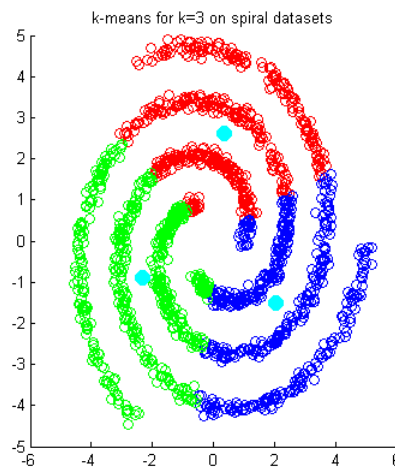
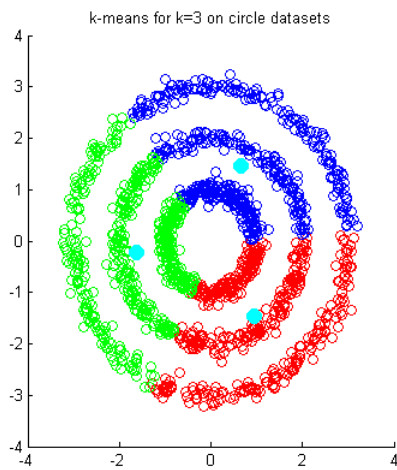
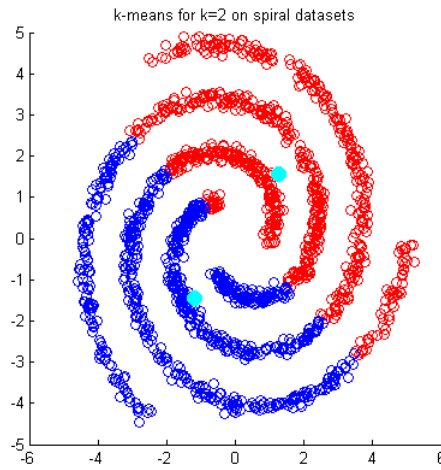
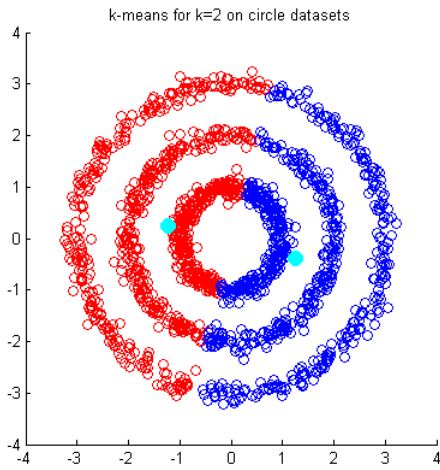

Matlab 4

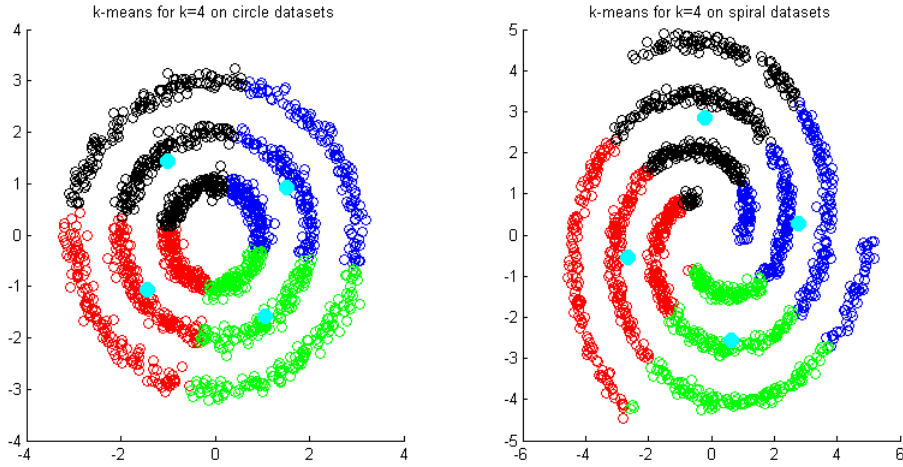
Mikhail Andreev

December 1, 2015

1 K-MEANS VS. SPECTRAL CLUSTERING

The k-means approach to the dataset yield the following three graphs for $k=2,3,4$ respectively:

