In [66]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib
from matplotlib import pyplot as plt
import sklearn
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import silhouette_score
from sklearn.cluster import KMeans
from sklearn.cluster import DBSCAN
```

In [67]:
```
print("Seaborn version: ",sns.__version__)
print("Pandas version: ",pd.__version__)
#print(matplotlib.__version__)
print('matplotlib: {}'.format(matplotlib.__version__))
print("sklearn version: ", sklearn.__version__)
```

```
Seaborn version:  0.9.0
Pandas version:  0.24.2
matplotlib: 3.1.0
sklearn version:  0.21.2
```

In [43]:
```
df = pd.read_csv("Mall_Customers.csv")
```

In [44]:
```
df.head()
```

Out[44]:

	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 [45]:
```
df.tail()
```

Out[45]:

	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 [46]:
```
df.isnull().sum()
```

Out[46]:
```
CustomerID                0
Gender                    0
Age                       0
Annual Income (k$)        0
Spending Score (1-100)    0
dtype: int64
```

In [47]:
```
df.describe(include = 'all')
```

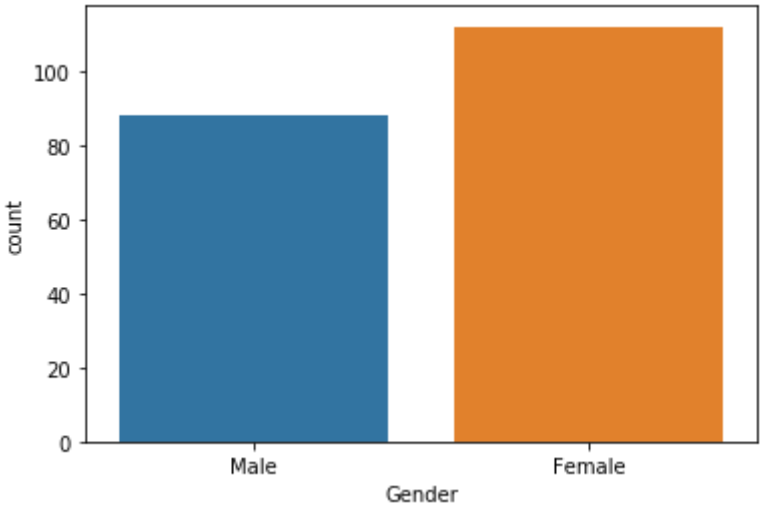
Out[47]:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
count	200.000000	200	200.000000	200.000000	200.000000
unique	NaN	2	NaN	NaN	NaN
top	NaN	Female	NaN	NaN	NaN
freq	NaN	112	NaN	NaN	NaN
mean	100.500000	NaN	38.850000	60.560000	50.200000
std	57.879185	NaN	13.969007	26.264721	25.823522
min	1.000000	NaN	18.000000	15.000000	1.000000
25%	50.750000	NaN	28.750000	41.500000	34.750000
