SPECTRAL LUSTERING YALE DATA SET

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Fernando P.D.R

FULLY CONNECT SIMILARITY GRAPH
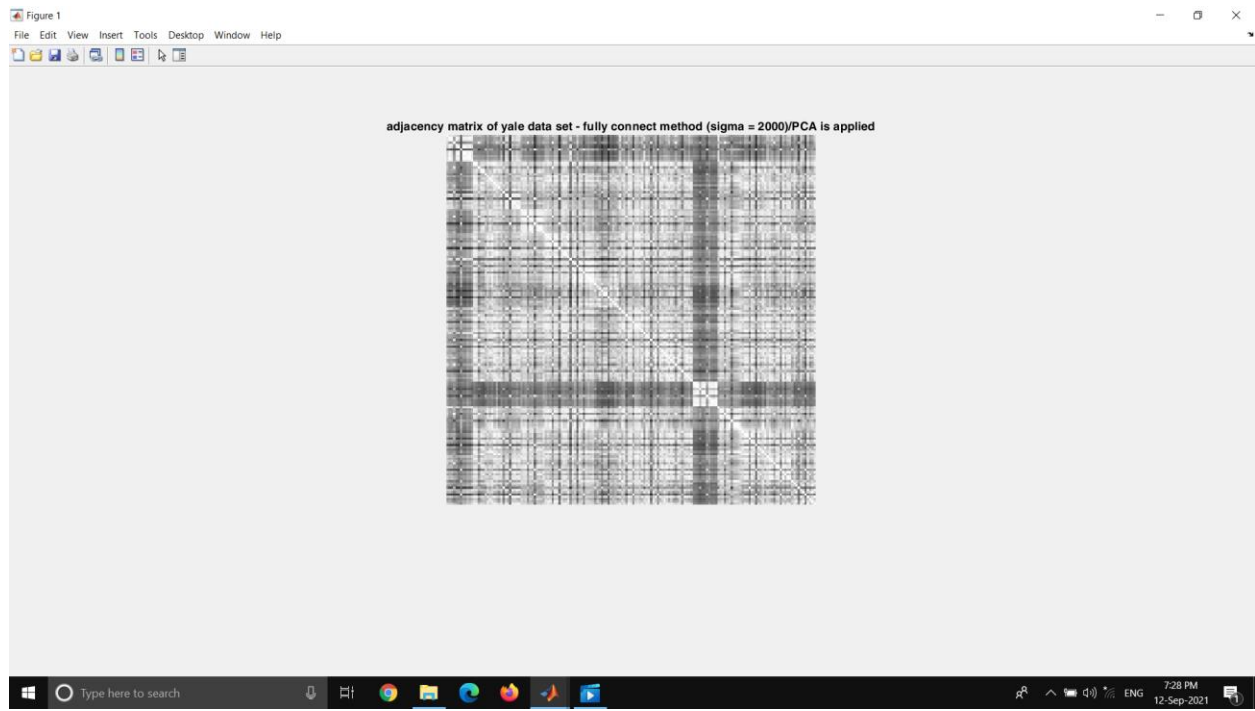
Sigma = 2000;

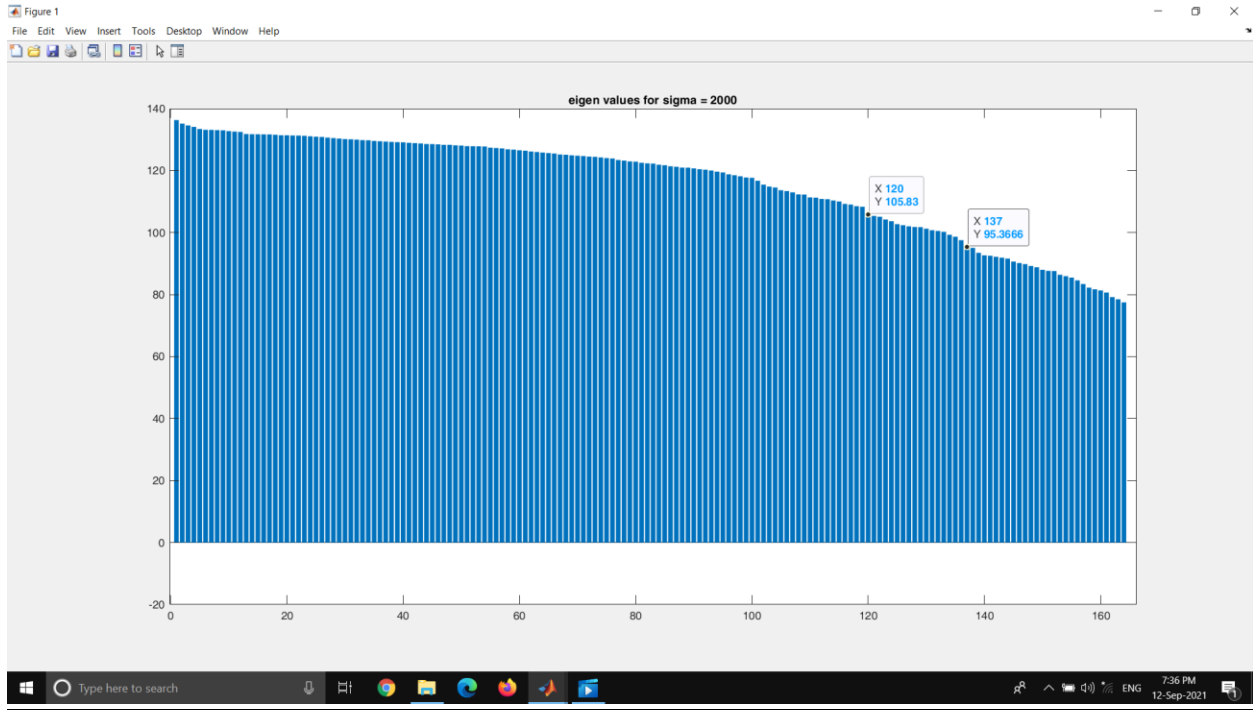Figure 1 : Adjacency matrix when sigma = 2000

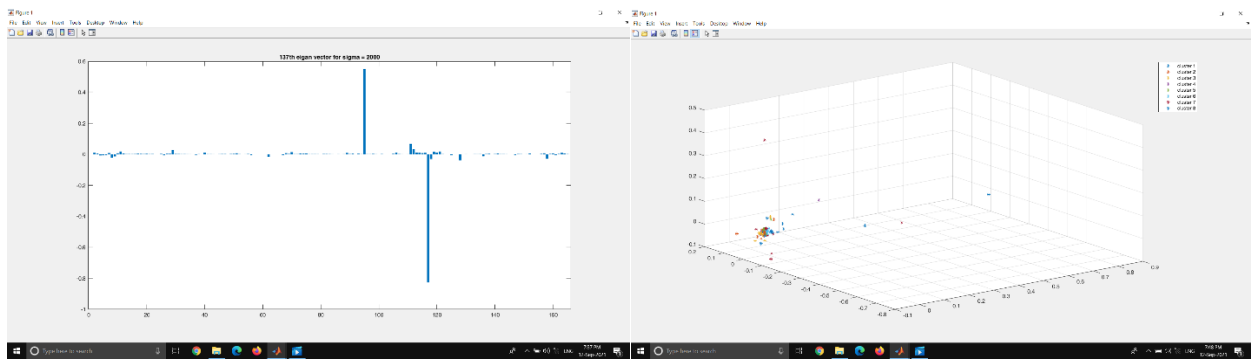Figure 2 : Eigan Values with maximum eigen gaps pointed

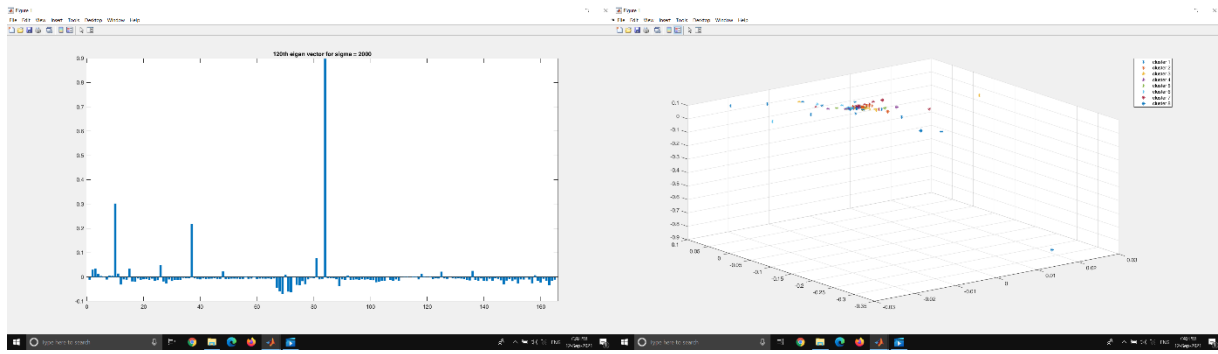Figure 3 : 137 th eigan vector & The clusters Formed

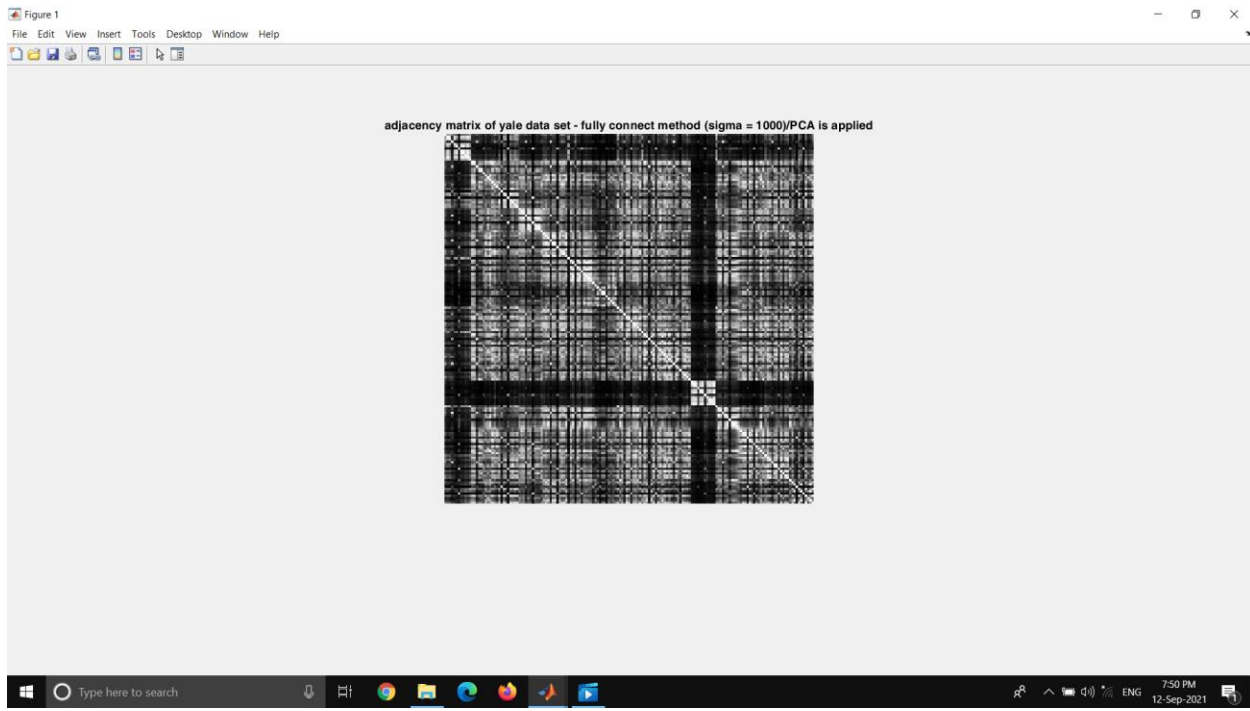Figure 4 : 120 th eigan vector & The clusters Formed

Sigma = 1000

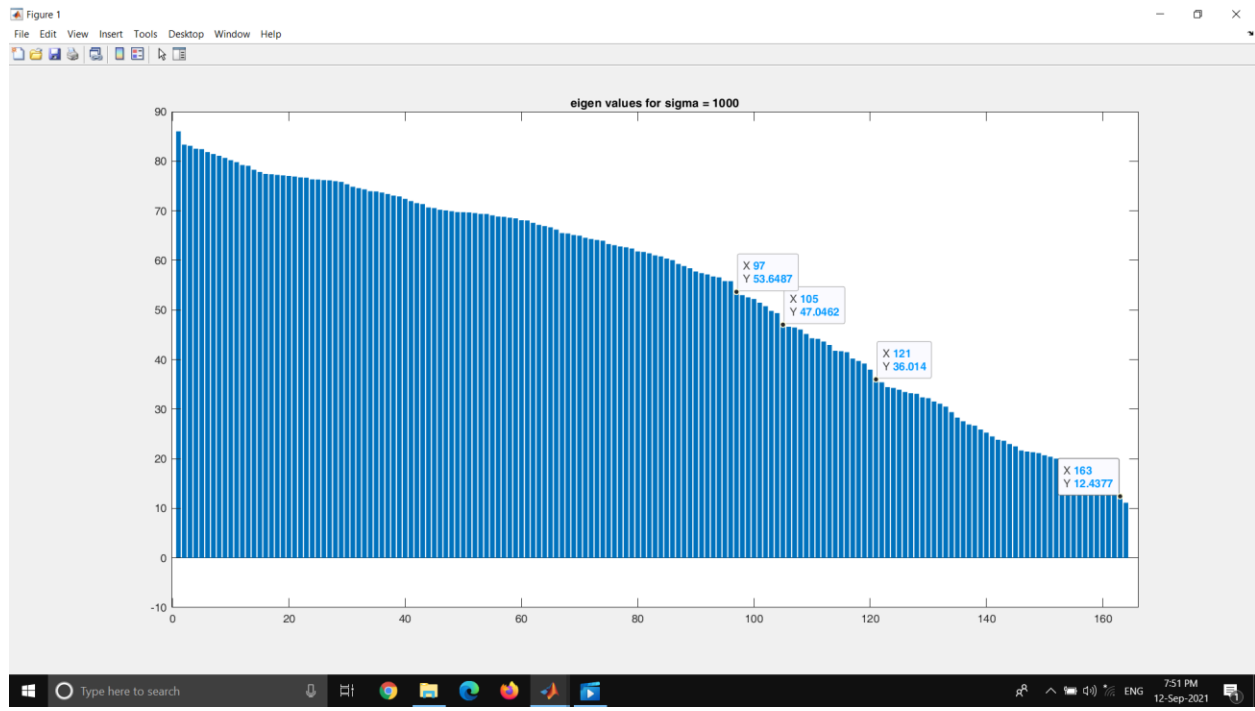Figure 5 : Adjacency matrix when sigma = 1000

