```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

UNDERSTANDING THE DATA

```
df=pd.read_csv('/content/Mall_Customers.csv')
df.columns = df.columns.str.replace(' ', '_')
df.head()
```

	CustomerID	Gender	Age	Annual_Income_	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

```
df.shape
```

```
(200, 5)
```

```
df.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_          200 non-null    int64 
 4   Spending_Score_(1-100)  200 non-null    int64 
dtypes: int64(4), object(1)
memory usage: 7.9+ KB
```

```
df.isnull().any()
```

```
CustomerID                False
Gender                    False
Age                       False
Annual_Income_            False
Spending_Score_(1-100)    False
dtype: bool
```

```
df.describe()
```

	CustomerID	Age	Annual_Income_	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

```
df.corr()
```

```
<ipython-input-10-2f6f6606aa2c>:1: FutureWarning: The default value of numeric_only i
  df.corr()
```

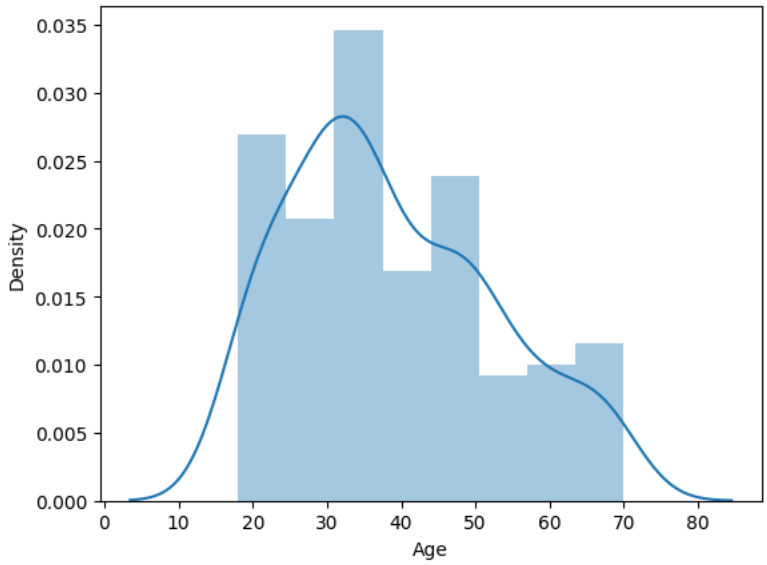
	CustomerID	Age	Annual_Income_	Spending_Score_(1-100)
CustomerID	1.000000	-0.026763	0.977548	0.013835
Annual_Income_	0.977548	0.012398	1.000000	0.009903
Spending_Score_(1-100)				

VISUALIZATION

UNIVARIATE ANALYSIS

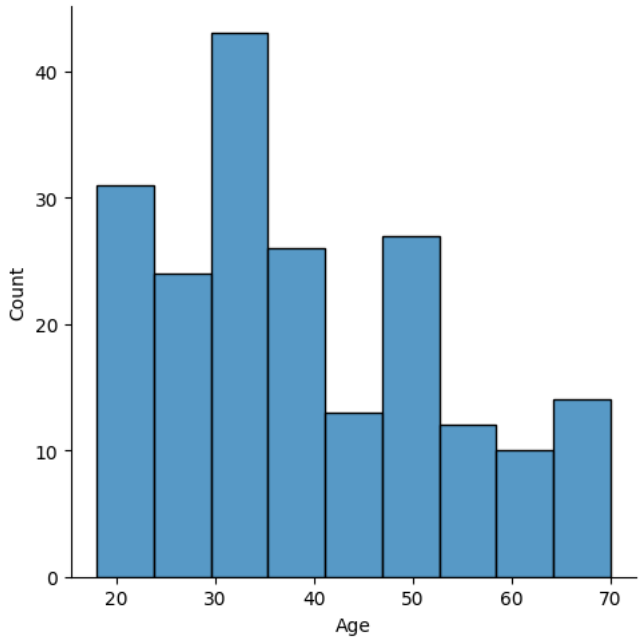
```
sns.distplot(df.Age)
```

```
<ipython-input-11-b2378c9d8a20>:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df.Age)
<Axes: xlabel='Age', ylabel='Density'>
```




