

BỘ CÔNG THƯƠNG
TRƯỜNG ĐẠI HỌC CÔNG NGHIỆP TP. HCM



CÔNG NGHỆ TÍNH TOÁN MỀM
BÀI BÁO CÁO

NHÓM 6

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Câu 1: Tính đạo hàm các hàm tác động

- Relu
- Sigmoid đơn cực
- Sigmoid lưỡng cực
- Tuyến tính

Bài làm

	Type of f	f	f'
1	Sigmoid	$g(x) = \frac{1}{1+e^{-x}}$	$\frac{e^{-x}}{(1+e^{-x})^2}$
2	Sigmoid lưỡng cực	$g(x) = \frac{1-e^{-x}}{1+e^{-x}}$	$\frac{2e^{-x}}{(1+e^{-x})^2}$
3	Relu	$\text{Relu} = \max(0, x)$	$\frac{\partial \text{Relu}(x)}{\partial x} = \begin{cases} 0 & \text{if } x \leq 0 \\ 1 & \text{if } x > 0 \end{cases}$
4	Linear	$ax + b$	a
5	tanh	$\tanh(x) = \frac{e^x - e^{-x}}{e^x + e^{-x}}$	$\frac{\partial \tanh(x)}{\partial x} = 1 - \tanh^2(x)$

Câu 2: Thực hiện tính toán 1 vòng lặp huấn luyện mạng NN

- a) f = sigmoid đơn cực, g = tuyến tính
 b) f = sigmoid lưỡng cực, g = tuyến tính
 c) f = Relu, g = tuyến tính

Bài làm

a) $f = \text{sigmoid đơn cực}$, $g = \text{tuyến tính}$

Câu 2: Tính đạo hàm các hàm đặc trưng.

$$W_0 = [0,2, 0,4, 0,6]^T \quad \eta = 0,1$$

$$V_0 = \begin{bmatrix} -0,1 & 0,1 & 0,3 \\ -0,2 & 0,2 & 0,4 \end{bmatrix} \quad \text{Đầu vào } \begin{bmatrix} 0 & 1 \end{bmatrix}$$

a) $f = \text{sigmoid đơn cực}$, $g = \text{tuyến tính}$

$$f = \frac{1}{1+e^{-x}}, \quad g(x) = x$$

b1:

$$z_1 = x_1 v_{11} + x_2 v_{21} = 0 \cdot (-0,1) + 1 \cdot (0,2) = 0,2 \rightarrow f_{z_1} = \frac{1}{1+e^{-0,2}} = 0,45$$

$$z_2 = x_1 v_{12} + x_2 v_{22} = 0 \cdot 0,1 + 1 \cdot 0,2 = 0,2 \rightarrow f_{z_2} = \frac{1}{1+e^{-0,2}} = 0,55$$

$$z_3 = x_1 v_{13} + x_2 v_{23} = 0 \cdot 0,3 + 1 \cdot 0,4 = 0,4 \rightarrow f_{z_3} = \frac{1}{1+e^{-0,4}} = 0,6$$

$$\hat{y} = f_{z_1} w_{11} + f_{z_2} w_{21} + f_{z_3} w_{31} = 0,45 \cdot 0,2 + 0,55 \cdot 0,4 + 0,6 \cdot 0,6 = 0,67 \neq 1$$

b2: $W = W - \eta \frac{\partial E}{\partial W}$

$$E = \frac{1}{2} (y - \hat{y})^2 \Rightarrow \frac{\partial E}{\partial \hat{y}} = -(y - \hat{y})$$

Cập nhập trực tiếp vào: $* W_{11} = W_{11} - \eta \frac{\partial E}{\partial W_{11}} \quad \text{Tác động: } \frac{\partial E}{\partial W_{11}} = \frac{\partial E}{\partial \hat{y}} \cdot \frac{\partial \hat{y}}{\partial W_{11}} = -(y - \hat{y}) \cdot f_{z_1}$

$$\Rightarrow W_{11} = W_{11} + \eta (y - \hat{y}) \cdot f_{z_1} = 0,2 + 0,1 \cdot (1 - 0,67) \cdot 0,45 = 0,21$$

