Forward School

Program Code: J620-002-4:2020

Program Name: FRONT-END SOFTWARE DEVELOPMENT

Title : Exe26 - Clusters of Grain

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Introduction : Learning clusters of grain

Conclusion :

How many clusters of grain?

This exercise is taken and modified from https://github.com/benjaminwilson/python-clustering-exercises (https://github.com/benjaminwilson/python-clustering-exercises)

This is a class to choose a good number of clusters for a dataset using the k-means inertia graph. You are given a dataset of the measurements of samples of grain. What's a good number of clusters in this case?

This dataset was obtained from the UCI (https://archive.ics.uci.edu/ml/datasets/seeds).

Step 1: Load the dataset *(written for you)*.

In [1]:

```
import pandas as pd

seeds_df = pd.read_csv('seeds.csv')
# forget about the grain variety for the moment - we'll use this later
del seeds_df['grain_variety']
```

Step 2: Display the DataFrame to inspect the data. Notice that there are 7 columns - so each grain sample (row) is a point in 7D space! Scatter plots can't help us here.

In [3]:

```
seeds_df.head()
```

Out[3]:

	area	perimeter	compactness	length	width	asymmetry_coefficient	groove_length
0	15.26	14.84	0.8710	5.763	3.312	2.221	5.220
1	14.88	14.57	0.8811	5.554	3.333	1.018	4.956
2	14.29	14.09	0.9050	5.291	3.337	2.699	4.825
3	13.84	13.94	0.8955	5.324	3.379	2.259	4.805
4	16.14	14.99	0.9034	5.658	3.562	1.355	5.175

Step 3: Extract the measurements from the DataFrame using its `.values` attribute:

In [4]:

```
measurements_array = seeds_df.values

measurements_array
```

Out[4]:

```
array([[15.26  , 14.84  ,  0.871 , ...,  3.312 ,  2.221 ,  5.22  ],
       [14.88  , 14.57  ,  0.8811, ...,  3.333 ,  1.018 ,  4.956 ],
       [14.29  , 14.09  ,  0.905 , ...,  3.337 ,  2.699 ,  4.825 ],
       ...,
       [13.2   , 13.66  ,  0.8883, ...,  3.232 ,  8.315 ,  5.056 ],
       [11.84  , 13.21  ,  0.8521, ...,  2.836 ,  3.598 ,  5.044 ],
       [12.3   , 13.34  ,  0.8684, ...,  2.974 ,  5.637 ,  5.063 ]])
```

Step 4: *(Written for you)*. Measure the quality of clusterings with different numbers of clusters using the inertia. For each of the given values of `k`, perform the following steps:

- Create a `KMeans` instance called `model` with `k` clusters.
- Fit the model to the grain data `samples`.
- Append the value of the `inertia_` attribute of `model` to the list `inertias`.

In [5]:

```
import pandas as pd
import numpy as np
from sklearn.cluster import KMeans

inertias = []

for k in range(1, 11):
    model = KMeans(n_clusters=k)

    model.fit(seeds_df.values)

    inertias.append(model.inertia_)

print(inertias)
```

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  warnings.warn(

[2719.852410177952, 1011.7123453151191, 587.3186115940429, 471.02714568221
09, 386.0421139658138, 323.27027205797947, 277.56117926703195, 240.5667293
168427, 220.39950681378002, 202.48459939311235]

