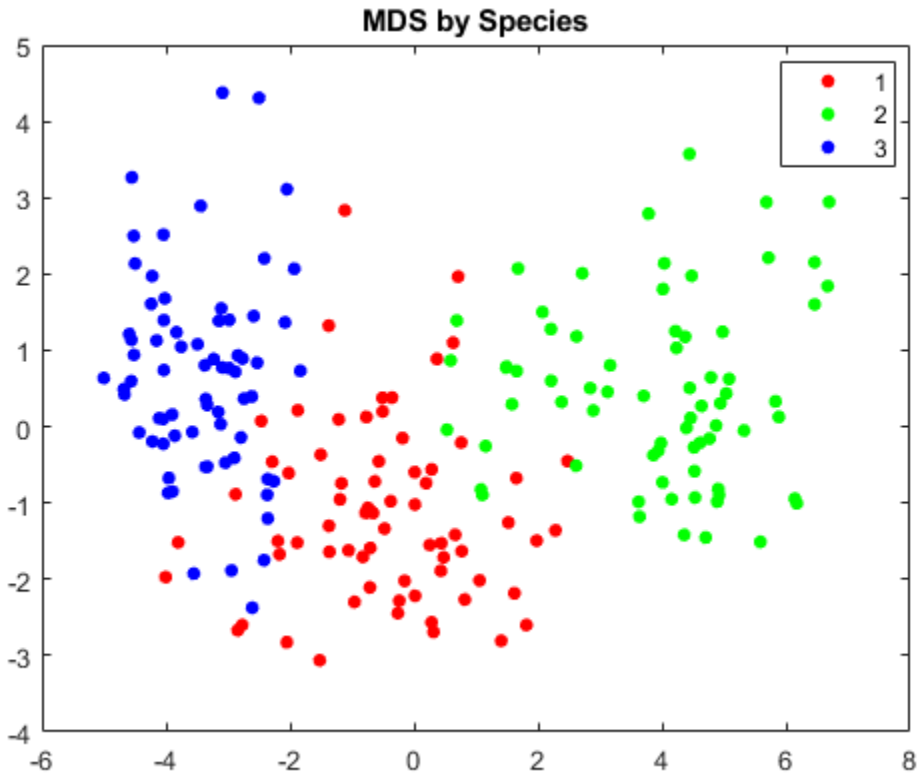
```
%Name: David George
%Student ID: 251004930

%Part A)
    T = readtable("seeds.csv");

    D = table2array(rmmissing(T(:,[1:7])));
    D = squareform(pdist(D));

    %Classical MDS
    MDS  = cmdscale(D, 2);
    gscatter(MDS(:,1), MDS(:,2),T.species);
    title("MDS by Species");
```




```
%Part B)

  methods = [ "complete" "centroid" ];

  %Performing complete and centroid clustering using a for loop
   figure
       for idx = 1:2
           rng(1234);
           subplot(2,2, idx);
           m = methods(idx);
           L = linkage(MDS,m);
```

```
            C = cluster(L,'Maxclust',3);

            C = num2str(C);

           %Plotting the clustering, using the grouping found by the
           %spefifc clustering method

            gscatter(MDS(:,1), MDS(:,2),C)
           title(methods(idx),'FontSize',12);

         GroupClassificaition = table2array(T);
         GroupClassificaition = GroupClassificaition( :, 8);
         GroupClassificaition = num2str(GroupClassificaition);

        for idx = 1:length(T.species)

            %labelling all the points of the specifc clustering with
the
            %actual group from the data set
            text(MDS(idx,1),MDS(idx, 2),  GroupClassificaition(idx));
        end


        end


        %K means clustering
        rng(1234);
        [idxCluster, centroids] = kmeans(MDS,3);

        % Color the data points wih their respective cluster:
        subplot(2,2, 3);

        idxCluster = num2str(idxCluster)

        gscatter(MDS(:,1), MDS(:,2),idxCluster)
        title("k-means Clustering",'FontSize',12)

        for idx = 1:length(idxCluster)
            %labelling all the points of the specifc clustering with
the
            %actual group from the data set
            text(MDS(idx,1),MDS(idx, 2), GroupClassificaition(idx));

         end

        rng(1234);
        spclust = spectralcluster(MDS,3);

        subplot(2,2, 4);
         spclust  = num2str(spclust);
         gscatter(MDS(:,1), MDS(:,2),spclust);
        title("Spectral Clustering",'FontSize',12)
```

```
        for idx = 1:length(idxCluster)
            %labelling all the points of the specifc clustering with
 the
            %actual group from the data set
            text(MDS(idx,1),MDS(idx, 2), GroupClassificaition(idx));
        end
```

```
Warning: Non-monotonic cluster tree -- the centroid linkage is
 probably not
appropriate.

idxCluster =

  210×1 char array

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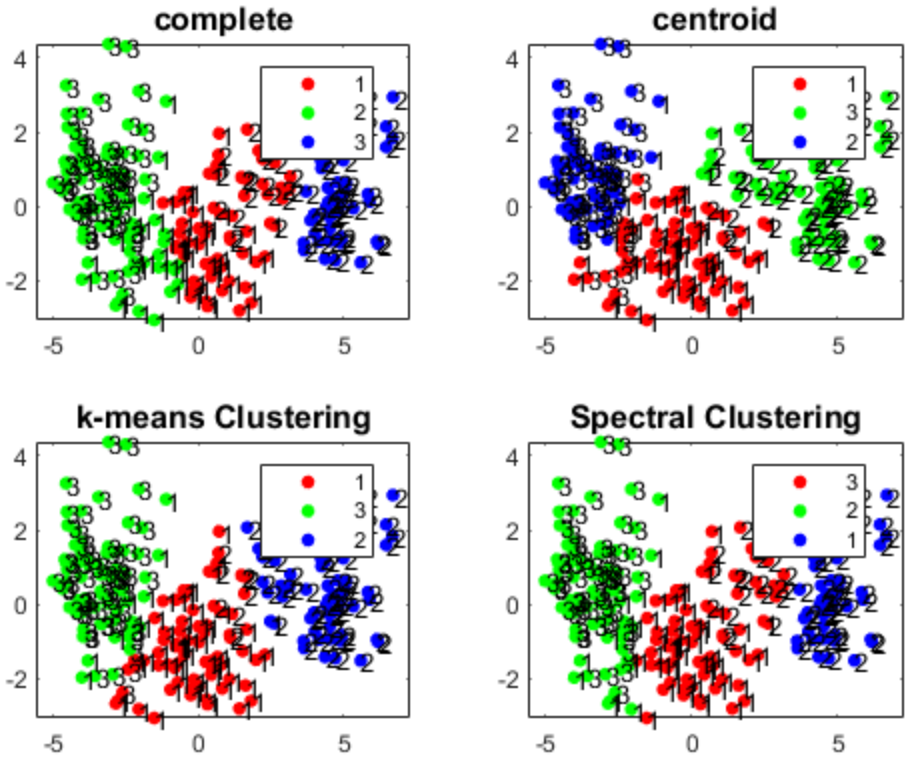



