

Κεφάλαιο 12

Πρόβλημα 12

12.1 Python Code

```
1 import matplotlib.pyplot as plt
2
3 from math import sin, pi, exp, sqrt
4 from random import uniform
5
6 # Initialize input vectors
7
8 p = [-1, 1]
9 p.sort()
10 learning_rate = 1
11
12 def g_function(p):
13     if p==1:
14         return 1
15     return 0
16
17 def radbas(n):
18     return exp(-n*n)
19
20 def purelin(n):
21     return n
22
23 def purelin_der(n):
24     return 1
25
26 def radbas_der(n):
27     return -2*n*exp(-n*n)
28
29 S = 1
30
31 print("1 -",S, "- 1 RBF network (one neuron in the hidden layer and one ouput neuron)\n")
32
33 # Initialize weights and biases
34
35 for k in range(2):
36     print("Iteration ", k, "\n")
37     w1 = []
```

```

38     b1 = []
39     w2 = []
40     for i in range(S):
41         w1.append(0)
42         b1.append(1)
43         w2.append(-2)
44     b2 = 1
45
46     # Start training
47
48     while True:
49         sum_sq_error = 0
50         for i in range(2):
51             n1 = []
52             a1 = []
53             n2 = b2
54             for j in range(S):
55                 n = sqrt((p[i]-w1[j])*(p[i]-w1[j]))+b1[j]
56                 n1.append(n)
57                 a = radbas(n)
58                 a1.append(a)
59                 n2 += a * w2[j]
60             a2 = purelin(n2)
61
62             # Calculate error
63
64             e = g_function(p[i])-a2
65             sum_sq_error = sum_sq_error + e*e
66
67             # Calculate sensitivities and recalculate weights and biases
68
69             s2 = -2*purelin_der(n2)*(e)
70             s1 = []
71             for j in range(S):
72                 s1.append(radbas_der(n1[j])*w1[j]*s2)
73
74             w2[j] -= learning_rate*s2*a1[j]
75             b2 -= learning_rate*s2
76
77             for j in range(S):
78                 w1[j] -= learning_rate*s1[j]*p[i]
79                 b1[j] -= learning_rate*s1[j]
80
81             # Check sum square error threshold
82
83             if sum_sq_error <= 1.2:
84                 print("Steepest descent algorithm iteration successfully completed .\n")
85                 break

```