Scilab Manual for Neural Networks by Dr G V Maha Lakshmi Electronics Engineering Sreenidhi Institute Of Science And Technology[1]

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November 28, 2026

[1]Funded by a grant from the National Mission on Education through ICT, http://spoken-tutorial.org/NMEICT-Intro. This Scilab Manual and Scilab codes written in it can be downloaded from the "Migrated Labs" section at the website http://scilab.in

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Experiment: 1

Generate AND NOT function using McCulloch-Pitts neural net

Scilab code Solution 1.1 1

```
1 //Generate AND NOT function using McCulloch-Pitts
     neural net
2 //Windows 10
3 //Scilab 5.4.1
4 clear;
5 clc;
6
7 //Generate weights and threshold value
8 disp('Enter the weights');
9 w1=input('Weight w1=');
10 w2=input('Weight w2=');
11 disp('Enter Threshold Value');
12 theta=input('theta=');
13 y=[0 0 0 0];
14 x1=[0 0 1 1];
15 x2=[0 1 0 1];
16 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 another 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 of Neuron');
disp(w1);
disp(w2);
disp('Threshold value');
disp(theta);

//Truth Table
//X1  X2  Y
//0   0   0
//0   1   0
//1   0   1
//1   1   0

//Output
//Enter the weights
```

```
54 //Weight w1=1
55 //Weight w2=1
56 //
57 // Enter Threshold Value
58 //theta=0.1
59 //
60 // Output of Net
61 //
62 //     0.     1.     1.     1.
63 //
64 // Net is not learning enter another set of weights
      and Threshold v
65 //       alue
66 //weight w1=1
67 //weight w2=-1
68 //theta=1
69 //
70 // Output of Net
71 //
72 //     0.     0.     1.     0.
73 //
74 // Mcculloch-Pitts Net for ANDNOT function
75 //
76 // Weights of Neuron
77 //
78 //     1.
79 //
80 //  - 1.
81 //
82 // Threshold value
83 //
84 //     1.
```

Experiment: 2

McCulloch-Pitts Net for XOR function

Scilab code Solution 2.2 2

```
1  //McCulloch-Pitts for XOR function
2  //Windows 10
3  //Scilab 5.4.1
4  clear;
5  clc;
6
7  //Getting weights and threshold value
8  disp('Enter weights');
9  w11=input('Weight w11=');
10 w12=input('weight w12=');
11 w21=input('Weight w21=');
12 w22=input('weight w22=');
13 v1=input('weight v1=');
14 v2=input('weight v2=');
15 disp('Enter Threshold Value');
16 theta=input('theta=');
17 x1=[0 0 1 1];
18 x2=[0 1 0 1];
19 z=[0;1;1;0];
```

```
20 con=1;
21 while con
22   zin1=x1*w11+x2*w21;
23   zin2=x1*w21+x2*w22;
24   for i=1:4
25       if zin1(i)>=theta
26           y1(i)=1;
27       else
28           y1(i)=0;
29       end
30       if zin2(i)>=theta
31           y2(i)=1;
32       else
33           y2(i)=0;
34       end
35   end
36   yin=y1*v1+y2*v2;
37   for i=1:4
38       if yin(i)>=theta;
39           y(i)=1;
40       else
41           y(i)=0;
42       end
43   end
44   disp('Output of Net');
45   disp(y);
46   if y == z
47       con=0;
48   else
49       disp('Net is not learning enter another set of
             weights and Threshold value');
50       w11=input('Weight w11=');
51       w12=input('weight w12=');
52        w21=input('Weight w21=');
53       w22=input('weight w22=');
54       v1=input('weight v1=');
55       v2=input('weight v2=');
56       theta=input('theta=');
```

```
57    end
58  end
59  disp('McCulloch-Pitts Net for XOR function');
60  disp('Weights of Neuron Z1');
61  disp(w11);
62  disp(w21);
63  disp('weights of Neuron Z2');
64  disp(w12);
65  disp(w22);
66  disp('weights of Neuron Y');
67  disp(v1);
68  disp(v2);
69  disp('Threshold value');
70  disp(theta);
71
72  //Truth Table
73  //X1  X2  Y
74  //0   0   0
75  //0   1   1
76  //1   0   1
77  //1   1   0
78
79  //Output
80
81  // Enter weights
82  //Weight w11=1
83  //weight w12=-1
84  //Weight w21=-1
85  //weight w22=1
86  //weight v1=1
87  //weight v2=1
88  //
89  // Enter Threshold Value
90  //theta=1
91  //
92  // Output of Net
93  //
94  //     0.
```

```
95 //     1.
96 //     1.
97 //     0.
98 //
99 // McCulloch-Pitts Net for XOR function
100 //
101 // Weights of Neuron Z1
102 //
103 //     1.
104 //
105 //   - 1.
106 //
107 // weights of Neuron Z2
108 //
109 //   - 1.
110 //
111 //     1.
112 //
113 // weights of Neuron Y
114 //
115 //     1.
116 //
117 //     1.
118 //
119 // Threshold value
120 //
121 //     1.
```

