

[실습예제 13-2][도전!]

```
11 phi = lambda u: 1/(1+np.exp(-u))
12 dphi = lambda u: np.exp(-u)/(1+np.exp(-u))**2
13
14 np.random.seed(5)
15 oW, oV = np.random.rand(4,2), np.random.rand(4)
16 MaxIter = 10000
17 alpha = 1.0
18 ns = MaxIter/10
19 print('n={:5d}'.format(0))
20 for n in range(MaxIter):
21     gradW, gradV = np.zeros((4,2)), np.zeros(4)
22     for i in range(N):
23         xi = x[i]
24         u1h, u2h, u3h = oW[1,0]+oW[1,1]*xi, oW[2,0]+oW[2,1]*xi, oW[3,0]+oW[3,1]*xi
25         z1, z2, z3 = phi(u1h), phi(u2h), phi(u3h)
26         v0, v1, v2, v3 = oV[0], oV[1], oV[2], oV[3]
27         ui = v0 + v1*z1 + v2*z2 + v3*z3
28         tmepW = [[
29             0,
30             0],
31             [v1*dphi(u1h), v1*dphi(u1h)*xi],
32             [v2*dphi(u2h), v2*dphi(u2h)*xi],
33             [v3*dphi(u3h), v2*dphi(u3h)*xi]]
34
35         gradW += 1/N*(phi(ui)-t[i])*dphi(ui)*np.array(tmepW)
36         gradV += 1/N*(phi(ui)-t[i])*dphi(ui)*np.array([1,z1,z2,z3])
37
38     nW, nV = oW-alpha*gradW, oV-alpha*gradV
39     oW, oV = nW.copy(), nV.copy()
40
41     Eval = 0.0
42     for i in range(N):
43         xi = x[i]
44         u1h, u2h, u3h = oW[1,0]+oW[1,1]*xi, oW[2,0]+oW[2,1]*xi, oW[3,0]+oW[3,1]*xi
45         z1, z2, z3 = phi(u1h), phi(u2h), phi(u3h)
46         v0, v1, v2, v3 = oV[0], oV[1], oV[2], oV[3]
47         ui = v0 + v1*z1 + v2*z2 + v3*z3
48         Eval += 0.5/N*(phi(ui)-t[i])**2
49
50     if (n+1)%ns == 0:
51         print('n={:5d}, Eval={:.4f}'.format(n+1, Eval))
```

```
n=      0
n= 1000, Eval=0.1055
n= 2000, Eval=0.1046
n= 3000, Eval=0.1035
n= 4000, Eval=0.1007
n= 5000, Eval=0.0952
n= 6000, Eval=0.0861
n= 7000, Eval=0.0561
n= 8000, Eval=0.0202
n= 9000, Eval=0.0094
n=10000, Eval=0.0056
```

```

49 xx = np.linspace(-1, 1, 100)
50 u1h, u2h, u3h = oW[1,0]+oW[1,1]*xx, oW[2,0]+oW[2,1]*xx, oW[3,0]+oW[3,1]*xx
51 yy = phi(oV[0]+oV[1]*phi(u1h)+oV[2]*phi(u2h)+oV[3]*phi(u3h))
52
53 plt.plot(xx, yy, 'k')
54 plt.plot(x, t, 'ro')
55 plt.show()

```