50%	100.500000	NaN	36.000000	61.500000	50.000000
75%	150.250000	NaN	49.000000	78.000000	73.000000
max	200.000000	NaN	70.000000	137.000000	99.000000

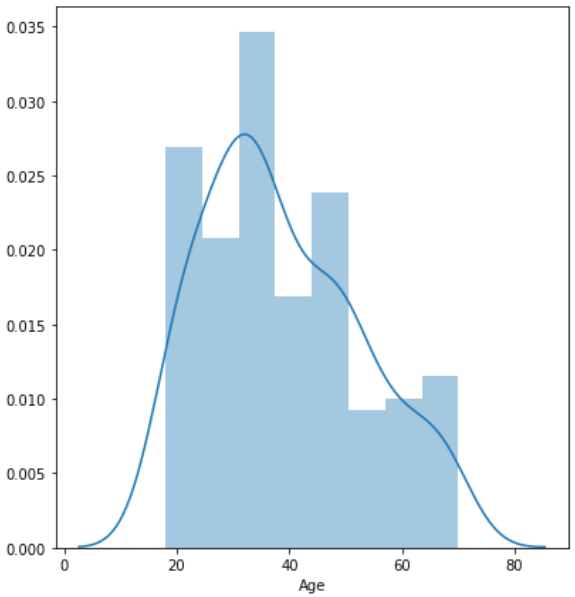
In [48]:
```
df.info()
```

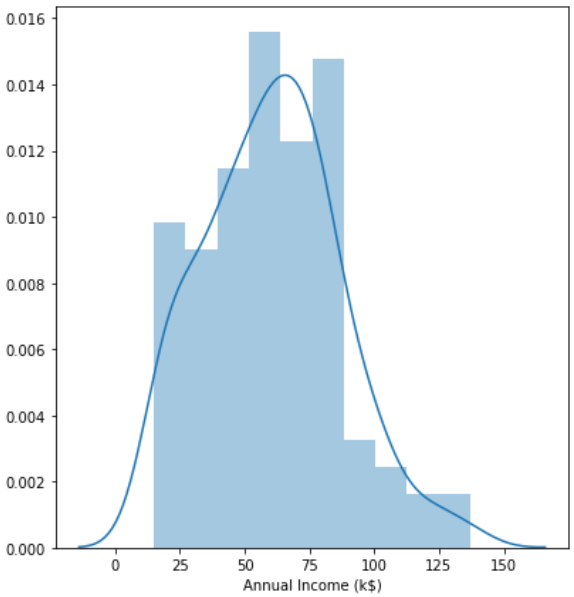
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 5 columns):
CustomerID                200 non-null int64
Gender                    200 non-null object
Age                       200 non-null int64
Annual Income (k$)        200 non-null int64
Spending Score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

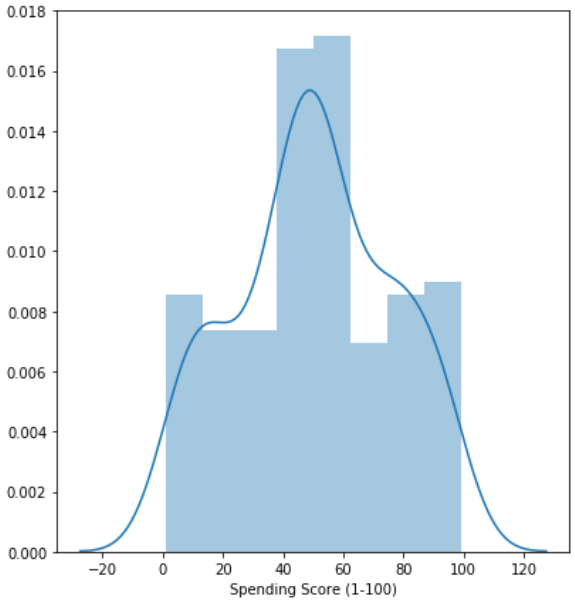
In [49]:
```
sns.countplot(df['Gender'])
plt.show()
f, ax = plt.subplots(figsize= (22,7))
plt.subplot(1,3,1)
sns.distplot(df['Age'])
#plt.show()
plt.subplot(1,3,2)
