BỘ CÔNG THƯƠNG

TRƯỜNG ĐẠI HỌC CÔNG NGHIỆP TP. HCM

CÔNG NGHỆ TÍNH TOÁN MỀM

BÀI BÁO CÁO

NHÓM 6

Giảng viên : Nguyễn Ngọc Sơn

Sinh viên :

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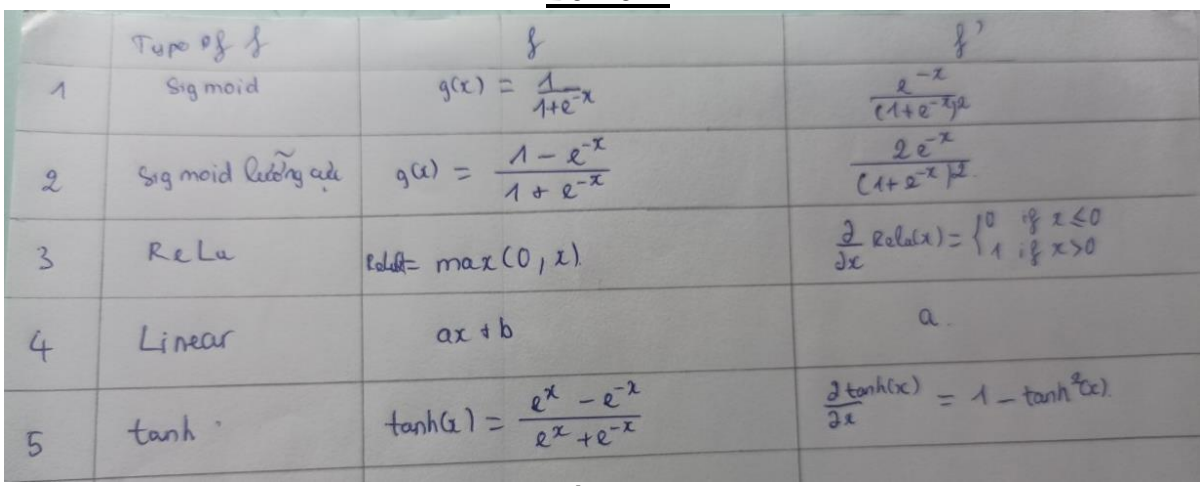
TP.HCM – 2022

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	$Relu = max(0, x)$	$\frac{\partial}{\partial x} Relu(x) = \begin{cases} 0 & \text{if } x \le 0 \\ 1 & \text{if } x > 0 \end{cases}$
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 1vòng lặp huấn luyện mạng NN

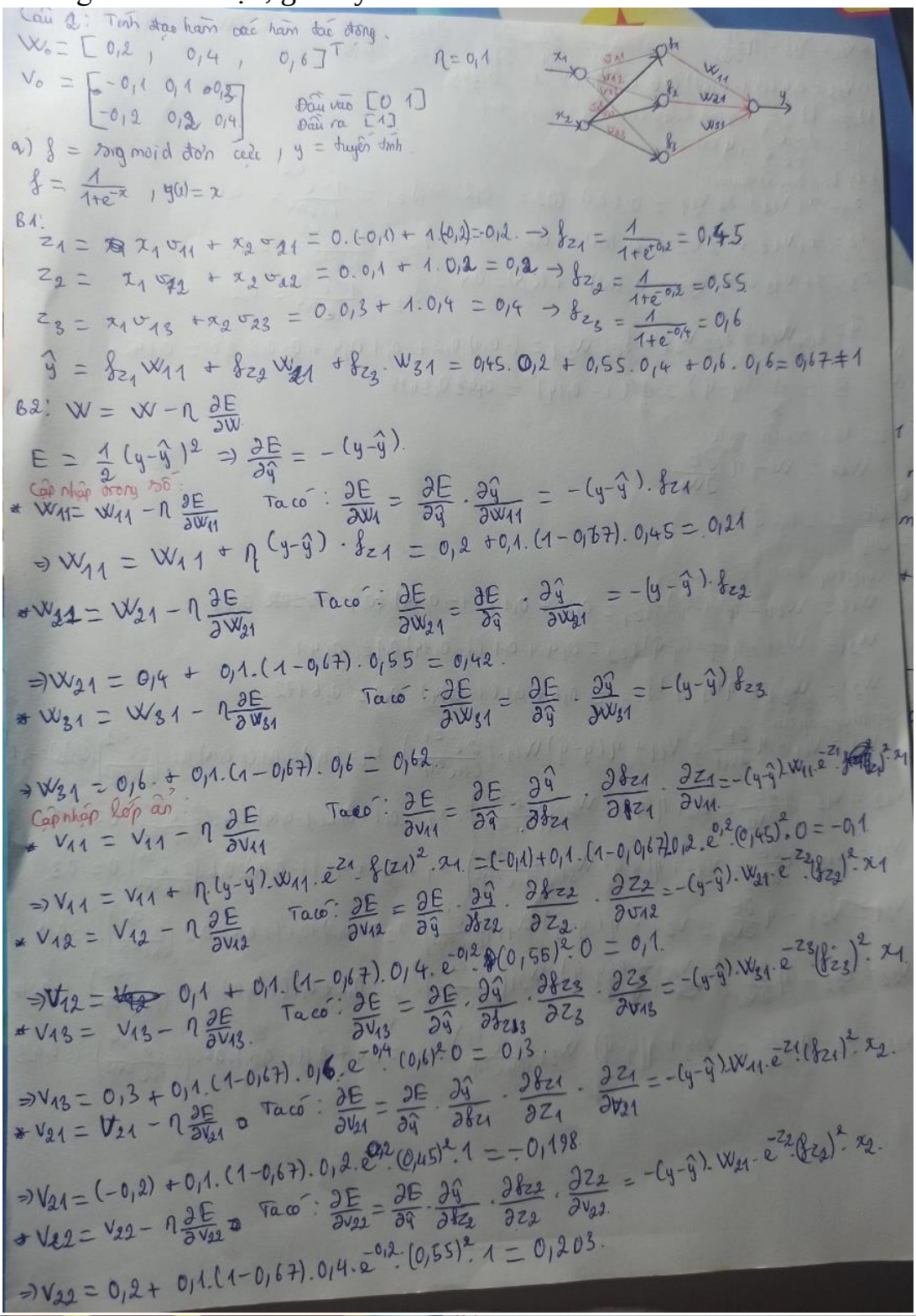
a) f = sigmoid đơn cực, g = tuyến tính

b) f = sigmoid lưỡng cực, g = tuyến tính

c) f =Relu, g = tuyến tính

Bài làm

a) f = sigmoid đơn cực, g = tuyến tính



Câu 2: Tính đạo hàm các hàm tác động.

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

$V_0 = \begin{bmatrix} -0,1 & 0,1 & 0,3 \\ -0,2 & 0,2 & 0,4 \end{bmatrix}$ Đầu vào [0 1] Đầu ra [1]

a) f = sigmoid đơn cực, g = tuyến tính

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

B1:

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

$z_2 = x_1 v_{12} + x_2 v_{22} = 0.0,1 + 1.0,2 = 0,2 \rightarrow f_{z2} = \frac{1}{1+e^{-0,2}} = 0,55$

$z_3 = x_1 v_{13} + x_2 v_{23} = 0.0,3 + 1.0,4 = 0,4 \rightarrow f_{z3} = \frac{1}{1+e^{-0,4}} = 0,6$

$\hat{y} = f_{z1} w_{11} + f_{z2} w_{21} + f_{z3} . w_{31} = 0,45.0,2 + 0,55.0,4 + 0,6.0,6 = 0,67 \neq 1$

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 trọng số:

* $w_{11} = w_{11} - \eta \frac{\partial E}{\partial w_{11}}$ Tacó: $\frac{\partial E}{\partial w_{11}} = \frac{\partial E}{\partial \hat{y}} . \frac{\partial \hat{y}}{\partial w_{11}} = -(y-\hat{y}) . f_{z1}$

$\Rightarrow w_{11} = w_{11} + \eta (y-\hat{y}) . f_{z1} = 0,2 + 0,1.(1-0,67).0,45 = 0,21$

* $w_{21} = w_{21} - \eta \frac{\partial E}{\partial w_{21}}$ Tacó: $\frac{\partial E}{\partial w_{21}} = \frac{\partial E}{\partial \hat{y}} . \frac{\partial \hat{y}}{\partial w_{21}} = -(y-\hat{y}) . f_{z2}$

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

* $w_{31} = w_{31} - \eta \frac{\partial E}{\partial w_{31}}$ Tacó: $\frac{\partial E}{\partial w_{31}} = \frac{\partial E}{\partial \hat{y}} . \frac{\partial \hat{y}}{\partial w_{31}} = -(y-\hat{y}) f_{z3}$

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

Cập nhập lớp ẩn

* $v_{11} = v_{11} - \eta \frac{\partial E}{\partial v_{11}}$ Tacó: $\frac{\partial E}{\partial v_{11}} = \frac{\partial E}{\partial \hat{y}} . \frac{\partial \hat{y}}{\partial f_{z1}} . \frac{\partial f_{z1}}{\partial z_1} . \frac{\partial z_1}{\partial v_{11}} = -(y-\hat{y}) . w_{11} . e^{-z_1} . (f_{z1})^2 . x_1$

$\Rightarrow v_{11} = v_{11} + \eta (y-\hat{y}) . w_{11} . e^{-z_1} . (f_{z1})^2 . x_1 = (-0,1) + 0,1.(1-0,67) . 0,2 . e^{-0,2} . (0,45)^2 . 0 = -0,1$

* $v_{12} = v_{12} - \eta \frac{\partial E}{\partial v_{12}}$ Tacó: $\frac{\partial E}{\partial v_{12}} = \frac{\partial E}{\partial \hat{y}} . \frac{\partial \hat{y}}{\partial f_{z2}} . \frac{\partial f_{z2}}{\partial z_2} . \frac{\partial z_2}{\partial v_{12}} = -(y-\hat{y}) . w_{21} . e^{-z_2} . (f_{z2})^2 . x_1$

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

* $v_{13} = v_{13} - \eta \frac{\partial E}{\partial v_{13}}$ Tacó: $\frac{\partial E}{\partial v_{13}} = \frac{\partial E}{\partial \hat{y}} . \frac{\partial \hat{y}}{\partial f_{z3}} . \frac{\partial f_{z3}}{\partial z_3} . \frac{\partial z_3}{\partial v_{13}} = -(y-\hat{y}) . w_{31} . e^{-z_3} . (f_{z3})^2 . x_1$

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

* $v_{21} = v_{21} - \eta \frac{\partial E}{\partial v_{21}}$ Tacó: $\frac{\partial E}{\partial v_{21}} = \frac{\partial E}{\partial \hat{y}} . \frac{\partial \hat{y}}{\partial f_{z1}} . \frac{\partial f_{z1}}{\partial z_1} . \frac{\partial z_1}{\partial v_{21}} = -(y-\hat{y}) . w_{11} . e^{-z_1} . (f_{z1})^2 . x_2$.

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

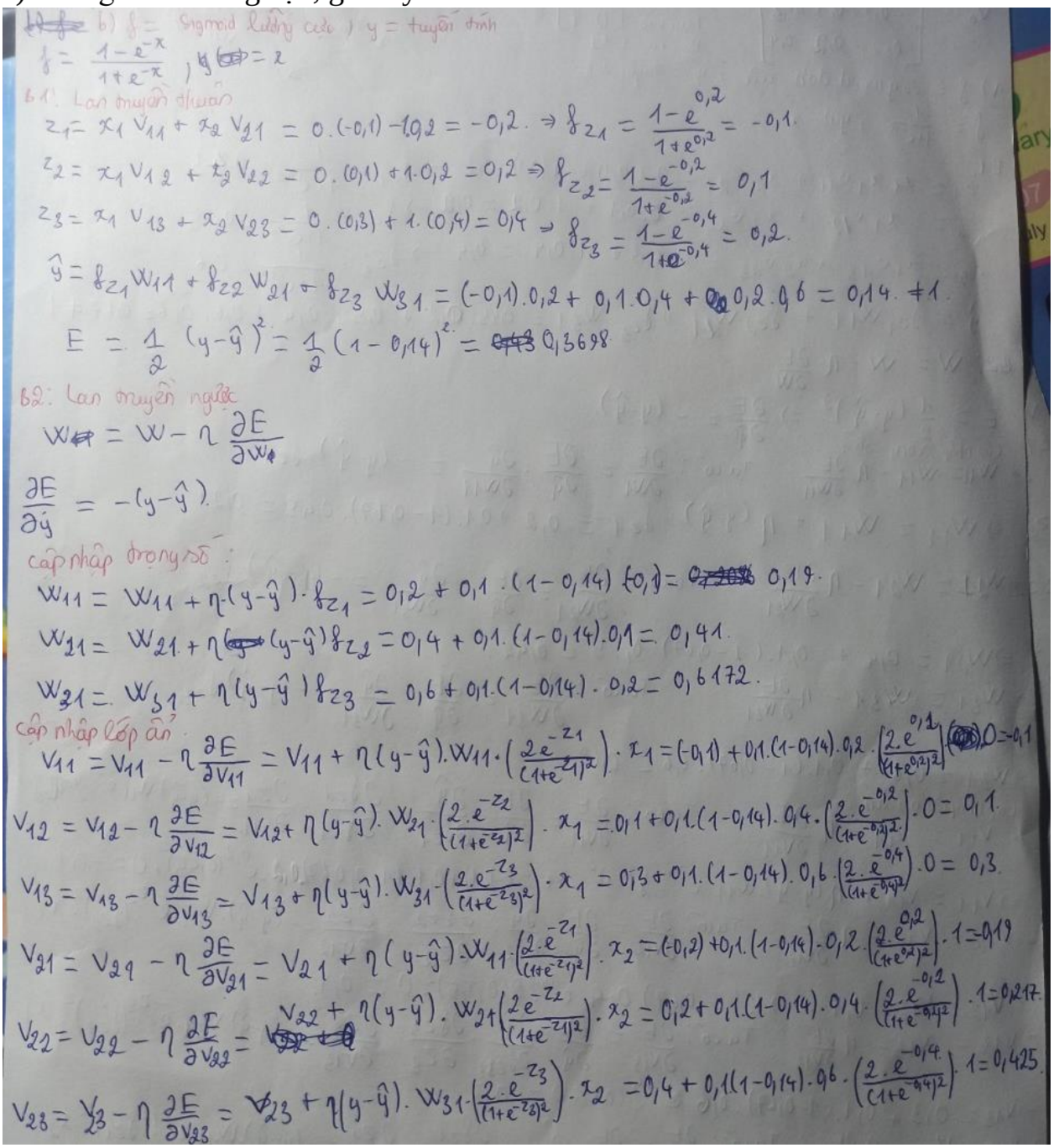
* $v_{22} = v_{22} - \eta \frac{\partial E}{\partial v_{22}}$ Tacó: $\frac{\partial E}{\partial v_{22}} = \frac{\partial E}{\partial \hat{y}} . \frac{\partial \hat{y}}{\partial f_{z2}} . \frac{\partial f_{z2}}{\partial z_2} . \frac{\partial z_2}{\partial v_{22}} = -(y-\hat{y}) . w_{21} . e^{-z_2} . (f_{z2})^2 . x_2$.

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

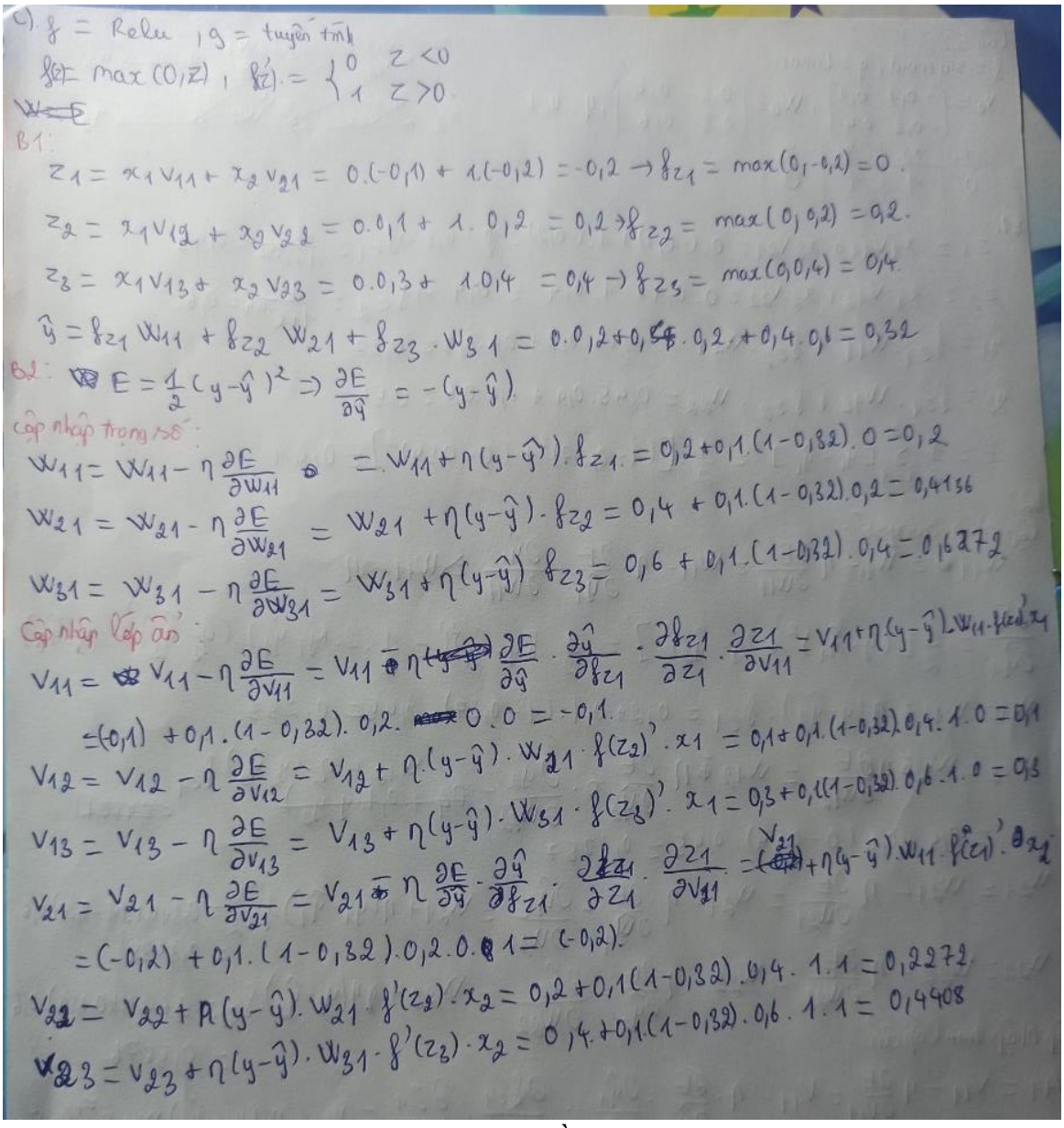
* $v_{23} = v_{23} - \eta \frac{\partial E}{\partial v_{23}}$ Tacó: $\frac{\partial E}{\partial v_{23}} = \frac{\partial E}{\partial \hat{y}} . \frac{\partial \hat{y}}{\partial f_{z3}} . \frac{\partial f_{z3}}{\partial z_3} . \frac{\partial z_3}{\partial v_{23}} = -(y-\hat{y}) . w_{31} . e^{-z_3} . (f_{z3})^2 . x_2$.

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

b) f = sigmoid lưỡng cực, g = tuyến tính



b) f =Relu, g = tuyến tính



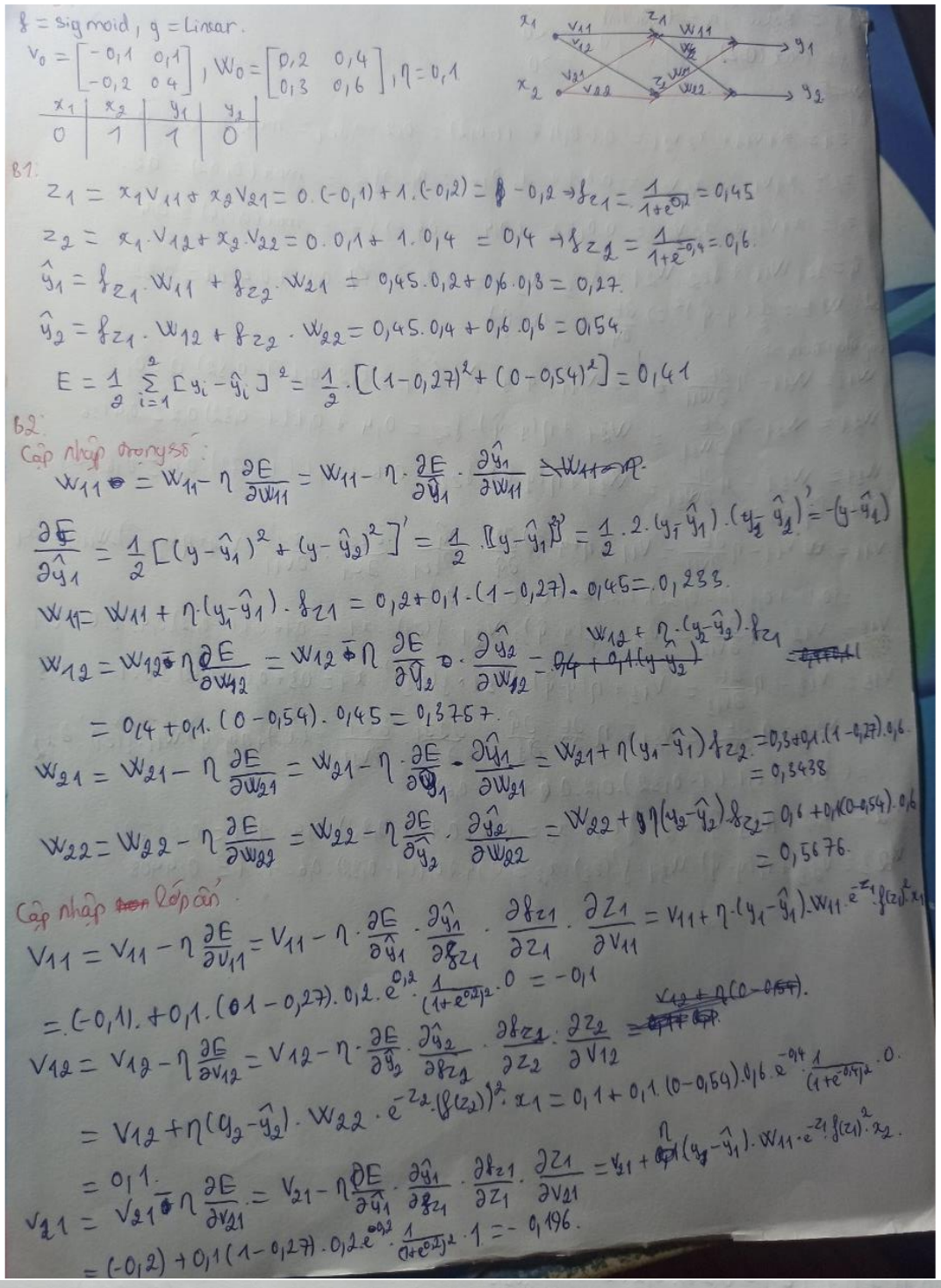
Câu 3: Lập trình các trường hợp câu 2 bằng matlab/Python

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 = sigmoid, g = 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
B1:
$z_1 = x_1 v_{11} + x_2 v_{21} = 0.(-0,1) + 1.(-0,2) = -0,2 \Rightarrow f_{z1} = \frac{1}{1+e^{0,2}} = 0,45$
$z_2 = x_1 . v_{12} + x_2 . v_{22} = 0.0,1 + 1.0,4 = 0,4 \Rightarrow f_{z2} = \frac{1}{1+e^{-0,4}} = 0,6$
$\hat{y}_1 = f_{z1} . w_{11} + f_{z2} . w_{21} = 0,45.0,2 + 0,6.0,3 = 0,27$
$\hat{y}_2 = f_{z1} . w_{12} + f_{z2} . w_{22} = 0,45.0,4 + 0,6.0,6 = 0,54$
$E = \frac{1}{2} \sum_{i=1}^{2} [y_i - \hat{y}_i]^2 = \frac{1}{2} . [(1-0,27)^2 + (0-0,54)^2] = 0,41$
B2:
Cập nhập trọng số:
$w_{11} = w_{11} - \eta \frac{\partial E}{\partial w_{11}} = w_{11} - \eta . \frac{\partial E}{\partial \hat{y}_1} . \frac{\partial \hat{y}_1}{\partial w_{11}}$
$\frac{\partial E}{\partial \hat{y}_1} = \frac{1}{2} [(y - \hat{y}_1)^2 + (y - \hat{y}_2)^2]' = \frac{1}{2} . [y - \hat{y}_1]^2 = \frac{1}{2} . 2 . (y_1 - \hat{y}_1) . (y_2 - \hat{y}_2)' = -(y - \hat{y}_1)$
$w_{11} = w_{11} + \eta . (y_1 - \hat{y}_1) . f_{z1} = 0,2 + 0,1 . (1 - 0,27) . 0,45 = 0,233$
$w_{12} = w_{12} - \eta \frac{\partial E}{\partial w_{12}} = w_{12} + \eta \frac{\partial E}{\partial \hat{y}_2} . \frac{\partial \hat{y}_2}{\partial w_{12}} = w_{12} + \eta . (y_2 - \hat{y}_2) . f_{z1}$
$= 0,4 + 0,1 . (0 - 0,54) . 0,45 = 0,3757$
$w_{21} = w_{21} - \eta \frac{\partial E}{\partial w_{21}} = w_{21} - \eta . \frac{\partial E}{\partial \hat{y}_1} . \frac{\partial \hat{y}_1}{\partial w_{21}} = w_{21} + \eta (y_1 - \hat{y}_1) f_{z2} = 0,3 + 0,1 . (1 - 0,27) . 0,6 = 0,3438$
$w_{22} = w_{22} - \eta \frac{\partial E}{\partial w_{22}} = w_{22} - \eta \frac{\partial E}{\partial \hat{y}_2} . \frac{\partial \hat{y}_2}{\partial w_{22}} = w_{22} + \eta (y_2 - \hat{y}_2) . f_{z2} = 0,6 + 0,1 (0 - 0,54) . 0,6 = 0,5676$
Cập nhập lớp ẩn:
$v_{11} = v_{11} - \eta \frac{\partial E}{\partial v_{11}} = v_{11} - \eta . \frac{\partial E}{\partial \hat{y}_1} . \frac{\partial \hat{y}_1}{\partial f_{z1}} . \frac{\partial f_{z1}}{\partial z_1} . \frac{\partial z_1}{\partial v_{11}} = v_{11} + \eta . (y_1 - \hat{y}_1) . w_{11} . e^{-z_1} . f(z_1)^2 . x_1$
$= -0,1 + 0,1 . (1 - 0,27) . 0,2 . e^{0,2} . \frac{1}{(1+e^{0,2})^2} . 0 = -0,1$
$v_{12} = v_{12} - \eta \frac{\partial E}{\partial v_{12}} = v_{12} - \eta . \frac{\partial E}{\partial \hat{y}_2} . \frac{\partial \hat{y}_2}{\partial f_{z2}} . \frac{\partial f_{z2}}{\partial z_2} . \frac{\partial z_2}{\partial v_{12}} = v_{12} + \eta (y_2 - \hat{y}_2) . w_{22} . e^{-z_2} . (f(z_2))^2 . x_1 = 0,1 + 0,1 . (0 - 0,54) . 0,6 . e^{-0,4} . \frac{1}{(1+e^{-0,4})^2} . 0 = 0,1$
$v_{21} = v_{21} - \eta \frac{\partial E}{\partial v_{21}} = v_{21} - \eta \frac{\partial E}{\partial \hat{y}_1} . \frac{\partial \hat{y}_1}{\partial f_{z1}} . \frac{\partial f_{z1}}{\partial z_1} . \frac{\partial z_1}{\partial v_{21}} = v_{21} + \eta (y_1 - \hat{y}_1) . w_{11} . e^{-z_1} f(z_1)^2 . x_2$
$= -0,2 + 0,1 (1 - 0,27) . 0,2 e^{0,2} . \frac{1}{(1+e^{0,2})^2} . 1 = -0,196$
$v_{22} = v_{22} - \eta \frac{\partial E}{\partial v_{22}} = v_{22} - \eta . \frac{\partial E}{\partial \hat{y}_2} . \frac{\partial \hat{y}_2}{\partial f_{z2}} . \frac{\partial f_{z2}}{\partial z_2} . \frac{\partial z_2}{\partial v_{22}} = v_{22} - \eta (y_2 - \hat{y}_2) . w_{22} . e^{-z_2} (f_{z2})^2 . x_2$
$= 0,4 - 0,1 . (0 - 0,54) . 0,6 . e^{-0,4} . (0,6)^2 . 1 = 0,3921$