HW2-REPORT

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Contents

1 MLQP Analyse

1.1 Forward

$$x_i^k = f^k(n_i^k)$$

$$n_i^k = b_i^k + \sum_{j=1}^{N^{k-1}} (u_{i,j}^k (x_j^{k-1})^2 + v_{i,j}^k x_j^{k-1})$$

$$f^1 = sigmoid, f^2 = purelin$$

1.2 Backpropagation

Let:

$$s_i^k = \frac{\partial F}{\partial n_i^k}$$

Then:

$$u_{i,j}^k(l+1) = u_{i,j}^k(l) - \alpha s_i^k \frac{\partial n_i^k}{\partial u_{i,j}^k} = u_{i,j}^k(l) - \alpha s_i^k (x_j^{k-1})^2$$

$$v_{i,j}^k(l+1) = v_{i,j}^k(l) - \alpha s_i^k \frac{\partial n_i^k}{\partial v_{i,j}^k} = v_{i,j}^k(l) - \alpha s_i^k x_j^{k-1}$$

$$b_{i,j}^k(l+1) = b_{i,j}^k(l) - \alpha s_i^k \frac{\partial n_i^k}{\partial b_{i,j}^k} = b_{i,j}^k(l) - \alpha s_i^k$$

Now calculate s^k :

$$s^k = \frac{\partial F}{\partial n^k} = \frac{\partial F}{\partial n^{k+1}} \frac{\partial n^{k+1}}{\partial n^k} = s^{k+1} \frac{\partial n^{k+1}}{\partial n^k}$$

To calculate the Jacobbi's matrix

$$J^k = \frac{\partial n^{k+1}}{\partial n^k}$$

We have:

$$J_{i,j}^k = \frac{\partial n_i^{k+1}}{\partial n_j^k} = \frac{\partial (b_i^{k+1} + \sum_{l=1}^{N^k} (u_{i,l}^{k+1} (x_l^k)^2 + v_{i,l}^{k+1} x_l^k))}{\partial n_j^k} = (2x_j^k u_{i,j}^{k+1} + v_{i,j}^k) \frac{\partial x_j^k}{\partial n_j^k}$$

For the first layer:

$$\frac{\partial x_j^1}{\partial n_j^1} = (1 - x_j^1) x_j^1$$

For the second layer:

$$\frac{\partial x_j^2}{\partial n_j^2} = 1$$

At last, calculate $\mathrm{s^m}$:

$$s_i^m = \frac{\partial \sum_{j=1}^{N^m} (t_j - x_j^m)^2}{\partial n_i^m} = 2(x_i^m - t_i) \frac{\partial x_i^m}{\partial n_i^m} = 2(x_i^m - t_i)$$

So:

$$s^2 = 2(x^2 - t)$$
$$s^1 = s^2 J^1$$

Where:

$$J_{i,j}^1 = (2x_j^1 u_{i,j}^1 + v_{i,j}^1)(1 - x_j^1) x_j^1$$

2 two-spirals problem