Problem - I

1-a

```
clear all;
iris=load('data/iris.txt');
X = iris(:,1:2); Y=iris(:,end);
[X,Y] = shuffleData(X,Y);
X = rescale(X);
XA = X(Y<2,:); YA=Y(Y<2);
XB = X(Y>0,:); YB=Y(Y>0);
figure;
gscatter(XA(:,1),XA(:,2),YA);
figure;
gscatter(XB(:,1),XB(:,2),YB);
```
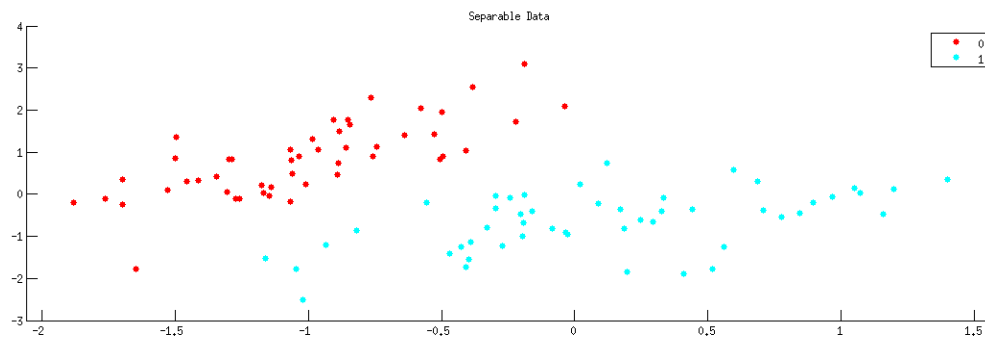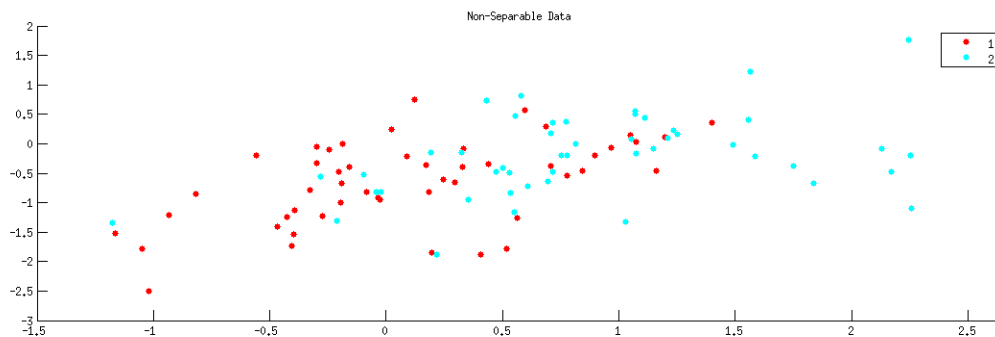

Figure 1: Separable Data

Figure 2: Non Separable Data

Problem-b
The part to be filled in Plot2DLinear.m looks like:

```
u=unique (Y);
class0 = find(Y==u(1));
class1= find(Y==u(2));
Xplt = linspace(min(X(:,1)),max(X(:,1)),200);
plot(X(class0,1),X(class0,2),'ro',...
X(class1,1),X(class1,2),'gx',...
Xplt,-obj.wts(1)/obj.wts(3) - obj.wts(2)/obj.wts(3).*Xplt,'b-');
```

To, verify, we manually set the weights to [0.5,1,-0.25] and plot it as shown in Fig3 and Fig4.

```
learner=logisticClassify2();
learner=setClasses(learner, unique(YA));
wts = [0.5 1 -0.25];
learner=setWeights(learner, wts);

figure;
plot2DLinear(learner,XA,YA)
figure;
plot2DLinear(learner,XB,YB)
```
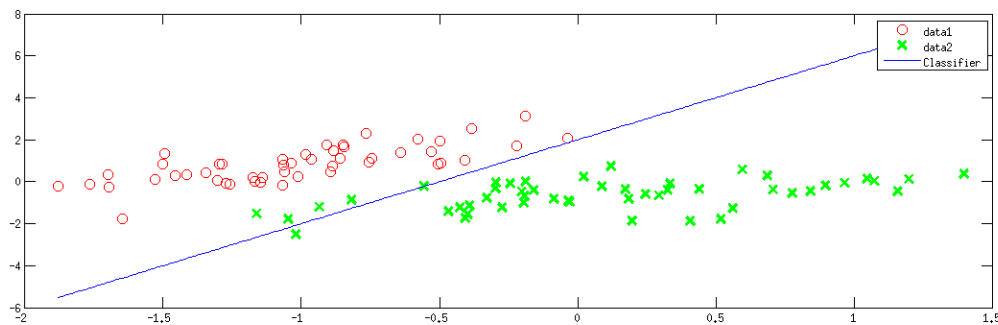

Figure 3: Separable Data

1-c
The predict.m function looks like

```
function Yte = predict(obj,Xte)
z = ( obj.wts(1) + Xte*obj.wts(2:end)');
sig = (1+exp(-z)).^(-1);
for i=1:size(sig)
if(sig(i) >0.5)
    Yte(i) = 1;
else
    Yte(i) = 0;
```
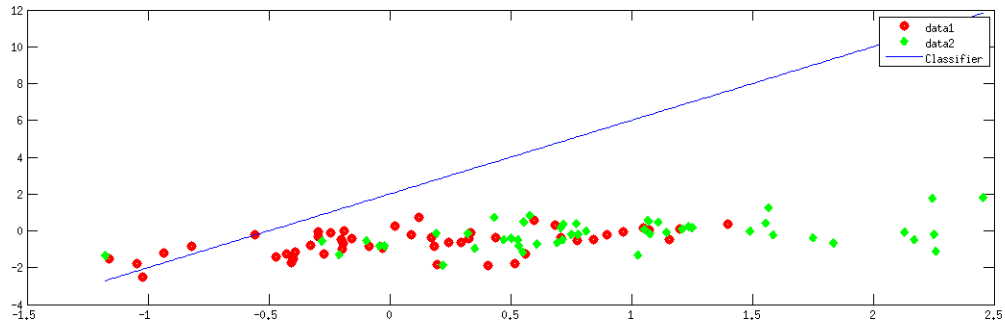
Figure 4: Non Separable Data

```
end
end
end
```

Ton Test we ran the general plotClassify2D.m and the results are shown in Fig 5, Fig6

```
figure;
plotClassify2D(learner,XA,YA)
figure;
plotClassify2D(learner,XB,YB)
```

Miss-classification rate is around 0.05 for the first data.

1-d The outer loop initialization:

```
iter=1;
done=0;
err=zeros(1,maxSteps);
```

Loop Initializarions :

```
while (~done)
stepi = stepsize;
grad= zeros(1,d+1);
e=0;
```

The Update:

```
for i=1:n,
% for each data example,
stepi = stepsize/i;
% harmonically decreasing Step Size
z = (Xtrain1(i,:))*(obj.wts)';
% compute linear response
s = 1./(1+exp(-z));
grad = (-1/n)*(Ytrain(i)-s).*(Xtrain1(i,:));
%perceptron update rule
```
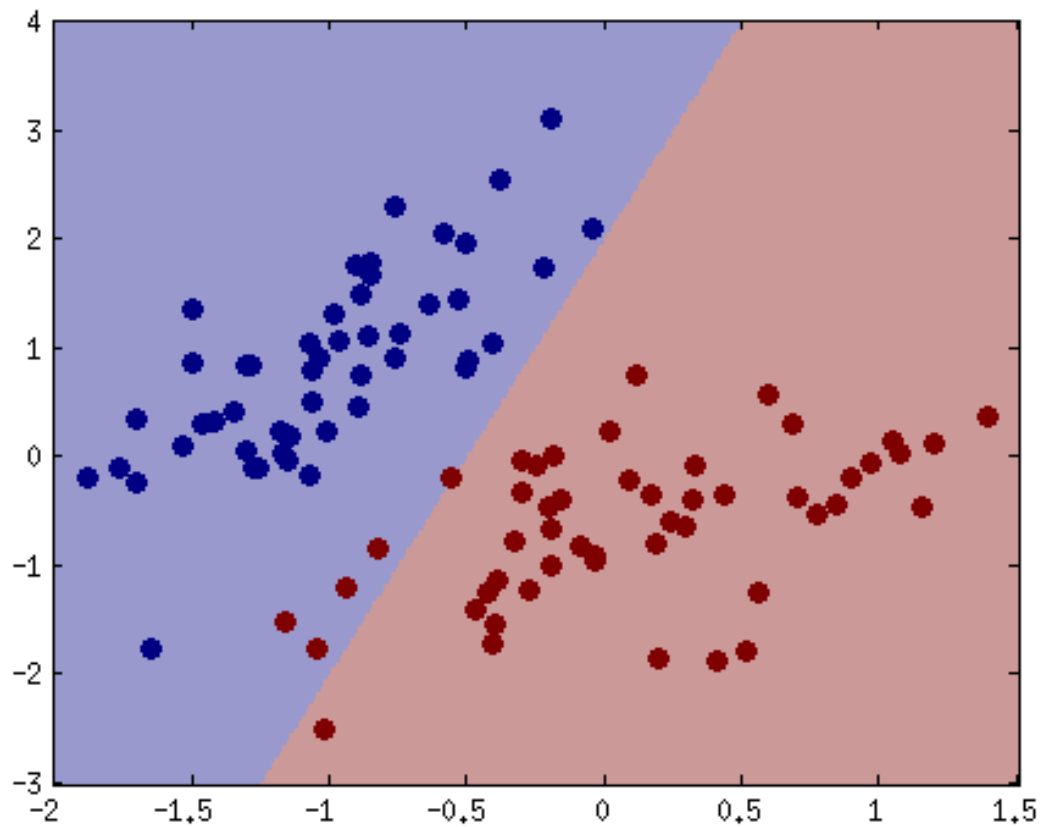
3

Figure 5: Separable Data

```
obj.wts = obj.wts - (stepi) * grad ;
end;
n_log(iter)= e;
% Compute current error values
err(iter) = mean( (Ytrain~=(sign(Xtrain1*obj.wts')+1)/2) );
```

The Stopping Condition:

```
done = (iter >= maxSteps || err(iter)==0);
iter = iter + 1;
```

1-f a
For the Separable Data: Misclassification Rate is : approx. 0.035
b
For the non-separable Data Misclassification rate is almost 0.42 Step Size is chosen 0.1 and MaxIter is set to 5000. However with some more trial and error it might be improved a little.
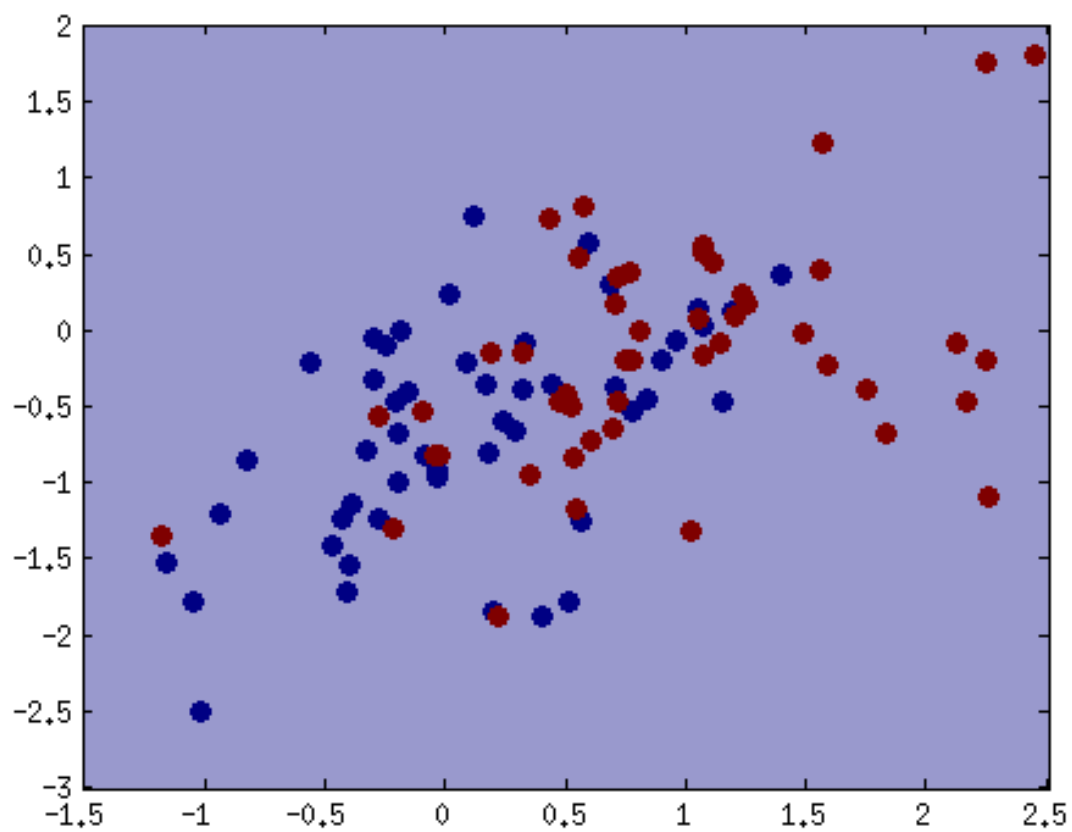
Figure 6: Non Separable Data
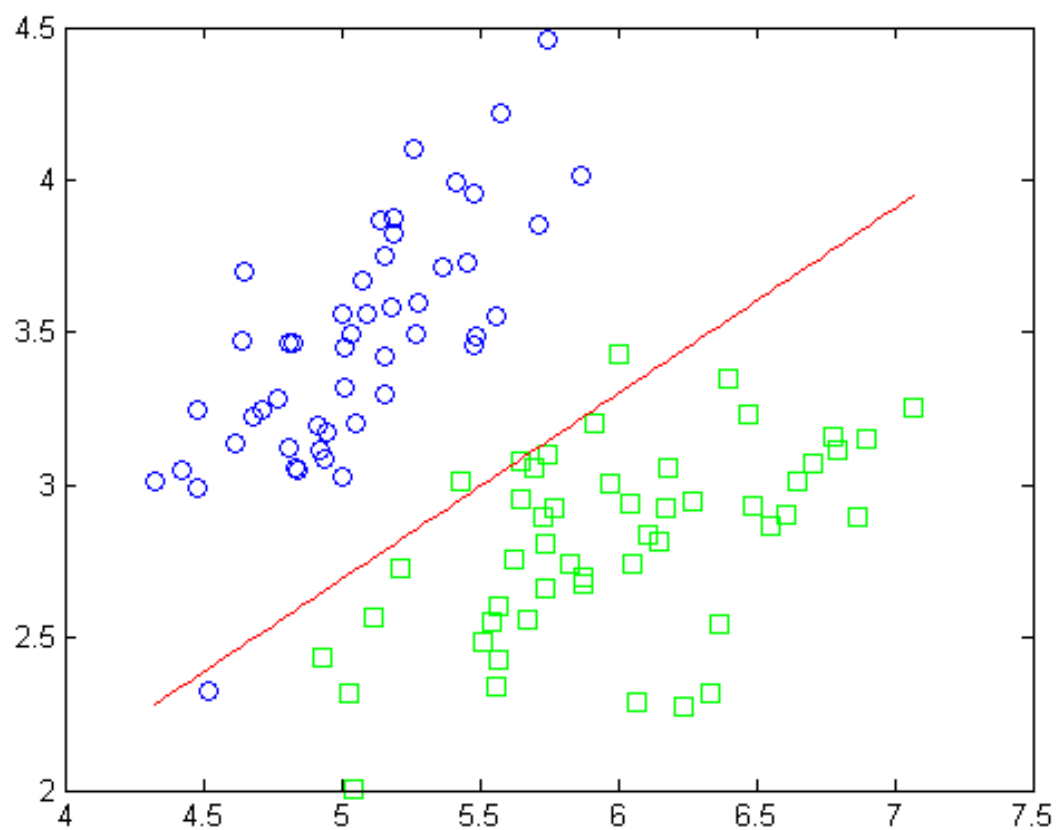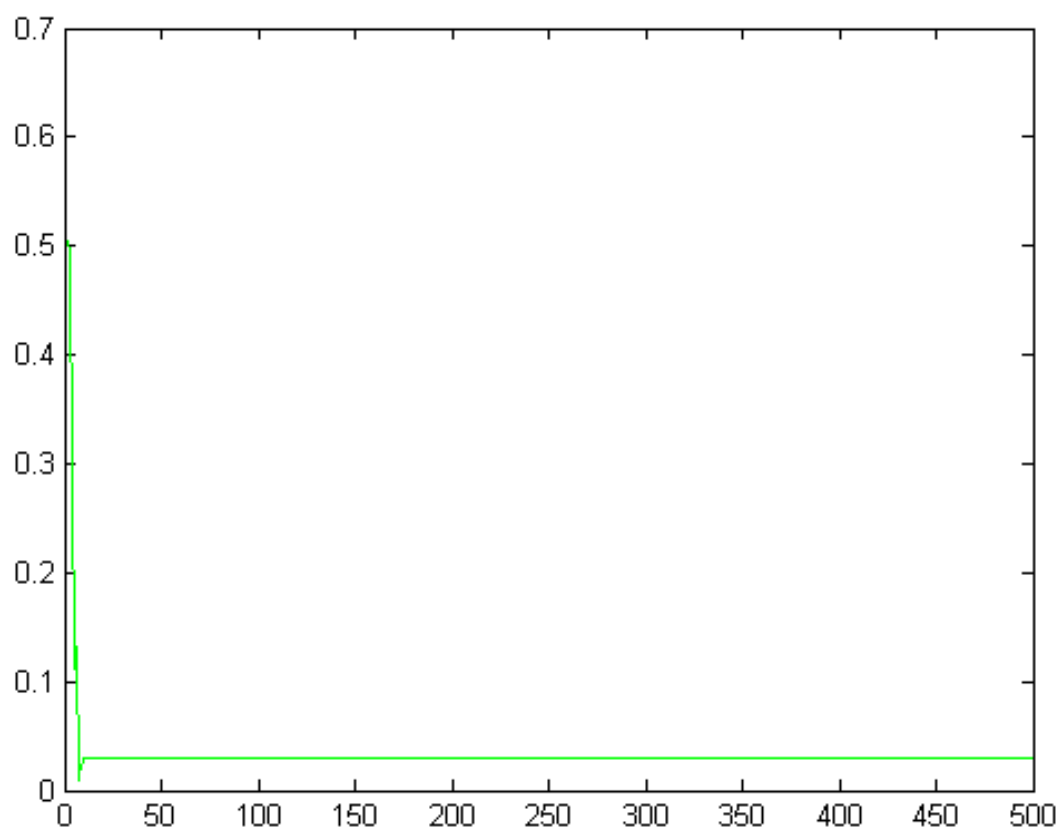
Figure 7: Classifier

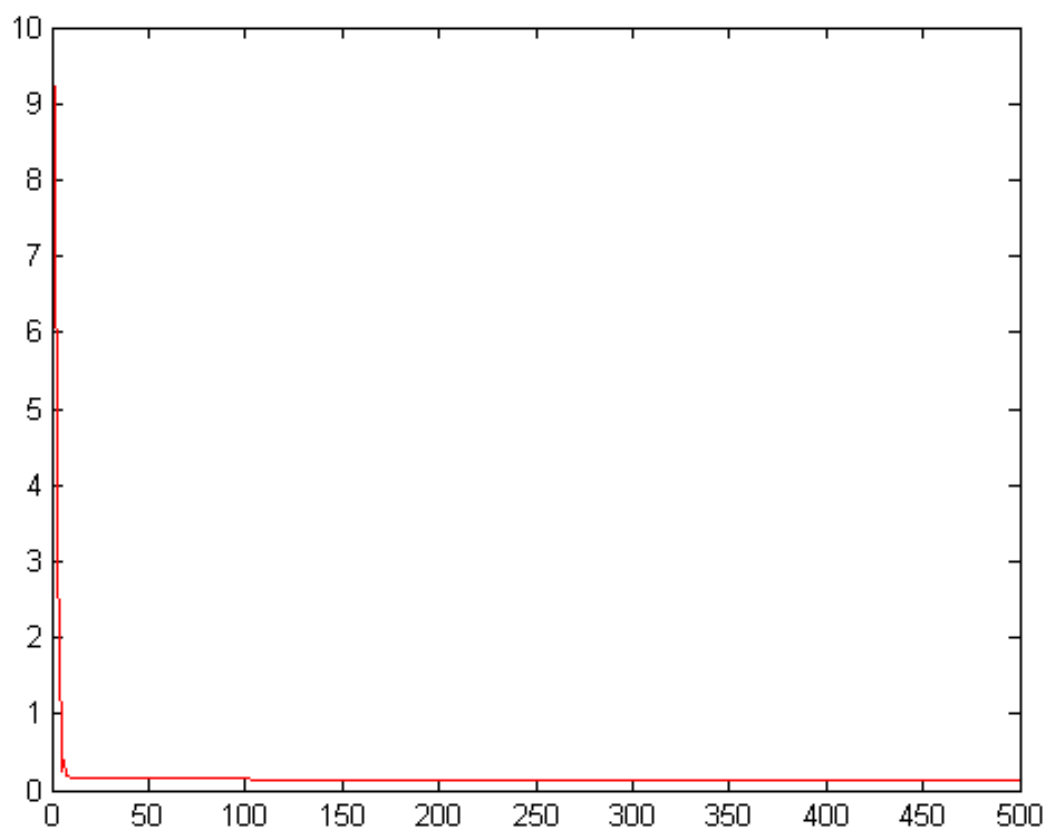Figure 8: Misclassification Error

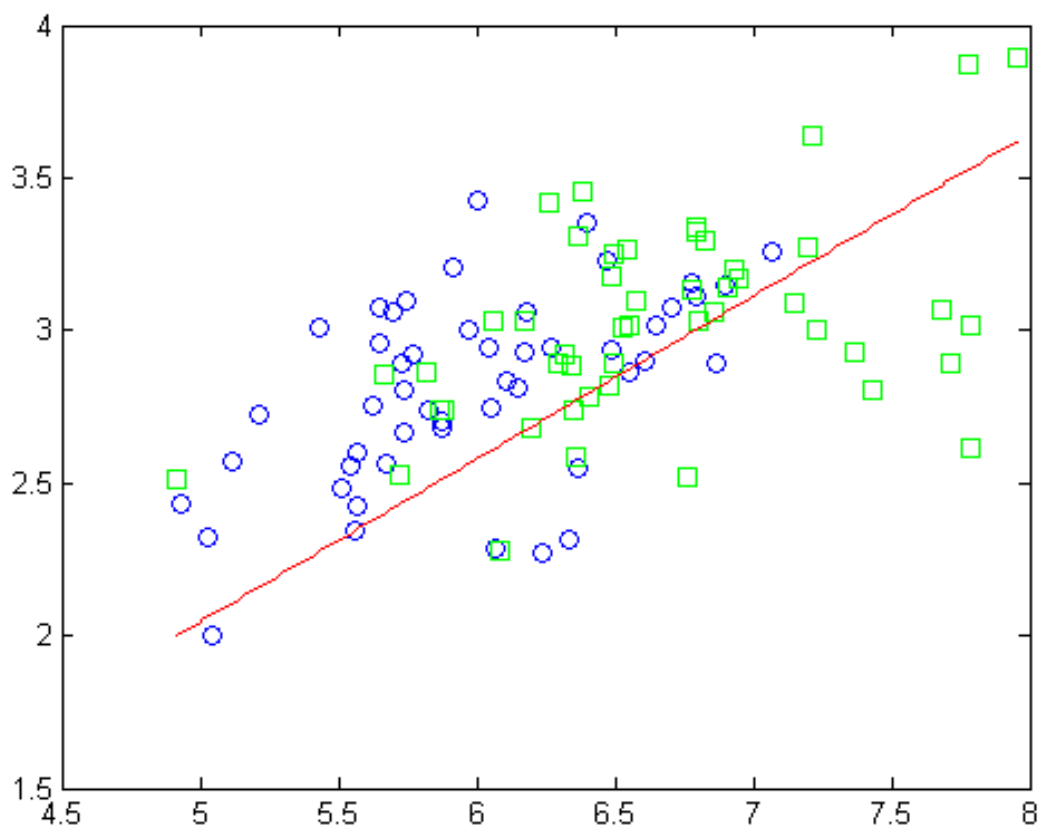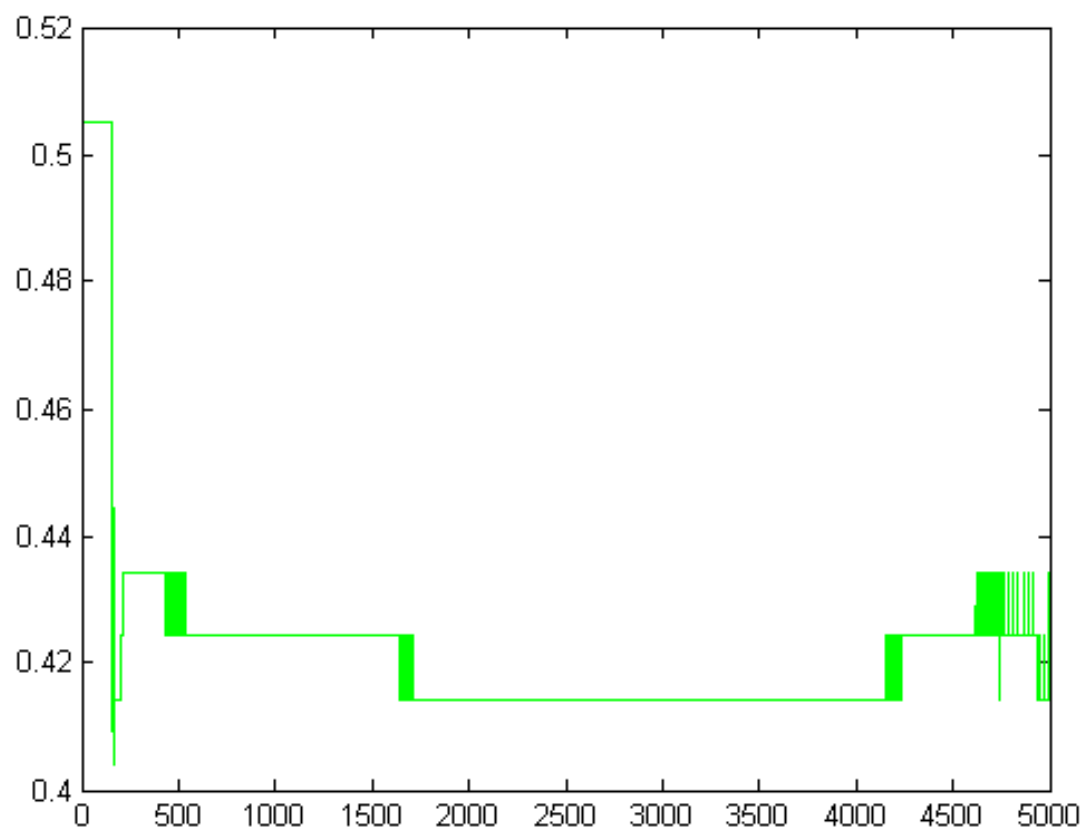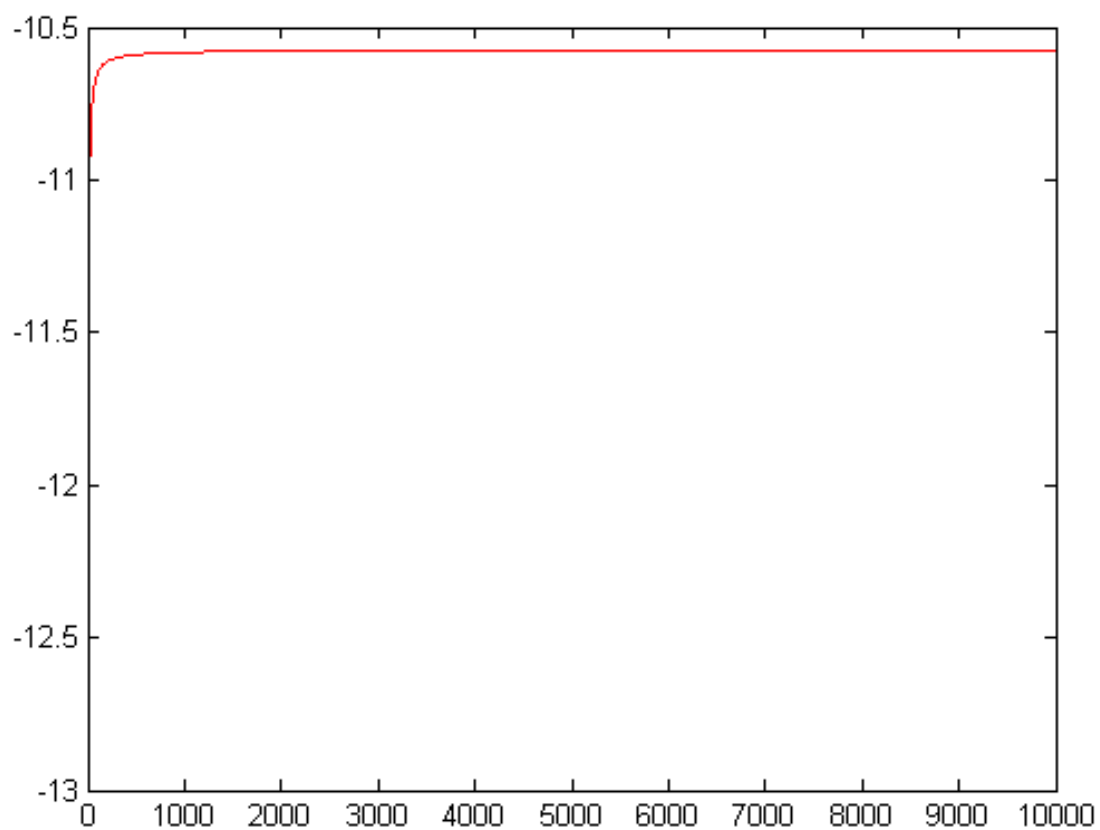Figure 9: Neg Log Likelihood Err

Figure 10: Classifier

Figure 11: Misclassification Error

Figure 12: Neg Log Likelihood Error