```
  %Part C

        %Conduct each clustering method, use the cluster grouping
array
        % Compare it to the original data's results to determine
results.

        %Isolating the eigth column of the data
        GroupClassificaition = table2array(T);
        GroupClassificaition = GroupClassificaition( :, 8);
        rng(1234);

        %Performing specteral and kmeans clustering once more
        spclust = spectralcluster(MDS,3);
```

```
        rng(1234);
        [idxCluster, centroids] = kmeans(MDS,3);

        methods = [ "complete" "centroid" ];
        L = linkage(MDS,methods(1));
        rng(1234);
        C = cluster(L,'Maxclust',3);

        % Compare it to the original data's results to determine
rates.
        [CompleteTPR, CompleteFPR] =
calculateRate(GroupClassificaition, C, "co");

        L = linkage(MDS,methods(2));
        C = cluster(L,'Maxclust',3);
        rng(1234);
        % Compare it to the original data's results to determine
rates.
        [CentroidTPR, CentroidFPR] =
calculateRate(GroupClassificaition, C, "ce");
        % Compare it to the original data's results to determine
rates.
        [KmeansTPR, KmeansFPR] = calculateRate(GroupClassificaition,
idxCluster, "k");
        % Compare it to the original data's results to determine
rates.
        [specterTPR, specterFPR] =
calculateRate(GroupClassificaition,spclust, "s");

        %Plotting the data
        TPR = [CompleteTPR, CentroidTPR, KmeansTPR, specterTPR];
        FPR = [CompleteFPR, CentroidFPR, KmeansFPR, specterFPR];
        figure
        methods = [ "complete" ,"centroid", "Kmeans", "Specteral" ];

        scatter(FPR, TPR);
        text(FPR(1), TPR(1),"complete");

        text(FPR(2), TPR(2),"centroid");
        text(FPR(3), TPR(3),"Kmeans");
        text(FPR(4), TPR(4),"Specteral")

        xlabel("FPR");
        ylabel("TPR");