$* W_{21} = W_{21} - \eta \frac{\partial E}{\partial W_{21}} \quad \text{Tác động: } \frac{\partial E}{\partial W_{21}} = \frac{\partial E}{\partial \hat{y}} \cdot \frac{\partial \hat{y}}{\partial W_{21}} = -(y - \hat{y}) \cdot f_{z_2}$

$$\Rightarrow W_{21} = 0,4 + 0,1 \cdot (1 - 0,67) \cdot 0,55 = 0,42$$

$* W_{31} = W_{31} - \eta \frac{\partial E}{\partial W_{31}} \quad \text{Tác động: } \frac{\partial E}{\partial W_{31}} = \frac{\partial E}{\partial \hat{y}} \cdot \frac{\partial \hat{y}}{\partial W_{31}} = -(y - \hat{y}) \cdot f_{z_3}$

$$\Rightarrow W_{31} = 0,6 + 0,1 \cdot (1 - 0,67) \cdot 0,6 = 0,62$$

Cập nhập lớp ẩn: $* v_{11} = v_{11} - \eta \frac{\partial E}{\partial v_{11}} \quad \text{Tác động: } \frac{\partial E}{\partial v_{11}} = \frac{\partial E}{\partial \hat{y}} \cdot \frac{\partial \hat{y}}{\partial f_{z_1}} \cdot \frac{\partial f_{z_1}}{\partial v_{11}} = -(y - \hat{y}) \cdot W_{11} \cdot e^{-z_1} \cdot f_{z_1}^2 \cdot x_1$

$$\Rightarrow v_{11} = v_{11} + \eta (y - \hat{y}) \cdot W_{11} \cdot e^{-z_1} \cdot f_{z_1}^2 \cdot x_1 = (-0,1) + 0,1 \cdot (1 - 0,67) \cdot 0,2 \cdot e^{0,2} \cdot (0,45)^2 \cdot 0 = -0,1$$

$* v_{12} = v_{12} - \eta \frac{\partial E}{\partial v_{12}} \quad \text{Tác động: } \frac{\partial E}{\partial v_{12}} = \frac{\partial E}{\partial \hat{y}} \cdot \frac{\partial \hat{y}}{\partial f_{z_2}} \cdot \frac{\partial f_{z_2}}{\partial v_{12}} = -(y - \hat{y}) \cdot W_{21} \cdot e^{-z_2} \cdot f_{z_2}^2 \cdot x_1$

$$\Rightarrow v_{12} = 0,1 + 0,1 \cdot (1 - 0,67) \cdot 0,4 \cdot e^{-0,2} \cdot (0,55)^2 \cdot 0 = 0,1$$

$* v_{13} = v_{13} - \eta \frac{\partial E}{\partial v_{13}} \quad \text{Tác động: } \frac{\partial E}{\partial v_{13}} = \frac{\partial E}{\partial \hat{y}} \cdot \frac{\partial \hat{y}}{\partial f_{z_3}} \cdot \frac{\partial f_{z_3}}{\partial v_{13}} = -(y - \hat{y}) \cdot W_{31} \cdot e^{-z_3} \cdot f_{z_3}^2 \cdot x_1$

$$\Rightarrow v_{13} = 0,3 + 0,1 \cdot (1 - 0,67) \cdot 0,6 \cdot e^{-0,4} \cdot (0,6)^2 \cdot 0 = 0,3$$

$* v_{21} = v_{21} - \eta \frac{\partial E}{\partial v_{21}} \quad \text{Tác động: } \frac{\partial E}{\partial v_{21}} = \frac{\partial E}{\partial \hat{y}} \cdot \frac{\partial \hat{y}}{\partial f_{z_1}} \cdot \frac{\partial f_{z_1}}{\partial v_{21}} = -(y - \hat{y}) \cdot W_{11} \cdot e^{-z_1} \cdot f_{z_1}^2 \cdot x_2$

