



$$W_h = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix}$$

$$W_y = [y_1 \ y_2]$$

$$b_h = \begin{bmatrix} b_{h1} \\ b_{h2} \end{bmatrix}$$

$$b_y = b_y$$

$$\eta = 0.1$$

$$H_1 = \sigma \left( \sum_i x_i \cdot h_{1i} + b_{h1} \right) = \sigma (h_{11} \cdot x_1 + h_{12} \cdot x_2 + b_{h1})$$

$$H_2 = \sigma \left( \sum_i x_i \cdot h_{2i} + b_{h2} \right) = \sigma (h_{21} \cdot x_1 + h_{22} \cdot x_2 + b_{h2})$$

$$y = \sigma \left( \sum_i y_i \cdot H_i + b_y \right) = \sigma (y_1 \cdot H_1 + y_2 \cdot H_2 + b_y)$$

$$\sigma(x) = \frac{1}{1 + e^{-x}}$$

$$E = y - y$$

$$\delta = \begin{cases} \text{выходной} \rightarrow y(1-y)(y-y) \\ \text{скрытый} \rightarrow H_i(1-H_i)(y_i - \delta_y) \end{cases}$$

$$b_i = b_i + \eta \cdot \delta_{H_i}$$

$$b_y = b_y + \eta \cdot \delta_y$$

$$\Delta W = \eta \cdot H_i \cdot \delta_i + W_{old}$$

$$\eta \cdot H_i \cdot \delta_i + h_{ji} = h_{ji}^{new}$$

$$\eta \cdot H_i \cdot \delta_y + y_i = y_i^{new}$$

## I Iteration

$$H_1 = \sigma(0.0991 \cdot 0.35 + 0.7976 \cdot 0.9 + 0.1) = \sigma(0.852435) = 0.701078$$

$$H_2 = \sigma(0.3971 \cdot 0.35 + 0.5925 \cdot 0.9 - 0.2) = \sigma(0.022235) = 0.494441$$

$$y = \sigma(0.2724 \cdot 0.701078 + 0.8731 \cdot 0.494441 + 0.05) = \sigma(0.67267) = 0.662101$$

$$E = 0.5 - 0.662101 = -0.162101$$

$$h_{11} = 0.0991 + 0.1 \cdot 0.35 \cdot 0.701078 \cdot (1 - 0.701078) \cdot (0.2724 - 0.036265) = 0.0990275$$

$$\delta_y = 0.662101 \cdot (1 - 0.662101) \cdot (-0.162101) = -0.036265$$

$$h_{21} = 0.3971 + 0.1 \cdot 0.35 \cdot 0.701078 \cdot (1 - 0.701078) \cdot (0.2724 - 0.036265) = 0.7973136$$

$$h_{12} = 0.7971 + 0.1 \cdot 0.35 \cdot 0.494441 \cdot (1 - 0.494441) \cdot (0.8731 - 0.036265) = 0.396822$$

$$h_{22} = 0.5925 + 0.1 \cdot 0.35 \cdot 0.494441 \cdot (1 - 0.494441) \cdot (0.8731 - 0.036265) = 0.591787$$

$$y_1 = 0.2724 + 0.1 \cdot 0.701078 \cdot (-0.036265) = 0.269857$$

$$y_2 = 0.8731 + 0.1 \cdot 0.494441 \cdot (-0.036265) = 0.871306$$

$$b_{h1} = 0.1 + 0.1 \cdot (-0.00207023) = 0.09979$$

$$b_{h2} = -0.2 + 0.1 \cdot (-0.0079147) = -0.20079$$

$$b_y = 0.05 + 0.1 \cdot (-0.036265) = 0.04637$$

## II iteration

$$H_1 = \sigma(0.0990275 \cdot 0.35 + 0.7973136 \cdot 0.9 + 0.09979) = 0.700993$$

$$H_2 = \sigma(0.396822 \cdot 0.35 + 0.591787 \cdot 0.9 - 0.20079) = 0.615551$$

$$y = \sigma(0.269857 \cdot 0.700993 + 0.871306 \cdot 0.615551 + 0.04637) = 0.673926$$

$$E = -0.183926$$

$$\delta_y = 0.673926 \cdot (1 - 0.673926) \cdot (-0.183926) = -0.03975$$

$$\delta_{H1} = 0.700993 \cdot (1 - 0.700993) \cdot (0.269857 - 0.03975) = -0.00224836$$

$$\delta_{H2} = 0.615551 \cdot (1 - 0.615551) \cdot (0.871306 - 0.03975) = -0.00819616$$

$$h_{11} = 0.0990275 + 0.1 \cdot 0.35 \cdot -0.00224836 = 0.098948$$

$$h_{21} = 0,7973136 + 0,1 \cdot 0,9 \cdot -0,00224836 = 0,797111$$

$$h_{12} = 0,396822 + 0,1 \cdot 0,35 \cdot -0,0019616 = 0,393963$$

$$h_{22} = 0,091787 + 0,1 \cdot 0,9 \cdot -0,00819616 = 0,091049$$

$$y_1 = 0,269857 + 0,1 \cdot 0,700993 \cdot -0,03976 = 0,26707$$

$$y_2 = 0,871306 + 0,1 \cdot 0,61507 \cdot -0,03976 = 0,86886$$

$$l_{h1} = 0,09999 + 0,1 \cdot -0,00224836 = 0,099665$$

$$l_{h2} = -0,20079 + 0,1 \cdot -0,00819616 = -0,201603$$

$$l_y = 0,04637 + 0,1 \cdot -0,03976 = 0,042395$$

### III Iteration.

$$H_1 = 5(0,098948 \cdot 0,35 + 0,797111 \cdot 0,9 + 0,099665) = 0,700902$$

$$H_2 = 5(0,393963 \cdot 0,35 + 0,091049 \cdot 0,9 - 0,201603) = 0,614962$$

$$y = 5(0,26707 \cdot 0,700902 + 0,86886 \cdot 0,614962 + 0,042395) = 0,682199$$

$$E = -0,182199$$

$$S_y = 0,682199 \cdot (1 - 0,682199) + 0,182199 = -0,039501$$

$$S_1 = 0,700902(1 - 0,700902) \cdot 0,26707 + -0,039501 = -0,00221158$$

$$S_2 = 0,614962(1 - 0,614962) \cdot 0,86886 + -0,039501 = -0,00812662$$

$$h_{11} = 0,098948 + 0,1 \cdot 0,35 \cdot -0,00221158 = 0,0988705$$

$$h_{21} = 0,797111 + 0,1 \cdot 0,9 \cdot -0,00221158 = 0,796911$$

$$h_{12} = 0,393963 + 0,1 \cdot 0,35 \cdot -0,00812662 = 0,393618$$

$$h_{22} = 0,091049 + 0,1 \cdot 0,9 \cdot -0,00812662 = 0,09031$$

$$y_1 = 0,26707 + 0,1 \cdot 0,700902 \cdot -0,039501 = 0,264301$$

$$y_2 = 0,86886 + 0,1 \cdot 0,614962 \cdot -0,039501 = 0,86642$$

$$l_{h1} = 0,09999 + 0,1 \cdot -0,00221158 = 0,099343$$

$$l_{h2} = -0,201603 + 0,1 \cdot -0,00812662 = -0,202421$$

$$l_y = 0,042395 + 0,1 \cdot -0,039501 = 0,0384449$$

$$y \Rightarrow H_1 = 5(0,0988705 \cdot 0,35 + 0,796911 \cdot 0,9 + 0,099343) = 0,700812$$

$$H_2 = 5(0,393618 \cdot 0,35 + 0,09031 \cdot 0,9 - 0,202421) = 0,614434$$

$$y = 5(0,264301 \cdot 0,700812 + 0,86642 \cdot 0,614434 + 0,0384449) = 0,686$$