    %Based on the criteria of having a TPR of at least 95%, and
minnimzing
    %the FPR, the best method is therefore K means clustering as it
meets
    %the criteria of at least 0.95 TPR and its FPR is the smallest
amongst all
    %the possible options

  function [TPR, FPR] = calculateRate(T, C, type)
```

```
%Basic idea of this funciton is as follows
%compare specfic clustering method results, to the actual data
% results. INcrement tp, fn, fp, and tn accordingly
%Use these results to calcualte TPR and FPR

tp = 0;
fn = 0;
fp = 0;
tn = 0;

if type == "co"
   num =2;
end

if type == "ce"
   num =2;
end

if type == "k"
   num =3;
end
if type == "s"
   num =2;
end


for idx = 1:length(T)

    if C(idx) == num & T(idx) == 3

        tp = tp +1;

    end

    if C(idx) ~= num & T(idx) == 3

        fn = fn +1;

    end

     if C(idx) == num & T(idx) ~= 3

        fp = fp +1;
     end

       if C(idx) ~= num & T(idx) ~= 3

       tn = tn +1;

    end
end
```

```
        %This if statments are used to ensure NaN is not returned if
 the
        %numerator is 0.

        if tp == 0 & fp~=0
            TPR =0;
            FPR = fp / (fp + tn);
            return;
        end

        if fp == 0 & tp~=0
           FPR =0;
           TPR = tp /(tp +fn);
           return;
        end

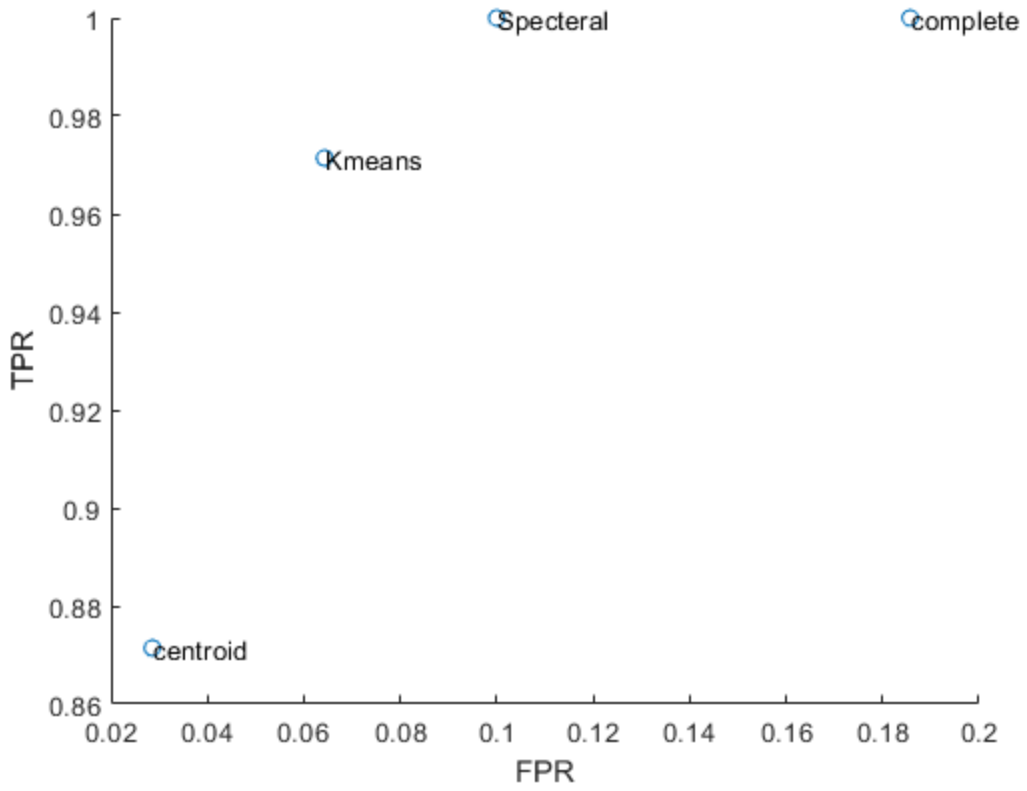

        if fp ~= 0 & tp~=0
          FPR =fp / (fp + tn);
          TPR = tp /(tp +fn);
          return;
        end


        if fp == 0 & tp ==0
          FPR = 0;
          TPR = 0;
          return;
        end



    end
```

```
Warning: Non-monotonic cluster tree -- the centroid linkage is
 probably not
appropriate.
```



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