$w = (1, -2, 1)$

$X = \{(6,3), (5,3), (1,1), (1, 1.1)\}$

$6 - (2 \cdot 3) = 0 \geq -1$

$5 - (2 \cdot 3) = -1 \geq -1$

$1 - (2 \cdot 1) = -1 \geq -1$

$1 - (2 \cdot 1{,}1) = -1{,}2 \not\geq -1$

$0 \geq A - B \quad \rightarrow \quad B \geq A$

$0 \leq A - B \quad \rightarrow \quad B \leq A$

Kvíz:

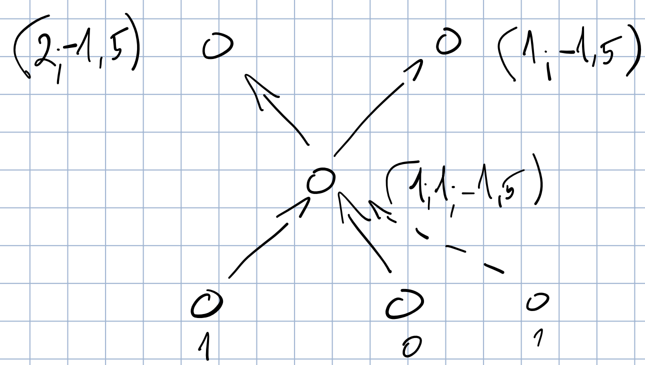
$\sigma(x) := \dfrac{1}{1+e^{-x}}$

Let B be a multi-layered neural network with 2 input neurons, 1 hidden neuron and 2 output neurons, standard sigmoidal transfer function and the weights/thresholds $\vec{w}_h = (1, 1, -1.5)$, $\vec{w}_{o_1} = (2, -1.5)$ and $\vec{w}_{o_2} = (1, -1.5)$.

For the training pattern $[(1,0),(1,0)]$ the actual network output will be

Vyberte jednu nebo více možností:

- [ ] different from the desired output.
- [ ] $y_h = 0.3775, \quad y_{o_1} = 1, \quad y_{o_2} = 0.$
- [ ] $y_h = 0.6225, \quad y_{o_1} = 0.5634, \quad y_{o_2} = 0.7063.$
- [ ] $y_h = 0.3775, \quad y_{o_1} = 0.3219, \quad y_{o_2} = 0.2456.$



$x = (1; 0; 1)$

$w = (1; 1; -1{,}5)$

$x^T w = -0{,}5$

$\sigma(x^T w) = \dfrac{1}{1+e^{1/2}} = 0{,}3775$

$y_h = (0{,}3775; 1)$

$w_{o_1} = (2; -1{,}5) \quad w_{o_2} = (1; -1{,}5)$

$y^T w_{o_1} = -0{,}745$

$y^T w_{o_2} = -1{,}1225$

$\sigma(y_h^T w_{o_1}) \doteq 0{,}3219$

$\sigma(y_h^T w_{o_2}) \doteq 0{,}2455$

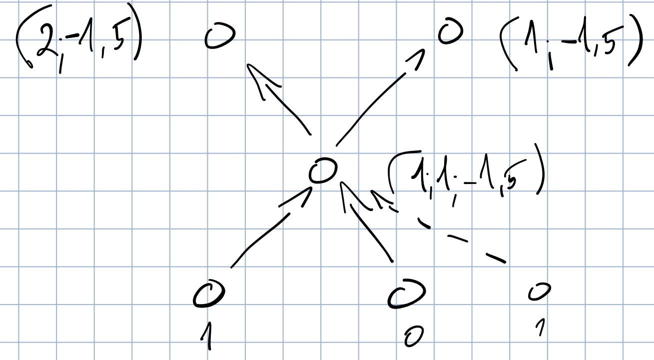
$y_h^T \cdot w < \sigma$

$y_h^T \cdot w - \sigma < 0$

For the network from question 3 and training pattern $((1,0),(1,0))$ (the input (1,0) is the same as the desired output) adjust the weights with $\alpha = 0.6$. The new weights w_{h1} and w_{h2} of the hidden neuron will be

Vyberte jednu z nabízených možností:

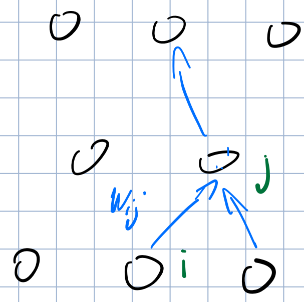
- $w_{h1} = 1.0353, \quad w_{h2} = 1$
- $w_{h1} = 1.0145, \quad w_{h2} = 1$
- $w_{h1} = 1.0133, \quad w_{h2} = 1.033$
- different from the previous ones.



Using MSE:

$$w_{ij}(t+1) = w_{ij}(t) + \alpha \cdot \delta_j y_i$$

$y_1 = 0 \rightarrow w_{10} = w_{10}$



δ_j for hidden: $\left(\sum_k \delta_k w_{jk}\right) \lambda y_j (1 - y_j)$

δ_j for output: $(t_j - y_j) \lambda y_j (1 - y_j)$

$$w_{00}^h(t+1) = 1 + 0{,}6 \cdot \delta_0 \cdot 1 = 1{,}0353$$

$$w_{10}^h(t+1) = 1 + 0{,}6 \cdot \delta_1 \cdot 0 = 1$$

$$\delta_0^h = \left(\delta_0^o \cdot w_{00}^o + \delta_1^o \cdot w_{01}^o\right) \cdot 0{,}3775 \cdot (1 - 0{,}3775)$$

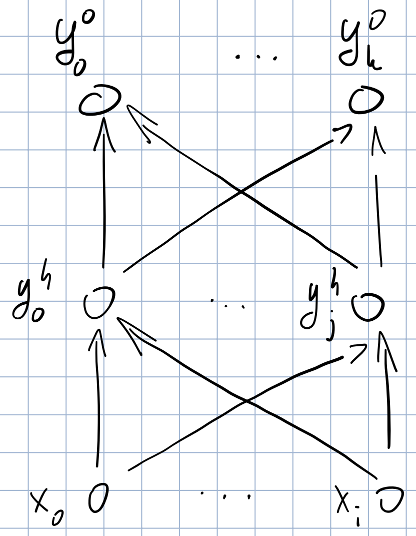
$$= \left(\delta_0^o \cdot 2 + \delta_1^o \cdot 1\right) \cdot 0{,}3775 \cdot (1 - 0{,}3775)$$

$$\delta_0^o = (1 - 0{,}3214) \cdot 0{,}3214 \cdot (1 - 0{,}3214) = 0{,}1480$$

$$\delta_1^o = (0 - 0{,}2455) \cdot 0{,}2455 \cdot (1 - 0{,}2455) = -0{,}0455$$

$$= (2 \cdot 0{,}1480 + 0{,}1398) \cdot 0{,}3775 \cdot (1 - 0{,}3775) = 0{,}0588$$

Obecně řečeno

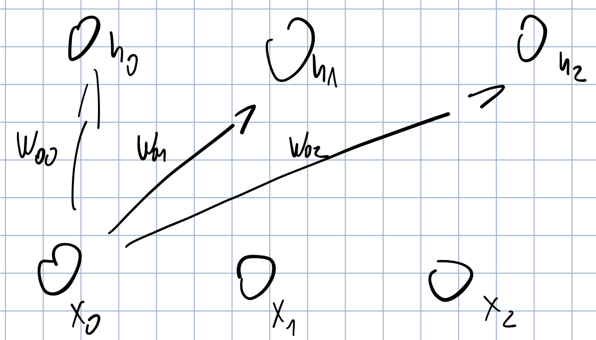


$$\delta_{out} = \left.\begin{bmatrix} (t_0 - y_0) \cdot y_0^o \cdot (1 - y_0), \\ \vdots \\ (t_k - y_k) \cdot y_k^o \cdot (1 - y_k) \end{bmatrix}\right\} k$$

$$\delta_{hidden} = \left.\begin{bmatrix} \left(\sum_l \delta_l w_{0l}\right) y_0^h \cdot (1 - y_0^h), \\ \vdots \\ \left(\sum_l \delta_l w_{jl}\right) \cdot y_j^h \cdot (1 - y_j^h) \end{bmatrix}\right\} j$$

při počítání δ_* uvažuju jako y_*^* z dané vrstvy

při počítání w_{**} uvažuju y_*^* z předchozí (nižší) vrstvy



$$w_{ij}(t+1) = w_{ij}(t) + \alpha \delta_j y_i$$

<-> váha, co váží i-tý vstup,
s j-tou pozicí v hidden vrstvě

For the network from question 3 and the training pattern $[(1,0),(1,0)]$, compute the new weights of the output neuron o_1 by means of relaxation with $\alpha = 0.5$ and $\beta = 0.1$

Vyberte jednu z nabízených možností:

- $w_{h,o_1} = 2.028$
- $w_{h,o_1} = 1.972$
- $w_{h,o_1} = 2.0341$
- $w_{h,o_1} = 1.9659$

$$W_o = (2, -1{,}5) \qquad W_o' = (2{,}1, -1{,}5) \qquad y_h = (0{,}3775, 1)$$

$$t_o = 1$$

$$y_h^T w_o' = -0{,}70725$$

$$y_o^o = 0{,}3219$$

$$\sigma(y_h^T w_o') = 0{,}3302$$

$$E := MSE$$

$$E(w_o) = \frac{(1-0{,}3219)^2}{2} = 0{,}2299 \qquad \frac{1}{2}\sum_i (t_i - y_i)^2 := MSE$$

$$E(w_o') = \frac{(1-0{,}3302)^2}{2} = 0{,}2243$$

$$\Delta w_i = \frac{0{,}2243 - 0{,}2299}{0{,}1} \cdot 0{,}5 = -0{,}028$$

$$w_i = 2 - 0{,}028 = \underline{\underline{1{,}972}}$$

$$e^{\ln x - \ln 2} - e^{\ln x - \ln y} = e^{\log\left(\frac{x}{2}\right)} - e^{\log\left(\frac{x}{y}\right)} = \frac{x}{2} - \frac{x}{y}$$

$$e^{\ln\left(e^{\ln x + \ln y - \ln 2} - x\right) - \ln y} = e^{\ln\left(e^{\ln\left(\frac{xy}{2}\right)} - x\right) - \ln y}$$

$$= e^{\ln\left(\frac{xy}{2} - x\right) - \ln y} = e^{\ln\left(\frac{\frac{xy}{2} - x}{y}\right)} = \frac{\frac{xy}{2} - x}{y}$$