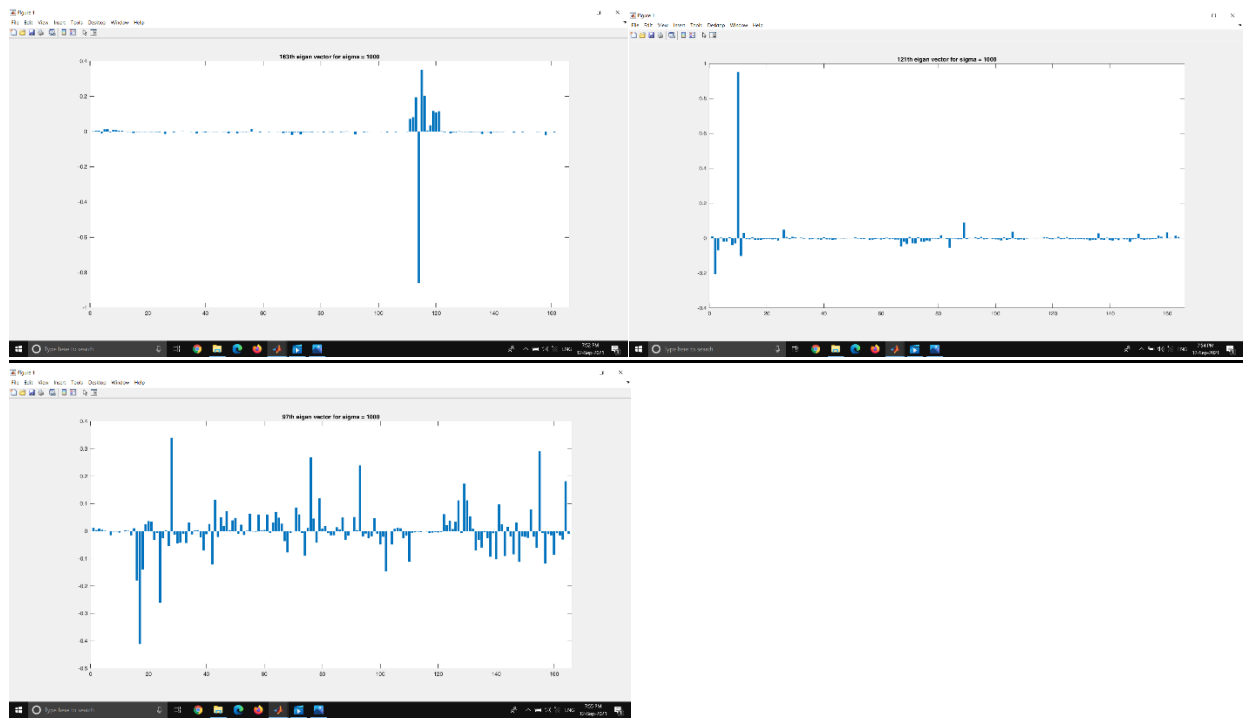Figure 6 : Eigan Values with maximum eigen gaps pointed

Figure 7 : 163,121,97 th eigan vector & The clusters Formed
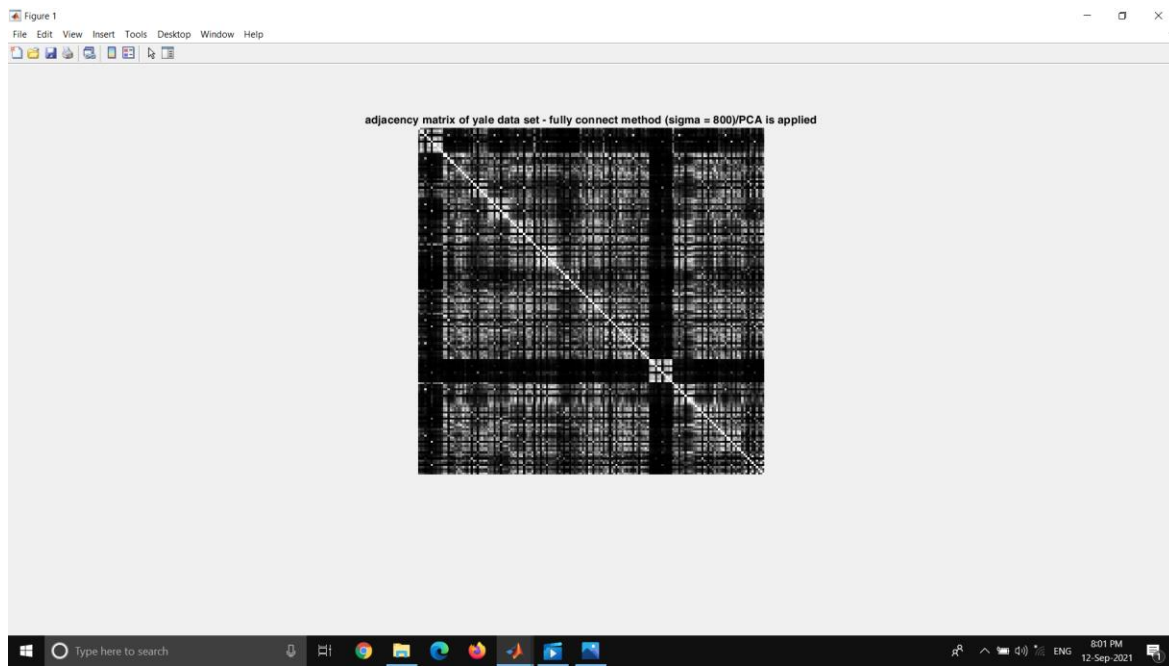
Sigma = 800

Figure 8 : Adjacency matrix when sigma = 800
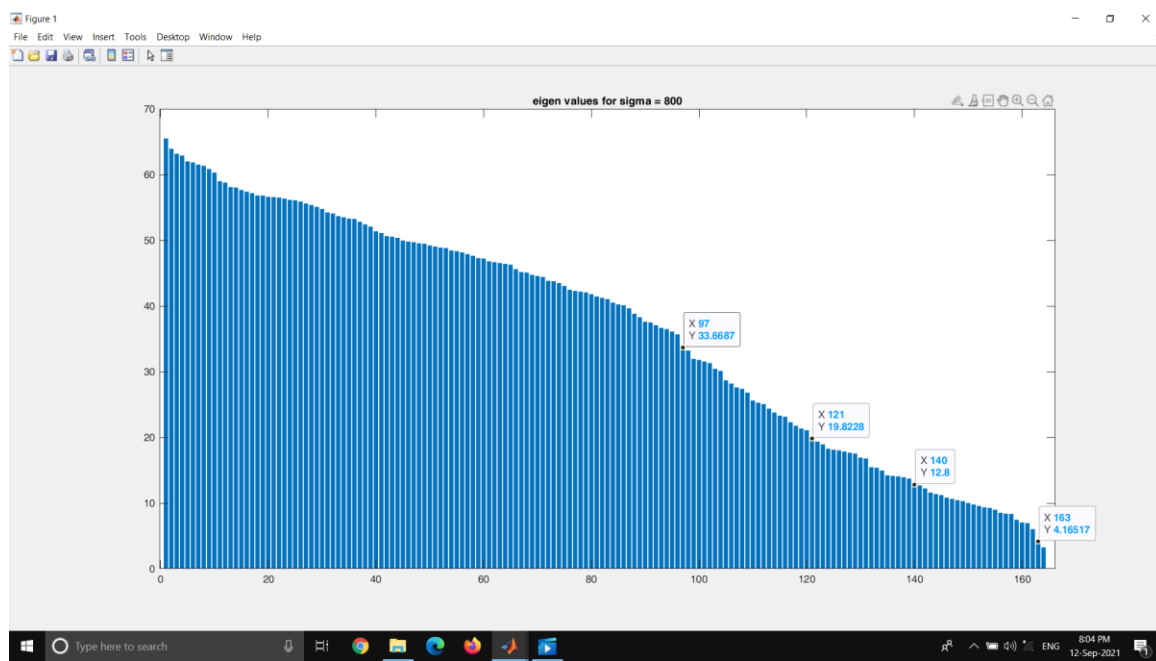

Figure 9 : Eigan Values with maximum eigen gaps pointed

Figure 10 : 163 rd eigan vector & The clusters Formed Sigma = 800

Figure 11 : 158 th eigan vector & The clusters Formed Sigma = 800

Figure 12 : 97 th eigan vector & The clusters Formed Sigma = 800

Sigma = 500
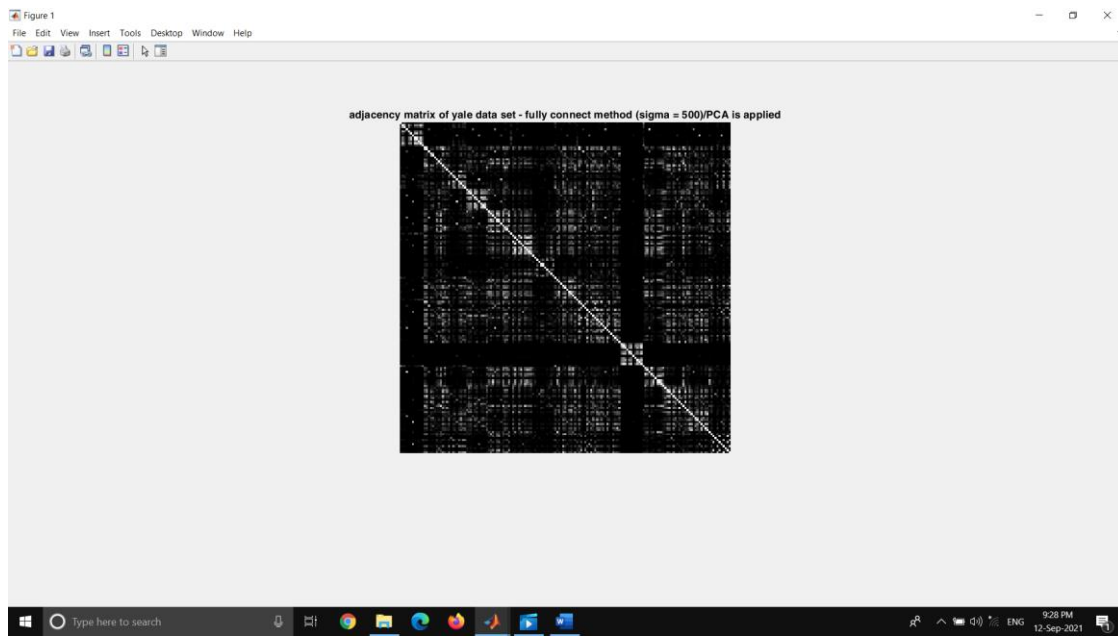
Figure 13 : Adjacency matrix when sigma = 500
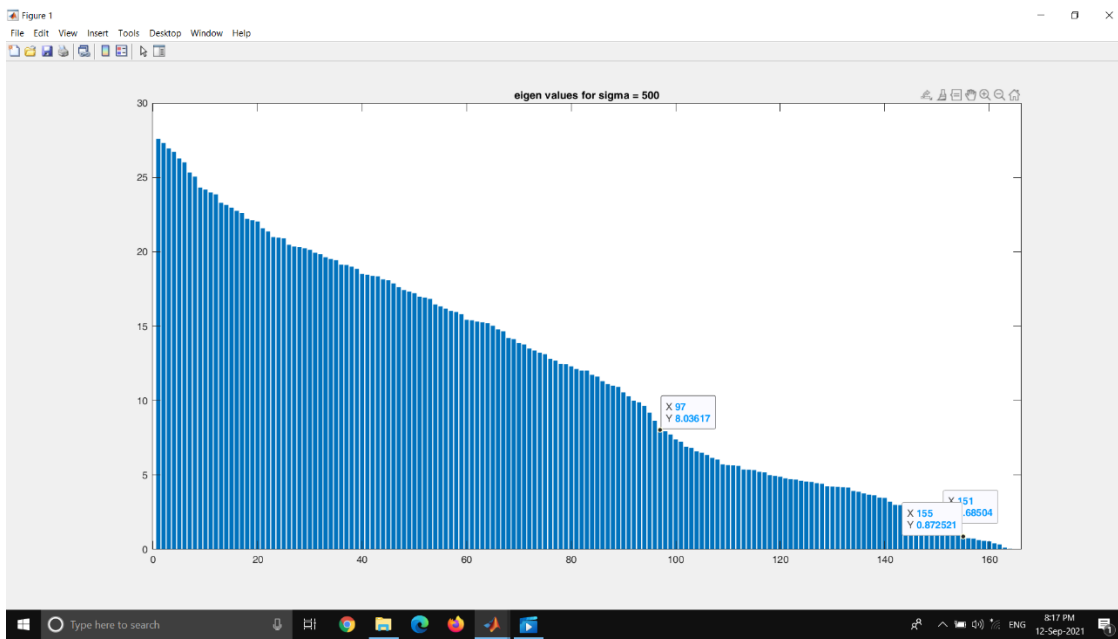
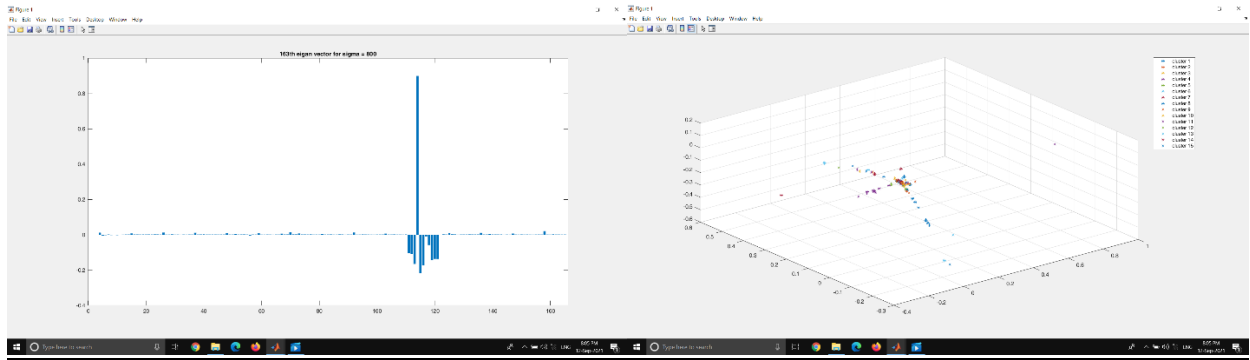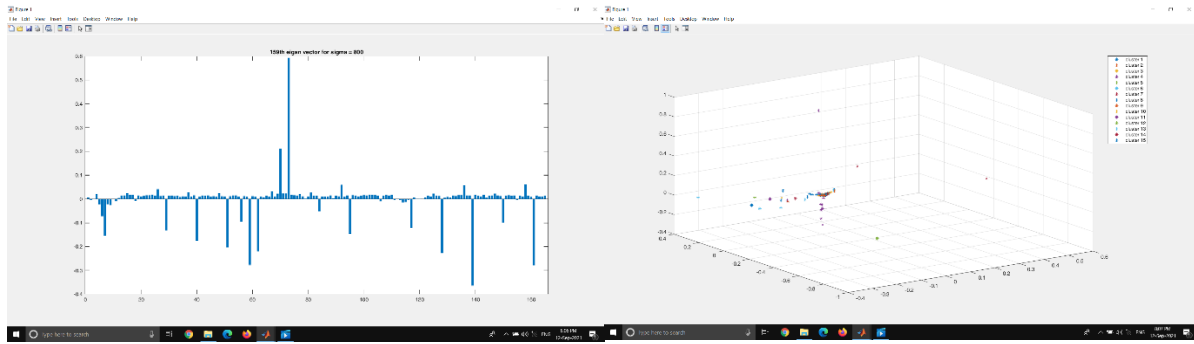Figure 14 : Eigan Values with maximum eigen gaps pointed
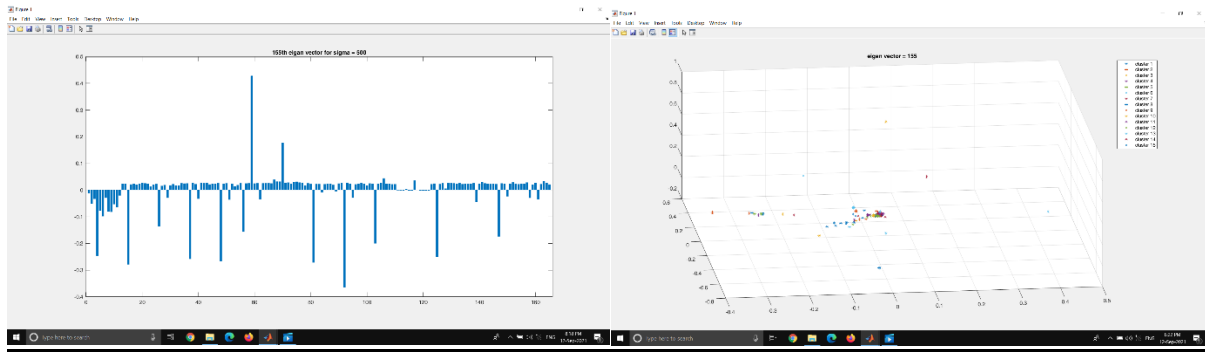
Figure 15 : 155 th eigan vector & The clusters Formed Sigma = 500