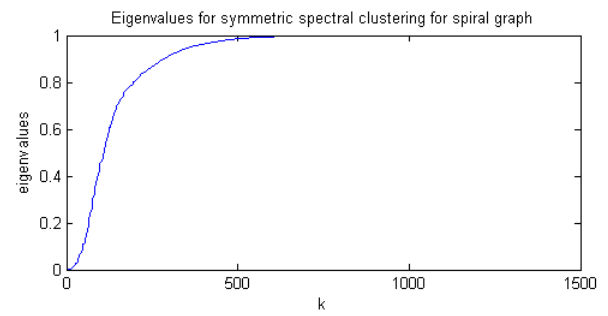
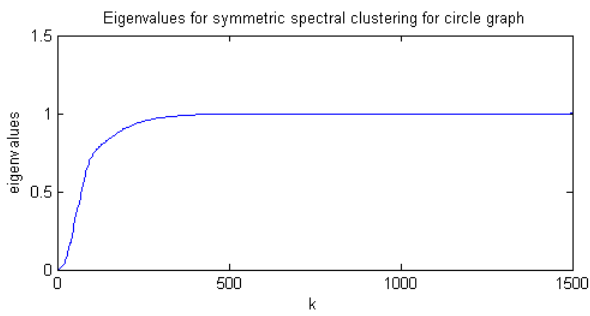
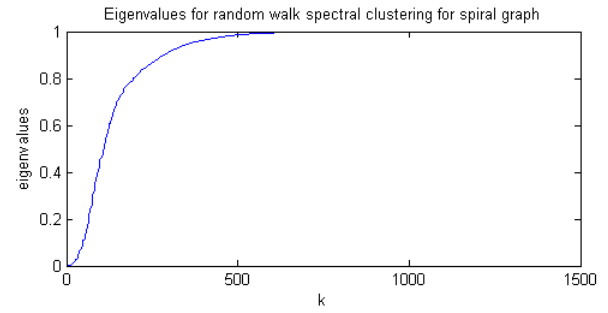
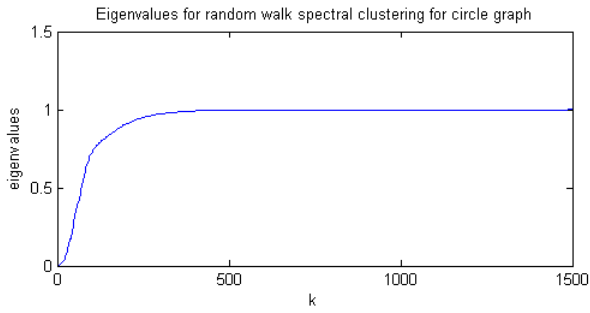
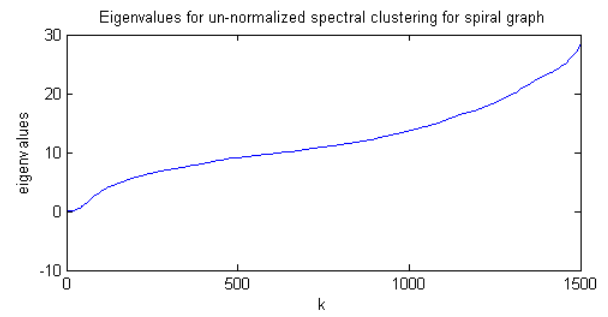
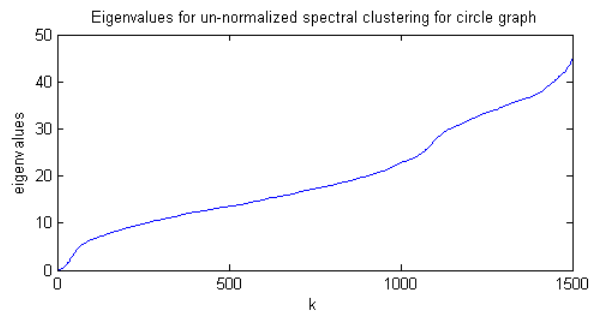




