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Implement k means algorithm on the criminal data collected in various US states. The data contains crimes committed like: assault, murder, and rape in arrests per 100,000 residents in each of the 50 US states in 1973.

1. Analyzing the data in various ways
2. Create and analyze the elbow curve.
3. Find the optimal number of clusters.
4. Minimizing the within-cluster Sum of Squared Errors (SSE), which is also called cluster inertia.

{Hint:

wcss.append (kmeans.inertia_)

As we used “kmeans.cluster_centers_” and “kmeans.labels_” to get centroids values and labels respectively. Similarly use kmeans.inertia_ to get the WCSS values for different K values.

}

5. Implement K means algorithm.

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

```
from google.colab import files
uploaded = files.upload()
```

Choose Files criminal_data.csv

- **criminal_data.csv**(application/vnd.ms-excel) - 1328 bytes, last modified: 7/1/2021 - 100% done

```
Saving criminal_data.csv to criminal_data.csv
```

```
data = pd.read_csv('criminal_data.csv', index_col=0)
```

```
data.head()
```

	Murder	Assault	UrbanPop	Rape
Alabama	13.2	236	58	21.2
Alaska	10.0	263	48	44.5
Arizona	8.1	294	80	31.0

```
data.describe()
```

	Murder	Assault	UrbanPop	Rape
count	50.00000	50.000000	50.000000	50.000000
mean	7.78800	170.760000	65.540000	21.232000
std	4.35551	83.337661	14.474763	9.366385
min	0.80000	45.000000	32.000000	7.300000
25%	4.07500	109.000000	54.500000	15.075000
50%	7.25000	159.000000	66.000000	20.100000
75%	11.25000	249.000000	77.750000	26.175000
max	17.40000	337.000000	91.000000	46.000000

```
X = data.iloc[:, 0:5]
```

```
from sklearn.preprocessing import StandardScaler
X = StandardScaler().fit_transform(X)
```

```
X
```