Experiment: 3

Hebb Net to classify two dimensional input patterns

Scilab code Solution 3.3 3

```
1  //Hebb Net to classify two dimensional input
       patterns
2  //Windows 10
3  //Scilab 5.4.1
4  clear;
5  clc;
6
7  //Input Patterns
8  E=[1 1 1 1 1 -1 -1 -1 1 1 1 1 1 -1 -1 -1 1 1 1 1];
9  F=[1 1 1 1 1 -1 -1 -1 1 1 1 1 1 -1 -1 -1 1 -1 -1
       -1];
10 x(1,1:20)=E;
11 x(2,1:20)=F;
12 w(1:20)=0;
13 w=w'
14 t=[1 -1];
15 b=0;
16 for i=1:2
17     w=w+x(i,1:20)*t(i);
```

```
18      b=b+t(i);
19  end
20  disp('Weight matrix');
21  disp(w);
22  disp('Bias');
23  disp(b);
24
25  //Output
26  //
27  // Weight matrix
28  //
29  //
30  //           column 1 to 18
31  //
32  //    0.    0.    0.    0.    0.    0.    0.    0.    0.
          0.    0.    0.    0.    0.//    0.    0.    2.
33  //
34  //           column 19 to 20
35  //
36  //    2.    2.
37  //
38  // Bias
39  //
40  //    0.
```

Experiment: 4

Hetro associative neural net

Scilab code Solution 4.4 4

```
1  //Hetro associative neural net
2  //Windows 10
3  //Scilab 5.4.1
4  clear;
5  clc;
6
7  x=[1 1 0 0;1 0 1 0;1 1 1 0;0 1 1 0];
8  t=[1 0;1 0;0 1;0 1];
9  w=zeros(4,2);
10 for i=1:4
11     w=w+x(i,1:4)'*t(i,1:2);
12 end
13 disp('Weight matrix');
14 disp(w);
15
16
17 //Auotassociative net to store the vector
18
19 x=[1 1 -1 -1];
20 xv=[1;1;-1;-1];
21 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 xv==y
    disp('The vector is a Known Vector');
else
    disp('The vector is an Unknown Vector');
end

//Output
// Weight matrix
//
//    2.    1.
//    1.    2.
//    1.    2.
//    0.    0.
//
// Weight matrix
//
//    1.    1.   -1.   -1.
//    1.    1.   -1.   -1.
//   -1.   -1.    1.    1.
//   -1.   -1.    1.    1.
//
// The vector is a Known Vector
```

Experiment: 5

Discrete Hopfield net

Scilab code Solution 5.5 5

```
1  //Discrete Hopfield net
2  //Windows 10
3  //Scilab 5.4.1
4  clear;
5  clc;
6
7  x=[1 1 1 0];
8  tx=[0 0 1 0];
9  w1=(2*x'-1);
10 w2=(2*x-1);
11 w=w1*w2;
12
13 for i=1:4
14     w(i,i)=0;
15 end
16 con=1;
17 y=[0 0 1 0];
18 while con
19     up=[4 2 1 3];
20     for i=1:4
21         yin(up(i))=tx(up(i))+y*w(1:4,up(i));
```

```
22          if yin(up(i))>0
23              y(up(i))=1;
24          end
25      end
26      if y==x
27          disp('Convergence has been obtained');
28          disp('The Converged Ouput');
29          disp(y);
30          con=0;
31      end
32  end
33
34  //Output
35  // Convergence has been obtained
36  //
37  // The Converged Ouput
38  //
39  //    1.    1.    1.    0.
```

Experiment: 6

Kohonen self organizing maps

Scilab code Solution 6.6 6

```
1  //Kohonen self organizing maps
2  //Windows 10
3  //Scilab 5.4.1
4  clear;
5  clc;
6
7  x=[1 1 0 0;0 0 0 1;1 0 0 0;0 0 1 1];
8  alpha=0.6;
9
10 //initial weight matrix
11 w=rand(4,2);
12 disp('Initial weight matrix');
13 disp(w);
14 con=1;
15 epoch=0;
16 while con
17     for i=1:4
18         for j=1:2
19             D(j)=0;
20             for k=1:4
21                 D(j)=D(j)+(w(k,j)-x(i,k))^2;
```

```
            end
        end
        for j=1:2
            if D(j)==min(D)
                J=j;
            end
        end
        w(:,J)=w(:,J)+alpha*(x(i,:)'-w(:,J));
    end
    alpha=0.5*alpha;
    epoch=epoch+1;
    if epoch==300
        con=0;
    end
end
disp('Weight Matrix after 300 epoch');
disp(w);

//Output
// Initial weight matrix
//
//    0.2113249    0.6653811
//    0.7560439    0.6283918
//    0.0002211    0.8497452
//    0.3303271    0.685731
//
// Weight Matrix after 300 epoch
//
//    0.9671633    0.0277033
//    0.4283588    0.0261632
//    0.0000092    0.5968633
//    0.0137532    0.9869153
```

