SAGNIK BASU 113EC0199

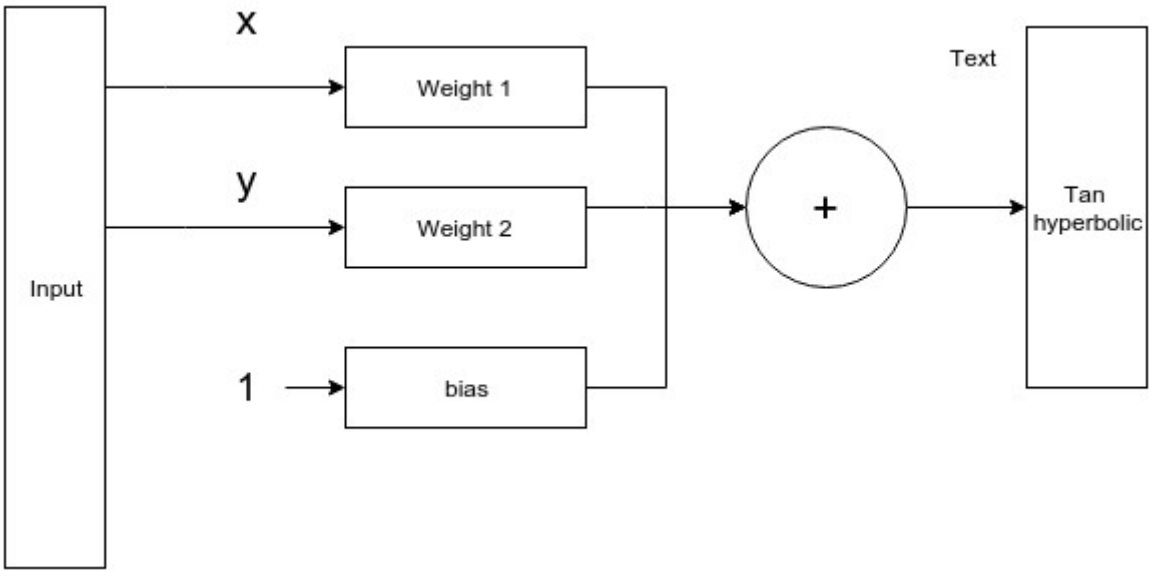
QUESTION

Application of Perceptron/ Adaline in function approximamtion

Design a perceptron to approximate the function z=sin(pi*x).Cos(pi*y) where -0.5 <= x, y <= 0.5. The perceptron consist of 2 inputs and 2 weights with only one threshold. Train the weights and threshold using perceptron learning rule. Consider a suitable activation function based on the application. Generate a training data table consisting of 100 samples spread across the input space. After training, determine the mean square error (MSE) of the network for the output for these 100 samples which are different from the input training data set.

SOLUTION

ARCHITECTURE

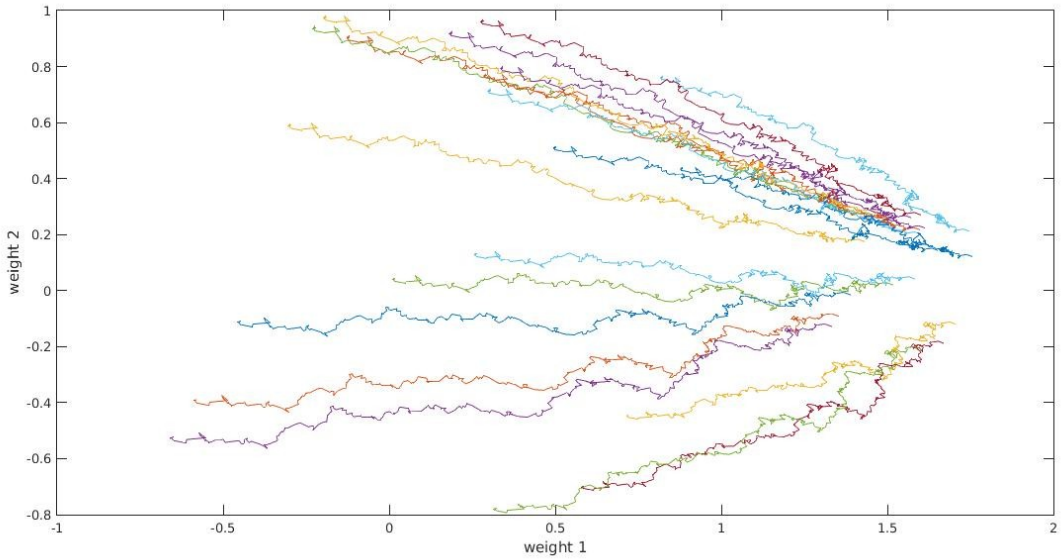


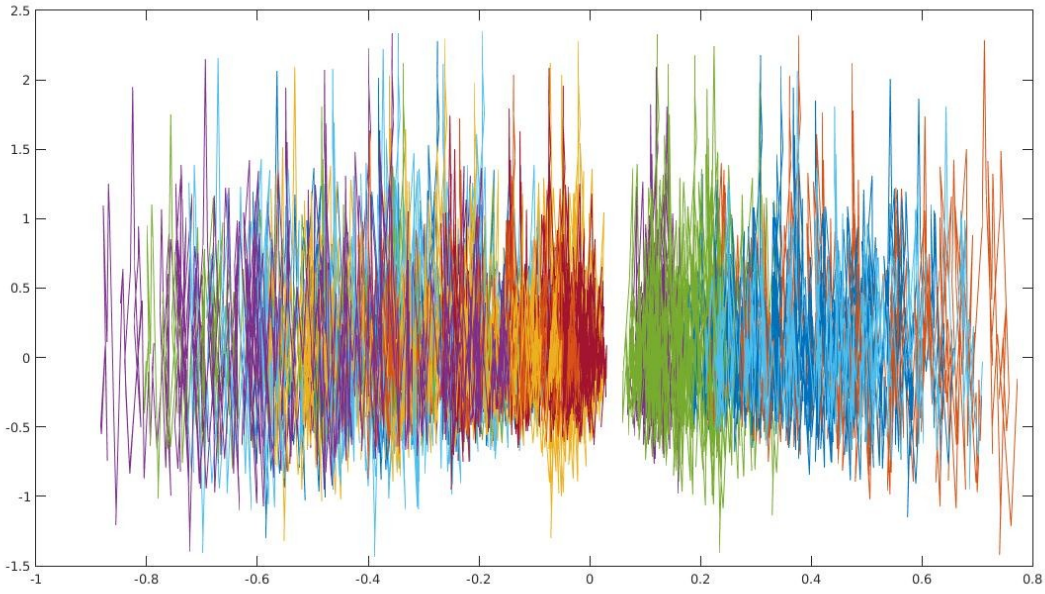
MATLAB CODE

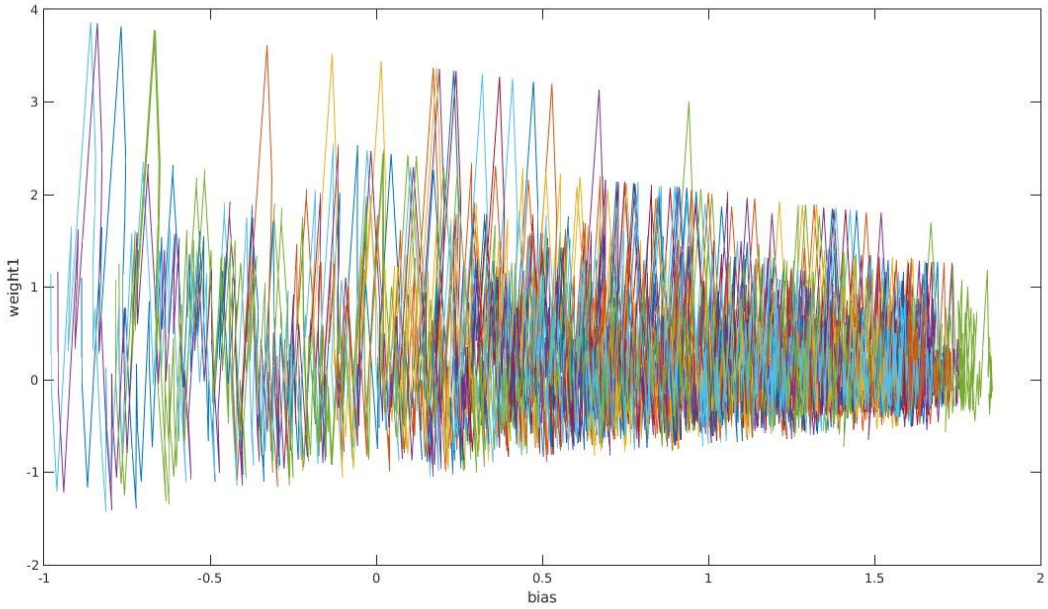
```
clc;
clear all;
close all;

% Function Approximation using perceptron
%
% Function = sin(x)*cos(y)
%

constant=500;
x=rand(1,constant)-0.5; %training table
y=rand(1,constant)-0.5;
inp=zeros(constant,2);
for i=1:length(x)
    inp(i,1)=x(i);
    inp(i,2)=y(i);
end
thr=0.000001;
for j=1:20
    var1=2*rand(1,1)-1;
    var2=2*rand(1,1)-1;
w=[var1 var2];
z_des=sin(pi*x).*cos(pi*y); %desired output
bias=rand(1,1);
e=100000000;
weight1=zeros(1,constant);
weight2=zeros(1,constant);
bias1=zeros(1,constant);
for i=1: length(x)
    e=100000000;
    while(e>thr)
     f=w(1)*x(i)+w(2)*y(i)+ bias;
     g=(exp(f)-exp(-f))/(exp(f)+exp(-f)); %tanh activation func
     e=z_des(i)-g; %error
     w=w+e*.040*inp(i,:);  %updating weight values
     bias=bias+e;
    end
    weight1(i)=w(1);
    weight2(i)=w(2);
    bias1(i)=bias;

end
plot(weight2,bias1);
hold on;
%plot(weight1,bias1);
%hold on;
end;
hold off;
percp=zeros(1,length(x));
for i=1:length(x)
    percp(i)=w(1)*x(i)+w(2)*y(i)+ bias;
end;


%nstant_test=500;
```

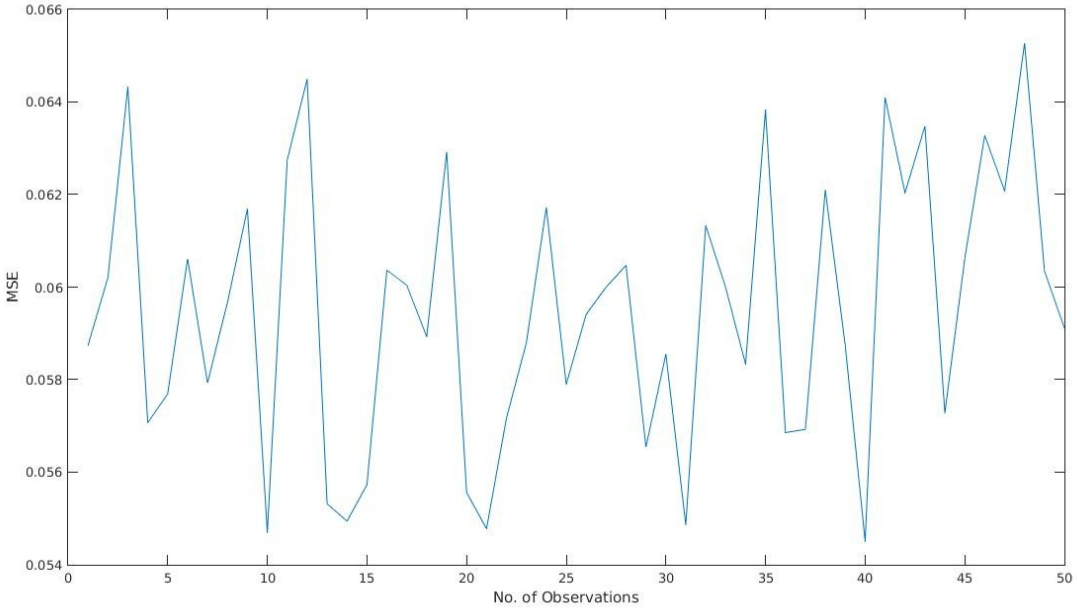
```
%no for testing our perceptron

for k=1:500
    error=0;
    constant_test=500;
    x_test=rand(1,constant_test)-0.5; %training table
    y_test=rand(1,constant_test)-0.5;

    for i=1:length(x_test)
     check1=sin(pi*x_test(i).*cos(pi*y_test(i)));
     check2=w(1)*x_test(i)+w(2)*y_test(i)+ bias;
     final_err=check1-check2;
     error=error+(final_err*final_err);
    end
    MSE(k)=error/length(x);
    z=zeros(constant,constant);

    plot(MSE);
    hold on;

end
for i=1:length(x)

        real(i,j)=sin(pi*x(i)).*cos(pi*y(i));
        estimated(i,j)=w(1)*x(i)+w(2)*y(i)+ bias;

end
%hold off;
%subplot(2,2,1);
%plot(real);
%subplot(2,2,2);
%plot(estimated);
%axis([1 100 1 100]);
%plot(z_des);
%plot(weight1,weight2);
```

FIGURES


weight 2
weight 1
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-0.5
0
0.5
1
1.5
2


2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8


weight1
bias
4
3
2
1
0
-1
-2
-1
-0.5
0
0.5
1
1.5
2


MSE
No. of Observations
0.066
0.064
0.062
0.06
0.058
0.056
0.054
0
5
10
15
20
25
30
35
40
45
50