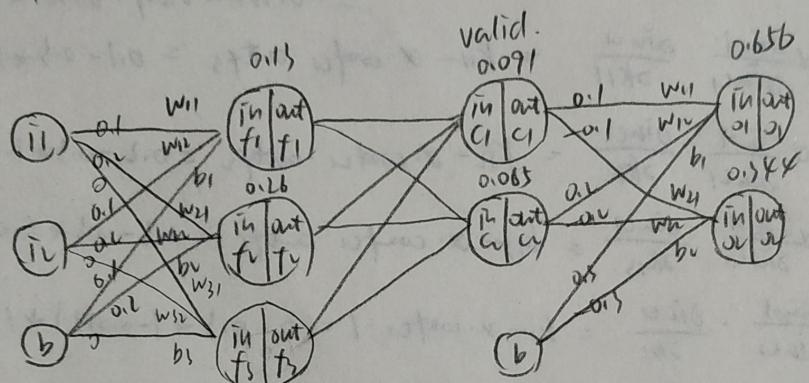


0.13 0.26 0  
0.14 0.2 0.1



装·订·线

## 正向的播

$$in_{f1} = w_{11} * i_1 + w_{12} * i_2 + b_1 \quad in_{f3} = w_{31} * i_1 + w_{32} * i_2 + b_3$$

$$infl = w_{21} * i_1 + w_n * i_n + b_n$$

$$\begin{pmatrix} k_{11} & k_{12} & k_{13} & b_1 \\ 0.1 & 0.2 & 0.1 & 0 \end{pmatrix}, \quad K_L \begin{pmatrix} 0.3 & 0.1 & 0.1 \end{pmatrix}.$$

$$T_{in1} = k_{13} * outf_1 + k_n * outf_n + k_{11} * \frac{outf_1}{0} + b_1$$

$$in_{C_1} = k_{21} * out_{f1} + k_{1n} * out_{f2} * k_{11} * out_{f3} + b_C$$

$$\bar{y}_{NO_1} = w_{11} * \text{outc1} + w_{12} * \text{outc2} + b_1$$

$$f_{HOR} = w_H * \text{out}_H + w_R * \text{out}_R + b_R$$

## 反向传播

$$\cot \theta_1 = \frac{\sin 1}{\cos \theta_1} = \tan 1 - \theta_1 = 0.656 - 1 = -0.344$$

$$\text{cofactor} = \frac{\partial m_1}{\partial h_{22}} = \text{out}_1 - \alpha_2 = 0.344 - 0 = 0.344$$

$$W_{II} = W_{II} - \alpha \frac{\partial w_{II}}{\partial W_{II}} = W_{II} - \alpha \frac{\partial w_{II}}{\partial \ln \omega_1} \cdot \frac{\partial \ln \omega_1}{\partial W_{II}} = W_{II} - \alpha \cdot 0.2 \text{ for entry} = 0.1 - 0.3 \cdot (-0.1) \cdot 0.2 = 0.109$$

$$W_{12} = W_{12} - \alpha \frac{\partial \text{out}_{12}}{\partial W_{12}} = W_{12} - \alpha \cdot \frac{\partial \text{out}_{12}}{\partial W_{12}} = W_{12} - \alpha \cdot \text{act}_{12} \cdot \text{out}_{12} = 0.2 - 0.1 \times (-0.1) \times 0.085 = 0.207$$

$$b_1 = b_1 - \alpha \frac{\partial \text{JML}}{\partial b_1} = b_1 - \alpha \frac{\partial \text{JML}}{\partial \text{h}(x)} \cdot \frac{\partial \text{h}(x)}{\partial b_1} = b_1 - \alpha \cdot \text{coef}_1 \cdot ( = 0.3 - 0.3 \times (-0.344) + 1 = 0.403 )$$

$$W_{21} = W_{21} - \alpha \frac{\partial \bar{w}_{21}}{\partial w_{21}} = W_{21} - \alpha \frac{\partial \bar{w}_{21}}{\partial \bar{w}_{12}} \cdot \frac{\partial \bar{w}_{12}}{\partial w_{21}} = W_{21} - \alpha \cdot \text{coff}_{12} \cdot \text{outp}_1 = -0.1 - 0.3 \times 0.344 + 0.091 = -0.109$$

$$W_{12} = W_{12} - \alpha \frac{\partial \bar{w}_{12}}{\partial w_{12}} = W_{12} - \alpha \frac{\partial \bar{w}_{12}}{\partial \bar{w}_{21}} \cdot \frac{\partial \bar{w}_{21}}{\partial w_{12}} = W_{12} - \alpha \cdot \text{coff}_{21} \cdot \text{outp}_2 = -0.2 - 0.3 \times 0.344 \times 0.065 = -0.207$$

$$b_2 = b_2 - \alpha \frac{\partial \bar{w}_{21}}{\partial b_2} = b_2 - \alpha \frac{\partial \bar{w}_{21}}{\partial \bar{w}_{12}} \cdot \frac{\partial \bar{w}_{12}}{\partial b_2} = b_2 - \alpha \cdot \text{coff}_{12} \cdot 1 = -0.1 - 0.3 \times 0.344 \times 1 = -0.140$$

$$\text{coff}_{12} = \frac{\partial \bar{w}_{12}}{\partial w_{12}} = \left( \frac{\partial \bar{w}_{12}}{\partial \bar{w}_{11}} \cdot \frac{\partial \bar{w}_{11}}{\partial w_{12}} + \frac{\partial \bar{w}_{12}}{\partial \bar{w}_{12}} \cdot \frac{\partial \bar{w}_{12}}{\partial w_{12}} \right) \cdot \frac{\partial \text{outp}_1}{\partial w_{12}} = (\text{coff}_{11} \cdot W_{11} + \text{coff}_{21} \cdot W_{21}) \cdot 1 \\ = -0.344 \times 0.109 + 0.344 \times (-0.109) = -0.075$$

$$\text{coff}_{21} = \frac{\partial \bar{w}_{21}}{\partial w_{21}} = \left( \frac{\partial \bar{w}_{21}}{\partial \bar{w}_{11}} \cdot \frac{\partial \bar{w}_{11}}{\partial w_{21}} + \frac{\partial \bar{w}_{21}}{\partial \bar{w}_{12}} \cdot \frac{\partial \bar{w}_{12}}{\partial w_{21}} \right) \cdot \frac{\partial \text{outp}_2}{\partial w_{21}} = (\text{coff}_{11} \cdot W_{11} + \text{coff}_{21} \cdot W_{21}) \cdot 1 \\ = -0.344 \times 0.207 + 0.344 \times (-0.207) = -0.142$$

$$k_{11} = k_{11} - \alpha \frac{\partial \bar{w}_{11}}{\partial k_{11}} = k_{11} - \alpha \frac{\partial \bar{w}_{11}}{\partial \bar{w}_{12}} \cdot \frac{\partial \bar{w}_{12}}{\partial k_{11}} = k_{11} - \alpha \cdot \text{coff}_{12} \cdot \text{outf}_3 = 0.1 - 0.3 \times (-0.075) + 0 = 0.1$$

$$k_{12} = k_{12} - \alpha \frac{\partial \bar{w}_{12}}{\partial k_{12}} = k_{12} - \alpha \frac{\partial \bar{w}_{12}}{\partial \bar{w}_{11}} \cdot \frac{\partial \bar{w}_{11}}{\partial k_{12}} = k_{12} - \alpha \cdot \text{coff}_{11} \cdot \text{outf}_3 = 0.2 - 0.3 \times (-0.075) + 0.26 = 0.206$$

$$k_{13} = k_{13} - \alpha \frac{\partial \bar{w}_{13}}{\partial k_{13}} = k_{13} - \alpha \frac{\partial \bar{w}_{13}}{\partial \bar{w}_{11}} \cdot \frac{\partial \bar{w}_{11}}{\partial k_{13}} = k_{13} - \alpha \cdot \text{coff}_{11} \cdot \text{outf}_3 = 0.3 - 0.3 \times (-0.075) + 0.13 = 0.303$$

$$b_1 = b_1 - \alpha \frac{\partial \bar{w}_{11}}{\partial b_1} = b_1 - \alpha \frac{\partial \bar{w}_{11}}{\partial \bar{w}_{12}} \cdot \frac{\partial \bar{w}_{12}}{\partial b_1} = b_1 - \alpha \cdot \text{coff}_{12} \cdot 1 = 0 - 0.3 \times (-0.075) + 1 = 0.023$$

$$k_{21} = k_{21} - \alpha \frac{\partial \bar{w}_{21}}{\partial k_{21}} = k_{21} - \alpha \frac{\partial \bar{w}_{21}}{\partial \bar{w}_{12}} \cdot \frac{\partial \bar{w}_{12}}{\partial k_{21}} = k_{21} - \alpha \cdot \text{coff}_{12} \cdot \text{outf}_3 = 0.3 - 0.3 \times (-0.140) + 0 = 0.3$$

$$k_{22} = k_{22} - \alpha \frac{\partial \bar{w}_{22}}{\partial k_{22}} = k_{22} - \alpha \frac{\partial \bar{w}_{22}}{\partial \bar{w}_{12}} \cdot \frac{\partial \bar{w}_{12}}{\partial k_{22}} = k_{22} - \alpha \cdot \text{coff}_{12} \cdot \text{outf}_3 = 0.1 - 0.3 \times (-0.140) + 0.26 = 0.211$$

$$k_{23} = k_{23} - \alpha \frac{\partial \bar{w}_{23}}{\partial k_{23}} = k_{23} - \alpha \frac{\partial \bar{w}_{23}}{\partial \bar{w}_{12}} \cdot \frac{\partial \bar{w}_{12}}{\partial k_{23}} = k_{23} - \alpha \cdot \text{coff}_{12} \cdot \text{outf}_3 = 0.1 - 0.3 \times (-0.140) + 0.11 = 0.106$$

$$b_2 = b_2 - \alpha \frac{\partial \bar{w}_{21}}{\partial b_2} = b_2 - \alpha \frac{\partial \bar{w}_{21}}{\partial \bar{w}_{12}} \cdot \frac{\partial \bar{w}_{12}}{\partial b_2} = b_2 - \alpha \cdot \text{coff}_{12} \cdot 1 = 0 - 0.3 \times (-0.140) + 1 = 0.046$$

$$\text{coff}_{12} = \frac{\partial \bar{w}_{12}}{\partial w_{12}} = \left( \frac{\partial \bar{w}_{12}}{\partial \bar{w}_{11}} \cdot \frac{\partial \bar{w}_{11}}{\partial w_{12}} + \frac{\partial \bar{w}_{12}}{\partial \bar{w}_{12}} \cdot \frac{\partial \bar{w}_{12}}{\partial w_{12}} \right) \cdot \frac{\partial \text{outf}_3}{\partial w_{12}} = (\text{coff}_{11} \cdot k_{11} + \text{coff}_{21} \cdot k_{21}) \cdot 1 \\ = -0.075 \times 0.303 + (-0.140) \times 0.106 = -0.038$$

$$\text{coff}_{12} = \frac{\partial \bar{w}_{12}}{\partial w_{12}} = \left( \frac{\partial \bar{w}_{12}}{\partial \bar{w}_{11}} \cdot \frac{\partial \bar{w}_{11}}{\partial w_{12}} + \frac{\partial \bar{w}_{12}}{\partial \bar{w}_{12}} \cdot \frac{\partial \bar{w}_{12}}{\partial w_{12}} \right) \cdot \frac{\partial \text{outf}_3}{\partial w_{12}} = (\text{coff}_{11} \cdot k_{11} + \text{coff}_{21} \cdot k_{21}) \cdot 1 \\ = -0.075 \times 0.206 + (-0.140) \times 0.211 = -0.045$$

$$\text{coff}_{12} = \frac{\partial \bar{w}_{12}}{\partial w_{12}} = \left( \frac{\partial \bar{w}_{12}}{\partial \bar{w}_{11}} \cdot \frac{\partial \bar{w}_{11}}{\partial w_{12}} + \frac{\partial \bar{w}_{12}}{\partial \bar{w}_{12}} \cdot \frac{\partial \bar{w}_{12}}{\partial w_{12}} \right) \cdot \frac{\partial \text{outf}_3}{\partial w_{12}} = (\text{coff}_{11} \cdot k_{11} + \text{coff}_{21} \cdot k_{21}) \cdot 1 \\ = -0.075 \times 0.1 + (-0.140) \times 0.3 = -0.050$$

$$W_{11} = W_{11} - \alpha \frac{\partial \bar{w}_{11}}{\partial W_{11}} = W_{11} - \alpha \frac{\partial \bar{w}_{11}}{\partial \bar{w}_{12}} \cdot \frac{\partial \bar{w}_{12}}{\partial W_{11}} = W_{11} - \alpha \cdot \text{coff}_{12} \cdot \bar{W}_{12} = 0.1 - 0.3 \times (-0.038) + 0.1 = 0.101$$

$$W_{12} = W_{12} - \alpha \frac{\partial \bar{w}_{12}}{\partial W_{12}} = W_{12} - \alpha \frac{\partial \bar{w}_{12}}{\partial \bar{w}_{11}} \cdot \frac{\partial \bar{w}_{11}}{\partial W_{12}} = W_{12} - \alpha \cdot \text{coff}_{11} \cdot \bar{W}_{11} = 0.1 - 0.3 \times (-0.038) + 0.2 = 0.102$$

$$b_1 = b_1 - \alpha \frac{\partial \bar{w}_{11}}{\partial b_1} = b_1 - \alpha \frac{\partial \bar{w}_{11}}{\partial \bar{w}_{12}} \cdot \frac{\partial \bar{w}_{12}}{\partial b_1} = b_1 - \alpha \cdot \text{coff}_{12} \cdot 1 = 0.1 - 0.3 \times (-0.038) + 1 = 0.111$$

$$W_{21} = W_{21} - \alpha \frac{\partial \bar{w}_{21}}{\partial W_{21}} = W_{21} - \alpha \frac{\partial \bar{w}_{21}}{\partial \bar{w}_{12}} \cdot \frac{\partial \bar{w}_{12}}{\partial W_{21}} = W_{21} - \alpha \cdot \text{coff}_{12} \cdot \bar{W}_{12} = 0.2 - 0.3 \times (-0.045) + 0.1 = 0.201$$

$$W_{22} = W_{22} - \alpha \frac{\partial \bar{w}_{22}}{\partial W_{22}} = W_{22} - \alpha \frac{\partial \bar{w}_{22}}{\partial \bar{w}_{12}} \cdot \frac{\partial \bar{w}_{12}}{\partial W_{22}} = W_{22} - \alpha \cdot \text{coff}_{12} \cdot \bar{W}_{12} = 0.2 - 0.3 \times (-0.045) + 0.2 = 0.203$$

$$b_2 = b_2 - \alpha \frac{\partial \bar{w}_{21}}{\partial b_2} = b_2 - \alpha \frac{\partial \bar{w}_{21}}{\partial \bar{w}_{12}} \cdot \frac{\partial \bar{w}_{12}}{\partial b_2} = b_2 - \alpha \cdot \text{coff}_{12} \cdot 1 = 0.2 - 0.3 \times (-0.045) + 1 = 0.214$$

$$w_1 = w_1 - \alpha \frac{\partial \text{err}_1}{\partial w_1} = w_1 - \alpha \frac{\partial \text{err}_1}{\partial w_1} \cdot \frac{\partial w_1}{\partial w_1} = w_1 - \alpha \text{softmax}'(1) = 0 - 0.1 * (-0.05) + 0.1 = 0.005$$

$$w_2 = w_2 - \alpha \frac{\partial \text{err}_2}{\partial w_2} = w_2 - \alpha \frac{\partial \text{err}_2}{\partial w_2} \cdot \frac{\partial w_2}{\partial w_2} = w_2 - \alpha \cdot \text{softmax}'(1) = 0 - 0.1 * (-0.05) + 0.2 = 0.005$$

$$b_3 = b_3 - \alpha \frac{\partial \text{err}_3}{\partial b_3} = b_3 - \alpha \frac{\partial \text{err}_3}{\partial b_3} \cdot \frac{\partial b_3}{\partial b_3} = b_3 - \alpha \cdot \text{softmax}'(1) = 0 - 0.1 * (-0.05) + 1 = 0.015$$