```
sns.displot(df.Age)
```

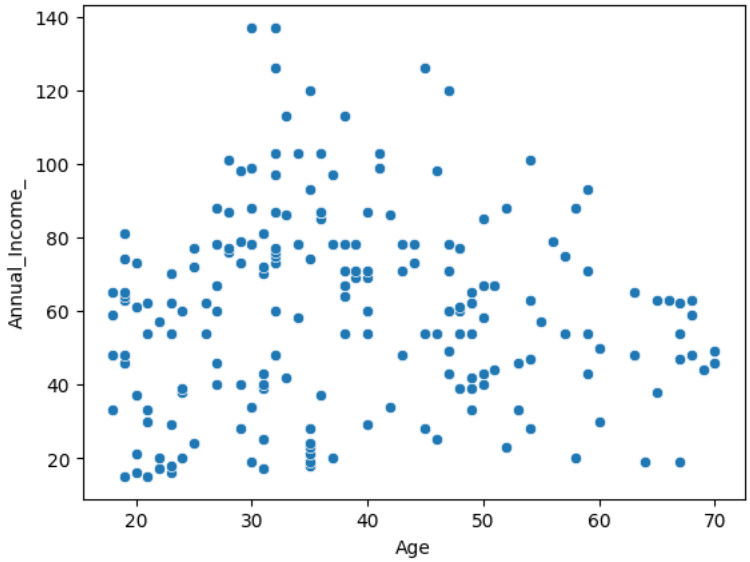
```
<seaborn.axisgrid.FacetGrid at 0x7cca86302a70>
```



BIVARIATE ANALYSIS

```
sns.scatterplot(x=df.Age,y=df.Annual_Income_)
```

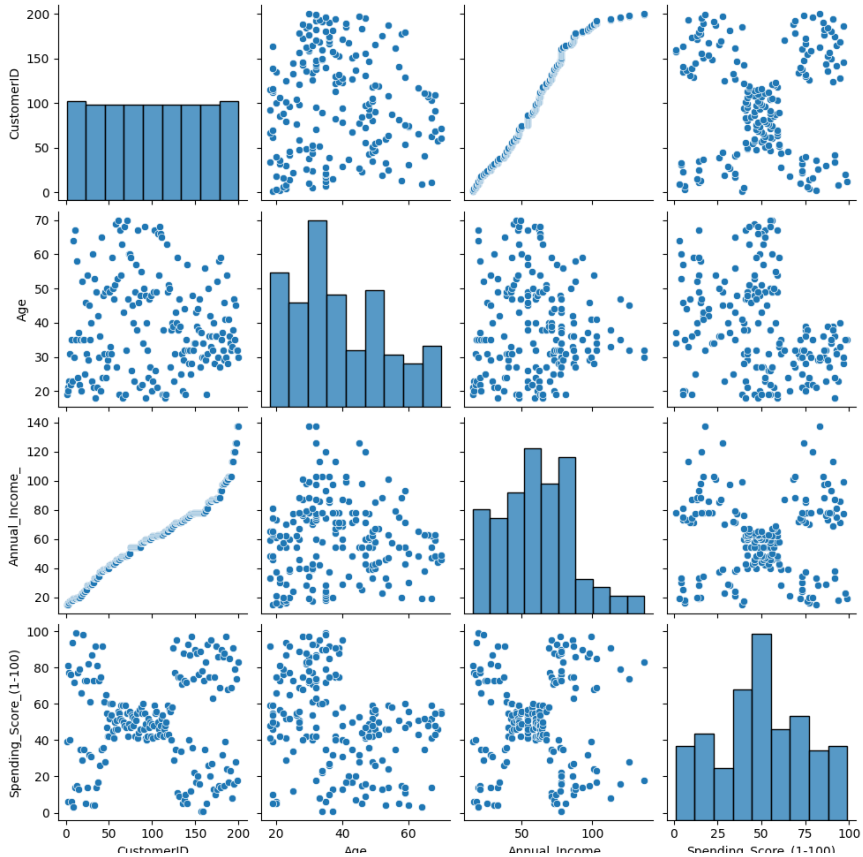
```
<Axes: xlabel='Age', ylabel='Annual_Income_'>
```



MULTIVARIATE ANALYSIS

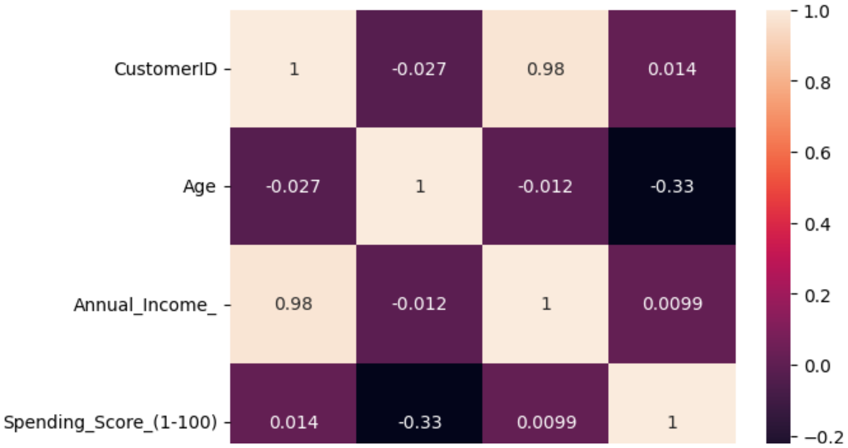
```
sns.pairplot(df)
```