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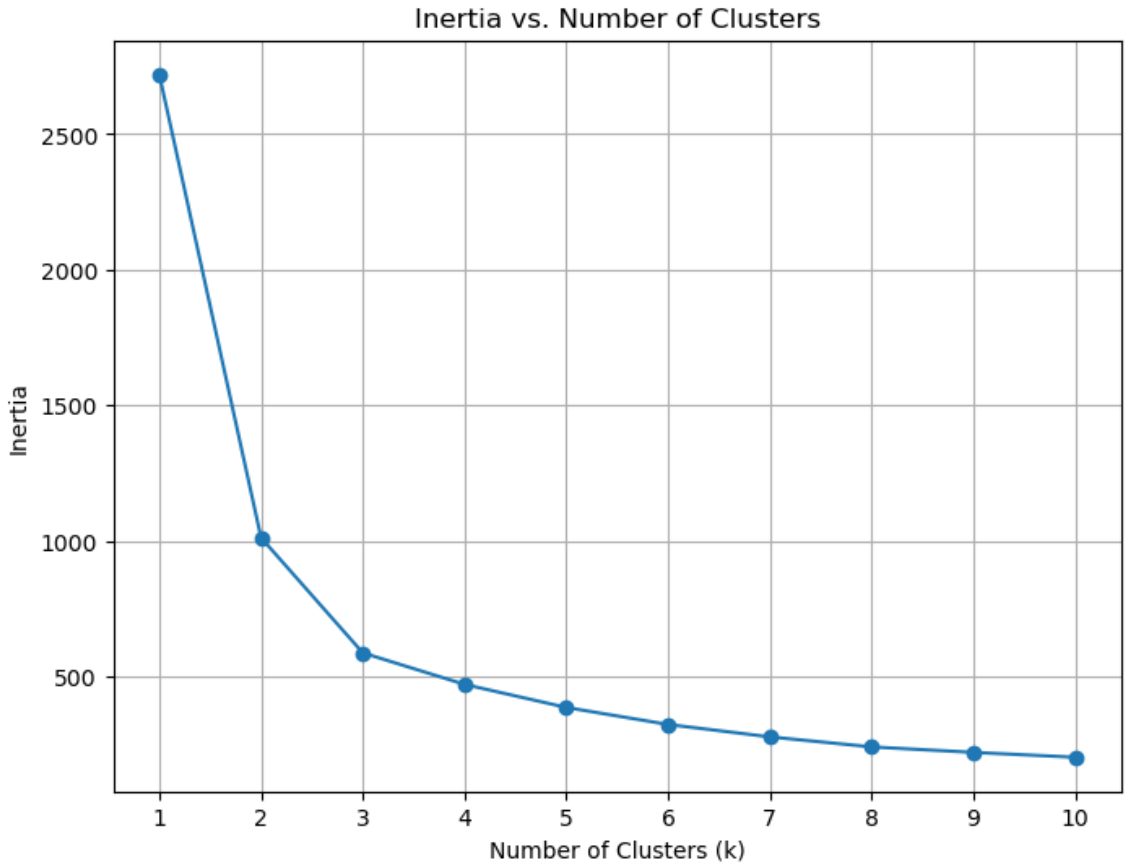
can avoid it by setting the environment variable OMP_NUM_THREADS=1.
  warnings.warn(
```

Step 5: Plot the inertia to see which number of clusters is best. Remember: lower numbers are better!

In [6]:

```
import matplotlib.pyplot as plt
plt.figure(figsize=(8, 6))
plt.plot(range(1, 11), inertias, marker='o')
plt.xlabel('Number of Clusters (k)')
plt.ylabel('Inertia')
plt.title('Inertia vs. Number of Clusters')
plt.xticks(range(1, 11))
plt.grid(True)
plt.show()
```



Excellent work! You can see from the graph the "best" number of clusters. Use this value for the next steps.

Step 6: Create a `KMeans` model called `model` with the best value from the above steps.

In [7]:

```
best_k = 3  # You need to set this to the value of k that you find best from the plot

# Create the KMeans model with the best value of k
model = KMeans(n_clusters=best_k)

# Fit the model to the grain data samples
model.fit(seeds_df.values)
```

```
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can avoid it by setting the environment variable OMP_NUM_THREADS=1.
  warnings.warn(
```

Out[7]:

```
KMeans
KMeans(n_clusters=3)
```

Step 7: Use the .fit_predict() method of model to fit it to samples and derive the cluster labels.

Calling .fit_predict() is the same as calling .fit() and then calling .predict().

In [8]:

```
cluster_labels = model.fit_predict(seeds_df.values)

# Print the cluster labels for each sample (grain)
print(cluster_labels)
```

```
[2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 2 2 1 2 2 2 2 2 2 1 2 2 2 2 2 2 2 2 2
 0 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 1 1 1 1 2 2 2 2 2 1 0 0 0 0
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can avoid it by setting the environment variable OMP_NUM_THREADS=1.
  warnings.warn(
```

Step 8: Create a DataFrame `df` with two columns named `'labels'` and `'varieties'`, using `labels` and `varieties`, respectively, for the column values.

In [10]:

```
df = pd.DataFrame({'labels': cluster_labels, 'varieties': seeds_df.index})

df
```

Out[10]:

	labels	varieties
0	2	0
1	2	1
2	2	2
3	2	3
4	2	4
...	...	...
205	1	205
206	1	206
207	1	207
208	1	208
209	1	209

210 rows × 2 columns

Step 9: Use the `pd.crosstab()` function on `df['labels']` and `df['varieties']` to count the number of times each grain variety coincides with each cluster label. Assign the result to `ct` .

In [12]:

```
ct = pd.crosstab(df['labels'], df['varieties'])
```

Step 10: Display `ct` by evaluating it - and inspect your cross-tabulation! You'll see that your clustering is pretty good.

In [13]:

```
ct
```

Out[13]:

varieties	0	1	2	3	4	5	6	7	8	9	...	200	201	202	203	204	205	206	207	208	20
labels																					
0	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0	0	0	0	0	
1	0	0	0	0	0	0	0	0	0	0	...	1	0	1	1	1	1	1	1	1	
2	1	1	1	1	1	1	1	1	1	1	...	0	1	0	0	0	0	0	0	0	

3 rows × 210 columns

Now you are done. If you wish, you can also try to plot the clusters to visualize it.

In [ ]:

```

```