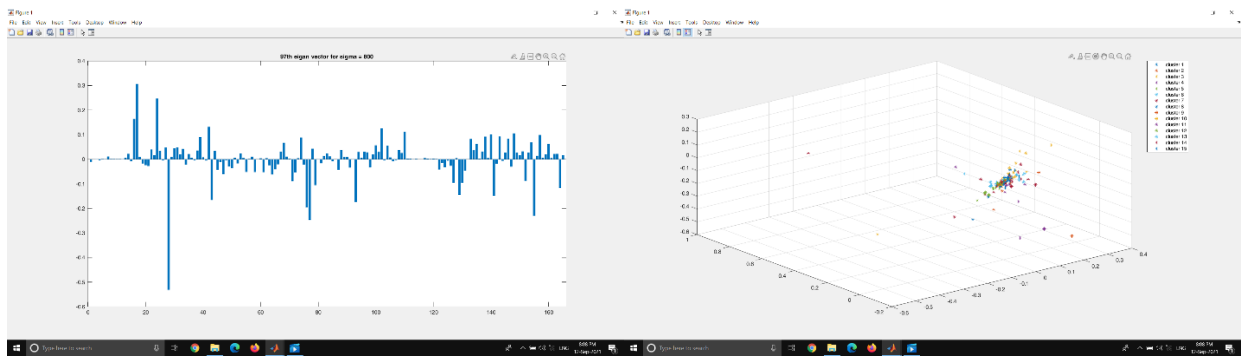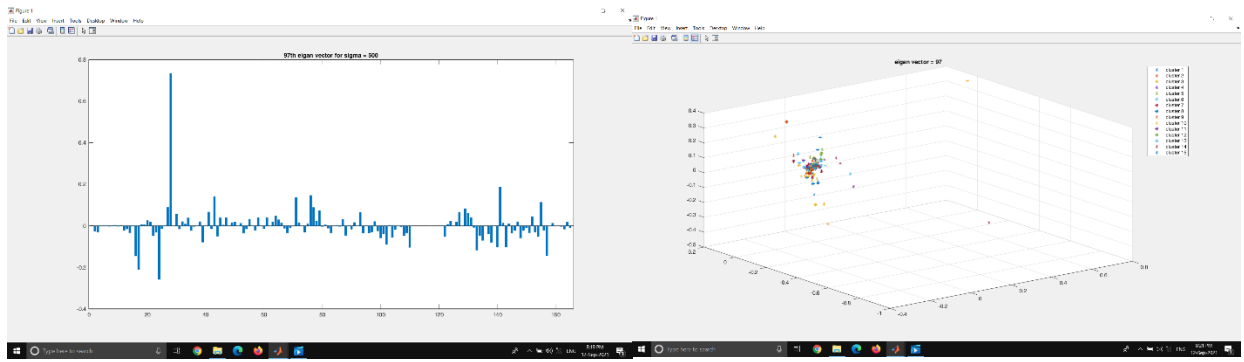Figure 16 : 97 th eigan vector & The clusters Formed Sigma = 500

Sigma = 550
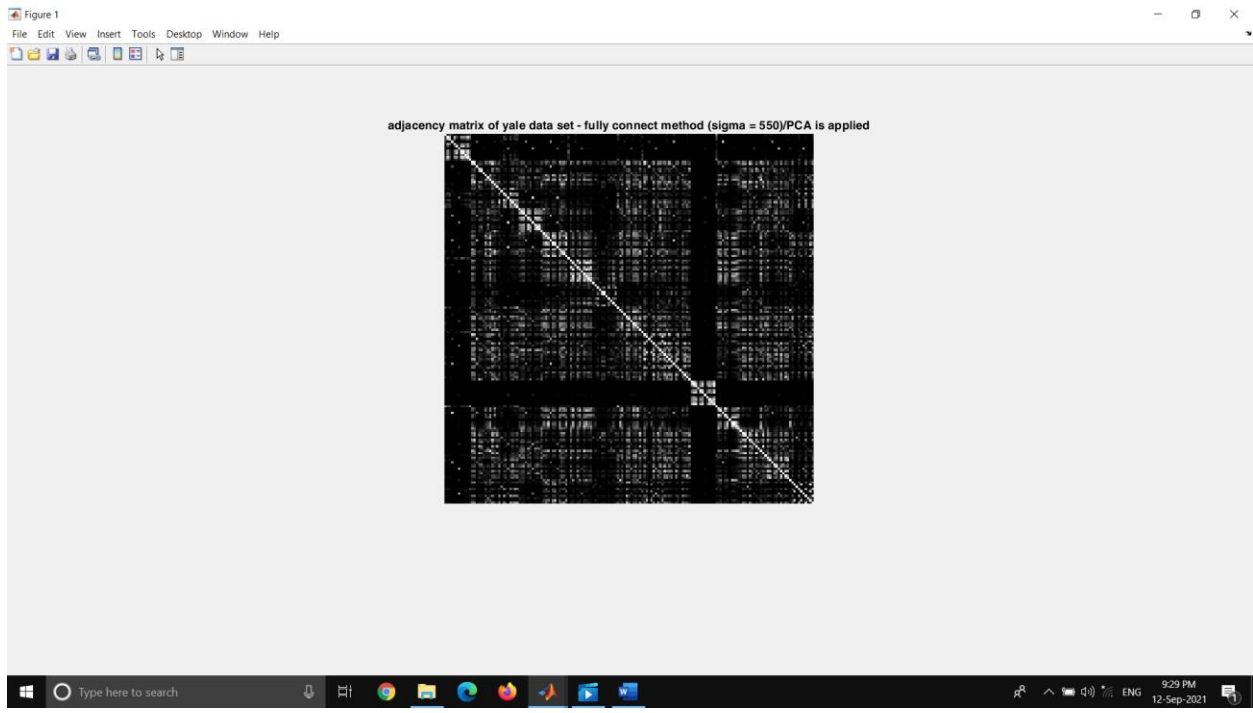
Figure 17 : Adjacency matrix when sigma = 550
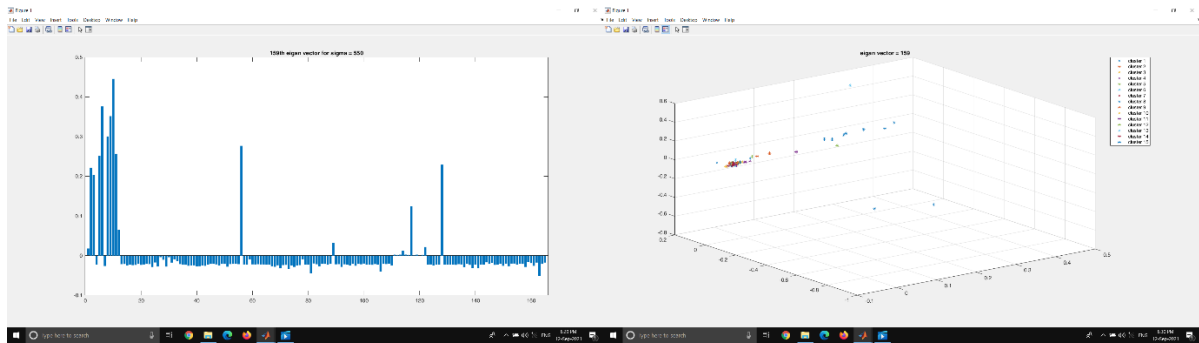
Figure 18 : 159 th eigan vector & The clusters Formed Sigma = 550