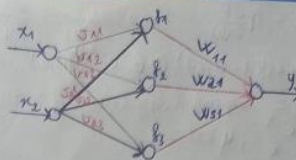
$$\Rightarrow v_{21} = (-0,2) + 0,1 \cdot (1 - 0,67) \cdot 0,2 \cdot e^{0,2} \cdot (0,45)^2 \cdot 1 = -0,198$$

$* v_{22} = v_{22} - \eta \frac{\partial E}{\partial v_{22}} \quad \text{Tác động: } \frac{\partial E}{\partial v_{22}} = \frac{\partial E}{\partial \hat{y}} \cdot \frac{\partial \hat{y}}{\partial f_{z_2}} \cdot \frac{\partial f_{z_2}}{\partial v_{22}} = -(y - \hat{y}) \cdot W_{21} \cdot e^{-z_2} \cdot f_{z_2}^2 \cdot x_2$

$$\Rightarrow v_{22} = 0,2 + 0,1 \cdot (1 - 0,67) \cdot 0,4 \cdot e^{-0,2} \cdot (0,55)^2 \cdot 1 = 0,203$$

$* v_{23} = v_{23} - \eta \frac{\partial E}{\partial v_{23}} \quad \text{Tác động: } \frac{\partial E}{\partial v_{23}} = \frac{\partial E}{\partial \hat{y}} \cdot \frac{\partial \hat{y}}{\partial f_{z_3}} \cdot \frac{\partial f_{z_3}}{\partial v_{23}} = -(y - \hat{y}) \cdot W_{31} \cdot e^{-z_3} \cdot f_{z_3}^2 \cdot x_2$

$$\Rightarrow v_{23} = 0,4 + 0,1 \cdot (1 - 0,67) \cdot 0,6 \cdot e^{-0,4} \cdot (0,6)^2 \cdot 1 = 0,395$$



b) $f = \text{sigmoid}$ lưỡng cực, $g = \text{tuyến tính}$

~~1.1~~ b) $f = \text{Sigmoid}$ lưỡng cực, $y = \text{tuyến tính}$
 $f = \frac{1-e^{-x}}{1+e^{-x}}$, $g(x) = x$

6.1. Lan truyền đi trước

$$z_1 = x_1 v_{11} + x_2 v_{21} = 0 \cdot (-0,1) - 1 \cdot 0,2 = -0,2 \Rightarrow f_{z_1} = \frac{1-e^{-0,2}}{1+e^{-0,2}} = -0,1$$

$$z_2 = x_1 v_{12} + x_2 v_{22} = 0 \cdot (0,1) + 1 \cdot 0,2 = 0,2 \Rightarrow f_{z_2} = \frac{1-e^{-0,2}}{1+e^{-0,2}} = 0,1$$

$$z_3 = x_1 v_{13} + x_2 v_{23} = 0 \cdot (0,3) + 1 \cdot (0,4) = 0,4 \Rightarrow f_{z_3} = \frac{1-e^{-0,4}}{1+e^{-0,4}} = 0,2$$

$$\hat{y} = f_{z_1} w_{11} + f_{z_2} w_{21} + f_{z_3} w_{31} = (-0,1) \cdot 0,2 + 0,1 \cdot 0,4 + 0,2 \cdot 0,6 = 0,14 \neq 1$$

$$E = \frac{1}{2} (y - \hat{y})^2 = \frac{1}{2} (1 - 0,14)^2 = 0,3698$$

6.2. Lan truyền ngược

$$w_{ij} = w_{ij} - \eta \frac{\partial E}{\partial w_{ij}}$$

$$\frac{\partial E}{\partial \hat{y}} = -(y - \hat{y})$$

cập nhật trọng số:

$$w_{11} = w_{11} + \eta (y - \hat{y}) \cdot f_{z_1} = 0,2 + 0,1 \cdot (1 - 0,14) \cdot (-0,1) = 0,19$$

$$w_{21} = w_{21} + \eta (y - \hat{y}) \cdot f_{z_2} = 0,4 + 0,1 \cdot (1 - 0,14) \cdot 0,1 = 0,41$$