Experiment: 7

Learning Vector Quantisation

Scilab code Solution 7.7 7

```
1  //Learning Vector Quantization
2  //Windows 10
3  //Scilab 5.4.1
4  clear;
5  clc;
6
7  s=[1 1 0 0;0 0 0 1;0 0 1 1;1 0 0 0;0 1 1 0];
8  st=[1 2 2 1 2];
9  alpha=0.6;
10
11 //initial weight matrix first two vectors of input
      patterns
12 w=[s(1,:);s(2,:)]';
13 disp('Initial weight matrix');
14 disp(w);
15
16 //set remaining as input vector
17 x=[s(3,:);s(4,:);s(5,:)];
18 t=[st(3);st(4);st(5)];
19 con=1;
20 epoch=0;
```

```
while con
    for i=1:3
        for j=1:2
            D(j)=0;
            for k=1:4
                D(j)=D(j)+(w(k,j)-x(i,k))^2;
            end
        end
        for j=1:2
            if D(j)==min(D)
                J=j;
            end
        end
        if J==t(i)
            w(:,J)=w(:,J)+alpha*(x(i,:)'-w(:,J));
        else
            w(:,J)=w(:,J)-alpha*(x(i,:)'-w(:,J));
        end
        end
    alpha=0.5*alpha;
    epoch=epoch+1;
    if epoch==100
        con=0;
    end
end
disp('Weight Matrix after 100 epochs');
disp(w);

//Output
// Initial weight matrix
//
//    1.    0.
//    1.    0.
//    0.    0.
//    0.    1.
//
// Weight Matrix after 100 epochs
//
```

```
59 //    1.          0.
60 //    0.2040471   0.561484
61 //    0.          0.9583648
62 //    0.          0.438516
```

Experiment: 8

Full Counter Propagation Network for given input pair

Scilab code Solution 8.8 8

```
1  //Full counter propagation network for given input
       pair
2  //Windows 10
3  //Scilab 5.4.1
4  clear;
5  clc;
6
7  //set initial weights
8   v=[0.6 0.2;0.6 0.2;0.2 0.6; 0.2 0.6];
9   w=[0.4 0.3;0.4 0.3];
10  x=[0 1 1 0];
11  y=[1 0];
12  alpha=0.3;
13  for j=1:2
14      D(j)=0;
15      for i=1:4
16          D(j)=D(j)+(x(i)-v(i,j))^2;
17      end
18      for k=1:2
```

```
19          D(j)=D(j)+(y(k)-w(k,j))^2;
20      end
21  end
22  for j=1:2
23      if D(j)==min(D)
24          J=j;
25      end
26  end
27  disp('After one step the weight matrix are');
28  v(:,J)=v(:,J)+alpha*(x'-v(:,J))
29  w(:,J)=w(:,J)+alpha*(y'-w(:,J))
30  disp('v')
31  disp(v)
32  disp('w')
33  disp(w)
34
35 //Output
36 //
37 // After one step the weight matrix are
38 //
39 // v
40 //
41 //    0.42    0.2
42 //    0.72    0.2
43 //    0.44    0.6
44 //    0.14    0.6
45 //
46 // w
47 //
48 //    0.58    0.3
49 //    0.28    0.3
```

Experiment: 9

ART1 Neural Net

Scilab code Solution 9.9 9

```
1  //ART1 Neural Net
2  //Windows 10
3  //Scilab 5.4.1
4  clear;
5  clc;
6
7  b=[0.57 0.0 0.3;0.0 0.0 0.3;0.0 0.57 0.3;0.0 0.47
       0.3];
8  t=[1 1 0 0;1 0 0 1;1 1 1 1];
9  vp=0.4;
10 L=2;
11 x=[1 0 1 1];
12 s=x;
13 ns=sum(s);
14 y=x*b;
15 con=1;
16 while con
17     for i=1:3
18         if y(i)==max(y)
19             J=i;
20         end
```

```
21      end
22      x=s.*t(J,:);
23      nx=sum(x);
24      if nx/ns >= vp
25          b(:,J)=L*x(:)/(L-1+nx);
26          t(J,:)=x(1,:);
27          con=0;
28      else
29          y(J)=-1;
30          con=1;
31      end
32      if y+1==0
33          con=0;
34      end
35  end
36  disp('Top Down Weights');
37  disp(t);
38  disp('Bottom up Weights');
39  disp(b);
40
41  //Output
42  // Top Down Weights
43  //
44  //    1.    1.    0.    0.
45  //    1.    0.    0.    1.
46  //    1.    1.    1.    1.
47  //
48  // Bottom up Weights
49  //
50  //    0.57    0.6666667    0.3
51  //    0.      0.           0.3
52  //    0.      0.           0.3
53  //    0.      0.6666667    0.3
```