E NEIGHBORHOOD SIMILARITY GRAPH
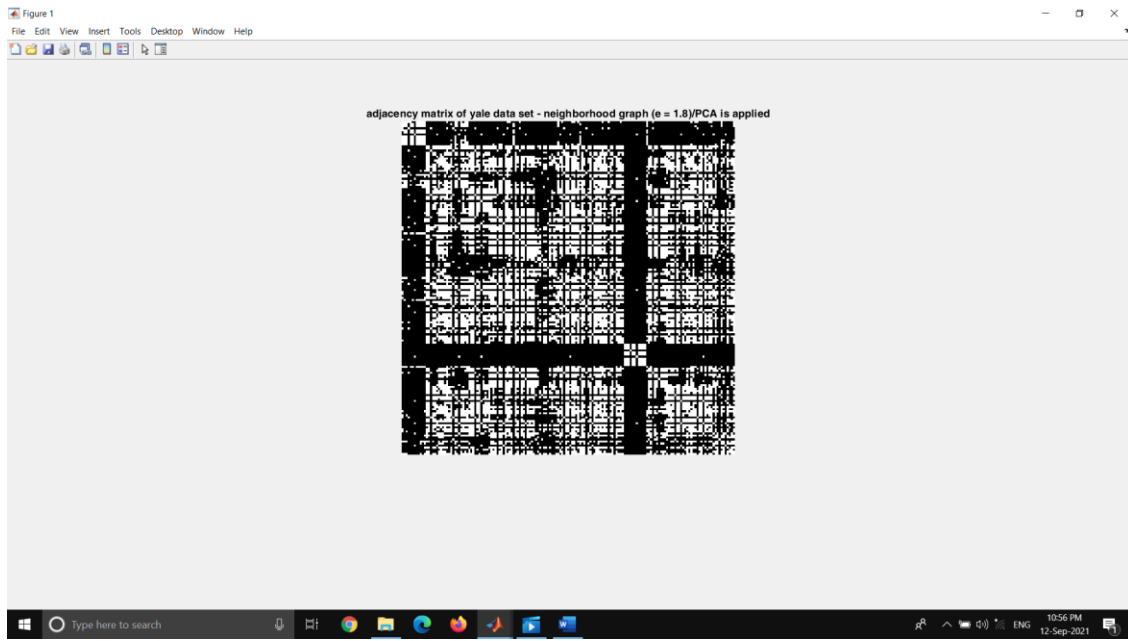
Figure 19 : Adjacency matrix when e = 1.8
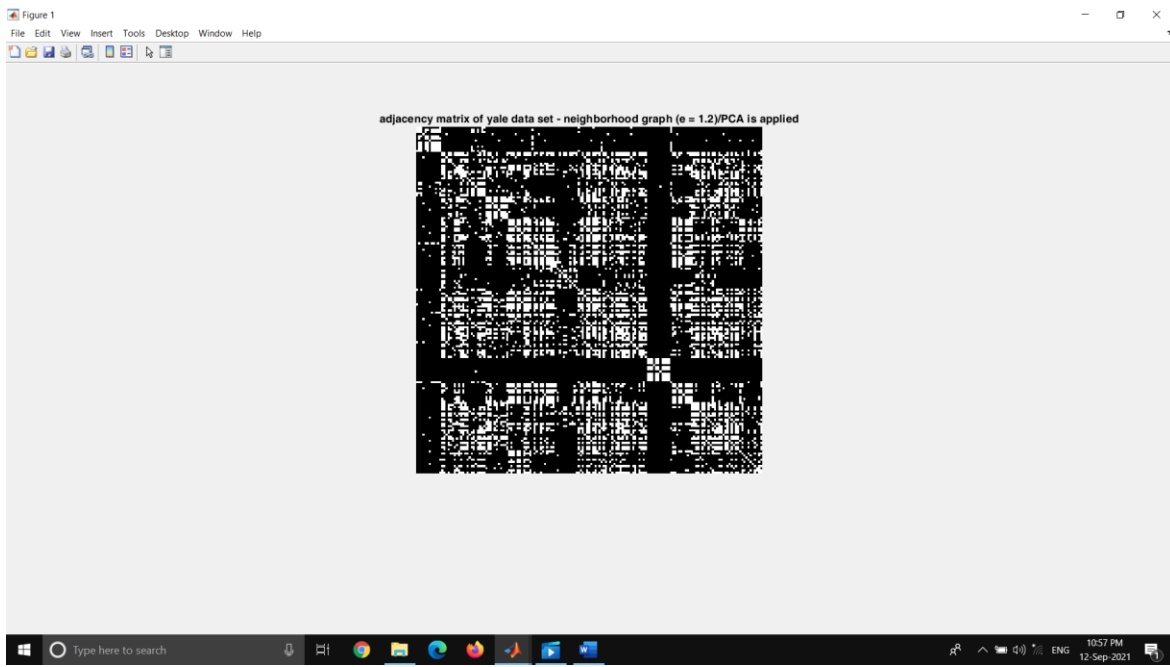
Figure 20 : Adjacency matrix when e = 1.2
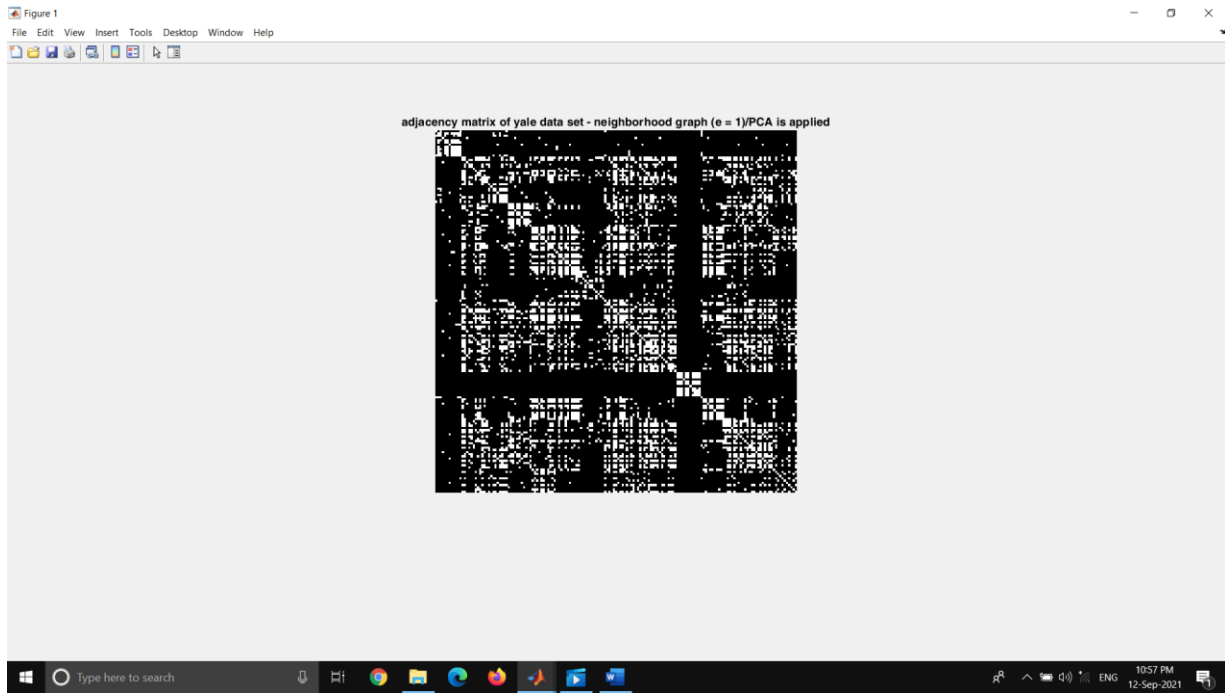
Figure 21 : Adjacency matrix when e = 1
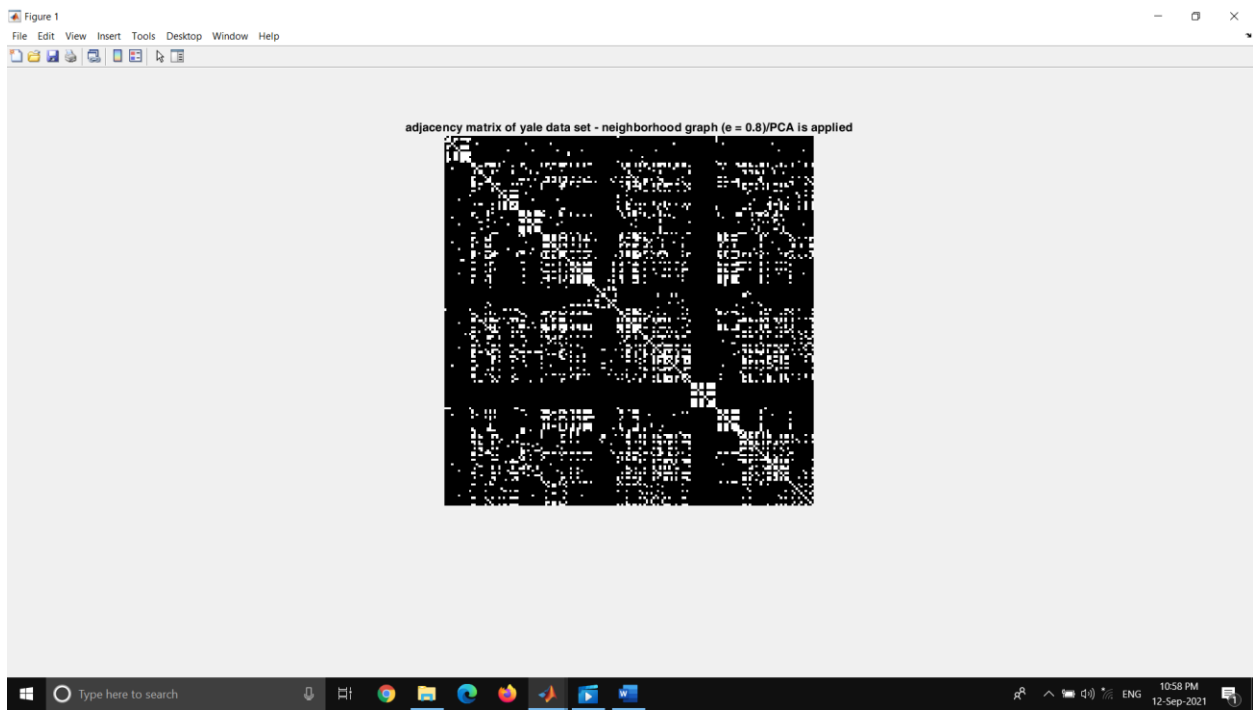
Figure 22 : Adjacency matrix when e = 0.8
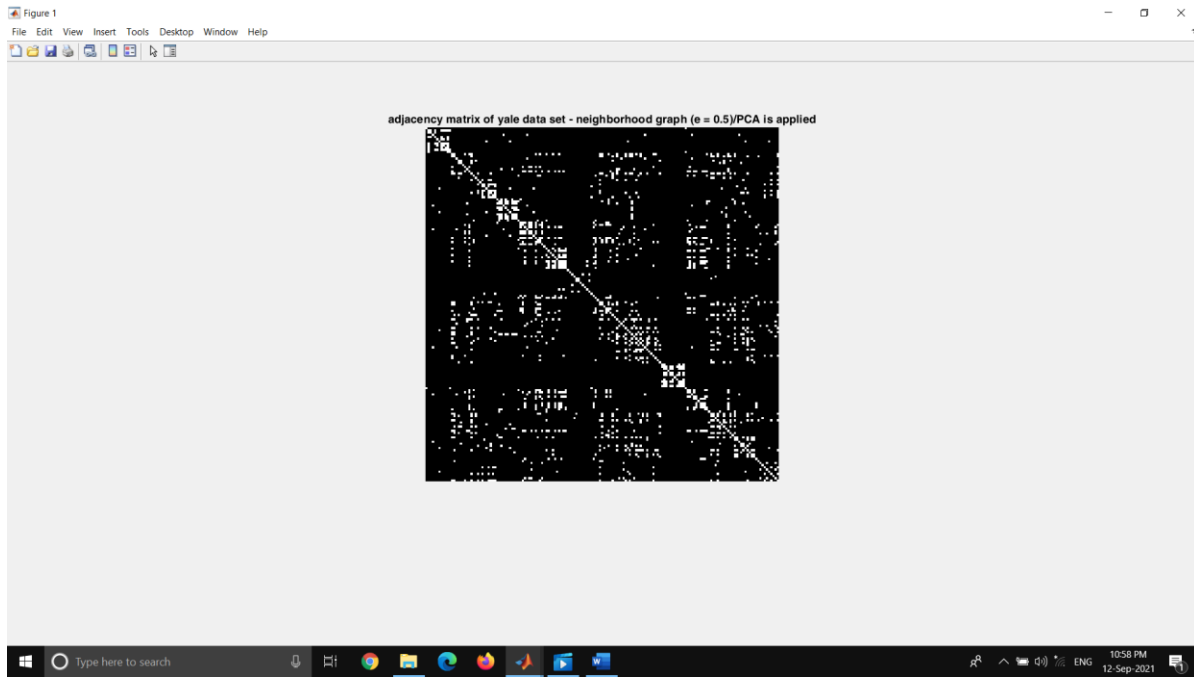
Figure 23 : Adjacency matrix when e = .5
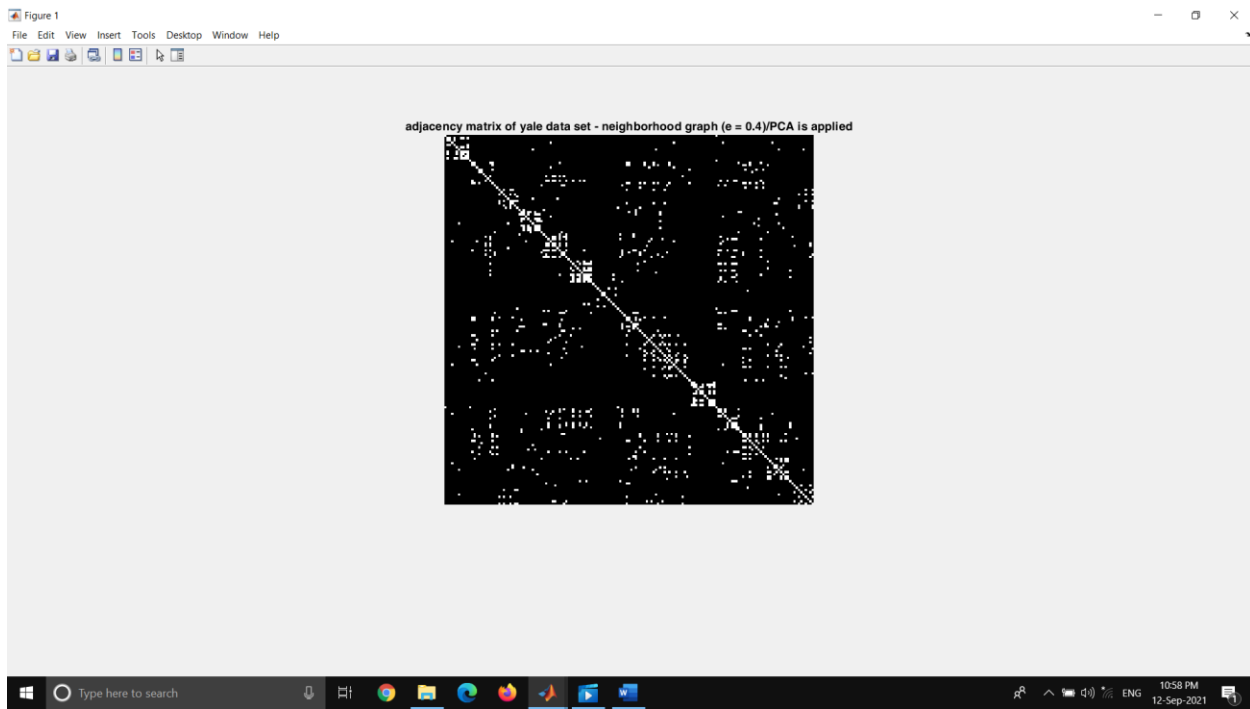
Figure 24 : Adjacency matrix when e = 0.4