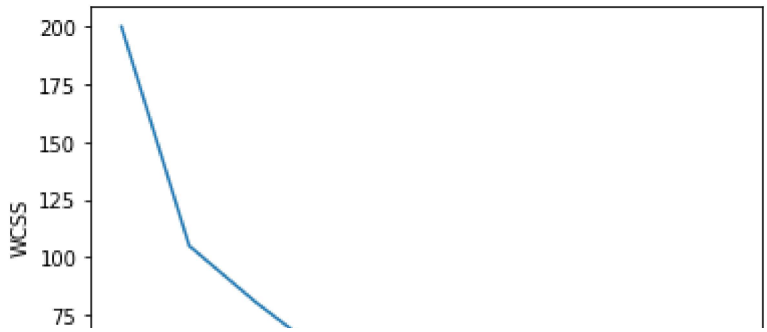
```
array([[ 1.25517927,  0.79078716, -0.52619514, -0.00345116],
       [ 0.51301858,  1.11805959, -1.22406668,  2.50942392],
       [ 0.07236067,  1.49381682,  1.00912225,  1.05346626],
       [ 0.23470832,  0.23321191, -1.08449238, -0.18679398],
       [ 0.28109336,  1.2756352 ,  1.77678094,  2.08881393],
       [ 0.02597562,  0.40290872,  0.86954794,  1.88390137],
       [-1.04088037, -0.73648418,  0.79976079, -1.09272319],
       [-0.43787481,  0.81502956,  0.45082502, -0.58583422],
       [ 1.76541475,  1.99078607,  1.00912225,  1.1505301 ],
       [ 2.22926518,  0.48775713, -0.38662083,  0.49265293],
       [-0.57702994, -1.51224105,  1.21848371, -0.11129987],
       [-1.20322802, -0.61527217, -0.80534376, -0.75839217],
       [ 0.60578867,  0.94836277,  1.21848371,  0.29852525],
       [-0.13637203, -0.70012057, -0.03768506, -0.0250209 ],
       [-1.29599811, -1.39102904, -0.5959823 , -1.07115345],
       [-0.41468229, -0.67587817,  0.03210209, -0.34856705],
       [ 0.44344101, -0.74860538, -0.94491807, -0.53190987],
       [ 1.76541475,  0.94836277,  0.03210209,  0.10439756],
       [-1.31919063, -1.06375661, -1.01470522, -1.44862395],
```

```
[ 0.81452136,  1.56654403,  0.10188925,  0.70835037],
[-0.78576263, -0.26375734,  1.35805802, -0.53190987],
[ 1.00006153,  1.02108998,  0.59039932,  1.49564599],
[-1.1800355 , -1.19708982,  0.03210209, -0.68289807],
[ 1.9277624 ,  1.06957478, -1.5032153 , -0.44563089],
[ 0.28109336,  0.0877575 ,  0.31125071,  0.75148985],
[-0.41468229, -0.74860538, -0.87513091, -0.521125  ],
[-0.80895515, -0.83345379, -0.24704653, -0.51034012],
[ 1.02325405,  0.98472638,  1.0789094 ,  2.671197  ],
[-1.31919063, -1.37890783, -0.66576945, -1.26528114],
[-0.08998698, -0.14254532,  1.63720664, -0.26228808],
[ 0.83771388,  1.38472601,  0.31125071,  1.17209984],
[ 0.76813632,  1.00896878,  1.42784517,  0.52500755],
[ 1.20879423,  2.01502847, -1.43342815, -0.55347961],
[-1.62069341, -1.52436225, -1.5032153 , -1.50254831],
[-0.11317951, -0.61527217,  0.66018648,  0.01811858],
[-0.27552716, -0.23951493,  0.1716764 , -0.13286962],
[-0.66980002, -0.14254532,  0.10188925,  0.87012344],
[-0.34510472, -0.78496898,  0.45082502, -0.68289807],
[-1.01768785,  0.03927269,  1.49763233, -1.39469959],
[ 1.53348953,  1.3119988 , -1.22406668,  0.13675217],
[-0.92491776, -1.027393  , -1.43342815, -0.90938037],
[ 1.25517927,  0.20896951, -0.45640799,  0.61128652],
[ 1.13921666,  0.36654512,  1.00912225,  0.46029832],
[-1.06407289, -0.61527217,  1.00912225,  0.17989166],
[-1.29599811, -1.48799864, -2.34066115, -1.08193832],
[ 0.16513075, -0.17890893, -0.17725937, -0.05737552],
[-0.87853272, -0.31224214,  0.52061217,  0.53579242],
[-0.48425985, -1.08799901, -1.85215107, -1.28685088],
[-1.20322802, -1.42739264,  0.03210209, -1.1250778 ],
[-0.22914211, -0.11830292, -0.38662083, -0.60740397]])
```

```
wcss = []
for k in range(1, 11):
  kmeans = KMeans(n_clusters=k)
  kmeans.fit(X)
  wcss.append(kmeans.inertia_)
print(wcss)
```

```
[200.0, 104.96163315756871, 80.08569526137276, 57.67285241283122, 50.52026552535069, 44
```

```
plt.plot(range(1, 11), wcss)
plt.xticks(range(1, 11))
plt.xlabel("Number of Clusters")
plt.ylabel("WCSS")
plt.show()
```




```
from sklearn.cluster import KMeans
kmeans = KMeans(n_clusters=4, init='k-means++' ,random_state = 1)
y_predict= kmeans.fit_predict(X)
```

Number of Clusters

```
y_predict
```

```
array([1, 3, 3, 1, 3, 3, 0, 0, 3, 1, 0, 2, 3, 0, 2, 0, 2, 1, 2, 3, 0, 3,
       2, 1, 3, 2, 2, 3, 2, 0, 3, 3, 1, 2, 0, 0, 0, 0, 0, 1, 2, 1, 3, 0,
       2, 0, 0, 2, 2, 0], dtype=int32)
```

```
y_predict.max()
```

```
3
```

```
kmeans.fit(X)
```

```
KMeans(algorithm='auto', copy_x=True, init='k-means++', max_iter=300,
       n_clusters=4, n_init=10, n_jobs=None, precompute_distances='auto',
       random_state=1, tol=0.0001, verbose=0)
```

```
kmeans.cluster_centers_
```

```
array([[-0.49440658, -0.3864845 ,  0.58167593, -0.26431024],
       [ 1.42622412,  0.88321132, -0.82279055,  0.01946669],
       [-0.97130281, -1.11783581, -0.93954982, -0.97657842],
       [ 0.70212683,  1.04999438,  0.72997363,  1.28990383]])
```