$$w_{31} = w_{31} + \eta (y - \hat{y}) \cdot f_{z_3} = 0,6 + 0,1 \cdot (1 - 0,14) \cdot 0,2 = 0,6172$$

cập nhật lớp ẩn

$$v_{11} = v_{11} - \eta \frac{\partial E}{\partial v_{11}} = v_{11} + \eta (y - \hat{y}) \cdot w_{11} \cdot \left(\frac{2e^{-z_1}}{(1+e^{-z_1})^2} \right) \cdot x_1 = (-0,1) + 0,1 \cdot (1 - 0,14) \cdot 0,2 \cdot \left(\frac{2e^{-0,2}}{(1+e^{-0,2})^2} \right) \cdot (-0,1) = -0,1$$

$$v_{12} = v_{12} - \eta \frac{\partial E}{\partial v_{12}} = v_{12} + \eta (y - \hat{y}) \cdot w_{21} \cdot \left(\frac{2e^{-z_2}}{(1+e^{-z_2})^2} \right) \cdot x_1 = 0,1 + 0,1 \cdot (1 - 0,14) \cdot 0,4 \cdot \left(\frac{2e^{-0,2}}{(1+e^{-0,2})^2} \right) \cdot 0 = 0,1$$

$$v_{13} = v_{13} - \eta \frac{\partial E}{\partial v_{13}} = v_{13} + \eta (y - \hat{y}) \cdot w_{31} \cdot \left(\frac{2e^{-z_3}}{(1+e^{-z_3})^2} \right) \cdot x_1 = 0,3 + 0,1 \cdot (1 - 0,14) \cdot 0,6 \cdot \left(\frac{2e^{-0,4}}{(1+e^{-0,4})^2} \right) \cdot 0 = 0,3$$

$$v_{21} = v_{21} - \eta \frac{\partial E}{\partial v_{21}} = v_{21} + \eta (y - \hat{y}) \cdot w_{11} \cdot \left(\frac{2e^{-z_1}}{(1+e^{-z_1})^2} \right) \cdot x_2 = (-0,2) + 0,1 \cdot (1 - 0,14) \cdot (-0,1) \cdot \left(\frac{2e^{-0,2}}{(1+e^{-0,2})^2} \right) \cdot 1 = -0,19$$

$$v_{22} = v_{22} - \eta \frac{\partial E}{\partial v_{22}} = v_{22} + \eta (y - \hat{y}) \cdot w_{21} \cdot \left(\frac{2e^{-z_2}}{(1+e^{-z_2})^2} \right) \cdot x_2 = 0,2 + 0,1 \cdot (1 - 0,14) \cdot 0,4 \cdot \left(\frac{2e^{-0,2}}{(1+e^{-0,2})^2} \right) \cdot 1 = 0,217$$

$$v_{23} = v_{23} - \eta \frac{\partial E}{\partial v_{23}} = v_{23} + \eta (y - \hat{y}) \cdot w_{31} \cdot \left(\frac{2e^{-z_3}}{(1+e^{-z_3})^2} \right) \cdot x_2 = 0,4 + 0,1 \cdot (1 - 0,14) \cdot 0,6 \cdot \left(\frac{2e^{-0,4}}{(1+e^{-0,4})^2} \right) \cdot 1 = 0,425$$

b) $f = \text{Relu}$, $g = \text{tuyến tính}$

c) $f = \text{Relu}$, $g = \text{tuyến tính}$

$$f(z) = \max(0, z), \quad f'(z) = \begin{cases} 0 & z < 0 \\ 1 & z > 0 \end{cases}$$

~~W = E~~
 B1:

$$z_1 = x_1 v_{11} + x_2 v_{21} = 0 \cdot (-0,1) + 1 \cdot (-0,2) = -0,2 \rightarrow f_{z_1} = \max(0, -0,2) = 0$$

$$z_2 = x_1 v_{12} + x_2 v_{22} = 0 \cdot 0,1 + 1 \cdot 0,2 = 0,2 \rightarrow f_{z_2} = \max(0, 0,2) = 0,2$$

$$z_3 = x_1 v_{13} + x_2 v_{23} = 0 \cdot 0,3 + 1 \cdot 0,4 = 0,4 \rightarrow f_{z_3} = \max(0, 0,4) = 0,4$$

$$\hat{y} = f_{z_1} w_{11} + f_{z_2} w_{21} + f_{z_3} w_{31} = 0 \cdot 0,2 + 0,2 \cdot 0,4 + 0,4 \cdot 0,6 = 0,32$$

B2: $E = \frac{1}{2} (y - \hat{y})^2 \Rightarrow \frac{\partial E}{\partial \hat{y}} = - (y - \hat{y})$

Cập nhập trong W :

$$w_{11} = w_{11} - \eta \frac{\partial E}{\partial w_{11}} = w_{11} + \eta (y - \hat{y}) \cdot f'_{z_1} = 0,2 + 0,1 \cdot (1 - 0,32) \cdot 0 = 0,2$$

$$w_{21} = w_{21} - \eta \frac{\partial E}{\partial w_{21}} = w_{21} + \eta (y - \hat{y}) \cdot f'_{z_2} = 0,4 + 0,1 \cdot (1 - 0,32) \cdot 0,2 = 0,4136$$

$$w_{31} = w_{31} - \eta \frac{\partial E}{\partial w_{31}} = w_{31} + \eta (y - \hat{y}) \cdot f'_{z_3} = 0,6 + 0,1 \cdot (1 - 0,32) \cdot 0,4 = 0,6272$$

Cập nhập lớp ẩn:

$$v_{11} = v_{11} - \eta \frac{\partial E}{\partial v_{11}} = v_{11} + \eta \frac{\partial E}{\partial \hat{y}} \cdot \frac{\partial \hat{y}}{\partial f_{z_1}} \cdot \frac{\partial f_{z_1}}{\partial v_{11}} = v_{11} + \eta (y - \hat{y}) \cdot w_{11} \cdot f'_{z_1} \cdot \frac{\partial f_{z_1}}{\partial v_{11}}$$

$$= (-0,1) + 0,1 \cdot (1 - 0,32) \cdot 0,2 \cdot 0 \cdot 0 = -0,1$$

$$v_{12} = v_{12} - \eta \frac{\partial E}{\partial v_{12}} = v_{12} + \eta (y - \hat{y}) \cdot w_{21} \cdot f'_{z_2} \cdot \frac{\partial f_{z_2}}{\partial v_{12}} = 0,1 + 0,1 \cdot (1 - 0,32) \cdot 0,2 \cdot 1 \cdot 0 = 0,1$$

$$v_{13} = v_{13} - \eta \frac{\partial E}{\partial v_{13}} = v_{13} + \eta (y - \hat{y}) \cdot w_{31} \cdot f'_{z_3} \cdot \frac{\partial f_{z_3}}{\partial v_{13}} = 0,3 + 0,1 \cdot (1 - 0,32) \cdot 0,4 \cdot 1 \cdot 0 = 0,3$$

$$v_{21} = v_{21} - \eta \frac{\partial E}{\partial v_{21}} = v_{21} + \eta \frac{\partial E}{\partial \hat{y}} \cdot \frac{\partial \hat{y}}{\partial f_{z_2}} \cdot \frac{\partial f_{z_2}}{\partial v_{21}} = (-0,2) + \eta (y - \hat{y}) \cdot w_{21} \cdot f'_{z_2} \cdot \frac{\partial f_{z_2}}{\partial v_{21}}$$

$$= (-0,2) + 0,1 \cdot (1 - 0,32) \cdot 0,2 \cdot 0 \cdot 1 = -0,2$$

$$v_{22} = v_{22} - \eta \frac{\partial E}{\partial v_{22}} = v_{22} + \eta (y - \hat{y}) \cdot w_{21} \cdot f'_{z_2} \cdot \frac{\partial f_{z_2}}{\partial v_{22}} = 0,2 + 0,1 \cdot (1 - 0,32) \cdot 0,2 \cdot 1 \cdot 1 = 0,2272$$

$$v_{23} = v_{23} - \eta \frac{\partial E}{\partial v_{23}} = v_{23} + \eta (y - \hat{y}) \cdot w_{31} \cdot f'_{z_3} \cdot \frac{\partial f_{z_3}}{\partial v_{23}} = 0,4 + 0,1 \cdot (1 - 0,32) \cdot 0,4 \cdot 1 \cdot 1 = 0,4408$$

Câu 3: Lập trình các trường hợp câu 2 bằng matlab/Python

Câu 4: Điều kiện dừng (điều kiện dừng GD)

Trả lời:

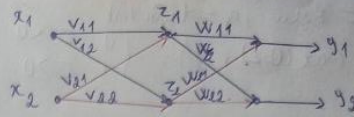
- Số lần lặp
- Độ chính xác mong muốn
- Mức độ cải thiện qua các lần lặp không có sự thay đổi

Câu 5:

$f = \text{sigmoid}, g = \text{Linear}$.

$$V_0 = \begin{bmatrix} -0,1 & 0,1 \\ -0,2 & 0,4 \end{bmatrix}, W_0 = \begin{bmatrix} 0,2 & 0,4 \\ 0,3 & 0,6 \end{bmatrix}, \eta = 0,1$$

x_1	x_2	y_1	y_2
0	1	1	0



81:

$$z_1 = x_1 v_{11} + x_2 v_{21} = 0 \cdot (-0,1) + 1 \cdot (-0,2) = -0,2 \rightarrow f_{z1} = \frac{1}{1+e^{-z_1}} = 0,45$$

$$z_2 = x_1 v_{12} + x_2 v_{22} = 0 \cdot 0,1 + 1 \cdot 0,4 = 0,4 \rightarrow f_{z2} = \frac{1}{1+e^{-z_2}} = 0,6$$

$$\hat{y}_1 = f_{z1} \cdot w_{11} + f_{z2} \cdot w_{21} = 0,45 \cdot 0,2 + 0,6 \cdot 0,3 = 0,27$$

$$\hat{y}_2 = f_{z1} \cdot w_{12} + f_{z2} \cdot w_{22} = 0,45 \cdot 0,4 + 0,6 \cdot 0,6 = 0,54$$

$$E = \frac{1}{2} \sum_{i=1}^2 [y_i - \hat{y}_i]^2 = \frac{1}{2} \cdot [(1-0,27)^2 + (0-0,54)^2] = 0,41$$

82:

Cập nhật trọng số:

$$w_{11} = w_{11} - \eta \frac{\partial E}{\partial w_{11}} = w_{11} - \eta \cdot \frac{\partial E}{\partial \hat{y}_1} \cdot \frac{\partial \hat{y}_1}{\partial w_{11}} = w_{11} - \eta \cdot (y_1 - \hat{y}_1) \cdot f_{z1}$$

$$\frac{\partial E}{\partial \hat{y}_1} = \frac{1}{2} [(y_1 - \hat{y}_1)^2 + (y_2 - \hat{y}_2)^2]' = \frac{1}{2} \cdot 2 \cdot (y_1 - \hat{y}_1) \cdot (-1) = -(y_1 - \hat{y}_1)$$

$$w_{11} = w_{11} + \eta \cdot (y_1 - \hat{y}_1) \cdot f_{z1} = 0,2 + 0,1 \cdot (1 - 0,27) \cdot 0,45 = 0,233$$

$$w_{12} = w_{12} - \eta \frac{\partial E}{\partial w_{12}} = w_{12} - \eta \cdot \frac{\partial E}{\partial \hat{y}_2} \cdot \frac{\partial \hat{y}_2}{\partial w_{12}} = w_{12} - \eta \cdot (y_2 - \hat{y}_2) \cdot f_{z1} = 0,4 - 0,1 \cdot (0 - 0,54) \cdot 0,45 = 0,3757$$

$$w_{21} = w_{21} - \eta \frac{\partial E}{\partial w_{21}} = w_{21} - \eta \cdot \frac{\partial E}{\partial \hat{y}_1} \cdot \frac{\partial \hat{y}_1}{\partial w_{21}} = w_{21} + \eta \cdot (y_1 - \hat{y}_1) \cdot f_{z2} = 0,3 + 0,1 \cdot (1 - 0,27) \cdot 0,6 = 0,5438$$

$$w_{22} = w_{22} - \eta \frac{\partial E}{\partial w_{22}} = w_{22} - \eta \cdot \frac{\partial E}{\partial \hat{y}_2} \cdot \frac{\partial \hat{y}_2}{\partial w_{22}} = w_{22} + \eta \cdot (y_2 - \hat{y}_2) \cdot f_{z2} = 0,6 + 0,1 \cdot (0 - 0,54) \cdot 0,6 = 0,5676$$

Cập nhật lớp ẩn:

$$v_{11} = v_{11} - \eta \frac{\partial E}{\partial v_{11}} = v_{11} - \eta \cdot \frac{\partial E}{\partial \hat{y}_1} \cdot \frac{\partial \hat{y}_1}{\partial z_1} \cdot \frac{\partial z_1}{\partial v_{11}} = v_{11} + \eta \cdot (y_1 - \hat{y}_1) \cdot w_{11} \cdot e^{-z_1} \cdot f_{z1} \cdot x_1$$

$$= (-0,1) + 0,1 \cdot (1 - 0,27) \cdot 0,2 \cdot \frac{1}{(1+e^{-z_1})^2} \cdot 0 = -0,1$$

$$v_{12} = v_{12} - \eta \frac{\partial E}{\partial v_{12}} = v_{12} - \eta \cdot \frac{\partial E}{\partial \hat{y}_2} \cdot \frac{\partial \hat{y}_2}{\partial z_2} \cdot \frac{\partial z_2}{\partial v_{12}} = v_{12} + \eta \cdot (y_2 - \hat{y}_2) \cdot w_{12} \cdot e^{-z_2} \cdot f_{z2} \cdot x_1 = 0,1 + 0,1 \cdot (0 - 0,54) \cdot 0,4 \cdot \frac{1}{(1+e^{-z_2})^2} \cdot 0 = 0,1$$

$$= 0,1 + \eta \cdot (y_2 - \hat{y}_2) \cdot w_{12} \cdot e^{-z_2} \cdot f_{z2} \cdot x_1 = 0,1 + 0,1 \cdot (0 - 0,54) \cdot 0,4 \cdot \frac{1}{(1+e^{-z_2})^2} \cdot 0 = 0,1$$

$$v_{21} = v_{21} - \eta \frac{\partial E}{\partial v_{21}} = v_{21} - \eta \cdot \frac{\partial E}{\partial \hat{y}_1} \cdot \frac{\partial \hat{y}_1}{\partial z_1} \cdot \frac{\partial z_1}{\partial v_{21}} = v_{21} + \eta \cdot (y_1 - \hat{y}_1) \cdot w_{21} \cdot e^{-z_1} \cdot f_{z1} \cdot x_2$$

$$= (-0,2) + 0,1 \cdot (1 - 0,27) \cdot 0,3 \cdot \frac{1}{(1+e^{-z_1})^2} \cdot 1 = -0,196$$

$$v_{22} = v_{22} - \eta \frac{\partial E}{\partial v_{22}} = v_{22} - \eta \cdot \frac{\partial E}{\partial \hat{y}_2} \cdot \frac{\partial \hat{y}_2}{\partial z_2} \cdot \frac{\partial z_2}{\partial v_{22}} = v_{22} + \eta \cdot (y_2 - \hat{y}_2) \cdot w_{22} \cdot e^{-z_2} \cdot f_{z2} \cdot x_2$$

$$= 0,4 - 0,1 \cdot (0 - 0,54) \cdot 0,6 \cdot \frac{1}{(1+e^{-z_2})^2} \cdot 1 = 0,3921$$