LAB MANUAL

Subject : Neural Networks Lab
Code : LC-CSE-421

Department of Computer Science
Engineering
RPS College of Engineering and Technology
Mahendergarh, Haryana - 123029

INSTRUCTIONS
<table>
<thead>
<tr>
<th>PROGRAM NO.</th>
<th>NAME OF PROGRAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Write a program to assign the following through a variable &amp; display the result in MATLAB.</td>
</tr>
<tr>
<td>2</td>
<td>Write a program to perform the basic matrix operations in MATLAB.</td>
</tr>
<tr>
<td>3</td>
<td>Write a program to plot the sine curve in MATLAB.</td>
</tr>
<tr>
<td>4</td>
<td>Write a program for McCulloch Pitts Model AND realization</td>
</tr>
<tr>
<td>5</td>
<td>Plot the graph for various activation function</td>
</tr>
<tr>
<td>6</td>
<td>Write a program in MATLAB for perceptron net for an AND function with bipolar inputs and targets</td>
</tr>
<tr>
<td>7</td>
<td>Write a MATLAB program for Hebb net to classify two-dimensional input patterns in bipolar with their targets given below. ‘*’ indicates a ‘1’ &amp; (.) indicates ‘-1’.</td>
</tr>
<tr>
<td>8</td>
<td>How the choice of activation function affects the output of neuron</td>
</tr>
<tr>
<td>9</td>
<td>Write a MATLAB program to find the weight matrix of an auto associative net to store the vector (1 1 -1 -1). Test the response of the network by presenting the same pattern and recognize whether it is a known vector or unknown vector.</td>
</tr>
<tr>
<td>10</td>
<td>Write an M-file to stores the vectors (-1 -1 -1 -1) and (-1 -1 1 1) in an associative net. Find the weight matrix. Test the net with (1 1 1 1) as input.</td>
</tr>
<tr>
<td>11</td>
<td>Generate ANDNOT function using McCulloch -Pitts neural net by a MATLAB program.</td>
</tr>
</tbody>
</table>
LAB REQUIREMENTS

HARDWARE REQUIREMENT:

- Processor: Any Intel or AMD x86-64 processor with two or more cores (minimum), or with four or more cores and AVX2 instruction set support (recommended).
- RAM: Minimum 4 GB (8 GB recommended).

SOFTWARE REQUIREMENT:

- Operating System: Windows 10, 11 (64-bit).
- MATLAB
PROGRAM 1: Write a program to assign the following through a variable & display the result in MATLAB.

CODE OF PROGRAM NO. 1:

```matlab
>> a=(3+4)/(5+6)
a = 0.6364

>> b=2*3.14*3.14
b = 19.7192

>> c=sqrt(2)
c = 1.4142

>> (3.5-6/8)*8^2
ans = 176
```

OUTPUT OF PROGRAM NO. 1:

```
a = 0.6364
b = 19.7192
c = 1.4142
ans = 176
```
PROGRAM 2: Write a program to perform the basic matrix operations in MATLAB.

CODE OF PROGRAM NO. 2:

```matlab
>> magic(3)

ans

8  1  6
3  5  7
4  9  2

>> a=ones(3)

a =

1  1  1
1  1  1
1  1  1

>> a=a*2

a =

2  2  2
2  2  2
2  2  2
>> a=[1 3 5; 2 4 7]

a =

    1     3     5
    2     4     7

>> b=[-5 8 11; 3 9 21; 4 0 8]

b =

    -5     8    11
     3     9    21
     4     0     8

>> c=a*b

c =

    24    35   114
    30    52   162

OUTPUT OF PROGRAM NO. 2 : As above output in MATLAB
PROGRAM 3: Write a program to plot the sine curve in MATLAB.

CODE OF PROGRAM NO. 3:

```matlab
x = 0:3.14/100: 2*3.14;
y = sin(x);
plot(x,y);
title('a plot of sin curve');
xlabel('x-axis');
ylabel('y-axis');
```

OUTPUT OF PROGRAM NO. 3:
PROGRAM 4: Write a program for McCulloch Pitts Model AND realization

CODE OF PROGRAM NO. 4:

clear;
clc;
x1= [1 1 0 0];
x2= [1 0 1 0];
w1= input('input the value of weight w1:');
w2= input('enter the value of weight w2:');
t= input('input the value of threshold value:');
for i=1:4
    n= (x1(i)*w1+x2(i)*w2);
    if(n>=t)
        y(i)=1;
    else
        y(i)=0;
    end
end
disp('x1  x2  y');
disp(x1);
disp(x2);
disp(y);

OUTPUT OF PROGRAM NO. 4:

input the value of weight w1:1
enter the value of weight w2:1
input the value of threshold value:2

x1  x2  y
1 1 0 0
1 0 1 0
1 0 0 0
PROGRAM 5: Plot the graph for various activation function

CODE OF PROGRAM NO. 5:

```matlab
x= -10:0.1:10;
temp= exp(-x);
y1=1./(1+temp);
y2= (1-temp)./(1+temp);
y3=x;
subplot(231); plot(x,y1); grid on;
axis([min(x) max(x) -2 2]);
title('logistic function');
xlabel('(a)');
axis('square');
subplot(232); plot(x,y2); grid on;
axis([min(x) max(x) -2 2]);
title('hyperbolic tangent function');
xlabel('(b)');
axis('square');
subplot(233); plot(x,y3); grid on;
axis([min(x) max(x) min(x) max(x)]);
title('identity function');
xlabel('(c)');
axis('square');
```

OUTPUT OF PROGRAM NO. 5:
PROGRAM 6: Write a program in MATLAB for perceptron net for an AND function with bipolar inputs and targets.

The truth table for AND function is given as:

<table>
<thead>
<tr>
<th>X1</th>
<th>X2</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>-1</td>
<td>1</td>
<td>-1</td>
</tr>
<tr>
<td>1</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

CODE OF PROGRAM NO. 6:

```matlab
clear;
c;lc;
x=[1 1 -1 -1; 1 -1 1 -1];
t=[1 -1 -1 -1];
w=[0 0];
b=0;
alpha= input('enter learning rate=');
theta= input('enter threshold=');
con=1;
epoch=0;
while con
    con=0;
    for i= 1:4
        yin= b+ x(1,i)*w(1)+x(2,i)*w(2);
        if yin>theta
            y=1;
        end
        if yin<=theta & yin>=-theta
            y=0;
        end
        if yin<=-theta
            y=-1;
        end
        if y-t(i)
            con=1;
            for j=1:2
                w(j)=w(j)+alpha*t(i)*x(j,i);
            end
            b=b+ alpha*t(i);
        end
    end
end
```
epoch=epoch+1
end
disp('Percept for end function');
disp('find weight matrix');
disp(w);
disp('bias');
disp(b);

OUTPUT OF PROGRAM NO. 6:

enter learning rate=1
enter threshold=.5
epoch = 1
epoch = 2
Percept for end function
find weight matrix

    1  1

bias

    -1
PROGRAM 7: Write a MATLAB program for Hebb net to classify two-dimensional input patterns in bipolar with their targets given below. ‘*’ indicates a ‘1’ & (.) indicates ‘-1’.

\[
\begin{array}{cccccccccccccccc}
** & ** & & & & & & & & & & & & & & \\
\end{array}
\]

\( \text{(E)} \) \hspace{1cm} \( \text{(F)} \)

Target +1 \hspace{1cm} target (-1)

Solution-> The ‘*’ symbol indicates that there exist a ‘+1’ & ‘.’ Symbol indicates that there exist a ‘-1.

The input is given by,

\[
\begin{array}{ccccccccccccccc}
E= & [1 & 1 & 1 & 1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & 1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & 1] \\
F= & [1 & 1 & 1 & 1 & 1 & -1 & -1 & -1 & 1 & 1 & 1 & 1 & 1 & -1 & -1 & -1 & -1 & -1 & -1 & -1]
\end{array}
\]

CODE OF PROGRAM NO. 7:

```matlab
%Hebb Net to classify two dimensionnal input patterns
clear;
clc;

% input pattern
E=[1 1 1 1 1 -1 -1 -1 1 1 1 1 -1 -1 1 1 1 1];
F=[1 1 1 1 1 -1 -1 -1 1 1 1 1 -1 -1 -1 1 -1 -1 -1 -1];
X(1,1:20)=E;
X(2,1:20)=F;
w(1:20)=0;
t=[1 -1];
b=0;
for i=1:2
    w=w+X(i,1:20)*t(i);
b=b+t(i);
end
```

end
disp('weight matrix');
disp(w);
disp('Bias');
disp(b);

OUTPUT OF PROGRAM NO. 7:

weight matrix

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 2 2

Bias

0
**PROGRAM 8**: How the choice of activation function affects the output of neuron

**CODE OF PROGRAM NO. 8:**

