

# 第七章作业

专业：计算机科学与技术

学号：17341178

姓名：薛伟豪

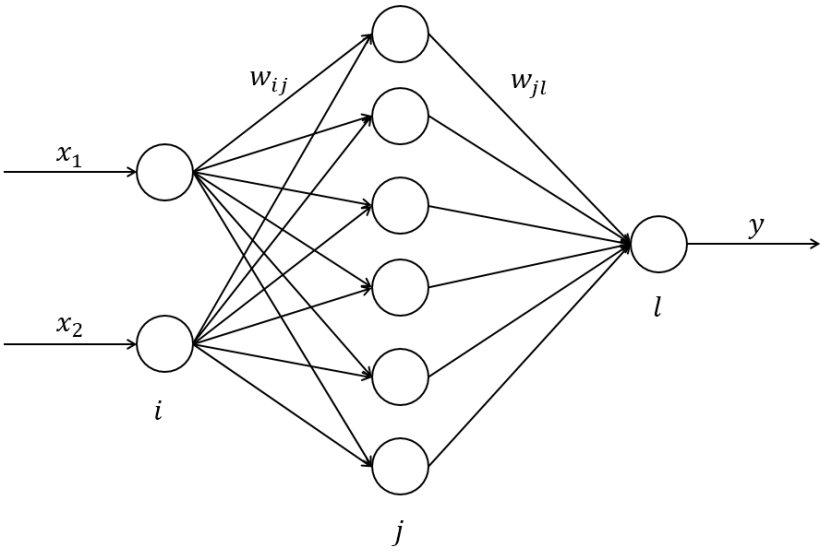
## 7-1

采用BP网络进行模式识别。训练样本为3对两输入单输出样本，见下表。

输入		输出
1	0	1
0	0	0
0	1	-1

试采用BP网络对训练样本进行训练，并针对一组实际样本进行测试，用于测试的3组样本输入分别为1, 0.1 ; 0.5, 0.5和0.1, 1。

解：我们设置BP网络为2-6-1结构，权值 $w_{ij}$ ,  $w_{jl}$ 的初始值取 $[-1, +1]$ 之间的随机值，学习参数取 $\eta = 0.50$ ,  $\alpha = 0.05$ 。网络结构如下：



在本题中，BP网络模式识别程序包括网络训练程序7\_1a.m和网络测试程序7\_1b.m，具体代码如下：

### • 网络训练程序

```
1 clc, clear;
2 eta = 0.50;
3 alpha = 0.05;
4
5 w1 = rands(2,6);
6 w1_1 = w1;
7 w1_2 = w1;
```

```

8   dw1 = 0*w1;
9
10  w2 = rand(6,1);
11  w2_1 = w2;
12  w2_2 = w2;
13
14  I = [0,0,0,0,0,0]';
15  Iout = [0,0,0,0,0,0]';
16  FI = [0,0,0,0,0,0]';
17
18  OUT = 2;
19  k = 0;
20  E = 1.0;
21  NS = 3;
22
23  while E >= 1e-20
24      k = k+1;
25      times(k) = k;
26      for s = 1:NS
27          xs = [1,0;0,0;0,1];
28          ys = [1,0,-1]';
29          x = xs(s,:);
30          for j = 1:6
31              I(j) = x*w1(:,j);
32              Iout(j) = 1/(1+exp(-I(j)));
33          end
34          y1 = w2'*Iout;
35          e1 = 0;
36          y = ys(s,:);
37          e1 = e1+0.5*(y(1)-y1(1))^2;
38          es(s) = e1;
39          E = 0;
40          if s == NS
41              for s = 1:NS
42                  E = E+es(s);
43              end
44          end
45          ey = y-y1;
46          w2 = w2_1 +eta*Iout*ey+alpha*(w2_1-w2_2);
47          for j=1:6
48              S = 1/(1+exp(-I(j)));
49              FI(j) = S*(1-S);
50          end
51          for i = 1:2
52              for j = 1:6
53                  dw1(i,j) = eta*FI(j)*x(i)*ey(1)*w2(j,1);
54              end
55          end
56          w1 = w1_1+dw1+alpha*(w1-w1_2);
57          w1_2 = w1_1;
58          w1_1 = w1;
59          w2_2 = w2_1;
60          w2_1 = w2;
61      end
62      Ek(k) = E;
63  end
64
65  figure(1);

```

```

66 plot(times, Ek, 'r');
67 xlabel('k');
68 ylabel('E');
69 save wfile w1 w2;

```

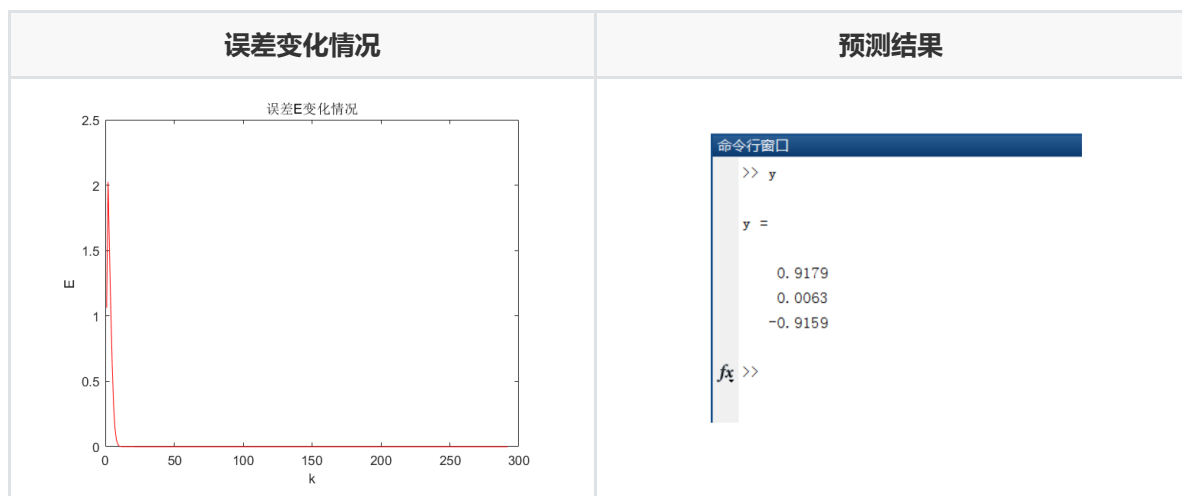
### • 网络测试程序

```

1  clc, clear;
2  load wfile w1 w2;
3
4  x = [1,0.1;0.5,0.5;0.1,1];
5  for i = 1:3
6      for j = 1:6
7          I(i,j) = x(i,:)*w1(:,j);
8          Iout(i,j) = 1/(1+exp(-I(i,j)));
9      end
10 end
11 y = w2'*Iout';
12 y = y';

```

### • 运行过程&预测结果



## 7-2

采用BP网络、RBF网络逼近非线性对象 $y(k) = (u(k-1) - 0.9y(k-1))/(1 + y(k-1)^2)$ ，分别进行Matlab仿真。

解：根据要求，有：

### • 采用BP网络逼近对象

采样时间取1ms。输入信号为 $u(t) = 0.5\sin(6\pi t)$ 。神经网络为2-6-1结构，权值 $W_1$ ， $W_2$ 的初始值取 $[-1, 1]$ 之间的随机值，取 $\eta = 0.50$ ， $\alpha = 0.05$ 。BP网络Matlab仿真代码如下所示：

```

1  clc, clear;

```

```

2  eta = 0.50;
3  alpha = 0.05;
4
5  w1 = rands(2,6);
6  w1_1 = w1;
7  w1_2 = w1;
8  w2 = rands(6,1);
9  w2_1 = w2;
10 w2_2 = w2;
11 dw1 = 0*w1;
12 x = [0,0]';
13 u_1 = 0;
14 y_1 = 0;
15
16 I = [0,0,0,0,0,0]';
17 Iout = [0,0,0,0,0,0]';
18 FI = [0,0,0,0,0,0]';
19
20 ts = 0.001;
21 for k = 1:1000
22     time(k) = k*ts;
23     u(k) = 0.50*sin(6*pi*k*ts);
24     y(k) = (u_1-0.9*y_1)/(1+y_1^2);
25     for j = 1:6
26         I(j) = x'*w1(:,j);
27         Iout(j) = 1/(1+exp(-I(j)));
28     end
29     yn(k) = w2'*Iout;
30     e(k) = y(k)-yn(k);
31     w2 = w2_1+(eta*e(k))*Iout+alpha*(w2_1-w2_2);
32     for j = 1:6
33         FI(j) = exp(-I(j))/(1+exp(-I(j)))^2;
34     end
35     for i = 1:2
36         for j = 1:6
37             dw1(i,j) = e(k)*eta*FI(j)*w2(j)*x(i);
38         end
39     end
40     w1 = w1_1+dw1+alpha*(w1_1-w1_2);
41
42     yu = 0;
43     for j = 1:6
44         yu = yu+w2(j)*w1(1,j)*FI(j);
45     end
46     dyu(k) = yu;
47     x(1) = u(k);
48     x(2) = y(k);
49     w1_2 = w1_1;
50     w1_1 = w1;
51     w2_2 = w2_1;
52     w2_1 = w2;
53     u_1 = u(k);
54     y_1 = y(k);
55 end
56
57 figure(1);
58 plot(time,y,'r',time,yn,'b');
59 xlabel('time(s)');

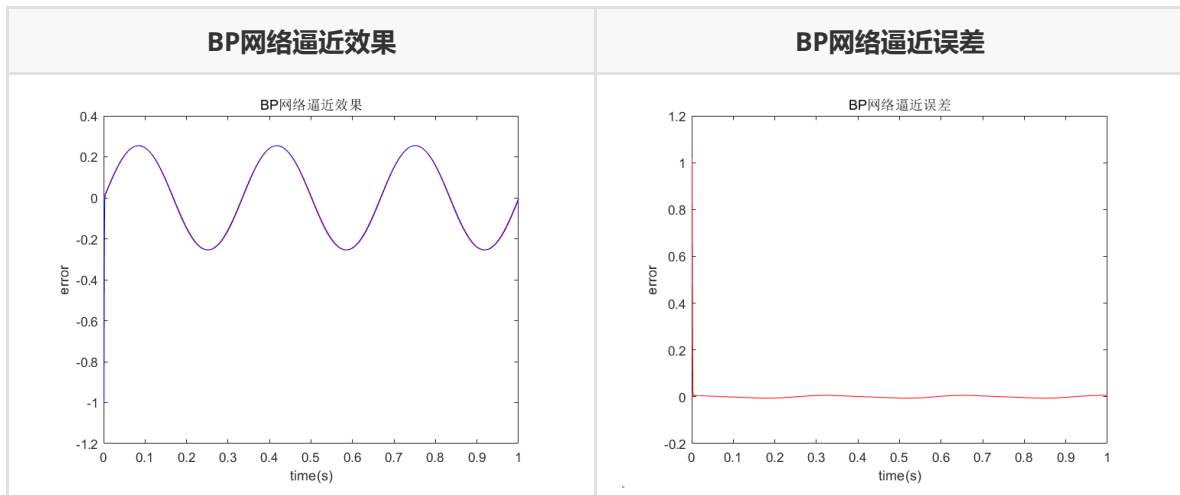
```

```

60 ylabel('error');
61 title('BP网络逼近效果');
62 figure(2);
63 plot(time,y-yn,'r');
64 xlabel('time(s)');
65 ylabel('error');
66 title('BP网络逼近误差');
67 figure(3);
68 plot(time,dyu);
69 xlabel('time(s)');
70 ylabel('dy');
71 title('Jacobian信息的辨识');
72

```

实验结果如下所示：



### • 采用RBF网络逼近对象

采样时间取1ms。输入信号为 $u(t) = 0.5\sin(6\pi t)$ 。网络为2-5-1结构，权值的初始值随机取值， $\eta = 0.50$ ， $\alpha = 0.05$ 。RBF网络Matlab仿真代码如下所示：

```

1  clc, clear;
2  eta = 0.50;
3  alpha = 0.05;
4
5  x = [0,0]';
6  b = 1.5*ones(5,1);
7  c = [-1.5, -0.5, 0, 0.5, 1.5;
8       -1.5, 0.5, 0, 0.5, 1.5];
9
10 w = rand(5,1);
11 w_1 = w;
12 w_2 = w;
13 u_1 = 0;
14 y_1 = 0;
15
16 ts = 0.001;
17 for k = 1:1000
18     time(k) = k*ts;
19     u(k) = 0.50*sin(6*pi*k*ts);
20     y(k) = (u_1-0.9*y_1)/(1+y_1^2);

```

```

21     x(1) = u(k);
22     x(2) = y(k);
23     for j = 1:5
24         h(j) = exp(-norm(x-c(:,j))^2/(2*b(j)*b(j)));
25     end
26     ym(k) = w'*h';
27     em(k) = y(k)-ym(k);
28     d_w = eta*em(k)*h';
29     w = w_1+d_w+alpha*(w_1-w_2);
30     y_1 = y(k);
31     u_1 = u(k);
32     w_2 = w_1;
33     w_1 = w;
34 end
35
36 figure(1);
37 plot(time,y,'r',time,ym,'b');
38 xlabel('time(s)');
39 ylabel('error');
40 title('RBF网络逼近效果');
41 figure(2);
42 plot(time,y-ym,'r');
43 xlabel('time(s)');
44 ylabel('error');
45 title('RBF网络逼近误差');

```

实验结果如下所示：