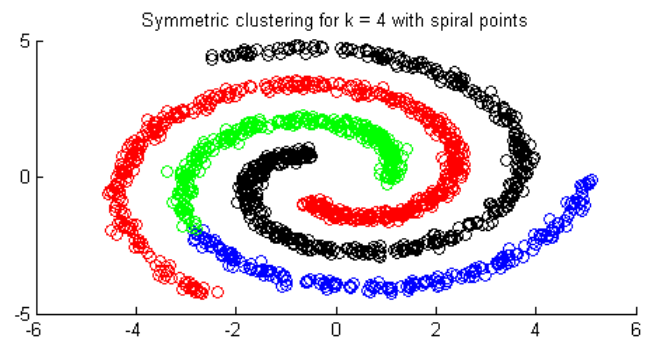
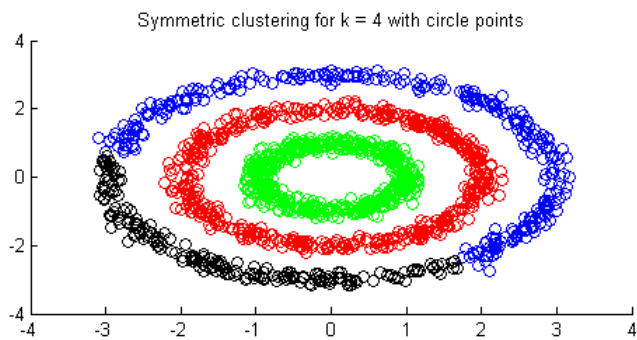
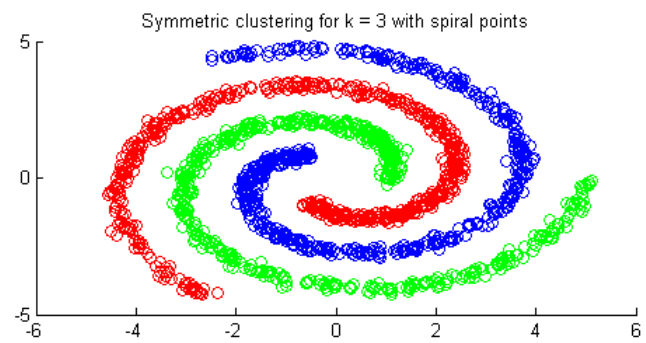
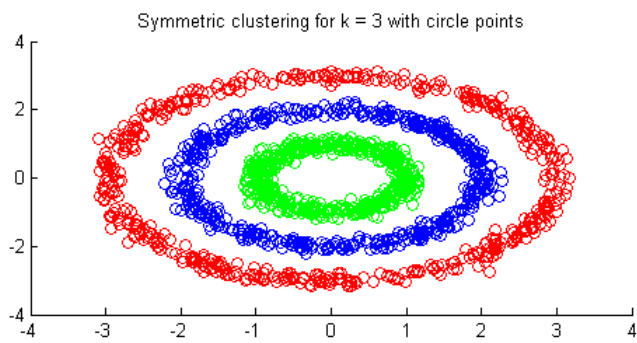
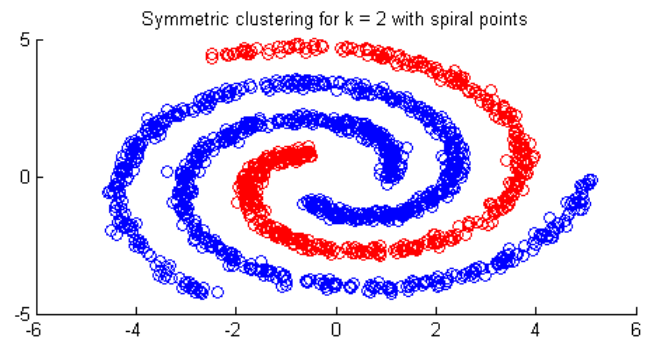
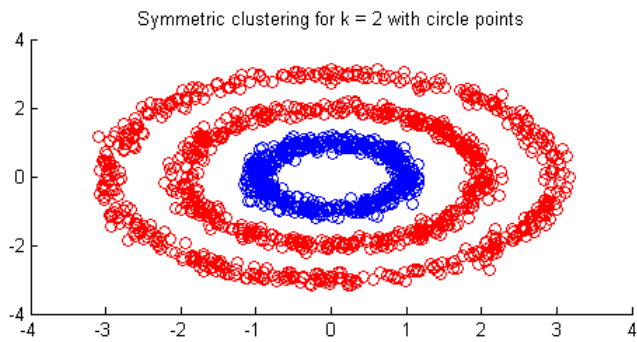
The cyan points in graphs indicate the centroids for each of the clusters. The overall sums of l2 distances between each point and the centroid for the clusters are:

cluster 1 (red) - circle: 757.41, spiral: 1098.18
cluster 2 (blue) - circle: 721.62, spiral: 1088.39
cluster 3 (green) - circle: 522.01, spiral: 750.26
cluster 4 (black) - circle: 444.34, spiral: 609.27

The eigenvalues of the Laplacian matrices can be seen here:

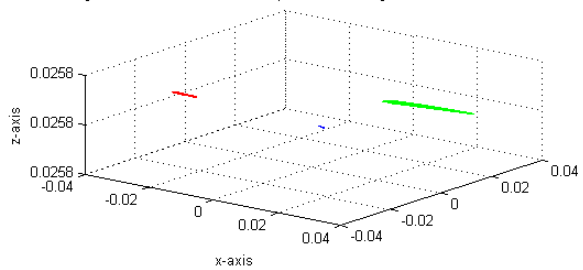


After applying spectral clustering we get the following output using symmetric normalization:

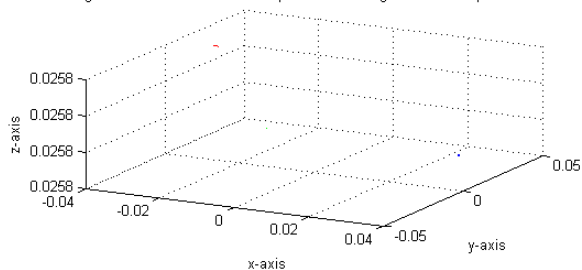


In the next figure we can see the 3D interpretation of the eigenvectors, showing that all three clusters are clearly separate in eigenspace:

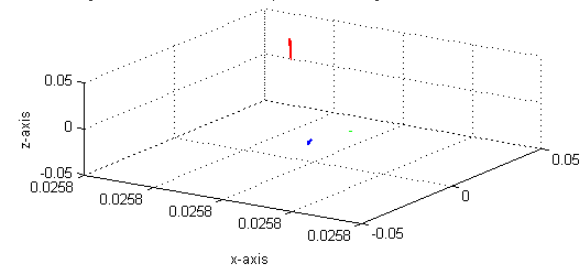
Eigenvectors for un-normalized spectral clustering for $k = 3$ on circle dataset



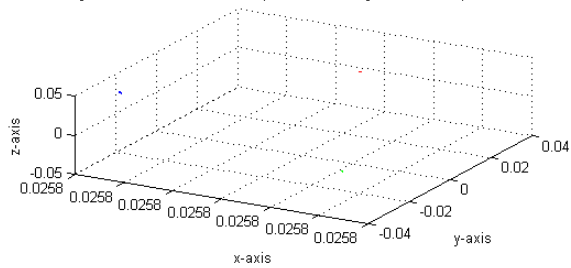
Eigenvectors for un-normalized spectral clustering for $k = 3$ on spiral dataset



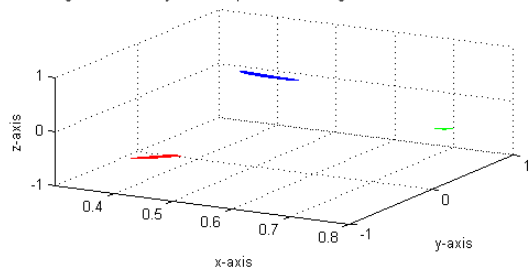
Eigenvectors for random walk spectral clustering for $k = 3$ on circle dataset