Experiment: 10

MLP

Scilab code Solution 10.10 10

```
1  //MLP Algorithm and implementation
2  //Windows 10
3  //Scilab 5.4.1
4  clear;
5  clc;
6
7  deff('y=f(x)','y=1/(1+exp(-x))')
8  Wih=[0.1,-0.3;0.3,0.4];
9  Who=[0.4;0.5]
10 i=[0.2,0.6];
11 t=0.7;
12 a=10;
13 for k=1:3
14     printf('\n\n\nAfter Iteration %i :\n\n',k)
15     disp(Wih,'Wih = ')
16     disp(Who,'Who = ')
17 a1=i*Wih;
18 disp(a1,'a = ')
19 h=[f(a1(1)),f(a1(2))]
20 disp(h,'h = ')
21 b1=h*Who
```

```
22 disp(b1,'b1 =')
23 o=f(b1)
24 disp(o,'o = ')
25 d=o*(1-o)*(t-o)
26 disp(d,'d =')
27 for j=1:2
28     e(1,j)=h(j)*(1-h(j))*d*Who(j)
29 end
30 disp(e,'e =')
31 dWho=a*h'*d;
32 disp(dWho,'dWho =')
33 Who=Who+dWho;
34 dWih=a*i'*e;
35 disp(dWih,'dWih =')
36 Wih=Wih+dWih;
37 end
38
39 //Output
40 //After Iteration 1 :
41 //
42 //
43 // Wih =
44 //
45 //    0.1   -0.3
46 //    0.3    0.4
47 //
48 // Who =
49 //
50 //    0.4
51 //    0.5
52 //
53 // a =
54 //
55 //    0.2    0.18
56 //
57 // h =
58 //
59 //    0.549834    0.5448789
```

```
60 //
61 // b1 =
62 //
63 //    0.492373
64 //
65 // o =
66 //
67 //    0.6206653
68 //
69 // d =
70 //
71 //    0.0186786
72 //
73 // e =
74 //
75 //    0.0018493    0.002316
76 //
77 // dWho =
78 //
79 //    0.102701
80 //    0.1017755
81 //
82 // dWih =
83 //
84 //    0.0036986    0.004632
85 //    0.0110958    0.0138961
86 //
87 //
88 //
89 //After Iteration 2 :
90 //
91 //
92 // Wih =
93 //
94 //    0.1036986   -0.295368
95 //    0.3110958    0.4138961
96 //
97 // Who =
```

```
98  //
99  //    0.502701
100 //    0.6017755
101 //
102 // a =
103 //
104 //    0.2073972    0.189264
105 //
106 // h =
107 //
108 //    0.5516642    0.5471753
109 //
110 // b1 =
111 //
112 //    0.6065989
113 //
114 // o =
115 //
116 //    0.6471646
117 //
118 // d =
119 //
120 //    0.0120646
121 //
122 // e =
123 //
124 //    0.0015    0.0017989
125 //
126 // dWho =
127 //
128 //    0.066556
129 //    0.0660144
130 //
131 // dWih =
132 //
133 //    0.0030001    0.0035978
134 //    0.0090002    0.0107933
135 //
```

```
136 //
137 //
138 //After Iteration 3 :
139 //
140 //
141 // Wih =
142 //
143 //    0.1066987   -0.2917702
144 //    0.320096     0.4246894
145 //
146 // Who =
147 //
148 //    0.569257
149 //    0.6677899
150 //
151 // a =
152 //
153 //    0.2133973    0.1964596
154 //
155 // h =
156 //
157 //    0.5531478    0.5489575
158 //
159 // b1 =
160 //
161 //    0.6814715
162 //
163 // o =
164 //
165 //    0.6640671
166 //
167 // d =
168 //
169 //    0.008016
170 //
171 // e =
172 //
173 //    0.0011279    0.0013254
```

```
174 //
175 // dWho =
176 //
177 //    0.0443403
178 //    0.0440044
179 //
180 // dWih =
181 //
182 //    0.0022558    0.0026508
183 //    0.0067674    0.0079525
```