```matlab
>> x= [1,2,3]

x =

1  2  3

>> w= [4,5,6]

w =

4  5  6

>> o=x*w'

o =

32

>> b=[1]

b =

1
```matlab
>> e=b*w'

```

```matlab
e =

4
5
6

>> n=o+e

```

```matlab
n =

36
37
38

>> heardlim(n)

Undefined function 'heardlim' for input arguments of type 'double'.

Did you mean:

```matlab
>> hardlim(n)

```

```matlab
ans =

1
1
1```
1

>> hardlims(n)

ans =

1
1
1
1

>> purelin(n)

ans =

36
37
38

>> logsig(n)

ans =

1.0000
1.0000
1.0000

>> tansig(n)
ans =

1

1

1

OUTPUT OF PROGRAM NO. 8: As Above output in MATLAB
PROGRAM 9: Write a MATLAB program to find the weight matrix of an auto associative net to store the vector (1 1 -1 -1). Test the response of the network by presenting the same pattern and recognize whether it is a known vector or unknown vector.

Solution: The auto associative net has the same inputs and targets. The MATLAB program for an auto associative net is as follows:

CODE OF PROGRAM NO. 9:

clc;
clear;
x= [1 1 -1 -1];
w=zeros(4,4);
w=x'*x;
yin=x*w;
for i=1:4
    if yin(i)>0
        y(i)=1;
    else
        y(i)=-1;
    end
end
disp('weight matrix');
disp(w);
if x==y
    disp('The vector is a known vector ');
else
    disp('The vector is unknown vector');
end

OUTPUT OF PROGRAM NO. 9:

Output:

   1  1  -1  -1
   1  1  -1  -1
 -1  -1  1  1
 -1  -1  1  1

The vector is a known vector
PROGRAM 10: Write an M-file to stores the vectors (-1 -1 -1 -1) and (-1 -1 1 1) in an associative net. Find the weight matrix. Test the net with (1 1 1 1) as input.

Solution: The MATLAB program for the auto associative problem is as follows:

```matlab
clc;
clear;
x= [1 1 -1 -1];
w=zeros(4,4);
w=x'*x;
yin=x*w;
for i=1:4
    if yin(i)>0
        y(i)=1;
    else
        y(i)=-1;
    end
end
disp('weight matrix');
disp(w);
if x==y
    disp('The vector is a known vector ');
else
    disp('The vector is unknown vector');
end
```

OUTPUT OF PROGRAM NO. 10:

```
2 2 0 0
2 2 0 0
0 0 2 2
0 0 2 2
```

The vector is a unknown vector
PROGRAM 11: Generate ANDNOT function using McCulloch-Pitts neural net by a MATLAB program.

Solution The truth table for the ANDNOT function is as follows:

<table>
<thead>
<tr>
<th>X1</th>
<th>X2</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

CODE OF PROGRAM NO. 11:

```matlab
% Getting weights and threshold values
disp('Enter weights');
w1=input('weight w1=');
w2=input('weight w2=');
disp('Enter threshold value');
theta=input('theta=');
y=[0 0 0 0];
x1= [0 0 1 1];
x2= [0 1 0 1];
z= [0 0 1 0];
con=1;
while con
    zin=x1*w1+x2*w2;
    for i=1:4
        if zin(i)>=theta
            y(i)=1;
        else
            y(i)=0;
        end
    end
    disp('Output of net');
disp(y);
    if y==z
        con=0;
    else
        disp('Net is not learning enter set of weights and threshold value');
w1=input('weight w1=');
w2=input('weight w2=');
theta=input('theta=');
    end
end
disp('McCulloch Pitts Net for ANDNOT function');
```
disp('weights on neuron');
disp(w1);
disp(w2);
disp('threshold value');
disp(theta);

OUTPUT OF PROGRAM NO. 11:

Enter weights
weight w1=1
weight w2=1
Enter threshold value
theta=0.1
Output of net
  0  1  1  1

Net is not learning enter set of weights and threshold value
weight w1=1
weight w2=-1
theta=1
Output of net
  0  0  1  0

McCulloch Pitts Net for ANDNOT function
weights on neuron
   1

   -1

threshold value