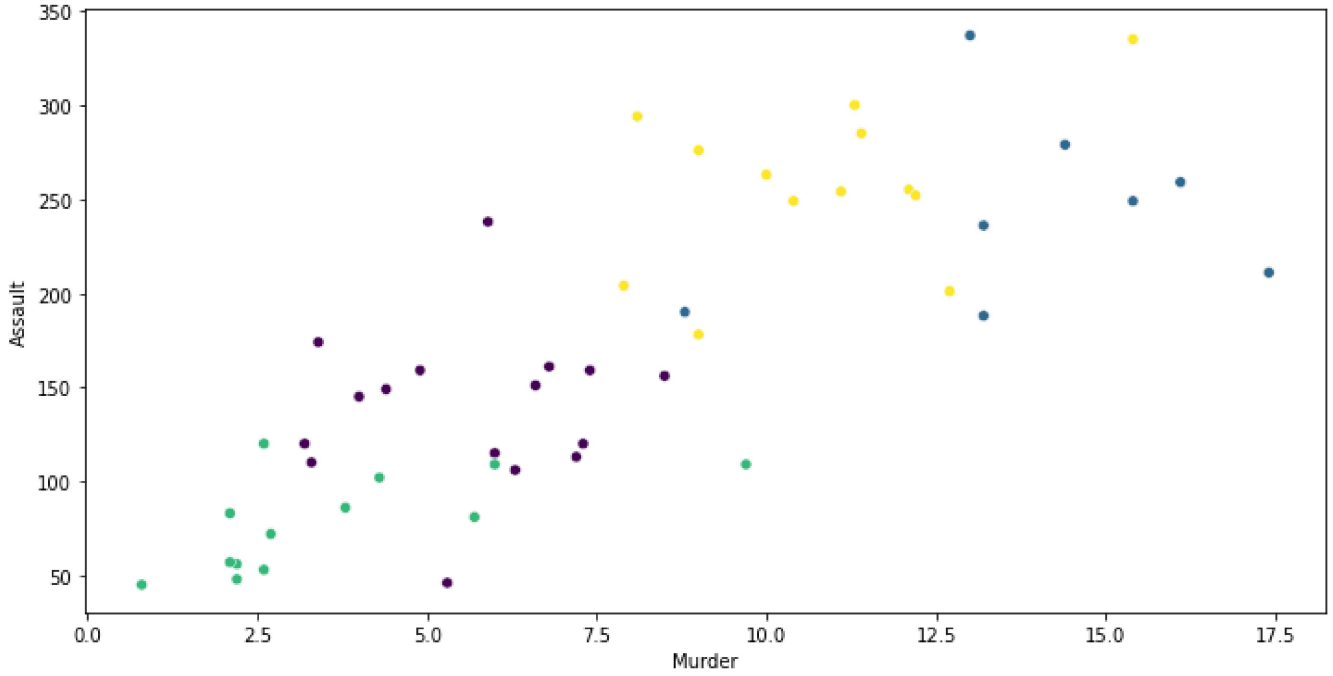
```
kmeans.labels_
```

```
array([1, 3, 3, 1, 3, 3, 0, 0, 3, 1, 0, 2, 3, 0, 2, 0, 2, 1, 2, 3, 0, 3,
       2, 1, 3, 2, 2, 3, 2, 0, 3, 3, 1, 2, 0, 0, 0, 0, 0, 1, 2, 1, 3, 0,
       2, 0, 0, 2, 2, 0], dtype=int32)
```

```
import seaborn as sns

plt.figure(figsize=(12,6))
sns.scatterplot(x=data['Murder'], y = data['Assault'],c=y_predict)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f60df231910>
```



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