For e = 0.5
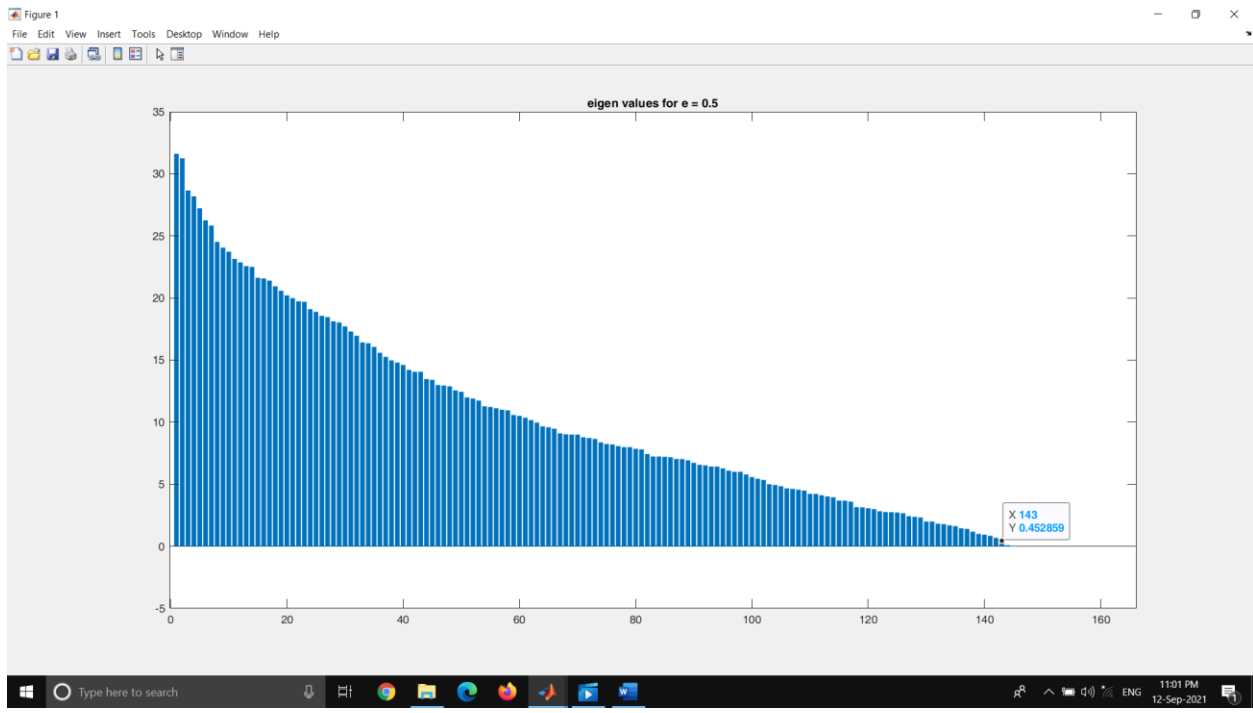
Figure 25 : eigan vectors e = 0.5
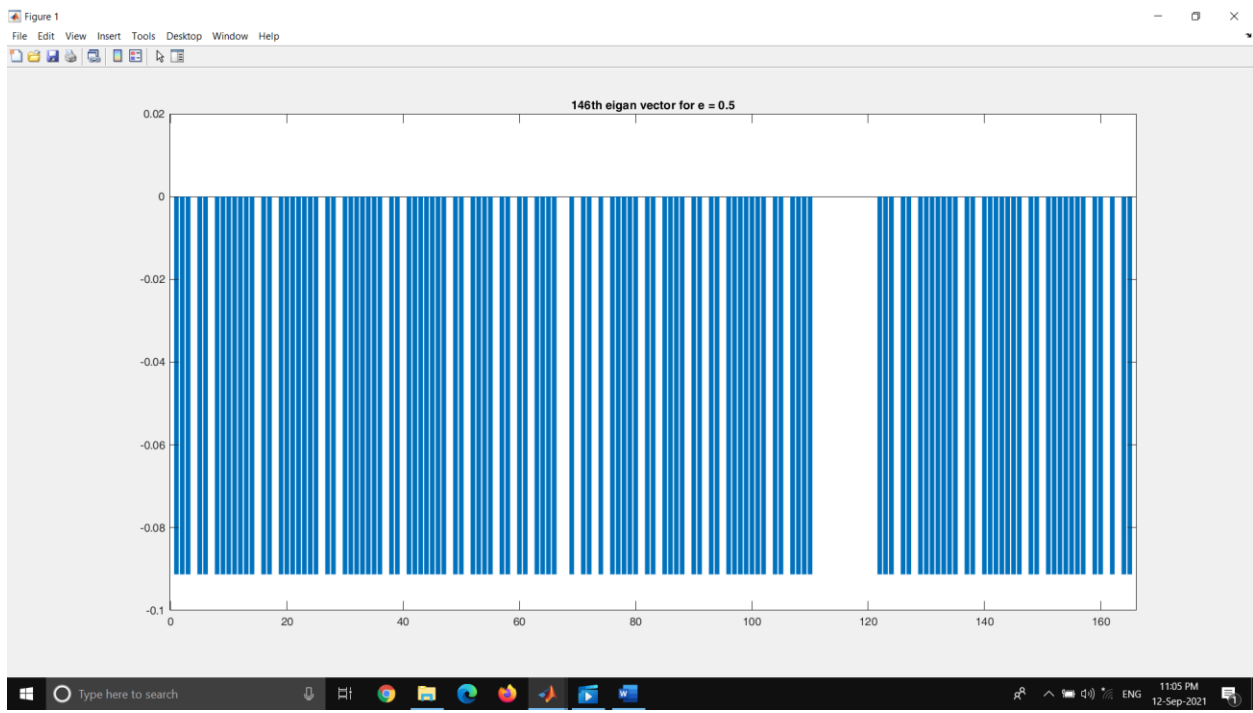
Figure 26 : 146 th eigan vector e = 0.5
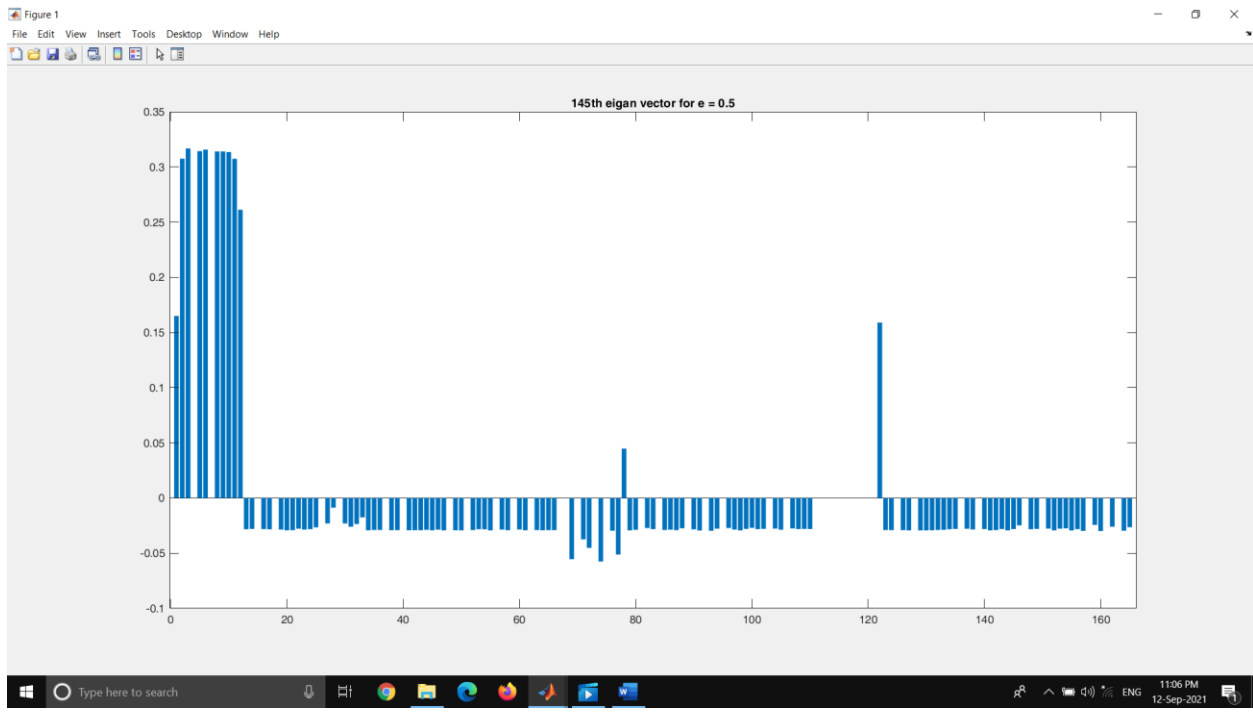
Figure 27 : 145 th eigan vector e = 0.5
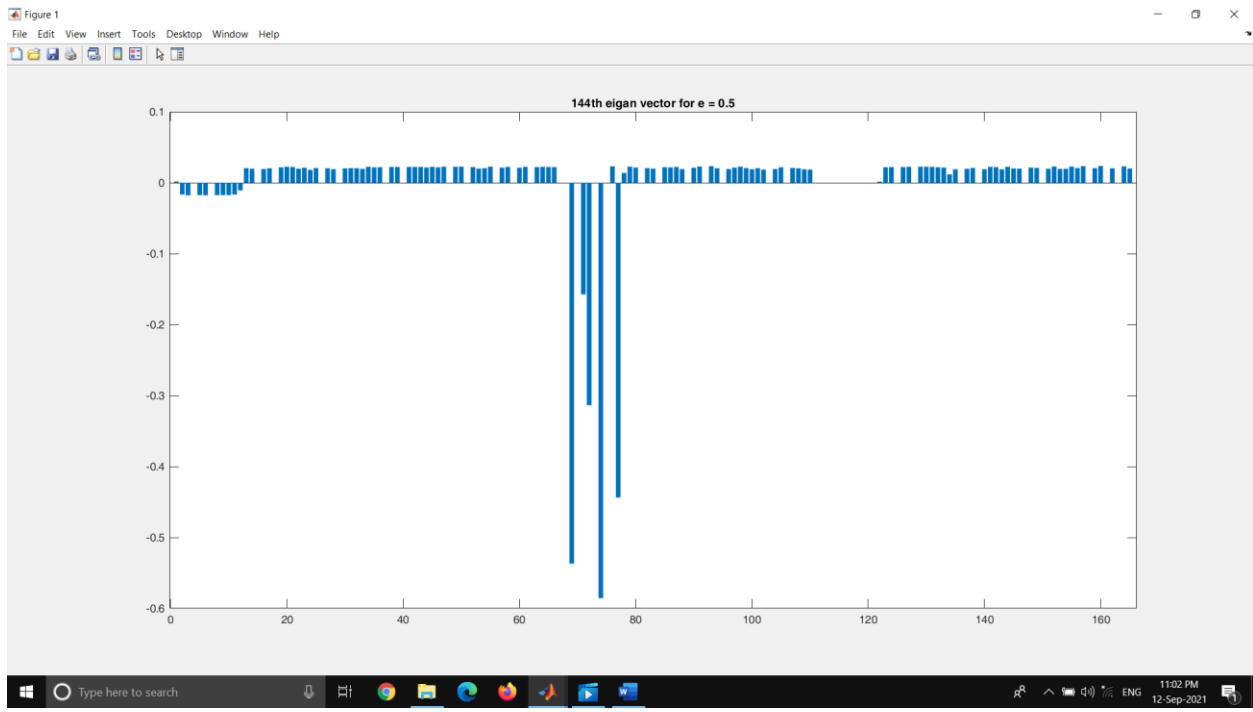
Figure 28 : 144 th eigan vector e = 0.5
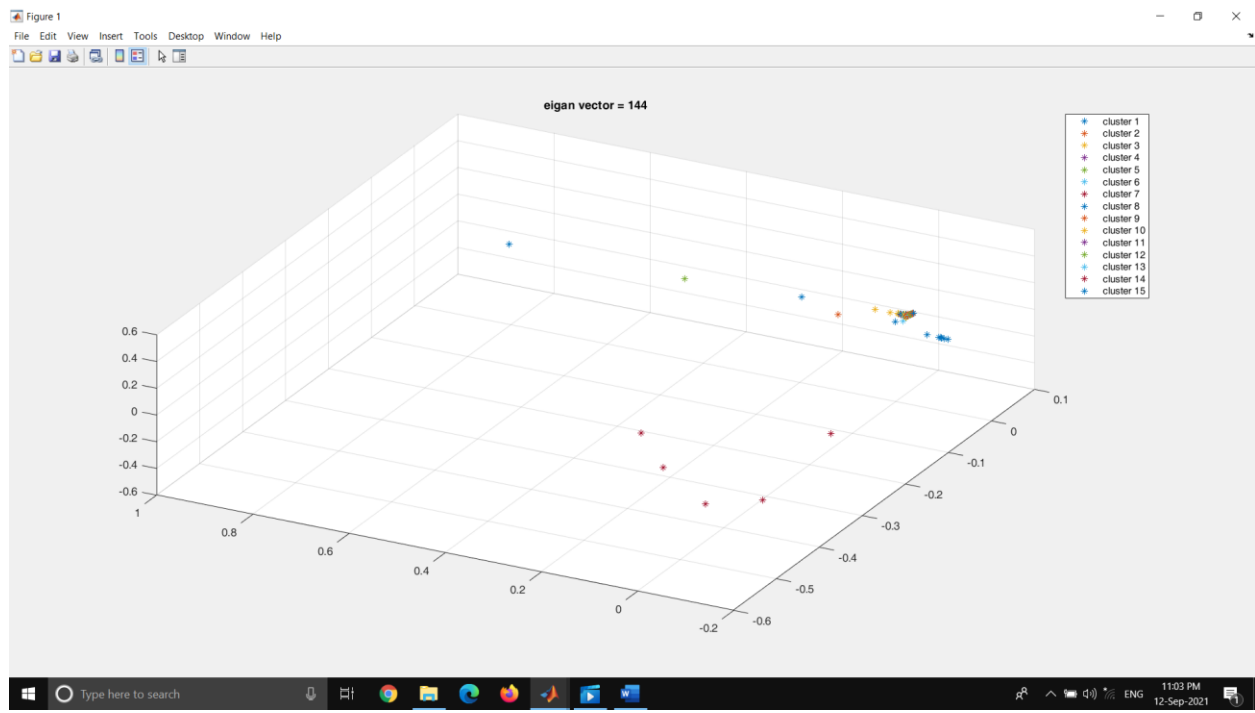
Figure 29 : Clusters formed e = 0.5

