Fisher Discriminant Analysis

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E/16/103

FDA : Iris Dataset Two Class

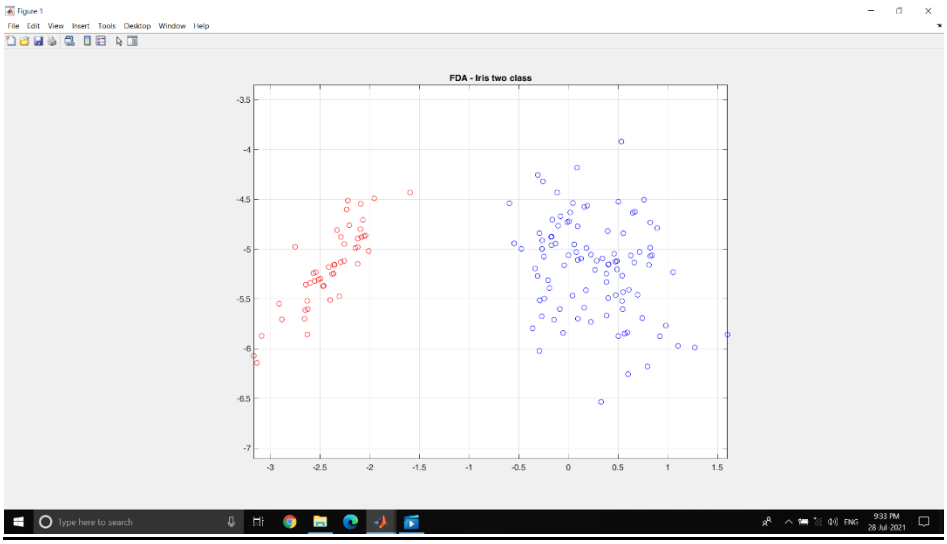

Figure 1: Iris Dataset for two classes

FDA : Yale Dataset Two Class

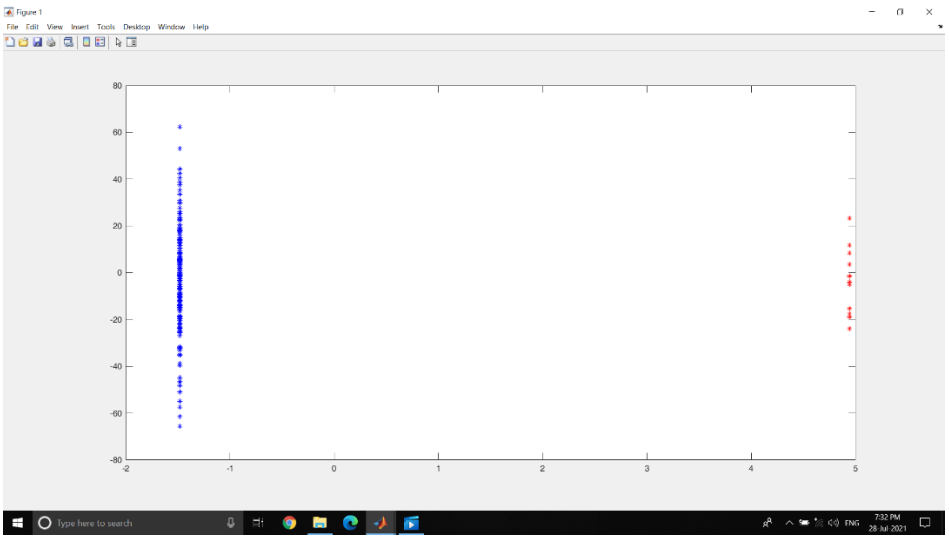

Figure 2 : Yale Dataset for two classes

FDA : Yale Dataset Multiclass

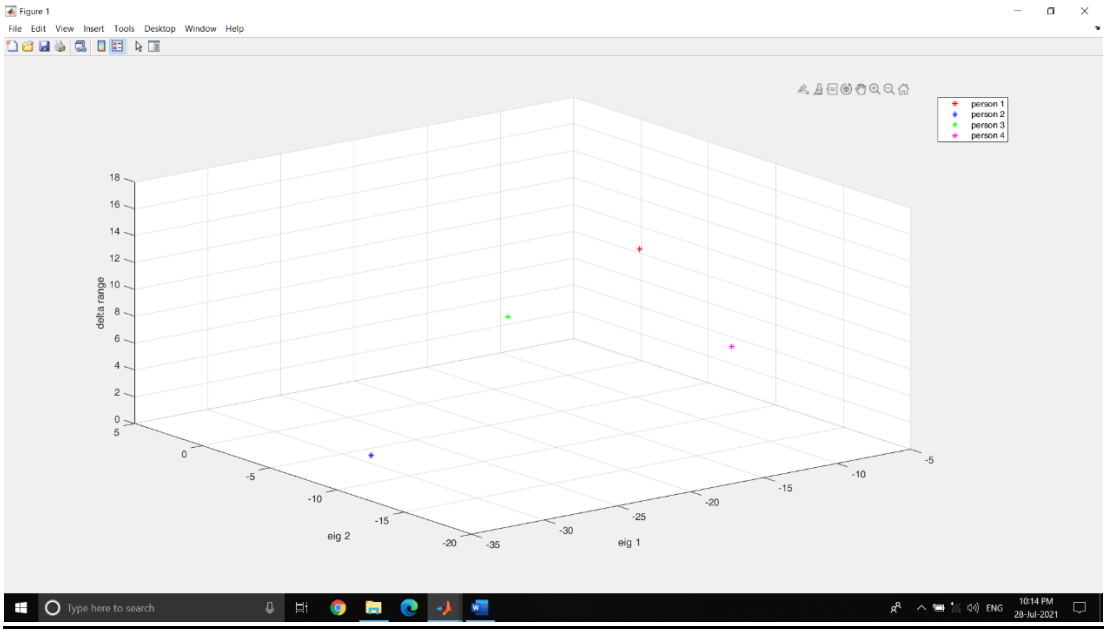

Figure 3 : Yale Dataset Multiclass

Since interclass scatter is high and in class scatter is low the plotted data points of each person are too close while from each other person datapoints are far away. Because of that we only see single points in the figure 3 corresponding to each person.

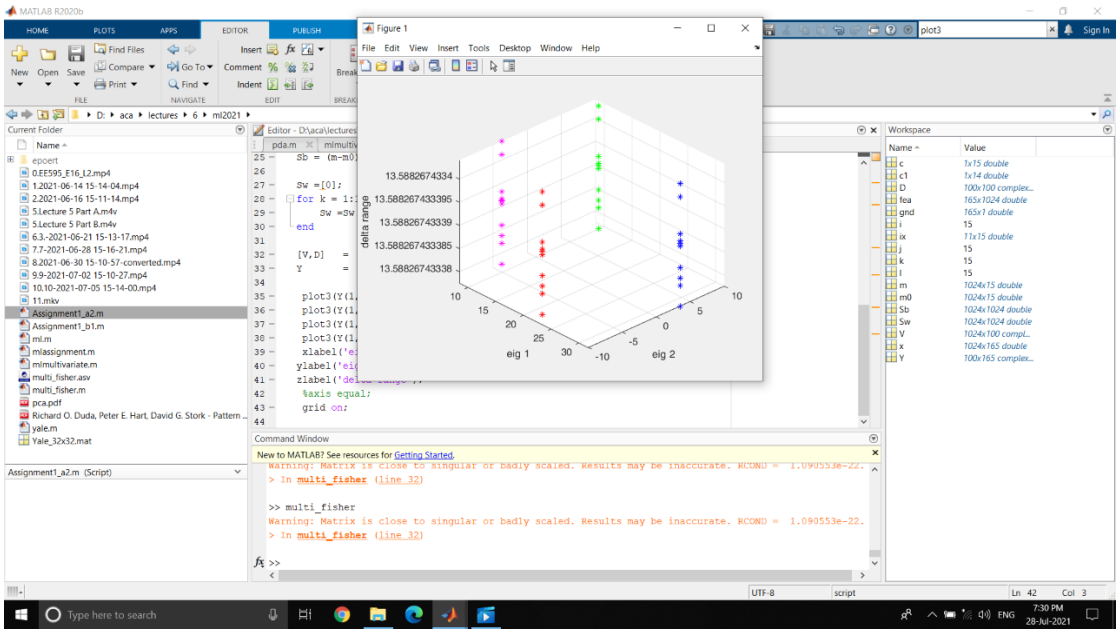

Figure 4 : Yale Dataset Multiclass (Zoomed in)

If we use a projected x data to a weak eigen vector to plot the data which defeats the purpose of fisher discriminant analysis we can clearly see multiple data points of each class as in figure 5 which we cannot see in figure 3.

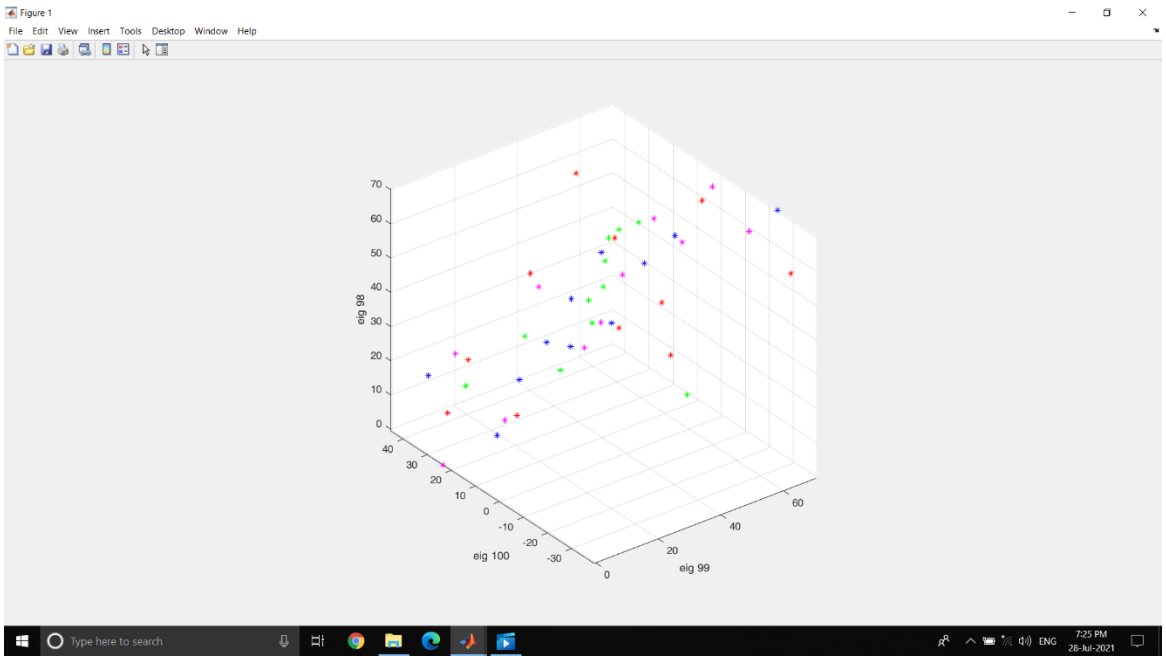

Figure 5 : Yale Dataset Projected in to less dominant eigen vectors

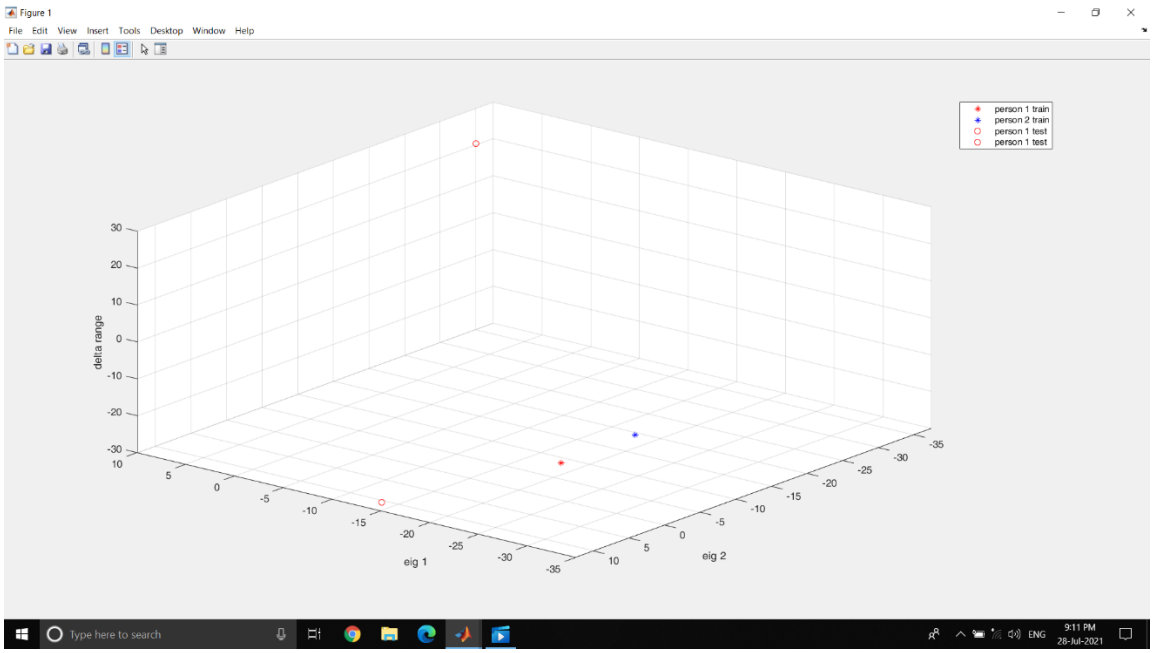

Figure 6 : Testing data on FDA for person 1

As in figure 6 person 1's last two images are not included (far away) in the cluster of person 1 which FDA presents.

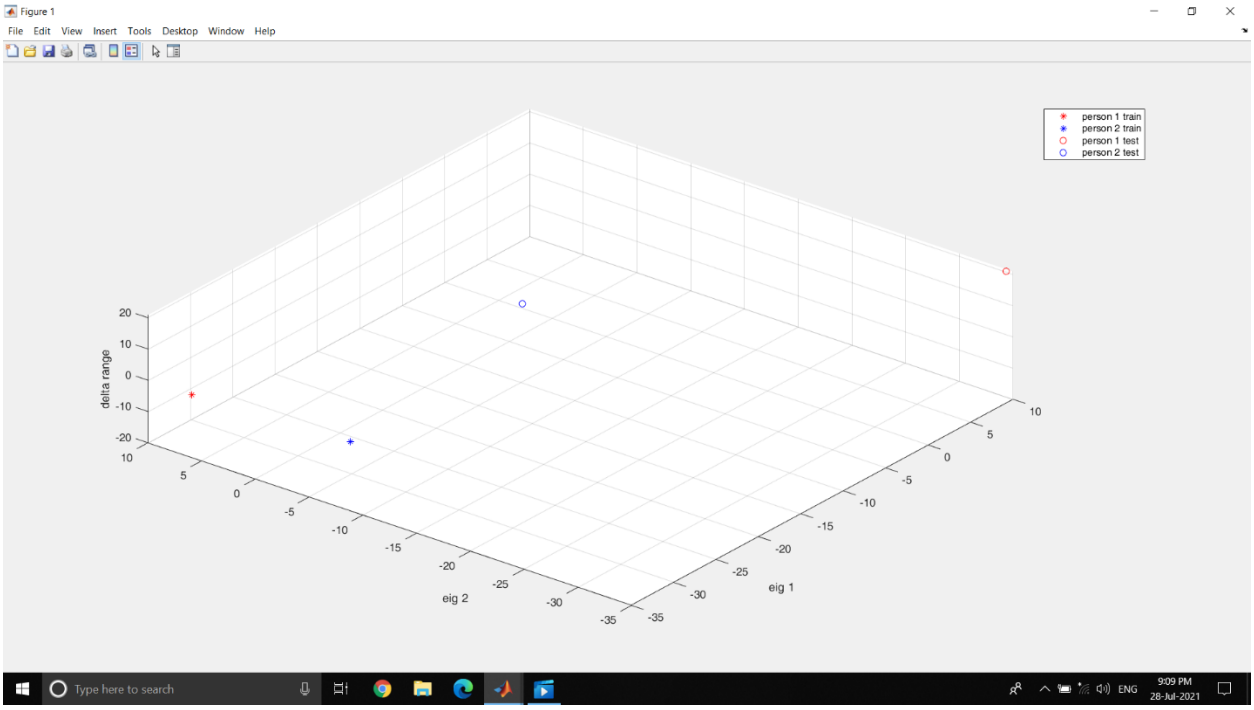

Figure 7 : Testing data on FDA for person 1 and 2

APPENDIX

FDA : Iris Dataset for two classes

```
x = iris_dataset;

ix0 = 1:50;
ix1 = 51:150;

m0  = mean(x(:,ix0)')';
m1  = mean(x(:,ix1)')';
Sb  = (m0-m1)*(m0-m1)';

S0  = 49*cov(x(:,ix0)');
S1  = 99*cov(x(:,ix1)');
Sw  = S0+S1;

[V,D]   = eigs(inv(Sw)*Sb);

Y   = V'*x;

plot(Y(1,ix0),Y(2,ix0),'ro');hold on;
plot(Y(1,ix1),Y(2,ix1),'bo');grid on;
title('FDA - Iris two class');
axis equal;
```

FDA : Yale Dataset for two classes

```
load Yale_32x32;
x=fea';

c  = [1:15];
c0 = 3;
c1 = setdiff(c,c0);

ix0 = (c0 - 1)*11+1 : 11*c0 ;
ix1 = [];

for k=1:length(c1)
    ix1 = [ix1 (c1(k) - 1)*11+1 : 11*c1(k)];
end

Nc0 = length(ix0);
Nc1 = length(ix1);

m  = mean(x')';
m0 = mean(x(:,ix0)')';
m1 = mean(x(:,ix1)')';

%interclass scatter - goal is to maxximize this
Sb = (m0-m1) * (m0-m1)';

%inclassScatter - goal is to minimize this
S0 = (Nc0-1)*cov(x(:,ix0)');
S1 = (Nc1-1)*cov(x(:,ix1)');
Sw = S0+S1;

[V,D] = eigs(inv(Sw)*Sb);
Y = V' * x;

plot(Y(1,ix0),Y(2,ix0),'r*');hold on;
plot(Y(1,ix1),Y(2,ix1),'b*');hold on;
```

FDA : Yale Dataset for multiclasses

```
load Yale_32x32;
x=fea';

c  = [1:15];
ix=[];
for i=1:15

    ix(:,i) = (i - 1)*11+1 : 11*i ;
end

%mean of lth lass dropped but rest of the classes
m0=[];

for l=1:15
   c1 = setdiff(c,l);
   c2 =
cat(2,ix(:,c1(1))',ix(:,c1(2))',ix(:,c1(3))',ix(:,c1(4))',ix(:,c1(5))'
,ix(:,c1(6))',ix(:,c1(7))',ix(:,c1(8))',ix(:,c1(9))',ix(:,c1(10))',ix(
:,c1(11))',ix(:,c1(12))',ix(:,c1(13))',ix(:,c1(14))');
   m0(:,l)= mean(x(:,c2)')';
end
m=[];

for j=1:15
    m(:,j) = mean(x(:,ix(:,j))')';
end


Sb = (m-m0)*(m-m0)';

Sw =[0];
for k = 1:15
    Sw =Sw +  10*cov(x(:,ix(:,k)')');
end

[V,D]   =   eigs(inv(Sw)*Sb,100);
Y       =   V'*x;

 plot3(Y(1,ix(:,1)'),Y(2,ix(:,1)'),Y(3,ix(:,1)'),'r*');hold on;
 plot3(Y(1,ix(:,2)'),Y(2,ix(:,2)'),Y(3,ix(:,2)'),'b*');hold on;
 plot3(Y(1,ix(:,3)'),Y(2,ix(:,3)'),Y(3,ix(:,3)'),'g*');hold on;
 plot3(Y(1,ix(:,4)'),Y(2,ix(:,4)'),Y(3,ix(:,4)'),'m*');
 grid on;
 xlabel('eig 1');
ylabel('eig 2');
zlabel('delta range');
legend('person 1 ','person 2','person 3','person 4'); %axis equal;
```

FDA : Yale Dataset for Multiclasses with test dataset and training dataset

```
load Yale_32x32;
x=fea';

c  = [1:15];
ix=[];
for i=1:15

    ix(:,i) = (i - 1)*11+1 : 11*i-2 ;
end

%mean of pth class dropped but rest of the classes included forr
claculting
%mean
m0=[];

for p=1:15
   c1 = setdiff(c,p);
   c2 =
cat(2,ix(:,c1(1))',ix(:,c1(2))',ix(:,c1(3))',ix(:,c1(4))',ix(:,c1(5))'
,ix(:,c1(6))',ix(:,c1(7))',ix(:,c1(8))',ix(:,c1(9))',ix(:,c1(10))',ix(
:,c1(11))',ix(:,c1(12))',ix(:,c1(13))',ix(:,c1(14))');
   m0(:,p)= mean(x(:,c2)')';

end

m=[];
for j=1:15
    m(:,j) = mean(x(:,ix(:,j)')')';
end




Sb = (m-m0)*(m-m0)';

Sw =[0];
for k = 1:15
    Sw =Sw +  10*cov(x(:,ix(:,k)')');
end

[V,D]    =   eigs(inv(Sw)*Sb);
Y        =   V'*x;

test     =   V'*x(:,[10:11 21:22]); %1 and second person samples
plot3(Y(1,ix(:,1)'),Y(2,ix(:,1)'),Y(3,ix(:,1)'),'r*');hold on;
 plot3(Y(1,ix(:,2)'),Y(2,ix(:,2)'),Y(3,ix(:,2)'),'b*');hold on;
 plot3(test(1,1),test(2,1),test(3,1),'ro');hold on;
 plot3(test(1,2),test(2,2),test(3,2),'ro');hold on;
 xlabel('eig 1');
```

```
ylabel('eig 2');
zlabel('delta range');
legend('person 1 train ','person 2 train','person 1 test','person 1
test');
 %axis equal;
 grid on;
```