Load the five sample data sets, and select a data set to cluster. These data sets have different numbers of clusters and data distributions.

load fcmdata3

dataset = fcmdata3;

Specify FCM Settings

Configure the clustering algorithm settings. For more information on these settings, see fcm. To obtain accurate clustering results for each data set, try different clustering options.

Specify the number of clusters to compute, which must be greater than 1.

N = 4;

Specify the exponent the fuzzy partition matrix, which controls the degree of fuzzy overlap between clusters. This value must be greater than 1, with smaller values creating more crisp cluster boundaries. For more information, see Adjust Fuzzy Overlap in Fuzzy C-Means Clustering.

exponent = 2;

Specify the maximum number of optimization iterations.

maxIterations = 100;

Specify the minimum improvement in the objective function between successive iterations. When the objective function improves by a value below this threshold, the optimization stops. A smaller value produces more accurate clustering results, but the clustering can take longer to converge.

minImprovement = 0.00001;

Specify whether to display the objective function value after each iteration.

displayObjectiveFunction = false;

Create an option vector for the fcm function using these settings.

options = [exponent maxIterations minImprovement displayObjectiveFunction];

Cluster Data

Cluster the data into N clusters.

[C,U] = fcm(dataset,N,options);

C contains the computed centers for each cluster. U contains the computed fuzzy partition matrix, which indicates the degree of membership of each data point within each cluster.

Classify each data point into the cluster for which it has the highest degree of membership.

maxU = max(U);

index = cell(N,1);

for i=1:N

index{i} = find(U(i,:) == maxU);

end

Plot Clustering Results

Plot the clustering results.

figure

hold on

for i=1:N

plot(dataset(index{i},1),dataset(index{i},2),'o')

plot(C(i,1),C(i,2),'xk','MarkerSize',15,'LineWidth',3)

end

hold off

The data points in each cluster are shown in a different colors. The center for each cluster is shown as a black X.

Plot Data Point Membership Values

Select a cluster for which to plot a membership function surface.

cluster = 2;

Obtain the membership function for the selected cluster by fitting a surface to the cluster membership values for all data points. For more information on interpolating scattered 3-D data, see griddata.

[X,Y] = meshgrid(0:0.05:1, 0:0.05:1);

Z = griddata(dataset(:,1),dataset(:,2),U(cluster,:),X,Y);

surf(X,Y,Z)

When you decrease the exponent value, the transition from maximum full cluster membership to zero cluster membership becomes more steep; that is, the cluster boundary becomes more crisp.

code

load fcmdata

dataset = fcmdata3;

N = 4;

exponent = 2;

maxIterations = 100;

minImprovement = 0.00001;

displayObjectiveFunction = false

options = [exponent maxIterations minImprovement displayObjectiveFunction];

[C,U] = fcm(dataset,N,options);

maxU = max(U);

index = cell(N,1);

for i=1:N

index{i} = find(U(i,:) == maxU);

end

figure

hold on

for i=1:N

plot(dataset(index{i},1),dataset(index{i},2),'o')

plot(C(i,1),C(i,2),'xk','MarkerSize',15,'LineWidth',3)

end

hold on

cluster = 2;

[X,Y] = meshgrid(0:0.05:1, 0:0.05:1);

Z = griddata(dataset(:,1),dataset(:,2),U(cluster,:),X,Y);

surf(X,Y,Z)

figure

hold on

for i=1:N

plot(dataset(index{i},1),dataset(index{i},2),'o')

plot(C(i,1),C(i,2),'xk','MarkerSize',15,'LineWidth',3)

end

hold on