E NEIGHBORHOOD SIMILARITY GRAPH
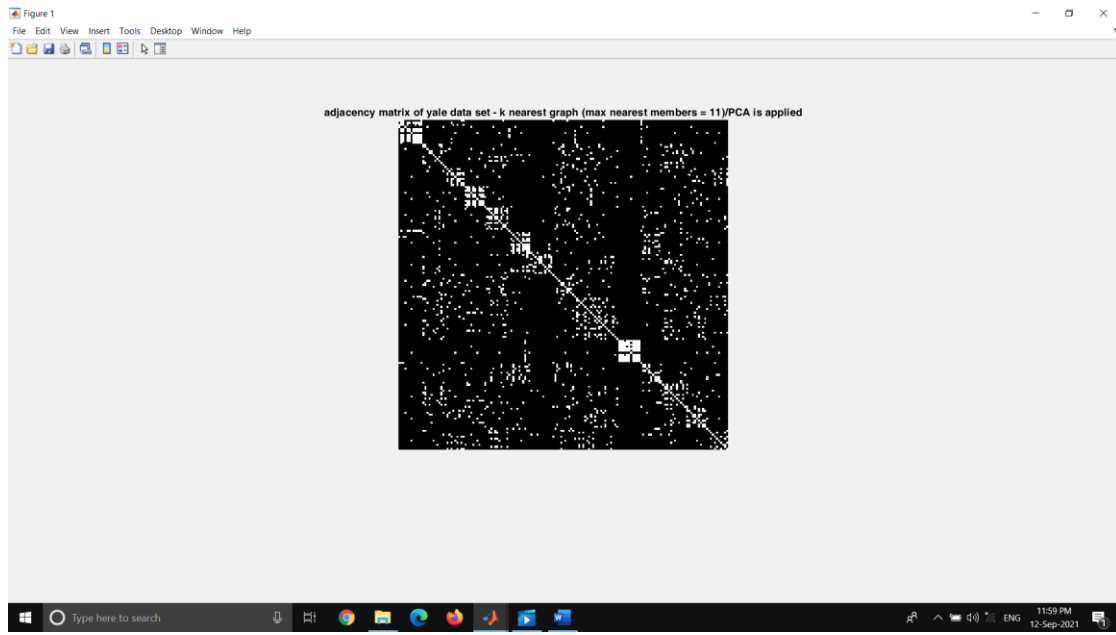
Figure 30 : Adjacency matrix when k nearest members = 11
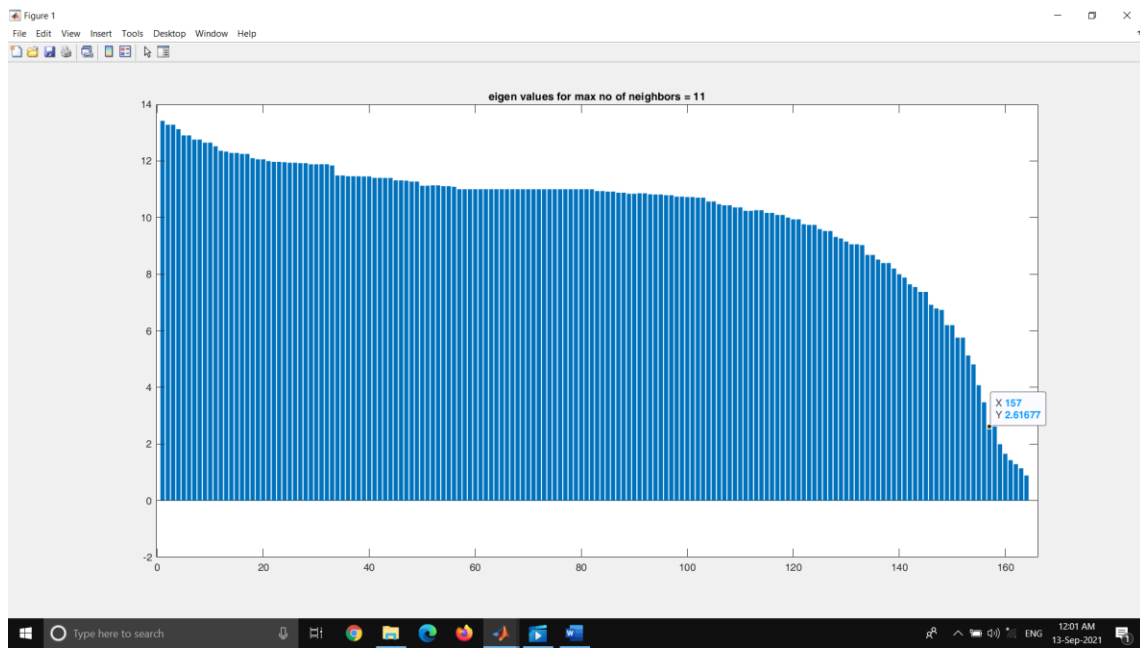
Figure 31 : eigen values when k nearest members = 11
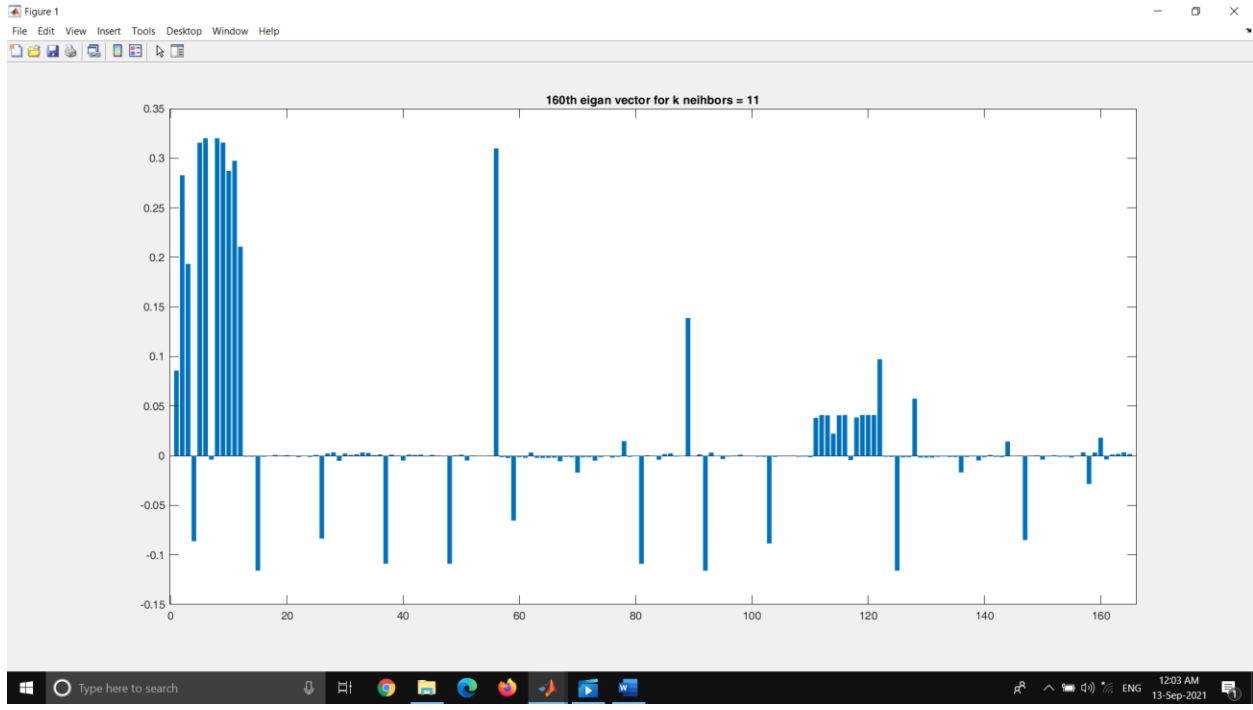
Figure 32 : 160 th eigan vector when k nearest members = 11
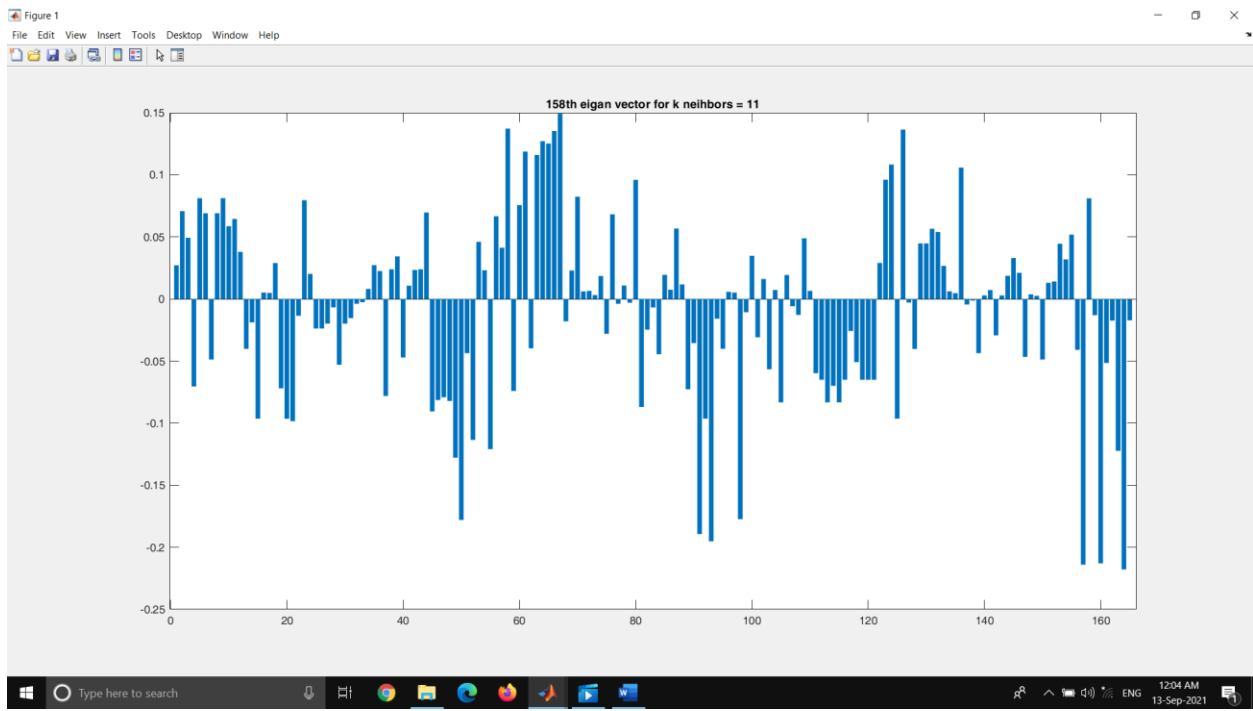
Figure 33 : 158 th eigan vector when k nearest members = 11
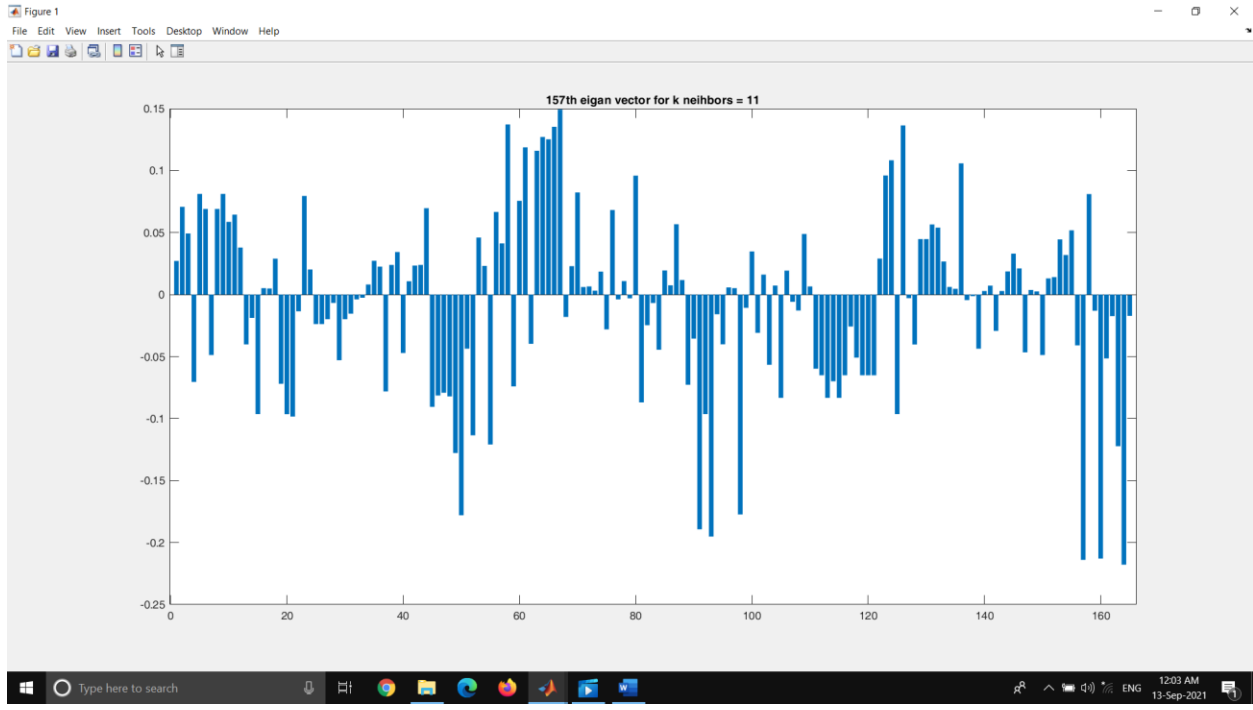
Figure 34 : 157 th eigan vector when k nearest members = 11
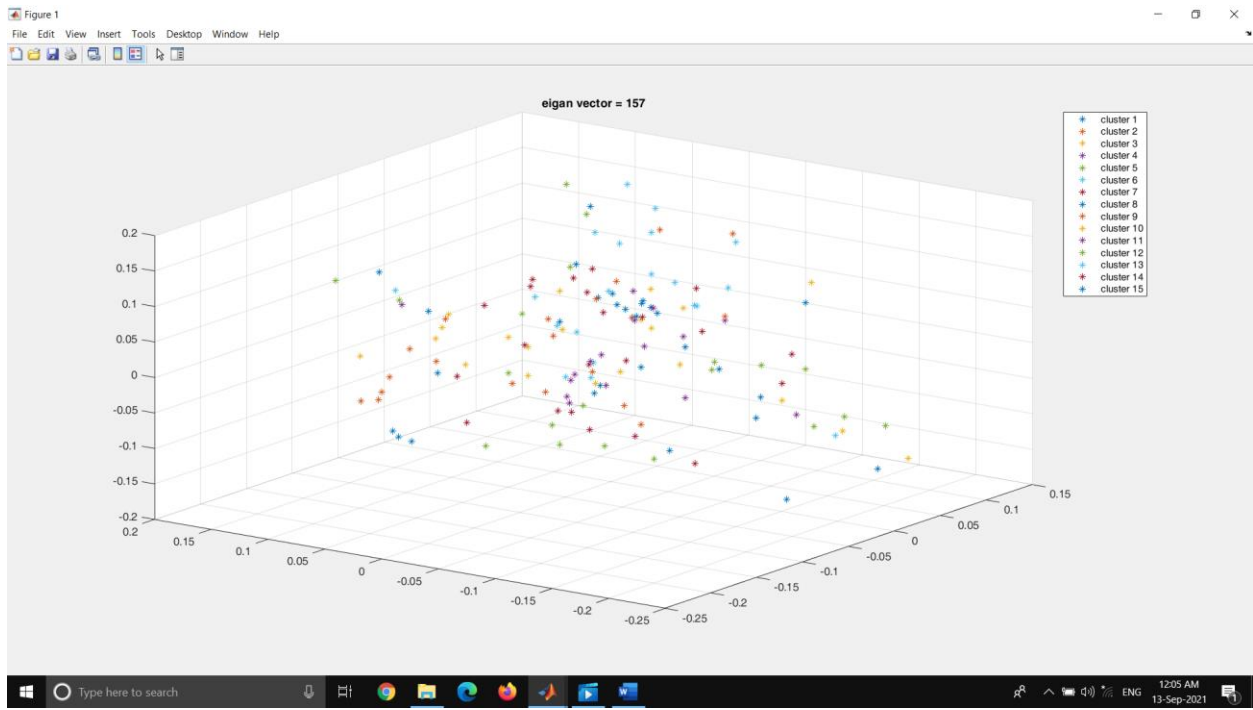
Figure 35 : clusters formed when k nearest members = 11 for 157th eig vector
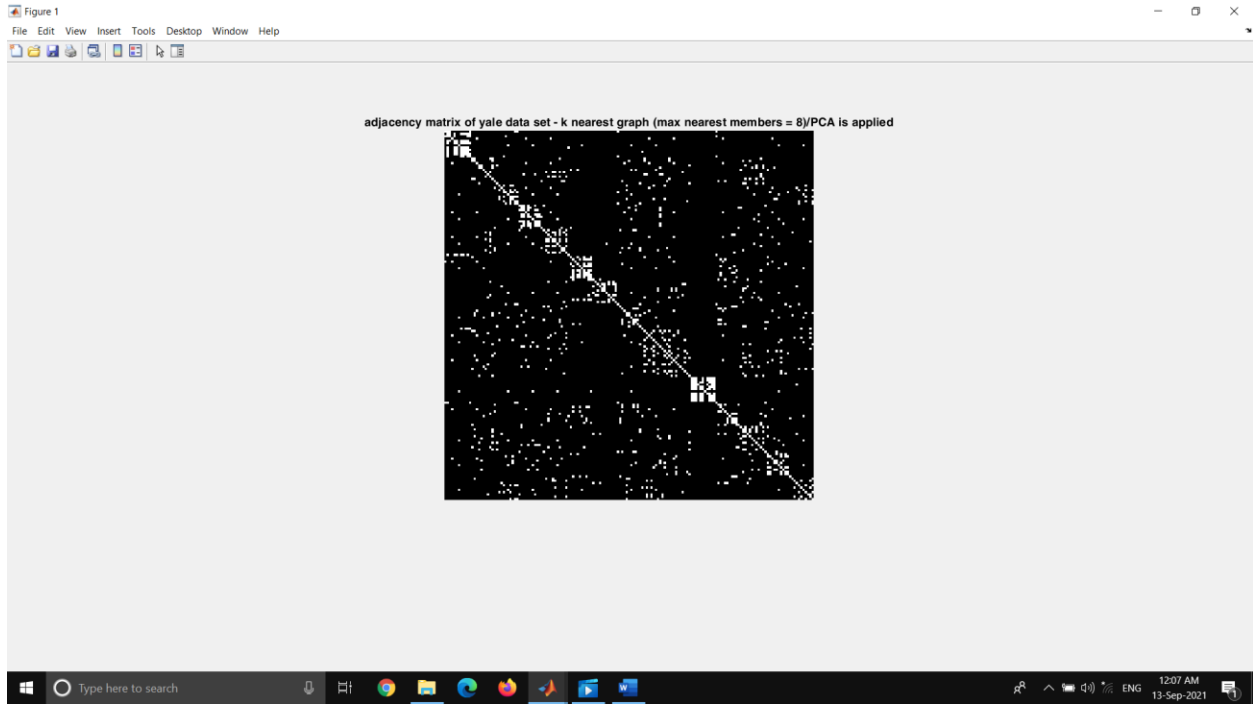
Figure 36 : Adjacency matrix when k nearest members = 8
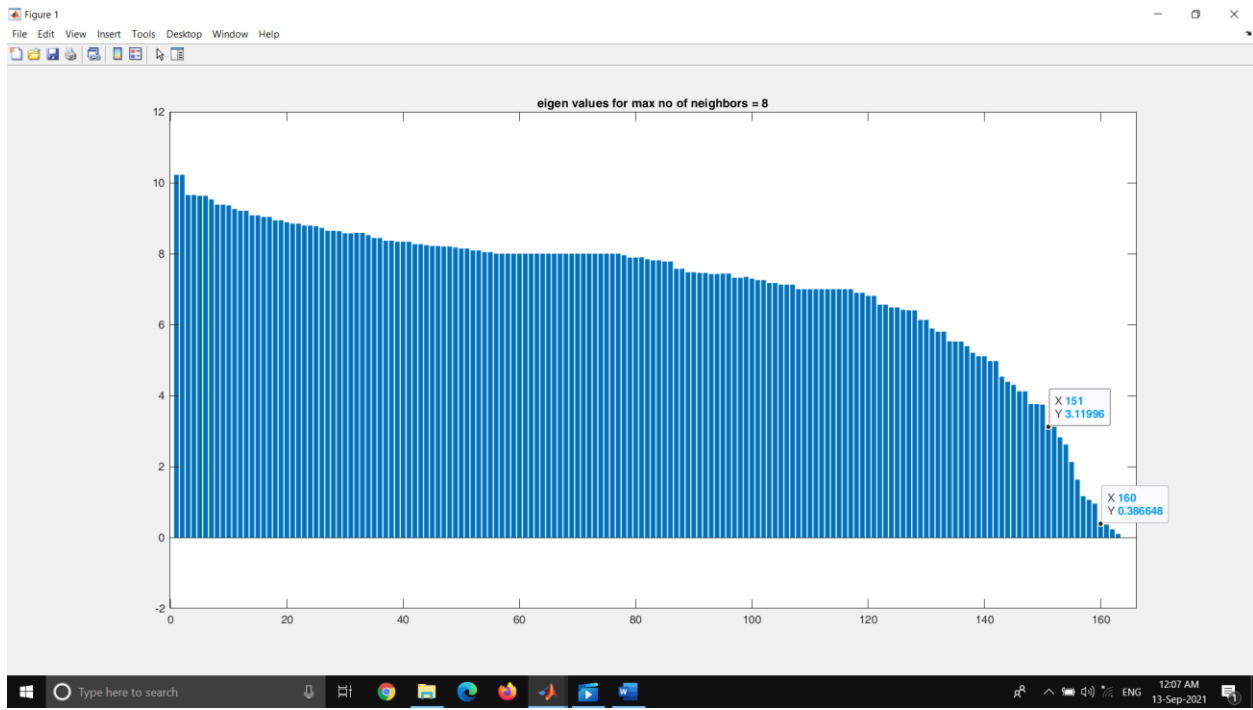
Figure 37 : eigen values when k nearest members = 8
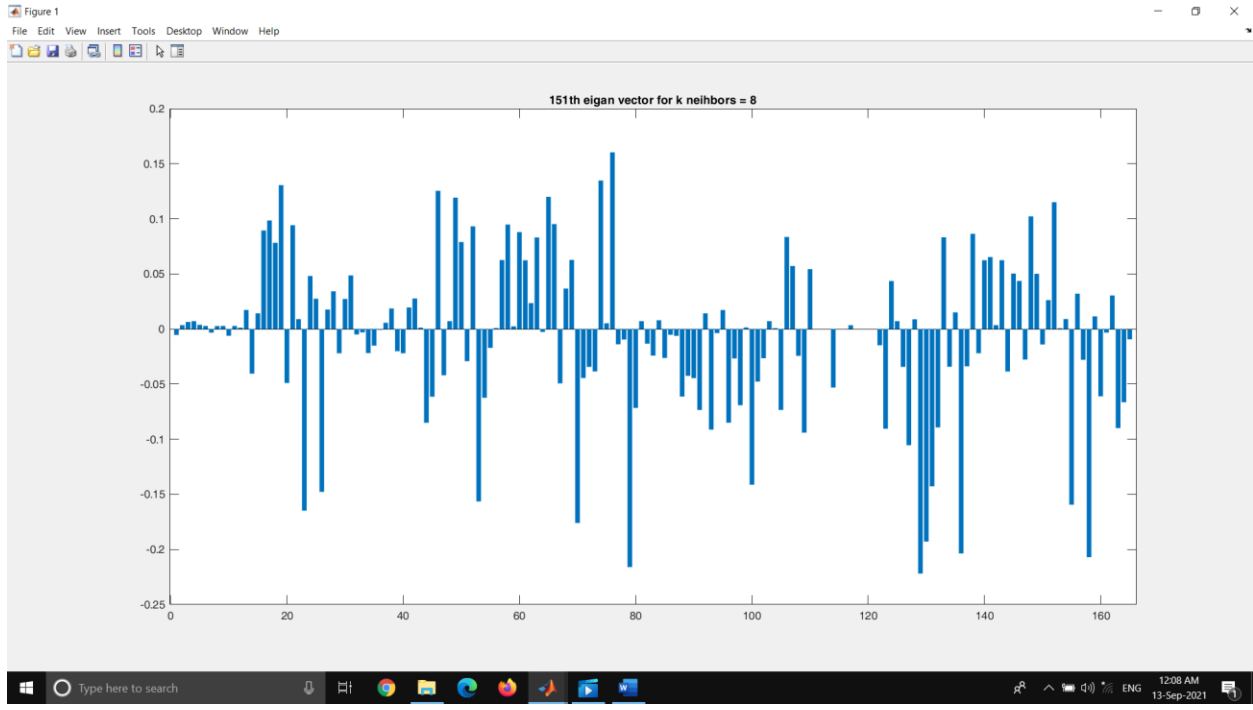
Figure 38 : 151 th eigan vector when k nearest members = 8
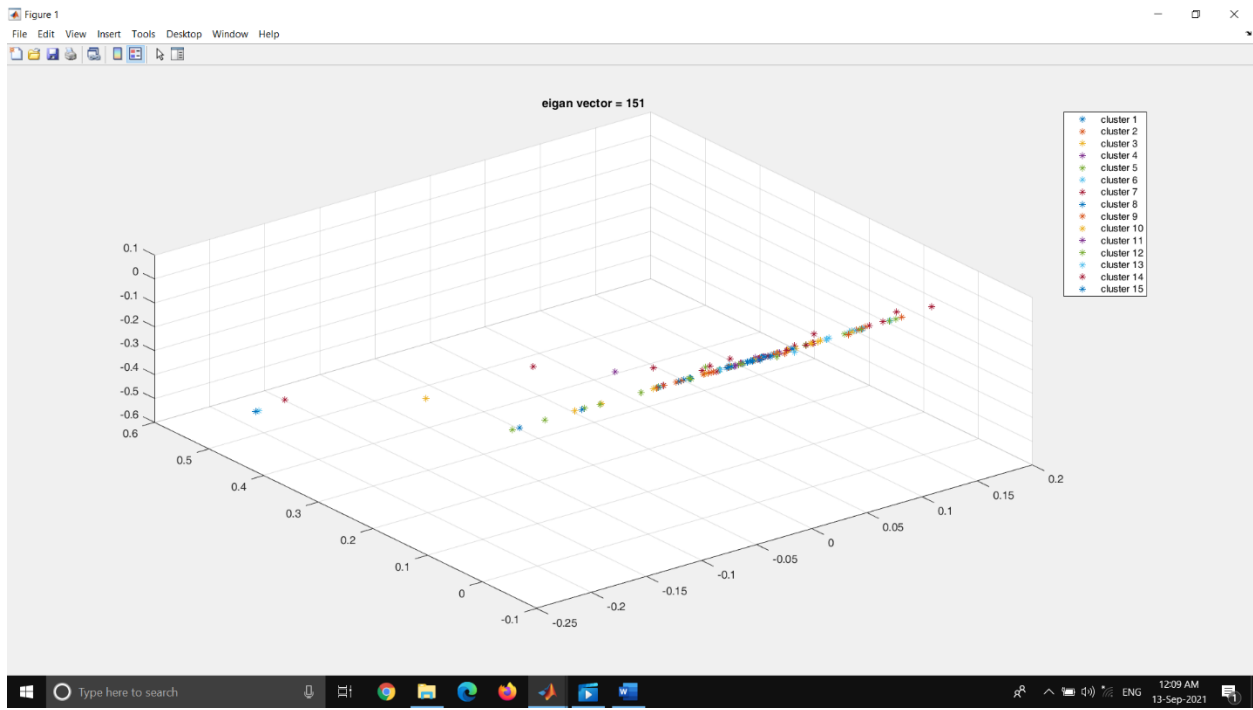
Figure 39 : clusters formed when k nearest members =8 for 151th eig vector
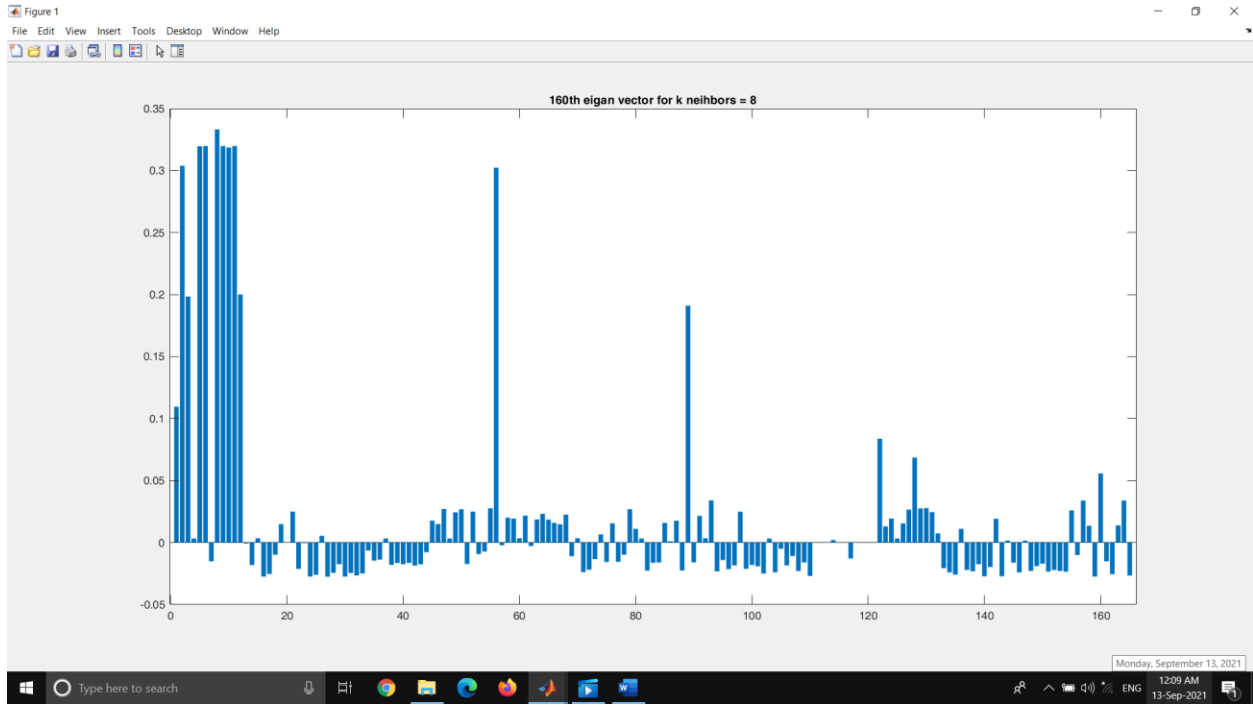
Figure 40 : 160 th eigan vector when k nearest members = 8
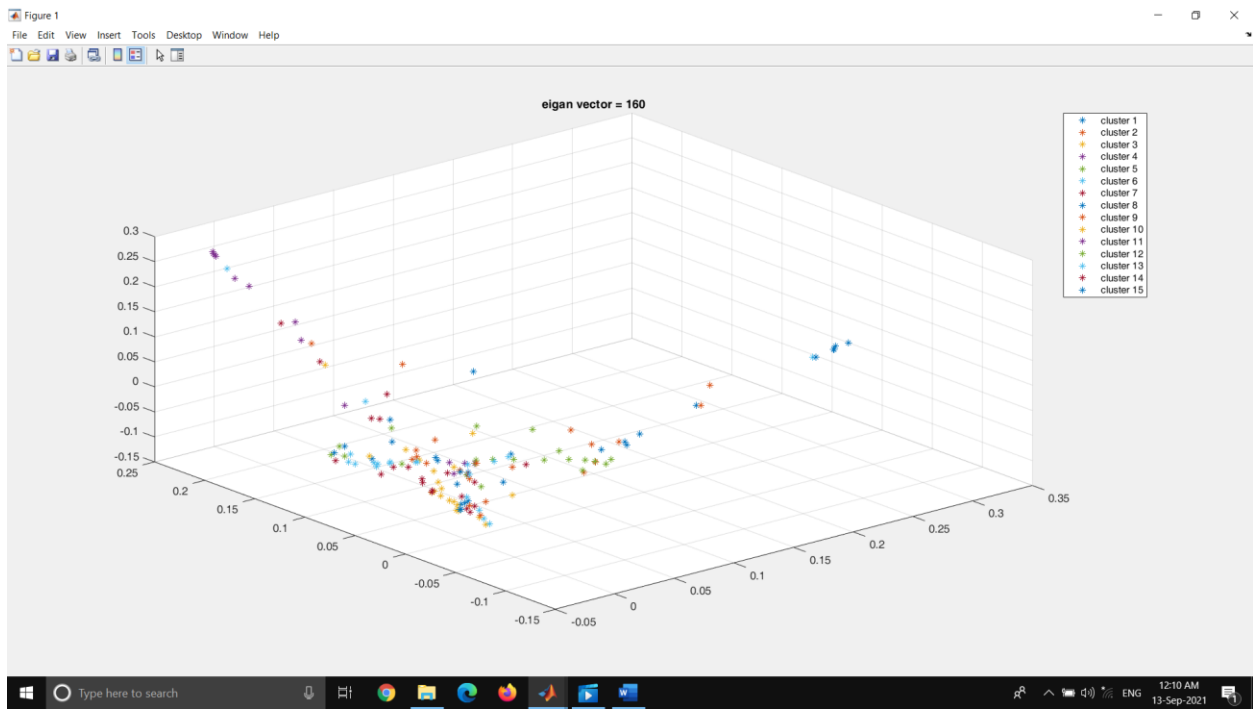
Figure 41 : clusters formed when k nearest members = 8 for 160 th eig vector