sns.distplot(df['Annual Income (k$)'])
#plt.show()
plt.subplot(1,3,3)
sns.distplot(df['Spending Score (1-100)'])
#plt.show()
```



Out[49]: <matplotlib.axes._subplots.AxesSubplot at 0x22b4542e710>

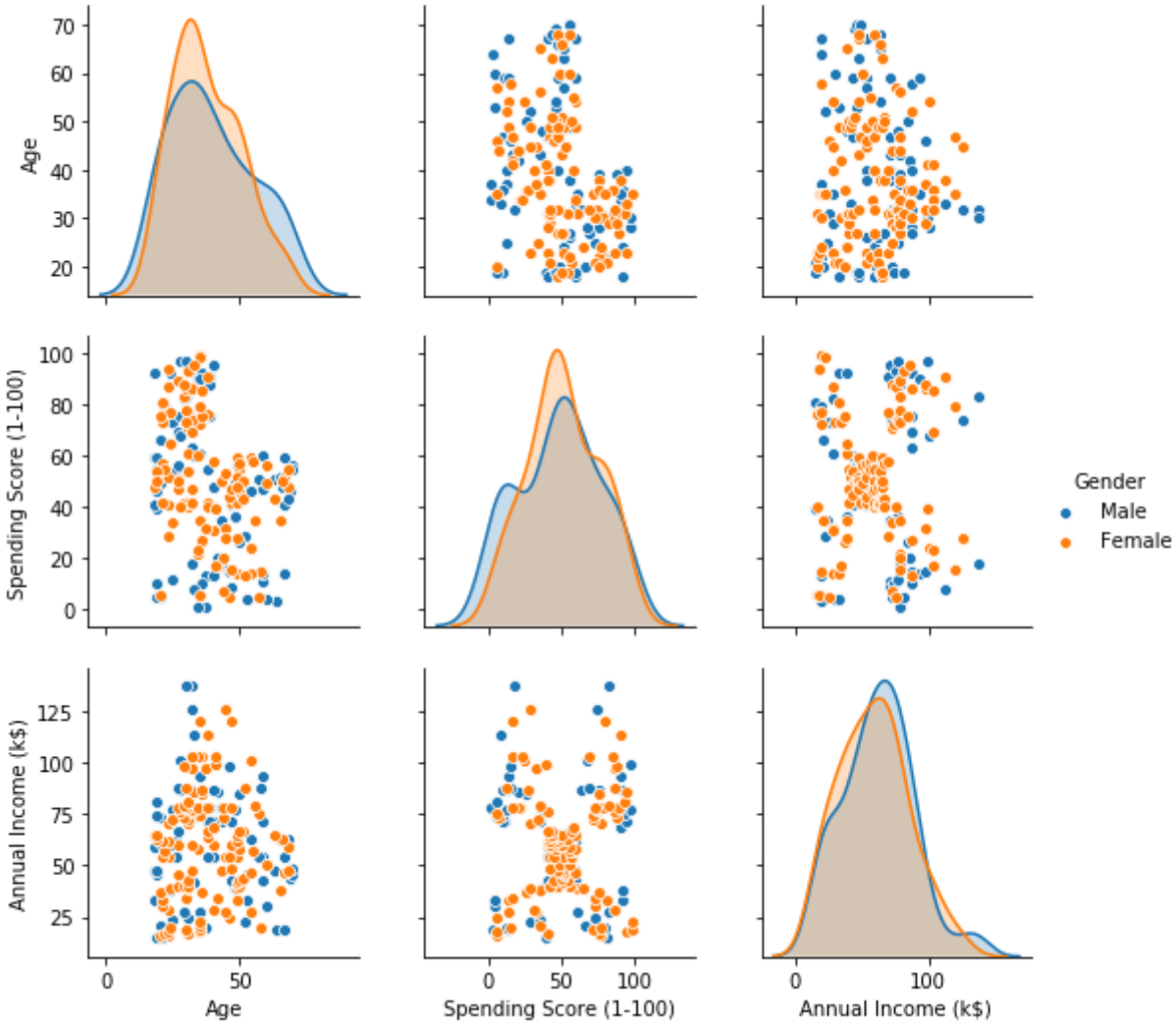






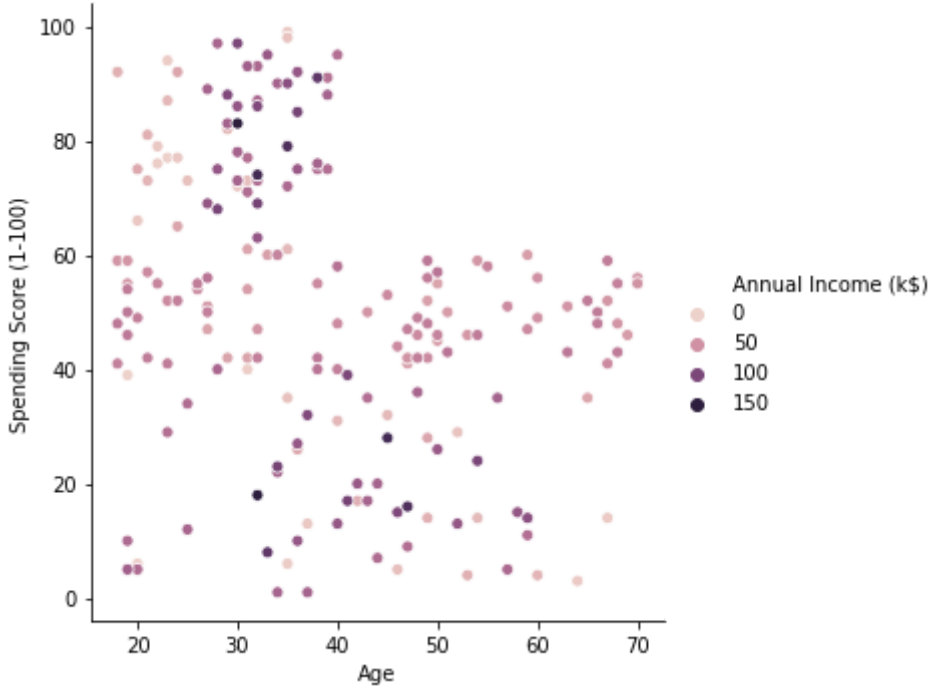
In [50]:
```
sns.pairplot(df, vars = ["Age", "Spending Score (1-100)", "Annual Income (k$)"], hue = 'Gender')
```

Out[50]: <seaborn.axisgrid.PairGrid at 0x22b452ea6d8>



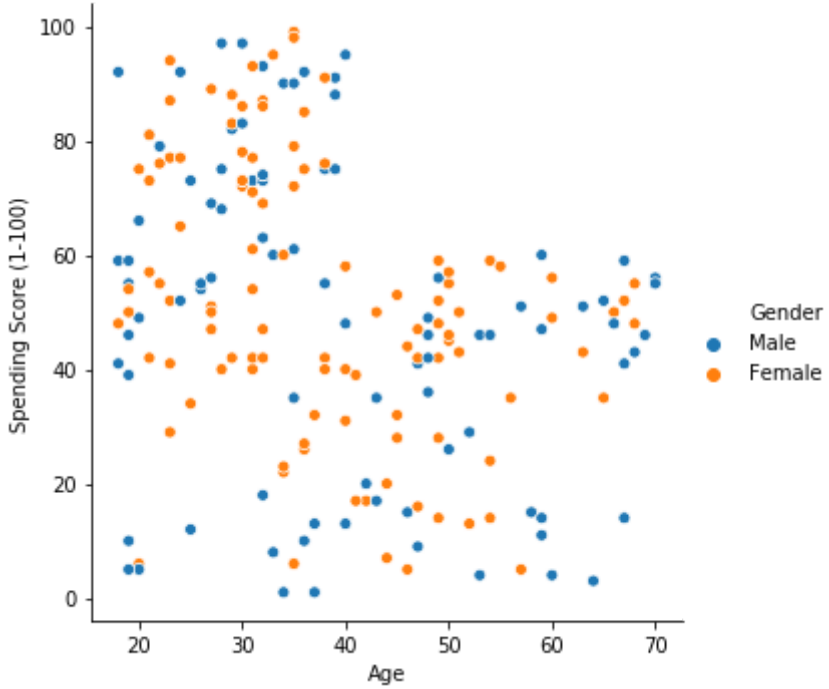
In [51]:
```
sns.relplot(x='Age', y='Spending Score (1-100)', hue ='Annual Income (k$)', data = df)
```

Out[51]:
```
<seaborn.axisgrid.FacetGrid at 0x22b446c6748>
```



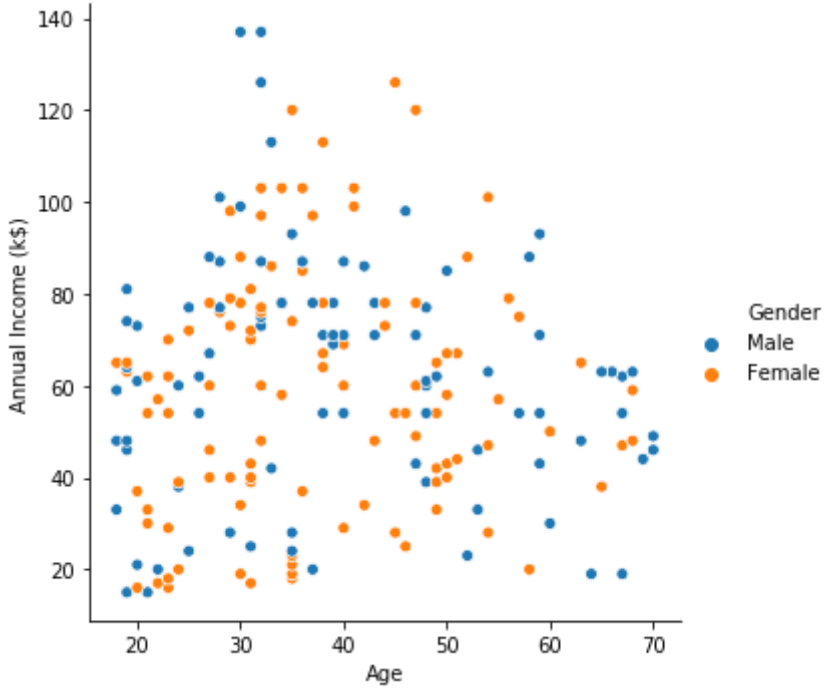
In [52]:
```
sns.relplot(x='Age', y='Spending Score (1-100)', hue ='Gender', data = df)
