Assignment1

1.

(a)

load('0\_1\_2.mat');

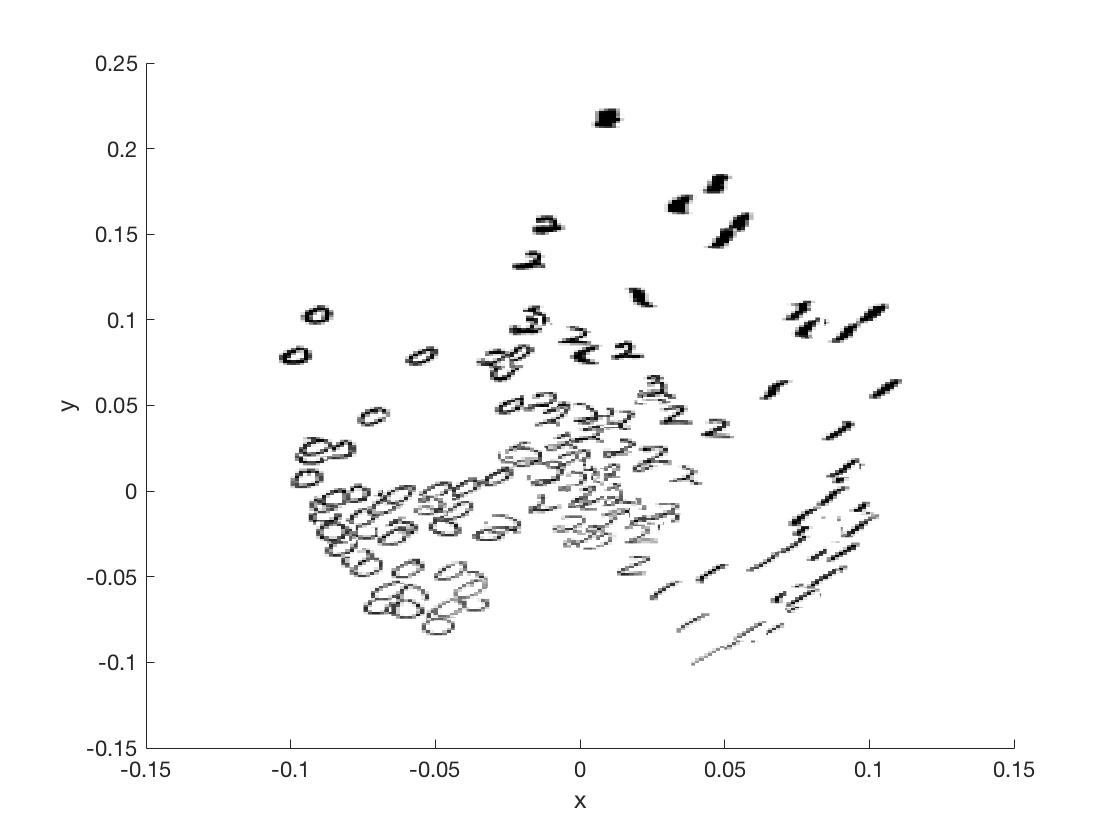
mu = mean(X,2);

a = X - mu\*ones(1,300);

[u,s,v]=svd(a);

b=u(:,1:2)'\*a;

plotimages(reshape(X,8,8,300),b,0.05,0.5)



(b)

x1=X(:,1:100);

x2=X(:,101:200);

x3=X(:,201:300);

n1=100;

n2=100;

n3=100;

mu\_1=0

for i=1:n1

    mu\_1=mu\_1+x1(:,i);

end

mu1=1/n1\*mu\_1

sigma\_1=0

for i=1:n1

    sigma\_1=sigma\_1+(x1(:,i)-mu1)\*(x1(:,i)-mu1)'

end

sigma1=1/36\*sigma\_1;

mu\_2=0

for i=1:n2

    mu\_2=mu\_2+x2(:,i);

end

mu2=1/n2\*mu\_2;

sigma\_2=0

for i=1:n2

    sigma\_2=sigma\_2+(x2(:,i)-mu2)\*(x2(:,i)-mu2)'

end

sigma2=1/36\*sigma\_2;

mu\_3=0

for i=1:n3

    mu\_3=mu\_3+x3(:,i);

end

mu3=1/n3\*mu\_3;

sigma\_3=0

for i=1:n3

    sigma\_3=sigma\_3+(x3(:,i)-mu3)\*(x3(:,i)-mu3)'

end

sigma3=1/36\*sigma\_3;

sigma\_0=0

for i=1:300

    sigma\_0=sigma\_0+(X(:,i)-mu)\*(X(:,i)-mu)'

end

sigma=1/236\*sigma\_0;