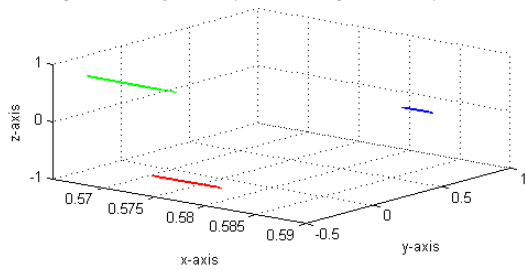
Eigenvectors for random walk spectral clustering for $k = 3$ on spiral dataset



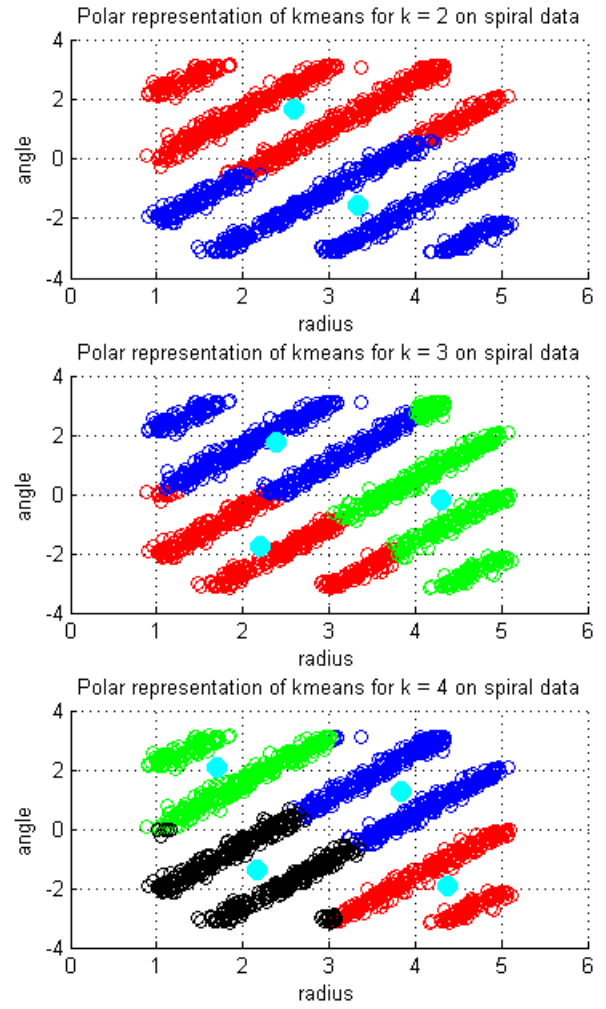
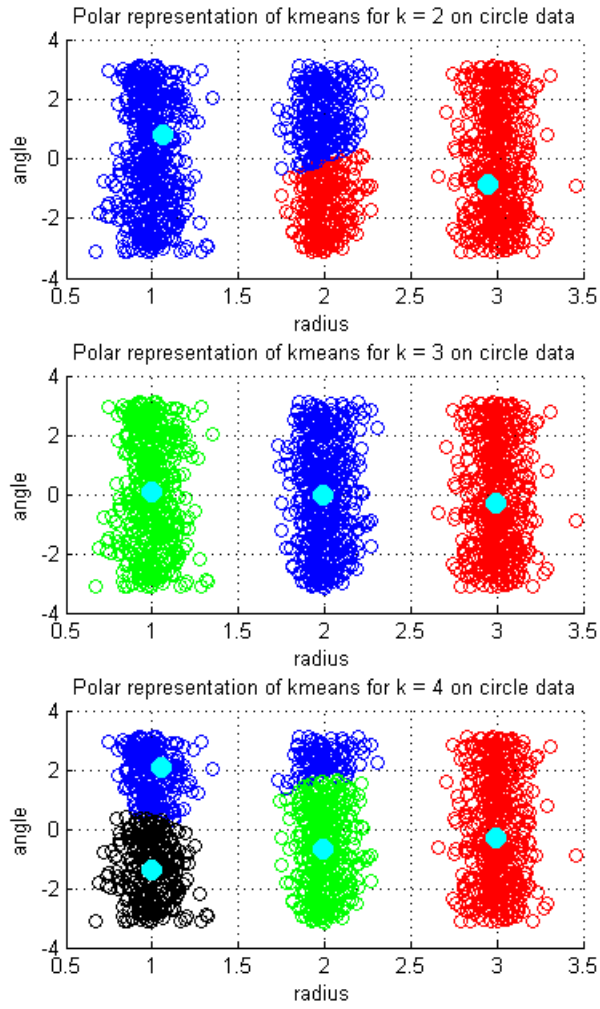
Eigenvectors for symmetric spectral clustering for $k = 3$ on circle dataset



Eigenvectors for symmetric spectral clustering for $k = 3$ on spiral dataset



If we convert the data into polar coordinates, we see it is much easier for kmeans to classify the circle dataset, but still difficult to classify the spiral dataset.

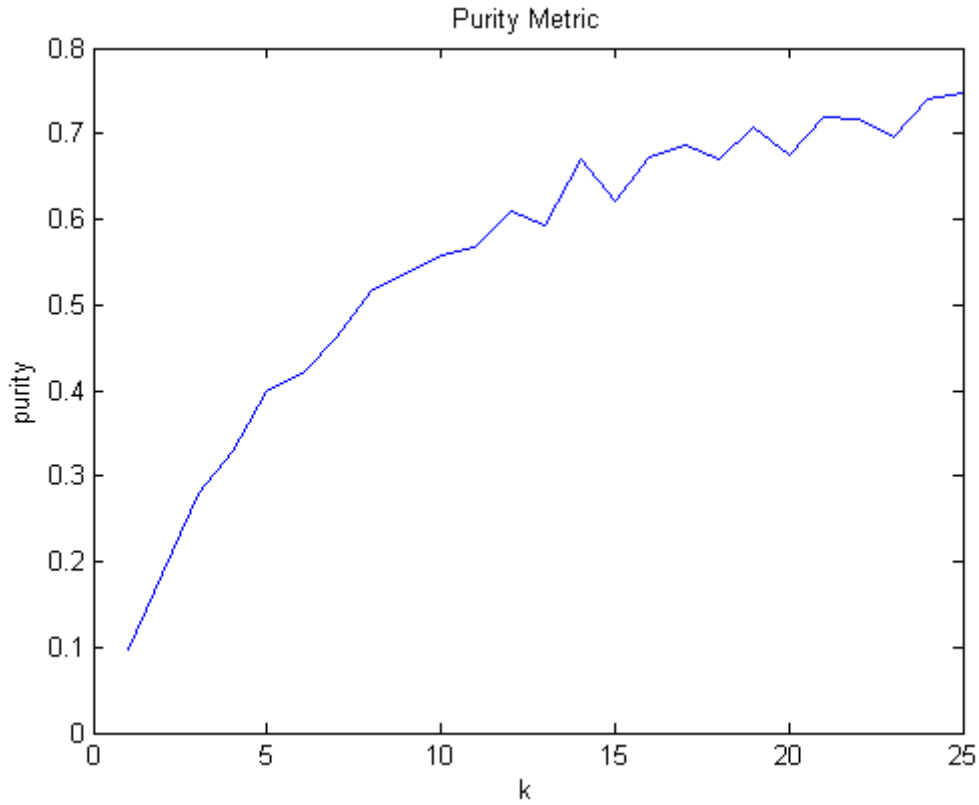


The cyan points in graphs indicate the centroids for each of the clusters. The overall sums of l2 distances between each point and the centroid for the clusters are:

cluster 1 (red) - circle: 904.57, spiral: 621.46
cluster 2 (blue) - circle: 742.63, spiral: 706.96
cluster 3 (green) - circle: 634.15, spiral: 539.10
cluster 4 (black) - circle: 236.26, spiral: 453.95

2 SPECTRAL CLUSTERING ON AIRBNB DATA

The Purity metric graph can be found [here](#). We can see that we start with very low purity rate when the number of predicted classes is much less than the number of actual classes. As the number of predicted classes rises, so does the purity rate, indicating the clusters are becoming closer to reality.



For $k = 5$ we can plot the clusters found onto the Google map:

