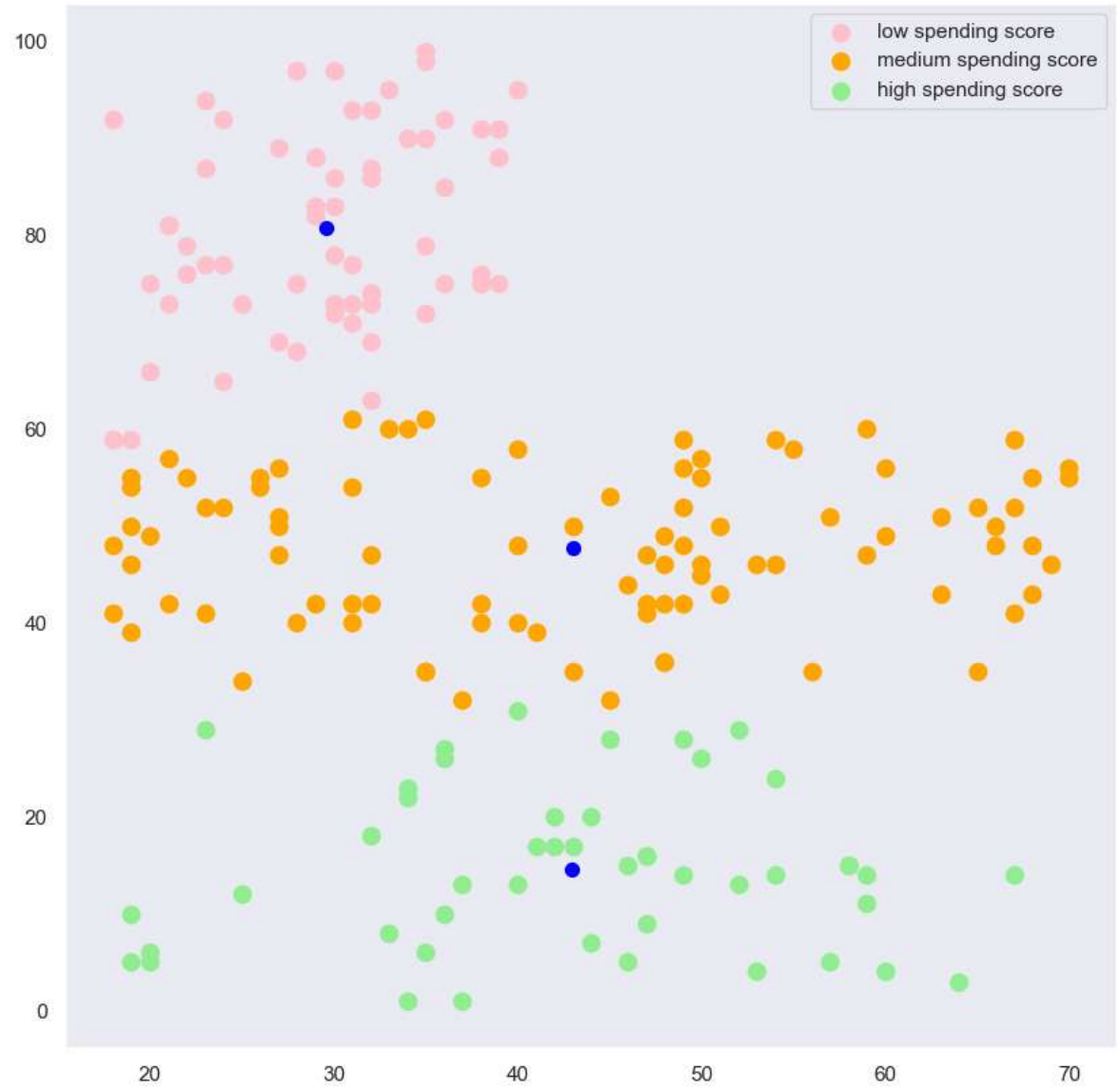
In [53]:
```
kmeans = KMeans(n_clusters = 4, init = 'k-means++', max_iter = 300, n_init = 1
ymeans = kmeans.fit_predict(x)

plt.rcParams['figure.figsize'] = (10, 10)
plt.title('Cluster of Ages', fontsize = 30)

plt.scatter(x[ymeans == 0, 0], x[ymeans == 0, 1], s = 100, c = 'pink', label =
plt.scatter(x[ymeans == 1, 0], x[ymeans == 1, 1], s = 100, c = 'orange', label
plt.scatter(x[ymeans == 2, 0], x[ymeans == 2, 1], s = 100, c = 'lightgreen', l
plt.scatter(x[ymeans == 3, 0], x[ymeans == 3, 1], s = 100, c = 'red', label =
plt.scatter(kmeans.cluster_centers_[:, 0], kmeans.cluster_centers_[:, 1], s =

plt.xlabel('Age')
plt.ylabel('Spending Score (1-100)')
plt.legend()
plt.show()
```

In [54]:
```
from sklearn.cluster import KMeans

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

plt.rcParams['figure.figsize'] = (7, 7)
plt.title('The Elbow Method', fontsize = 20)
plt.plot(range(1, 11), wcss)
plt.xlabel('No. of Clusters', fontsize = 10)
plt.ylabel('wcss')
plt.show()
```

```
C:\Users\LENOVO\anaconda3\lib\site-packages\sklearn\cluster\_kmeans.py:1036:
UserWarning: KMeans is known to have a memory leak on Windows with MKL, when
there are less chunks than available threads. You can avoid it by setting the
environment variable OMP_NUM_THREADS=1.
  warnings.warn(
```



In [55]:
```
kmeans = KMeans(n_clusters = 3, max_iter = 300, n_init = 10, random_state = 0)
ymeans = kmeans.fit_predict(x)

plt.rcParams['figure.figsize'] = (10, 10)
plt.scatter(x[ymeans == 0, 0], x[ymeans == 0, 1], s = 80, c = 'pink', label =
plt.scatter(x[ymeans == 1, 0], x[ymeans == 1, 1], s = 80, c = 'orange', label
plt.scatter(x[ymeans == 2, 0], x[ymeans == 2, 1], s = 80, c = 'lightgreen', la
plt.scatter(kmeans.cluster_centers_[:,0], kmeans.cluster_centers_[:, 1], s = 5
plt.legend()
plt.show()
```



In [ ]: