**ENGR421 HW8 report**

I first generated the distance matrix between points of datapoints using the spicy.spatial.distance\_matrix function then using a threshold of 1.25 I constructed the B matrix with where the matrix entry denotes 1 if the two points in the dataset have distance below the threshold and they aren’t the same point, and 0 if they have distance above it.

Using this B matrix, I plotted the connectivity matrix between points that have a connection.

Then I constructed the D matrix by summing the row values of the B matrix, indicating the connectivity of each datapoint. Then these sums I multiplied with an identity matrix rows so that these sums are on the diagonal only.

Then, I constructed the L symmetric matrix as obeying the equation as stated in the homework description,

Text

Description automatically generated

*(I used the equation in the red box)*

After this, I used np.linalg.eig function to get the eigenvalues and eigenvectors of the L matrix. Using the sort function of numpy I sorted the eigenvalues array and with nested for loops I searched for the indices that correspond to the smallest 2nd to 6th eigenvalues in the original, unsorted eigenvalues array which have the indices correspondent to the eigenvectors matrix.

To construct the Z matrix, I horizontally stacked the eigenvectors so that each column is for an eigenvector. Before this operation I also took the transpose of the eigenvectors since after extracting each column it gives an array for each vector in dimension (1x300). The transpose makes it a column of size (300x1).

Then I made an array of the rows to be selected from the Z matrix as given in the description then I extracted these rows of Z matrix and assigned as the initial centroids. Then I used the code given in the Lab 11 for the K means algorithm and I gave the Z matrix to update functions instead of the whole dataset as is in the standard K-means algorithm.

Finally I updated the centroids to visualize the mean points of the found clusters and plotted the clusters, and their centroids.