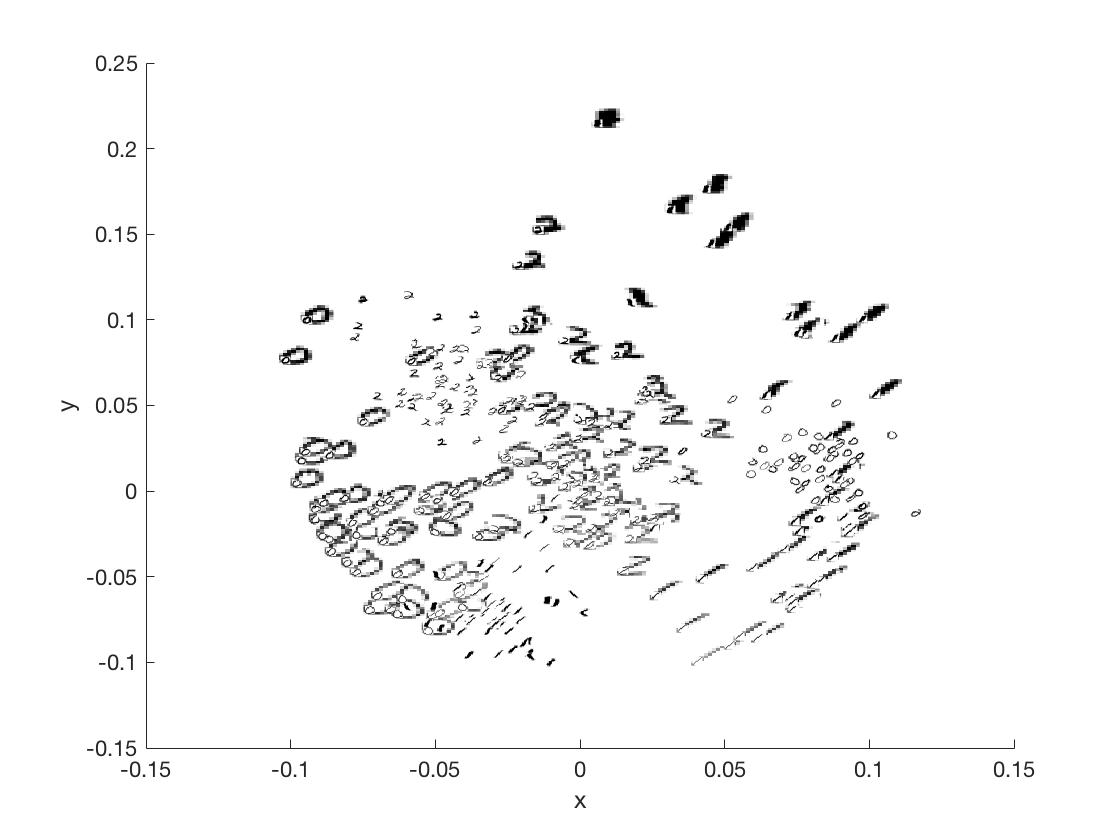
sw=sigma1+sigma2+sigma3;

sb=sigma-sw;

[v,u] = eig(inv(sw)\*sb);

b2=v(:,1:2)'\*a;

plotimages(reshape(X,8,8,300),b2,0.01,0.5);



(c-LDA)

mu0\_b=mean(b(:,1:100),2);

mu1\_b=mean(b(:,101:200),2);

mu2\_b=mean(b(:,201:300),2);

sigma\_b=cov(b');

plotimages(reshape(X,8,8,300),b,0.01,1);

hold on;

a\_1=(mu2\_b'-mu1\_b')\*(inv(sigma\_b));

a\_0=(1/2)\*((mu1\_b'\*inv(sigma\_b)\*mu1\_b)-(mu2\_b'\*inv(sigma\_b)\*mu2\_b));

syms x y

h2 = ezplot((a\_1(1)\*x+a\_1(2)\*y+a\_0),[-3,3]);

h2.Color = 'r';

hold on

a\_2=mu2\_b'\*inv(sigma\_b)-mu0\_b'\*inv(sigma\_b);

a\_3=(1/2)\*((mu0\_b'\*inv(sigma\_b)\*mu0\_b)-(mu2\_b'\*inv(sigma\_b)\*mu2\_b));

syms x y

h3 = ezplot((a\_2(1)\*x+a\_2(2)\*y+a\_3),[-3,3]);

h2.Color = 'b';

hold on

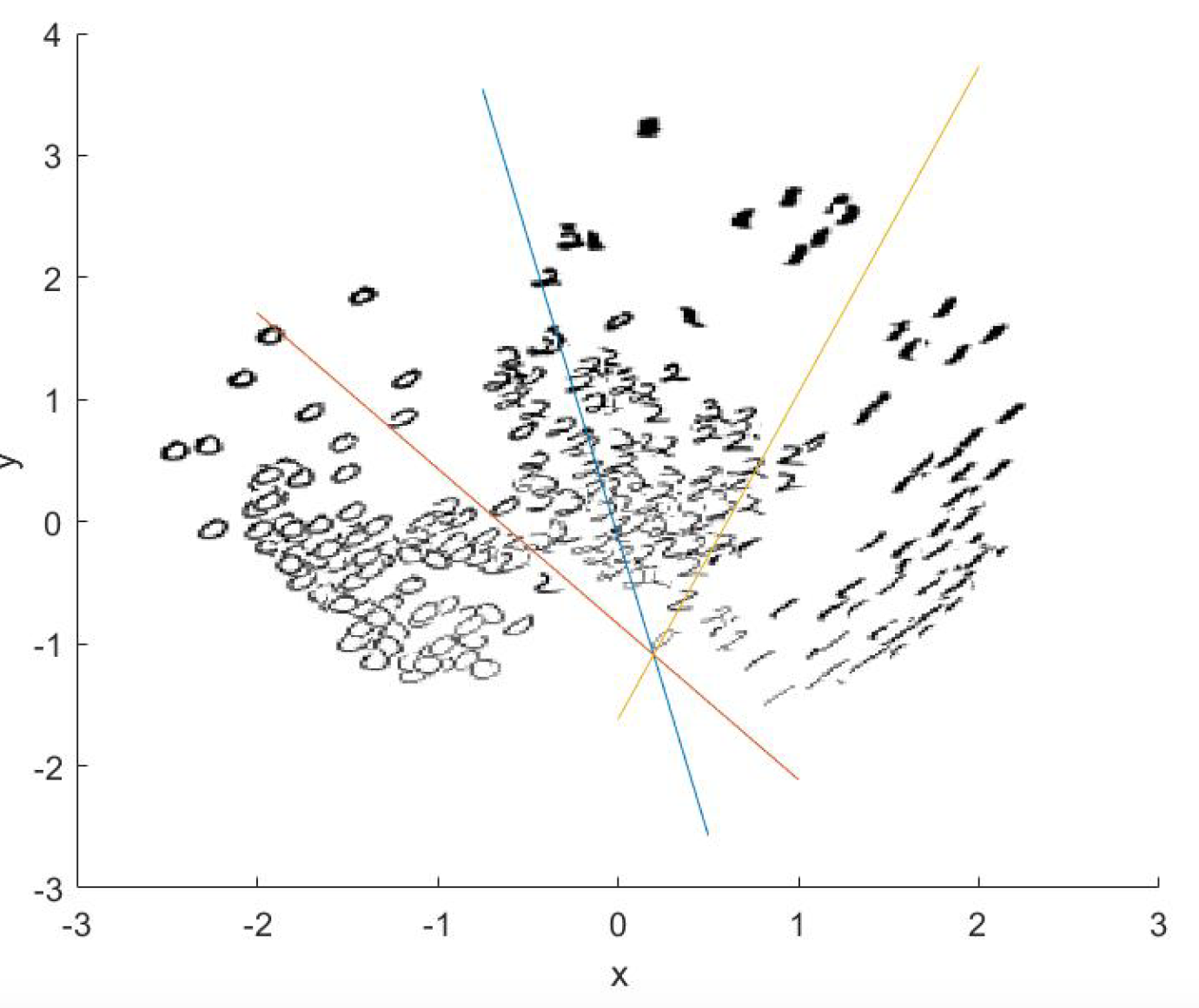
a\_1=mu1\_b'\*inv(sigma\_b)-mu0\_b'\*inv(sigma\_b);

a\_0=(1/2)\*((mu0\_b'\*inv(sigma\_b)\*mu0\_b)-(mu1\_b'\*inv(sigma\_b)\*mu1\_b));

syms x y

h3 = ezplot((a\_1(1)\*x+a\_1(2)\*y+a\_0),[-3,3]);

h2.Color = 'y';



(c-QDA)

load('0\_1\_2.mat');

mu = mean(X,2);

a = X - mu\*ones(1,300);

[u,s,v]=svd(a);

b=u(:,1:2)'\*a;

plotimages(reshape(X,8,8,300),b,0.05,0.5)

sigma0=cov(b(:,1:100)');

sigma1=cov(b(:,101:200)');

sigma2=cov(b(:,201:300)');

a0\_1=inv(sigma0)-inv(sigma1);

b0\_1=2\*(mu0\_b'\*inv(sigma0)-mu1\_b'\*inv(sigma1));

c0\_1=mu0\_b'\*inv(sigma0)\*mu0\_b-mu1\_b'\*inv(sigma1)\*mu1\_b+log(det(sigma0))-log(det(sigma1));

a1\_2=inv(sigma1)-inv(sigma2);

b1\_2=2\*(mu1\_b'\*inv(sigma1)-mu2\_b'\*inv(sigma2));

c1\_2=mu1\_b'\*inv(sigma1)\*mu1\_b-mu2\_b'\*inv(sigma2)\*mu2\_b+log(det(sigma1))-log(det(sigma2));

a0\_2=inv(sigma0)-inv(sigma2);

b0\_2=2\*(mu0\_b'\*inv(sigma0)-mu2\_b'\*inv(sigma2));

c0\_2=mu0\_b'\*inv(sigma0)\*mu0\_b-mu2\_b'\*inv(sigma2)\*mu2\_b+log(det(sigma0))-log(det(sigma2));

plotimages(reshape(X,8,8,300),Ya,0.01,1);

hold on

syms x y

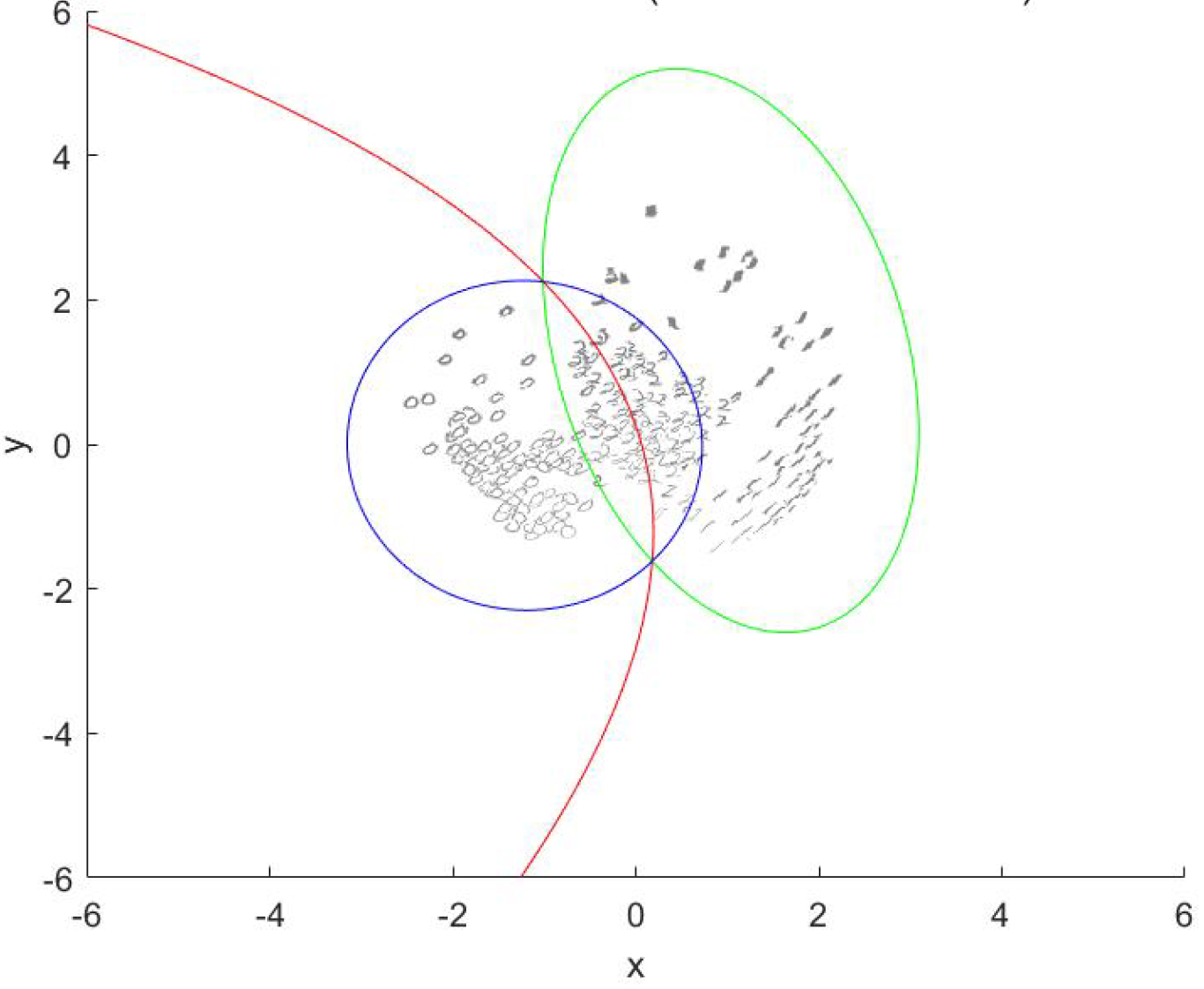
set(ezplot(a0\_1(2,2)\*y^2+(a0\_1(2,1)\*x+a0\_1(1,2)\*x-b0\_1(2))\*y+a0\_1(1,1)\*x^2-b0\_1(1)\*x+c0\_1,[-6,6]));

hold on

set(ezplot(a0\_2(2,2)\*y^2+(a0\_2(2,1)\*x+a0\_2(1,2)\*x-b0\_2(2))\*y+a0\_2(1,1)\*x^2-b0\_2(1)\*x+c0\_2,[-6,6]));

hold on

set(ezplot(a1\_2(2,2)\*y^2+(a1\_2(2,1)\*x+a1\_2(1,2)\*x-b1\_2(2))\*y+a1\_2(1,1)\*x^2-b1\_2(1)\*x+c1\_2,[-6,6]));



(e)

h=zeros(3,300);

SIGMA=ones(64,64);

for i =1:300

    h(1,i)=X(:,i)'\*mu1-(1/2)\*mu1'\*mu1+log(1/3)

    h(2,i)=X(:,i)'\*mu2-(1/2)\*mu2'\*mu2+log(1/3)

    h(3,i)=X(:,i)'\*mu3-(1/2)\*mu3'\*mu3+log(1/3)

end;

[Y,I]=max(h,[],1);

R=[repmat(1,1,100),repmat(2,1,100),repmat(3,1,100)];

error=1-sum(I==R)/300;

error=0.0733

(f)

Yes and the code is below. The difference is in (f) we do not choose main components, but in (c) we conduct PCA and find the first 2 main components and using data with dimension 2\*300

mu1=mean(X(:,1:100),2);

mu2=mean(X(:,101:200),2);

mu3=mean(X(:,201:300),2);

Sigma=cov(X');

est=zeros(1,300);

for i=1:300

[com1,com2]=max([-(X(:,i)-mu1)'\*inv(Sigma)\*(X(:,i)-mu1),-(X(:,i)-mu2)'\*inv(Sigma)\*(X

(:,i)-mu2),-(X(:,i)-mu3)'\*inv(Sigma)\*(X(:,i)-mu3)]);

resulte(1,i)=com2-1;

end

true=[repmat(0,1,100),repmat(1,1,100),repmat(2,1,100)];

errorrate1=1-sum(est==answer1)/300;