APPENDIX

Similarity Graph

```
load Yale_32x32;
x=fea';
R = cov(x');
[V,D] = eigs(R);
Y = V'*x;
Y=x;
% plot3(Y(1,1:11),Y(2,1:11),Y(3,1:11),'b*');hold
on;plot3(Y(1,12:165),Y(2,12:165),Y(3,12:165),'r*');

W = zeros(size(Y,2));
P=[];
sig = 550;
for i=1:size(Y,2)
    for j=i:size(Y,2)
        a = Y(:,i)-Y(:,j);
        W(i,j)=exp(-(a'*a)/(2*sig*sig));
        W(j,i)=W(i,j);
    end
    P = [P sum(W(i,:))];
end
%imshow(W);hold on;title(['adjacency matrix of yale data
set - fully connect method (sigma = ',num2str(sig),')/PCA
is applied'])
Degree_matrix = diag(P);
Lap = Degree_matrix - W;
[l,d] = eigs(Lap,165);

S=diag(d);
bar(S);hold on;title(['eigen values for sigma =
',num2str(sig)]);
[i,g]=max(abs(diff(S)));


bar(l(:,g));hold on;title([num2str(g),'th eigan vector for
sigma = ',num2str(sig)])
plot3(l(1:11,g),l(1:11,g-1),l(1:11,g-2),'*');hold on;
plot3(l(12:22,g),l(12:22,g-1),l(12:22,g-2),'*');hold on;
```

```matlab
plot3(l(23:33,g),l(23:33,g-1),l(23:33,g-2),'*');hold on;
plot3(l(34:44,g),l(34:44,g-1),l(34:44,g-2),'*');hold on;
plot3(l(45:55,g),l(45:55,g-1),l(45:55,g-2),'*');hold on;
plot3(l(56:66,g),l(56:66,g-1),l(56:66,g-2),'*');hold on;
plot3(l(67:77,g),l(67:77,g-1),l(67:77,g-2),'*');hold on;
plot3(l(78:88,g),l(78:88,g-1),l(78:88,g-2),'*');hold on;
plot3(l(89:99,g),l(89:99,g-1),l(89:99,g-2),'*');hold on;
plot3(l(100:110,g),l(100:110,g-1),l(100:110,g-2),'*');hold
on;
plot3(l(111:121,g),l(111:121,g-1),l(111:121,g-2),'*');hold
on;
plot3(l(122:132,g),l(122:132,g-1),l(122:132,g-2),'*');hold
on;
plot3(l(133:143,g),l(133:143,g-1),l(133:143,g-2),'*');hold
on;
plot3(l(144:154,g),l(144:154,g-1),l(144:154,g-2),'*');hold
on;
plot3(l(155:165,g),l(155:165,g-1),l(155:165,g-2),'*');hold
on;grid on;
legend('cluster 1','cluster 2','cluster 3','cluster
4','cluster 5','cluster 6','cluster 7','cluster 8','cluster
9','cluster 10','cluster 11','cluster 12','cluster
13','cluster 14','cluster 15');hold on;title(['eigan vector
= ',num2str(g)]);
```

E Neighborhood graph

```matlab
load Yale_32x32;
x=fea';
R = cov(x');
[V,D] = eigs(R);
Y = V'*x;
%Y=x;
% plot3(Y(1,1:11),Y(2,1:11),Y(3,1:11),'b*');hold
on;plot3(Y(1,12:165),Y(2,12:165),Y(3,12:165),'r*');

W = zeros(size(Y,2));
P=[];
e=.5;
for i=1:size(Y,2)
    for j=i:size(Y,2)
        a = Y(:,i)-Y(:,j);
        if((a'*a)/(10^6)<e)
            W(i,j)=1;
        else
            W(i,j)=0;
        end
        W(j,i)=W(i,j);
    end
    P = [P sum(W(i,:))];
end
%imshow(W);hold on;title(['adjacency matrix of yale data
set - neighborhood graph (e = ',num2str(e),')/PCA is
applied'])
Degree_matrix = diag(P);
Lap = Degree_matrix - W;
[l,d] = eigs(Lap,165);

S=diag(d);
bar(S);hold on;title(['eigen values for e = ',num2str(e)]);
[i,g]=max(abs(diff(S)));
```

```matlab
bar(l(:,g));hold on;title([num2str(g),'th eigan vector for
e = ',num2str(e)])
plot3(l(1:11,g),l(1:11,g-1),l(1:11,g-2),'*');hold on;
plot3(l(12:22,g),l(12:22,g-1),l(12:22,g-2),'*');hold on;
plot3(l(23:33,g),l(23:33,g-1),l(23:33,g-2),'*');hold on;
plot3(l(34:44,g),l(34:44,g-1),l(34:44,g-2),'*');hold on;
plot3(l(45:55,g),l(45:55,g-1),l(45:55,g-2),'*');hold on;
plot3(l(56:66,g),l(56:66,g-1),l(56:66,g-2),'*');hold on;
plot3(l(67:77,g),l(67:77,g-1),l(67:77,g-2),'*');hold on;
plot3(l(78:88,g),l(78:88,g-1),l(78:88,g-2),'*');hold on;
plot3(l(89:99,g),l(89:99,g-1),l(89:99,g-2),'*');hold on;
plot3(l(100:110,g),l(100:110,g-1),l(100:110,g-2),'*');hold
on;
plot3(l(111:121,g),l(111:121,g-1),l(111:121,g-2),'*');hold
on;
plot3(l(122:132,g),l(122:132,g-1),l(122:132,g-2),'*');hold
on;
plot3(l(133:143,g),l(133:143,g-1),l(133:143,g-2),'*');hold
on;
plot3(l(144:154,g),l(144:154,g-1),l(144:154,g-2),'*');hold
on;
plot3(l(155:165,g),l(155:165,g-1),l(155:165,g-2),'*');hold
on;grid on;
legend('cluster 1','cluster 2','cluster 3','cluster
4','cluster 5','cluster 6','cluster 7','cluster 8','cluster
9','cluster 10','cluster 11','cluster 12','cluster
13','cluster 14','cluster 15');hold on;title(['eigan vector
= ',num2str(g)]);
```

K Nearest Neighbor graph

```matlab
load Yale_32x32;
x=fea';
R = cov(x');
[V,D] = eigs(R);
Y = V'*x;
%Y=x;
% plot3(Y(1,1:11),Y(2,1:11),Y(3,1:11),'b*');hold
on;plot3(Y(1,12:165),Y(2,12:165),Y(3,12:165),'r*');

W = zeros(size(Y,2));
P=[];
e=8;
dis=zeros(1,size(Y,2));
for i=1:size(Y,2)

    for j=1:size(Y,2)
        a = Y(:,i)-Y(:,j);
        dis(1,j)=(a'*a)/(10^6);
    end
    [B,Ind] = mink(dis,e);

    for k=Ind
        W(i,k)=1;
    end

    P = [P sum(W(i,:))];
end
%imshow(W);hold on;title(['adjacency matrix of yale data
set - k nearest graph (max nearest members =
',num2str(e),')/PCA is applied'])
Degree_matrix = diag(P);
Lap = Degree_matrix - W;
[l,d] = eigs(Lap,165);

S=diag(d);
```

```matlab
bar(S);hold on;title(['eigen values for max no of neighbors
= ',num2str(e)]);
[i,g]=max(abs(diff(S)));


bar(l(:,g));hold on;title([num2str(g),'th eigan vector for
k neihbors = ',num2str(e)])
plot3(l(1:11,g),l(1:11,g-1),l(1:11,g-2),'*');hold on;
plot3(l(12:22,g),l(12:22,g-1),l(12:22,g-2),'*');hold on;
plot3(l(23:33,g),l(23:33,g-1),l(23:33,g-2),'*');hold on;
plot3(l(34:44,g),l(34:44,g-1),l(34:44,g-2),'*');hold on;
plot3(l(45:55,g),l(45:55,g-1),l(45:55,g-2),'*');hold on;
plot3(l(56:66,g),l(56:66,g-1),l(56:66,g-2),'*');hold on;
plot3(l(67:77,g),l(67:77,g-1),l(67:77,g-2),'*');hold on;
plot3(l(78:88,g),l(78:88,g-1),l(78:88,g-2),'*');hold on;
plot3(l(89:99,g),l(89:99,g-1),l(89:99,g-2),'*');hold on;
plot3(l(100:110,g),l(100:110,g-1),l(100:110,g-2),'*');hold
on;
plot3(l(111:121,g),l(111:121,g-1),l(111:121,g-2),'*');hold
on;
plot3(l(122:132,g),l(122:132,g-1),l(122:132,g-2),'*');hold
on;
plot3(l(133:143,g),l(133:143,g-1),l(133:143,g-2),'*');hold
on;
plot3(l(144:154,g),l(144:154,g-1),l(144:154,g-2),'*');hold
on;
plot3(l(155:165,g),l(155:165,g-1),l(155:165,g-2),'*');hold
on;grid on;
legend('cluster 1','cluster 2','cluster 3','cluster
4','cluster 5','cluster 6','cluster 7','cluster 8','cluster
9','cluster 10','cluster 11','cluster 12','cluster
13','cluster 14','cluster 15');hold on;title(['eigan vector
= ',num2str(g)]);
```