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ECE 175A HW4

(a)

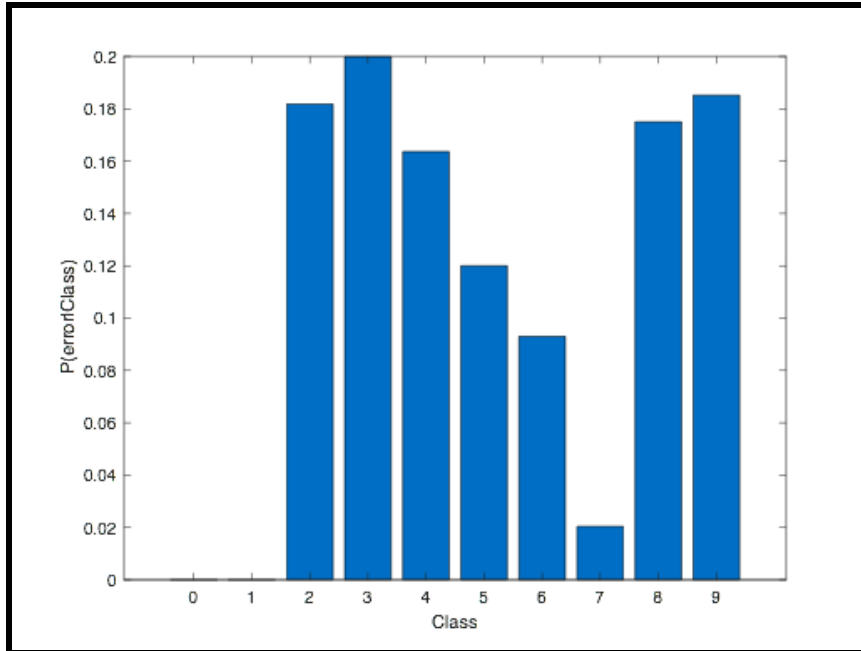Use the least square solution:

a=(x'*x)^-1*x'*y

```
sampletest=imread('sampletest.png');
sampletrain=imread('sampletrain.png');
sampletest=double(sampletest(:));
sampletrain=double(sampletrain(:));
a=inv((sampletrain'*sampletrain))*sampletrain'*sampletest;
```

```
a =

    0.6796
```

(b)

```
errorrate1 =

        0        0    0.1818    0.2000    0.1636    0.1200    0.0930    0.0204    0.1750    0.1852


totalerrorrate1 =

    0.1120
```
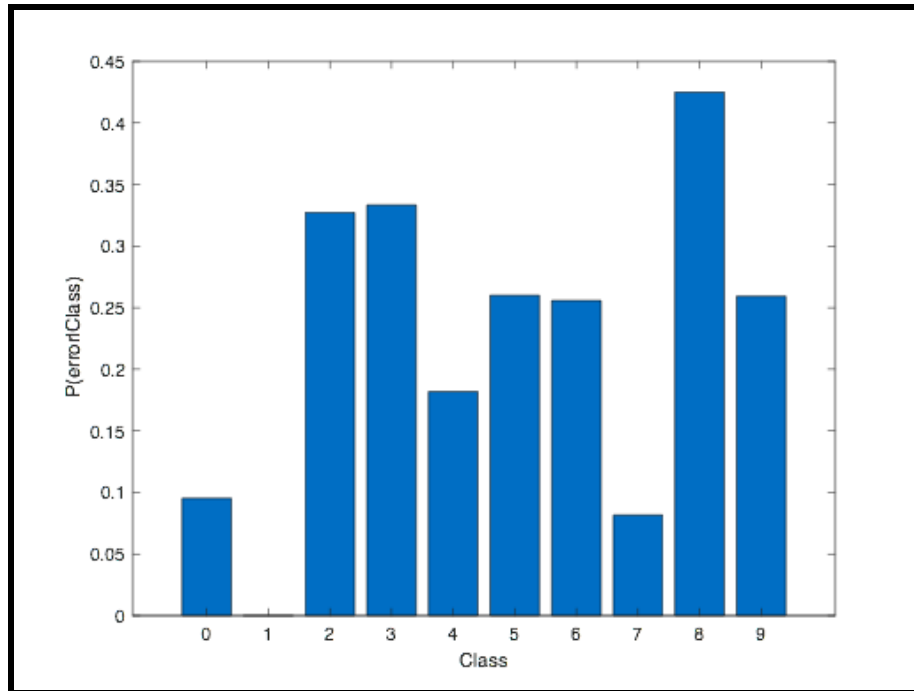
(c)

```
errorrate2 =

   0.0952        0    0.3273    0.3333    0.1818    0.2600    0.2558    0.0816    0.4250    0.2593

totalerrorrate2 =

   0.2120
```

The NN classification using Euclidean distance metric has **higher** error rate than the least square distance metric.

```matlab
%(1)
sampletest=imread('sampletest.png');
sampletrain=imread('sampletrain.png');
sampletest=double(sampletest(:));
sampletrain=double(sampletrain(:));
a=inv((sampletrain'*sampletrain))*sampletrain'*sampletest;

%(2)
class1=zeros(500,1);
for i=1:500
d1=zeros(5000,1);
for j=1:5000
testimage=reshape(imageTestNew(:,:,i),784,1);
trainimage = reshape(imageTrain(:,:,j),784,1);
normalizeTest=testimage/a;
d1(j)=sqrt(sum((normalizeTest-trainimage).^2));
end
[M,I]=min(d1);
class1(i)=labelTrain(I);
end
figure;
errorrate1=zeros(1,10); %%calculate the error rate for each class
error1=zeros(1,10);
for c=0:9
x=find(labelTestNew==c);
for j=1:length(x)
if class1(x(j))~=labelTestNew(x(j))
    error1(c+1)=error1(c+1)+1;
end
end
 errorrate1(c+1)=error1(c+1)/length(x);
end
totalerrorrate1=sum(error1)/500; %% calculate the total error rate
bar(0:9,errorrate1)   %%plot the error rate for each class
xlabel('Class');
ylabel('P(error|Class)');

%(3)
class2=zeros(500,1);
for i=1:500
d2=zeros(5000,1);
for j=1:5000
d2(j)=sqrt(sum(sum((imageTrain(:,:,j) - imageTestNew(:,:,i)).^2)));
end
[M,I]=min(d2);
class2(i)=labelTrain(I);
```

```matlab
end
figure;
errorrate2=zeros(1,10); %%calculate the error rate for each class
error2=zeros(1,10);
for c=0:9
x=find(labelTestNew==c);
for j=1:length(x)
if class2(x(j))~=labelTestNew(x(j))
    error2(c+1)=error2(c+1)+1;
end
end
 errorrate2(c+1)=error2(c+1)/length(x);
end
totalerrorrate2=sum(error2)/500; %% calculate the total error rate
bar(0:9,errorrate2)   %%plot the error rate for each class
xlabel('Class');
ylabel('P(error|Class)');
```