```
<seaborn.axisgrid.PairGrid at 0x7cca86303e20>
```




```
sns.heatmap(df.corr(),annot=True)
```

```
<ipython-input-15-8df7bcac526d>:1: FutureWarning: The default value of numeric_only i
  sns.heatmap(df.corr(),annot=True)
<Axes: >
```



DATA PREPROCESSING

```
from sklearn import cluster
```

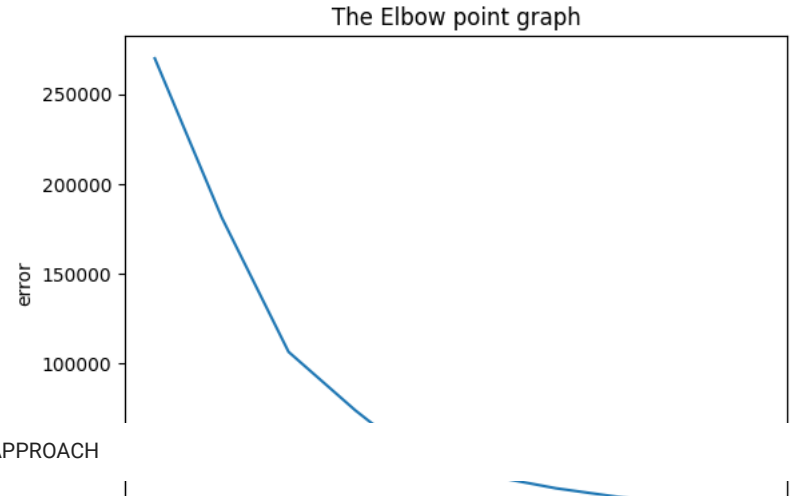
```
df2=df.iloc[:,-2:]
df2.head()
```

	Annual_Income_	Spending_Score_(1-100)
0	15	39
1	15	81
2	16	6
3	16	77
4	17	40

```
error=[]
for i in range(1,11):
  kmeans = cluster.KMeans(n_clusters=i,init = 'k-means++',random_state=4)
  kmeans.fit(df2)
  error.append(kmeans.inertia_)
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning: The default value of `n_init` will change fr
  warnings.warn(
```

```
plt.plot(range(1,11),error)
plt.title('The Elbow point graph')
plt.xlabel('number of clusters')
plt.ylabel('error')
plt.show()
```



ML APPROACH

```
km_model = cluster.KMeans(n_clusters=5,init = 'k-means++',random_state=0)
km_model.fit(df2)
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_kmeans.py:870: FutureWarning
  warnings.warn(
```

```
KMeans(n_clusters=5, random_state=0)
```

```
pred = km_model.predict(df2)
pred
```

```
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, 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, 0, 2,
       0, 2], dtype=int32)
```

TESTING WITH RANDOM OBSERVATIONS

```
km_model.predict([[10,20]])
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/base.py:439: UserWarning: X does not have valid feature names, but KMeans was fitte
  warnings.warn(
array([4], dtype=int32)
```

```
km_model.predict([[11,1]])
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/base.py:439: UserWarning: X does not have valid feature names, but KMeans was fitte
  warnings.warn(
array([4], dtype=int32)
```

```
km_model.predict([[55,77]])
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/base.py:439: UserWarning: X does not have valid feature names, but KMeans was fitte
  warnings.warn(
array([1], dtype=int32)
```