Clustering IRIS Dataset

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Summary

We present steps to cluster the Iris data set. The Iris data set is one of the most used data sets to study pattern recognition. The data set is created by R. A. Fisher. The dataset includes three different classes of flowers: Iris Setosa, Iris Versicolour, and Iris Virginica. These classes can be categorized based on their sepal length, sepal width, petal length, and petal width. We use the k-means clustering algorithm to cluster these flowers. The k-means clustering starts from random cluster centers and can provide different clusters for different runs. We take the necessary steps to make the processing reproducible.

Data

The Iris data can be downloaded from the UC Irvine Machin Learning Repository (https://archive.ics.uci.edu/ml/datasets/iris). Here is the link of download.

- https://archive.ics.uci.edu/ml/machine-learning-databases/iris/iris.data

More information about the data can be downloaded from the following link.

- https://archive.ics.uci.edu/ml/machine-learning-databases/iris/iris.names

We put a copy of these files inside the `data` folder.

```
data = readtable("data/iris.csv", 'Format','%f%f%f%f%s');
varNames = {'sepal length','sepal width','petal length','petal width', 'class'};
data.Properties.VariableNames = varNames;
head(data)
```

ans = 8×5 table

	sepal length	sepal width	petal length	petal width	class
1	5.1000	3.5000	1.4000	0.2000	'Iris-setosa'
2	4.9000	3	1.4000	0.2000	'Iris-setosa'
3	4.7000	3.2000	1.3000	0.2000	'Iris-setosa'
4	4.6000	3.1000	1.5000	0.2000	'Iris-setosa'
5	5	3.6000	1.4000	0.2000	'Iris-setosa'
6	5.4000	3.9000	1.7000	0.4000	'Iris-setosa'
7	4.6000	3.4000	1.4000	0.3000	'Iris-setosa'
8	5	3.4000	1.5000	0.2000	'Iris-setosa'

```
% convert features table to matrix
feature_mat = data{:,1:4}
```

```
feature_mat = 150×4
    5.1000    3.5000    1.4000    0.2000
    4.9000    3.0000    1.4000    0.2000
    4.7000    3.2000    1.3000    0.2000
    4.6000    3.1000    1.5000    0.2000
    5.0000    3.6000    1.4000    0.2000
    5.4000    3.9000    1.7000    0.4000
    4.6000    3.4000    1.4000    0.3000
    5.0000    3.4000    1.5000    0.2000
    4.4000    2.9000    1.4000    0.2000
    4.9000    3.1000    1.5000    0.1000
      ⋮
```

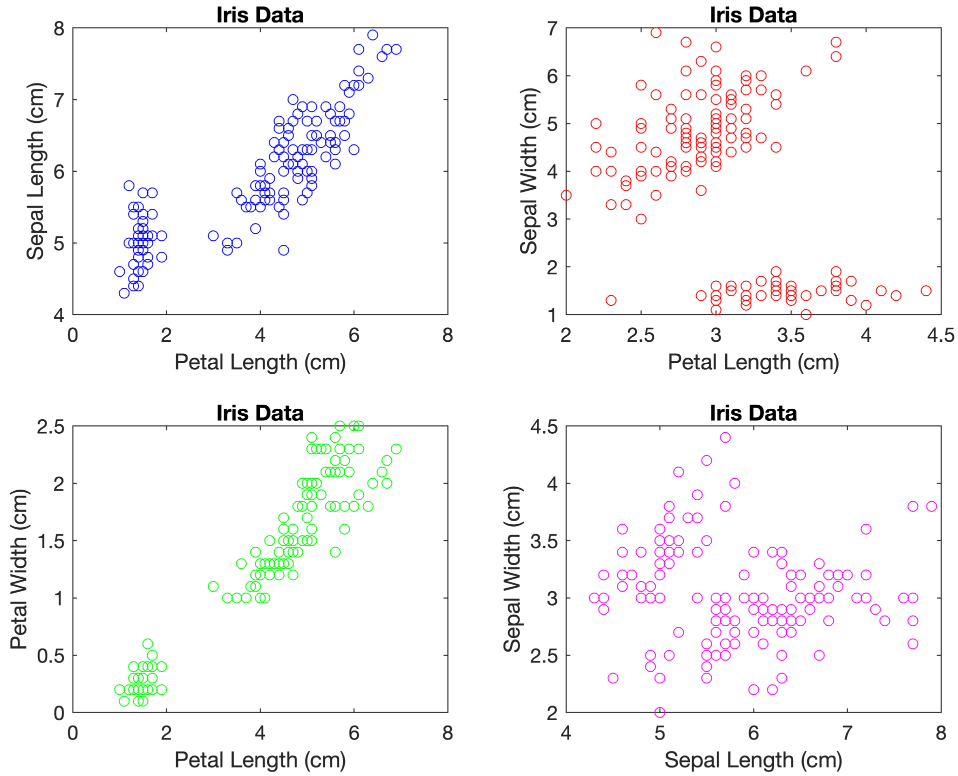
Now, we can take a look at data.

```
figure;
subplot(2,2,1)
plot(feature_mat(:,3),feature_mat(:,1),'bo', 'MarkerSize',5);
title('Iris Data')
xlabel('Petal Length (cm)');
ylabel('Sepal Length (cm)');


subplot(2,2,2)
plot(feature_mat(:,2),feature_mat(:,3),'ro', 'MarkerSize',5);
title('Iris Data')
xlabel('Petal Length (cm)');
ylabel('Sepal Width (cm)');


subplot(2,2,3)
plot(feature_mat(:,3),feature_mat(:,4),'go', 'MarkerSize',5);
title('Iris Data')
xlabel('Petal Length (cm)');
ylabel('Petal Width (cm)');


subplot(2,2,4)
plot(feature_mat(:,1),feature_mat(:,2),'mo', 'MarkerSize',5);
title('Iris Data')
xlabel('Sepal Length (cm)');
ylabel('Sepal Width (cm)');
```



k-means Clustering

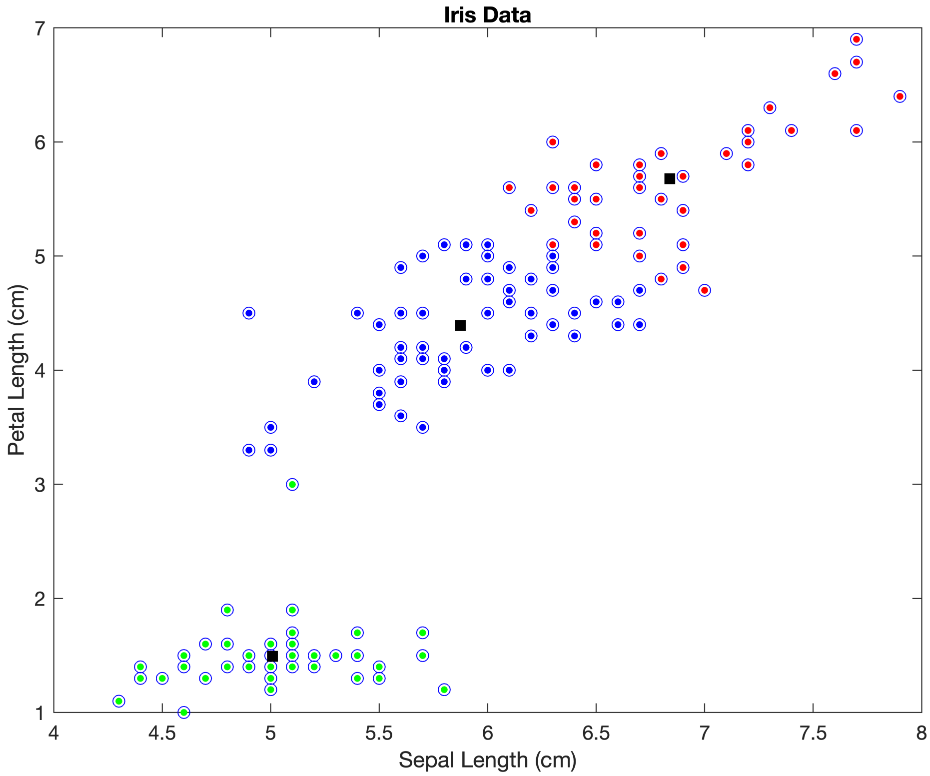
In the k-means algorithm, we need to decide on the number of clusters. Estimating the number of clusters based on the study data is beyond the scope of this summary. We use the number of unique classes as a number of clusters. Let's say we want to cluster data based on `petal length` and `sepal lenght`.

```
rng(123); % For reproducibiliy
n_cluster = 3;
[idx, C] = kmeans(feature_mat(:,[1,3]),n_cluster);
```

C represents the cluster centers and idx is the vector of corresponding predicted clusters. Let's take a look at hte results on a figure.

```
% Create a color matrix.
color_mat = (idx==1)*[1 0 0] + (idx==2)*[0 1 0] + (idx==3)*[0 0 1];

figure;
plot(feature_mat(:,1), feature_mat(:,3), 'bo')
hold on
scatter(feature_mat(:,1), feature_mat(:,3), 12, color_mat, 'filled')
scatter(C(:,1), C(:,2), 48, 'black','filled','square')
title('Iris Data')
xlabel('Sepal Length (cm)');
ylabel('Petal Length (cm)');
```



In the figure, hollow circles represent the original data, color-filled circles represent the clusters, and black-filled squares represent the cluster center.

Saving Output

We store the output data in the `output` folder.

```
writematrix(C, "output/cluster_centers.csv")
writematrix(idx, "output/cluster_index.csv")
```

Done!

Computing Environment

```
ver
```

```
-----------------------------------------------------------------------------------------------------
MATLAB Version: 9.12.0.1956245 (R2022a) Update 2
MATLAB License Number: 596681
Operating System: macOS  Version: 11.2 Build: 20D64
Java Version: Java 1.8.0_202-b08 with Oracle Corporation Java HotSpot(TM) 64-Bit Server VM mixed mode
-----------------------------------------------------------------------------------------------------
MATLAB                                                Version 9.12        (R2022a)
Statistics and Machine Learning Toolbox               Version 12.3        (R2022a)
```