```

Out[52]:
```
<seaborn.axisgrid.FacetGrid at 0x22b42654710>
```



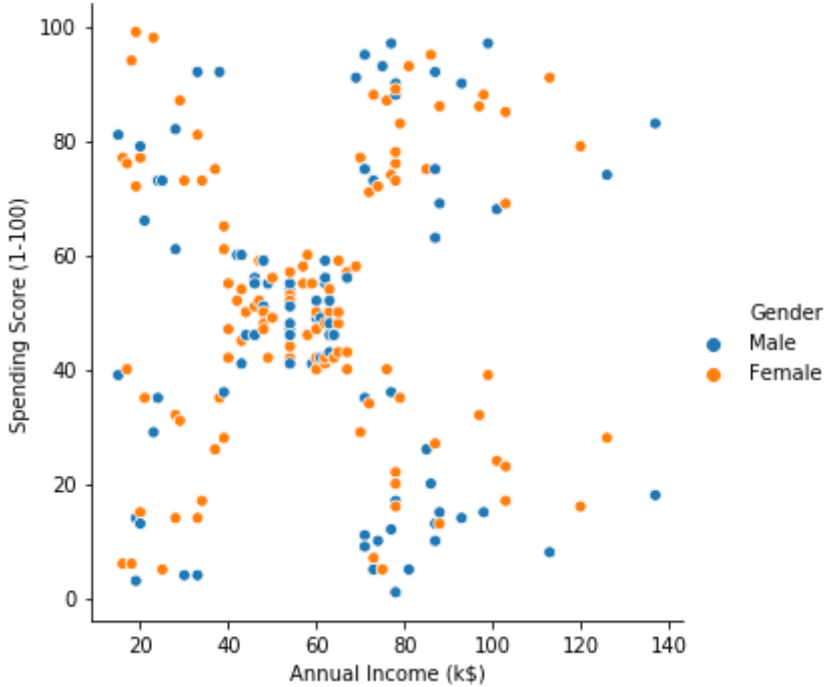
In [53]:
```
sns.relplot(x='Age', y='Annual Income (k$)', hue ='Gender', data = df)
```

Out[53]:
```
<seaborn.axisgrid.FacetGrid at 0x22b46d40400>
```



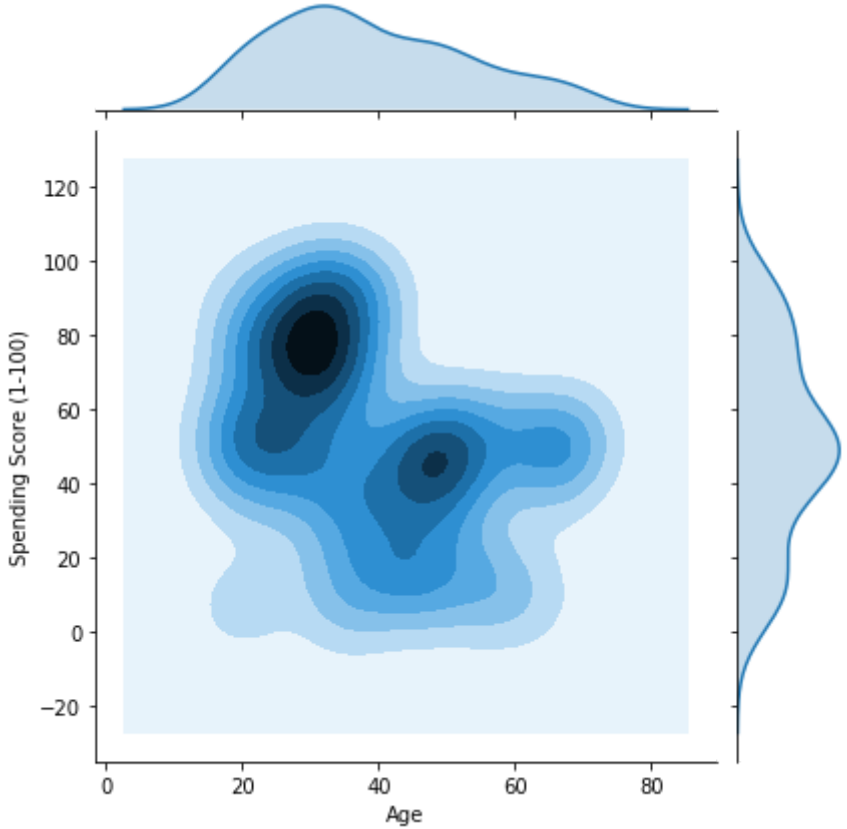
In [54]:
```
sns.relplot(x='Annual Income (k$)', y = 'Spending Score (1-100)', hue = 'Gender', data = df)
```

Out[54]:
```
<seaborn.axisgrid.FacetGrid at 0x22b46d78c50>
```



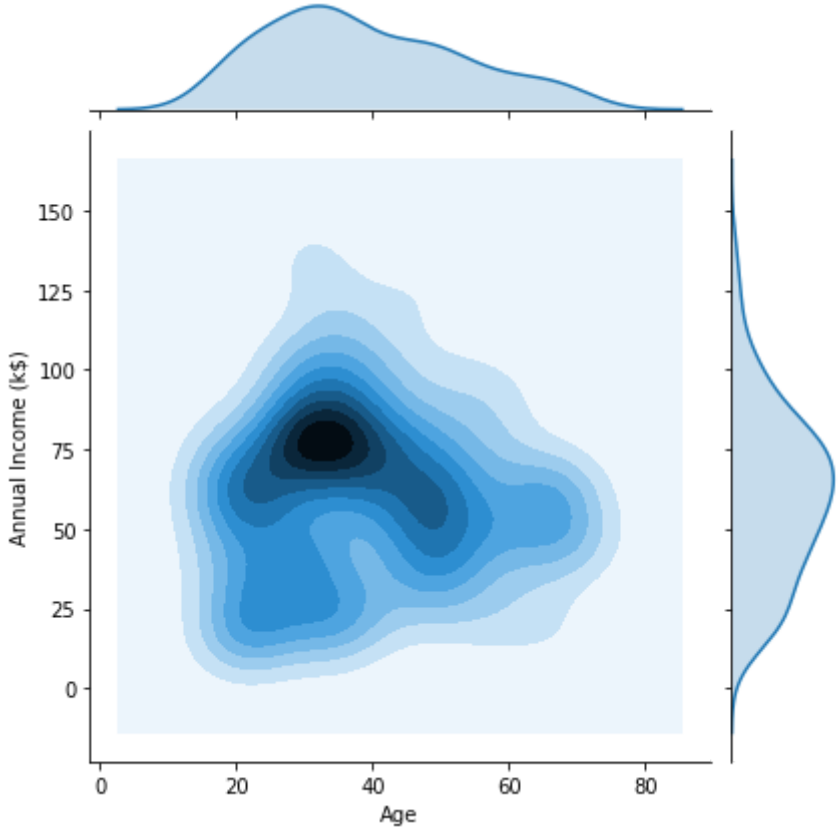
In [55]:
```
sns.jointplot(df['Age'], df['Spending Score (1-100)'], kind = 'kde' )
```

Out[55]:
```
<seaborn.axisgrid.JointGrid at 0x22b46e43fd0>
```



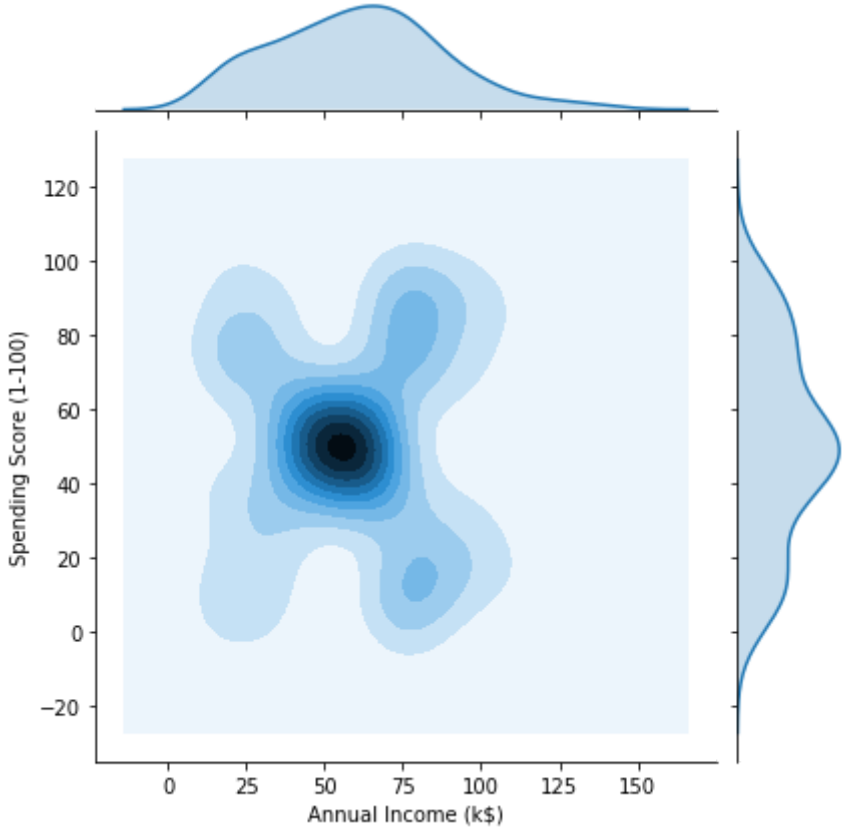
In [56]:
```
sns.jointplot(df['Age'], df['Annual Income (k$)'], kind = 'kde' )
```

Out[56]:
```
<seaborn.axisgrid.JointGrid at 0x22b46f4bc88>
```



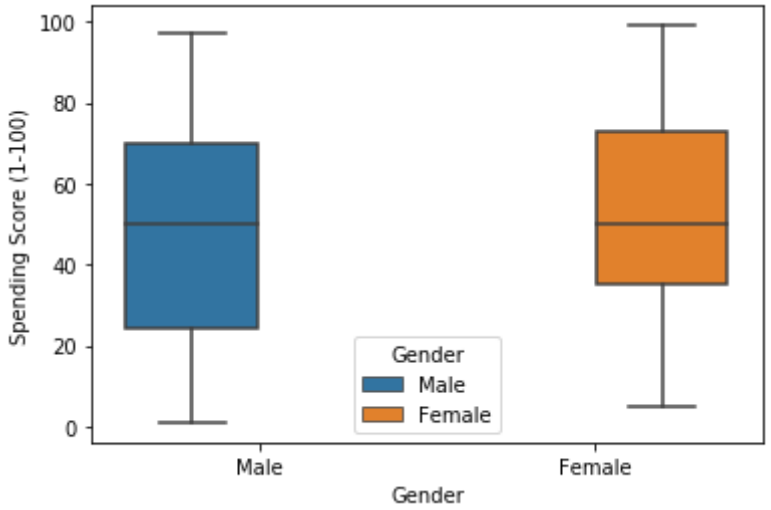
In [57]:
```
sns.jointplot(df['Annual Income (k$)'], df['Spending Score (1-100)'], kind = 'kde' )
```

Out[57]:
```
<seaborn.axisgrid.JointGrid at 0x22b47077828>
```



In [58]:
```
sns.boxplot(x="Gender", y="Spending Score (1-100)", hue = 'Gender', data=df)
data_male = df[df.Gender == 'Male']
data_female = df[df.Gender == 'Female']
print("Mean of male spending score: ", data_male['Spending Score (1-100)'].mean())
print("Mean of female spending score: ", data_female['Spending Score (1-100)'].mean())
```

```
Mean of male spending score:  48.51136363636363
Mean of female spending score:  51.526785714285715
```



In [59]:
```
df.cov()
```

Out[59]:

	CustomerID	Age	Annual Income (k$)	Spending Score (1-100)
CustomerID	3350.000000	-21.638191	1486.050251	20.678392
Age	-21.638191	195.133166	-4.548744	-118.040201
Annual Income (k$)	1486.050251	-4.548744	689.835578	6.716583
Spending Score (1-100)	20.678392	-118.040201	6.716583	666.854271

In [60]:
```
df['Gender']= df['Gender'].map({'Male':1,'Female':0})
corrmat = df.corr()
sns.heatmap(corrmat, annot = True, square = True, cmap = 'summer')
```

Out[60]: <matplotlib.axes._subplots.AxesSubplot at 0x22b471c8160>

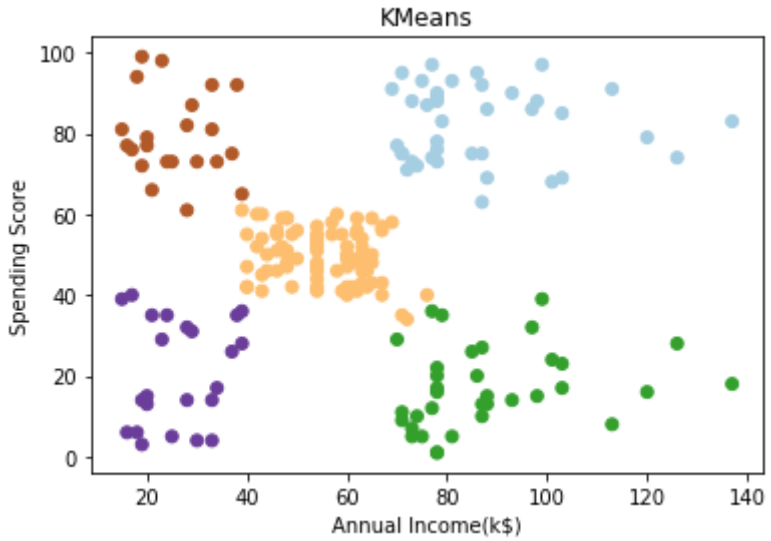
In [61]:
```
from sklearn.cluster import KMeans
def kmeans(X, n_clusters):
    km = KMeans(n_clusters=n_clusters)
    km.fit(X)
    y_pred = km.predict(X)
    return y_pred


def plot_clusters(algo_name, y_pred, x_label,y_label):
    plt.scatter(X[:,0], X[:,1],c=y_pred,cmap='Paired')
    plt.title(algo_name)
    plt.xlabel(x_label)
    plt.ylabel(y_label)
```

In [62]:
```
X=df.iloc[:,3:].to_numpy()

silhouette_scores = {}


for k in range(2,10):
    y_pred = kmeans(X,k)
    silhouette_scores[k]= silhouette_score(X,y_pred)
```

In [63]:
```
silhouette_scores
```

Out[63]:
```
{2: 0.2968969162503008,
 3: 0.46761358158775435,
 4: 0.4931963109249047,
 5: 0.553931997444648,
 6: 0.53976103063432,
 7: 0.5288104473798049,
 8: 0.4539560903726814,
 9: 0.45819645551960536}
```

In [64]:
```
y_pred= kmeans(X,5)
plot_clusters("KMeans",y_pred,"Annual Income(k$)","Spending Score")
```



In [ ]:

In [ ]: