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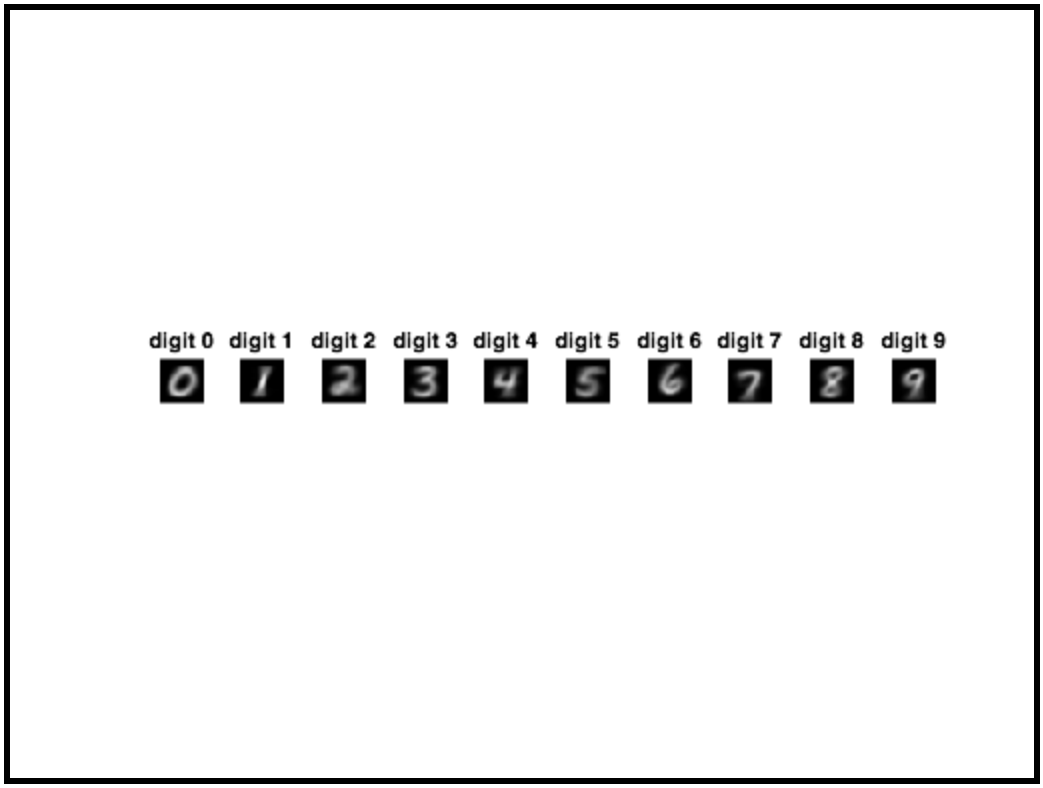
ECE 175A HW3

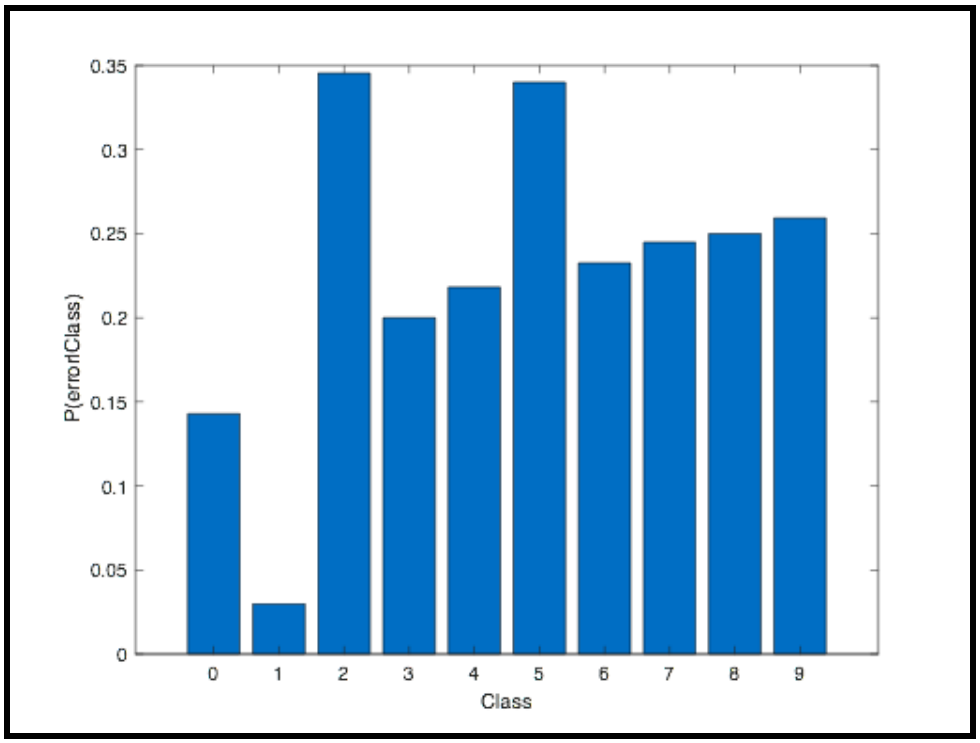
(1)Display of sample mean



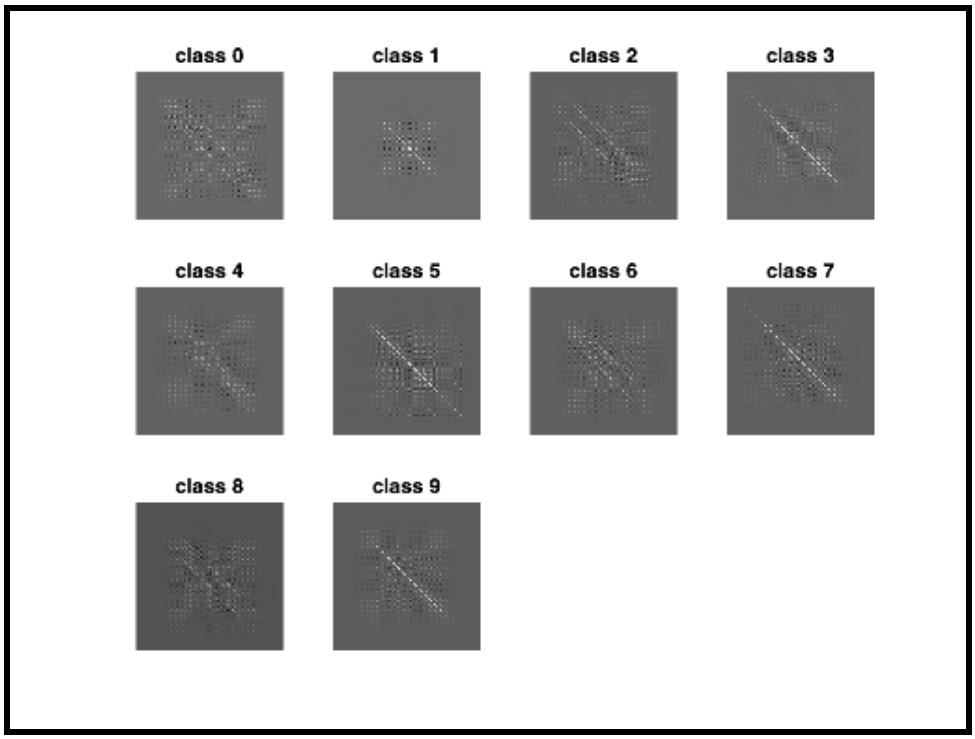
(2) Error rate for digit 0-9 and total error rate

```
errorrate =

    0.1429    0.0299    0.3455    0.2000    0.2182    0.3400    0.2326    0.2449    0.2500    0.2593


total_error_rate =

    0.2220
```

Plot the error rate for each class



(3)Display of the covariance matrix for class 0-9 (extra credit)



We can not use these covariance matrices to do distance computation because the matrices are **not invertible**. When I plugged in those matrices to calculate BDR, my matlab screen showed the following:

```
> In untitled (line 81)
Warning: Matrix is singular to working precision.
> In untitled (line 81)
Operation terminated by user during untitled (line 81)
```

```
%(1) Calculate and plot the mean for each class
mean=zeros(784,10);
figure;
for i=0:9
[a,b]=find(labelTrain==i);
c=size(a);
sum=0;
for j=1:c(1)
    sum=sum+imageTrain(:,:,a(j));
end
m=sum/c(1);
subplot(1,10,i+1)
imshow(uint8(m));
%title(sprintf("digit %d",i));
d=m(:);
mean(:,i+1)=mean(:,i+1)+d;
end

%(2) Calculate and plot the error rate for each class and total error
rate, plot them
figure;
TestStack=zeros(784,500);
for i=1:500
    OneImage=zeros(28,28);
    OneImage=imageTest(:,:,i);
    d=OneImage(:);
    TestStack(:,i)=TestStack(:,i)+d;
end
d=zeros(10,500);
for i=1:10
   for j=1:500
        dis(i,j)=-0.5*(TestStack(:,j)-mean(:,i))'*(TestStack(:,j)-
mean(:,i));
   end
end
I=zeros(500,1);
class=zeros(500,1);
for i=1:500
 [M,I]=max(dis(:,i));
 class(i)=I-1;
end
errorrate=zeros(1,10);
error=zeros(1,10);
for c=0:9
x=find(labelTest==c);
for j=1:length(x)
```

```
if class(x(j))~=labelTest(x(j))
    error(c+1)=error(c+1)+1;
end
end
 errorrate(c+1)=error(c+1)/length(x);
end
total_error=0;
for i=1:10
    total_error=error(i)+total_error;
end
total_error_rate=total_error/500;
bar(0:9,errorrate)
xlabel('Class');
ylabel('P(error|Class)');

%(3)extra credit
 Cov=zeros(784,784,10);
for i=0:9
[a,b]=find(labelTrain==i);
c=size(a);
TrainStack=zeros(784,c(1));
 S=zeros(784,784);
for k=1:c(1)
    L=imageTrain(:,:,a(k));
    TrainStack(:,k)=L(:);
    S=S+(TrainStack(:,k)-mean(:,i+1))*(TrainStack(:,k)-mean(:,i+1))';
end
Cov(:,:,i+1)=S/c(1);
end
figure;
for i=1:10
subplot(3,4,i)
imshow(Cov(:,:,i),[])
end
```