Multi Layer Feed-forward Network

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Course Outline

Lesson 1.

Definition of Multi Layer Feed-forward Network

Lesson 2.

Example for

Multi Layer Feed-forward Network

Multi Layer Feed-forward Network

- It consists of multiple layers. The architecture of this class of network, besides having the input and the output layers, also have one or more intermediary layers called hidden layers. The computational units of the hidden layer are known as hidden neurons.

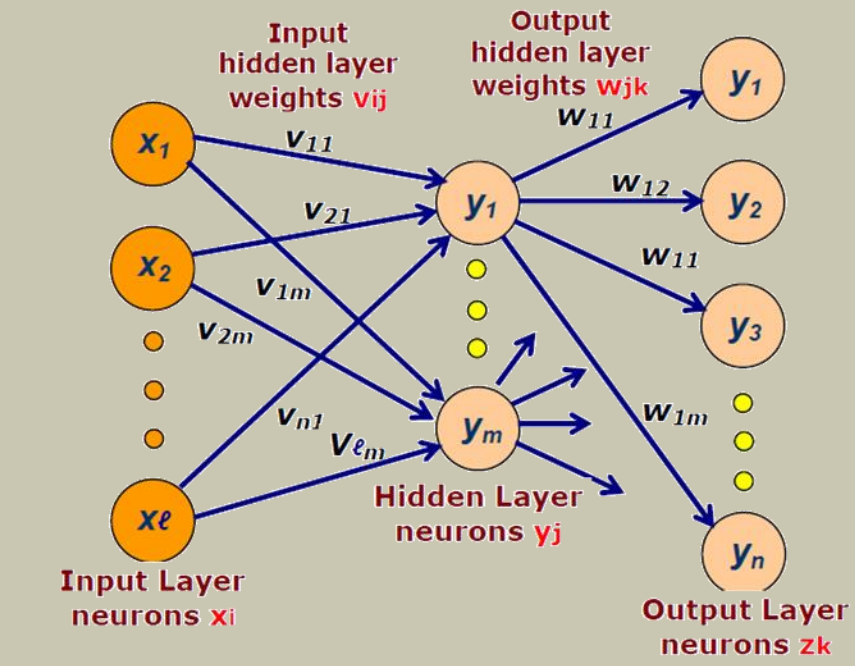


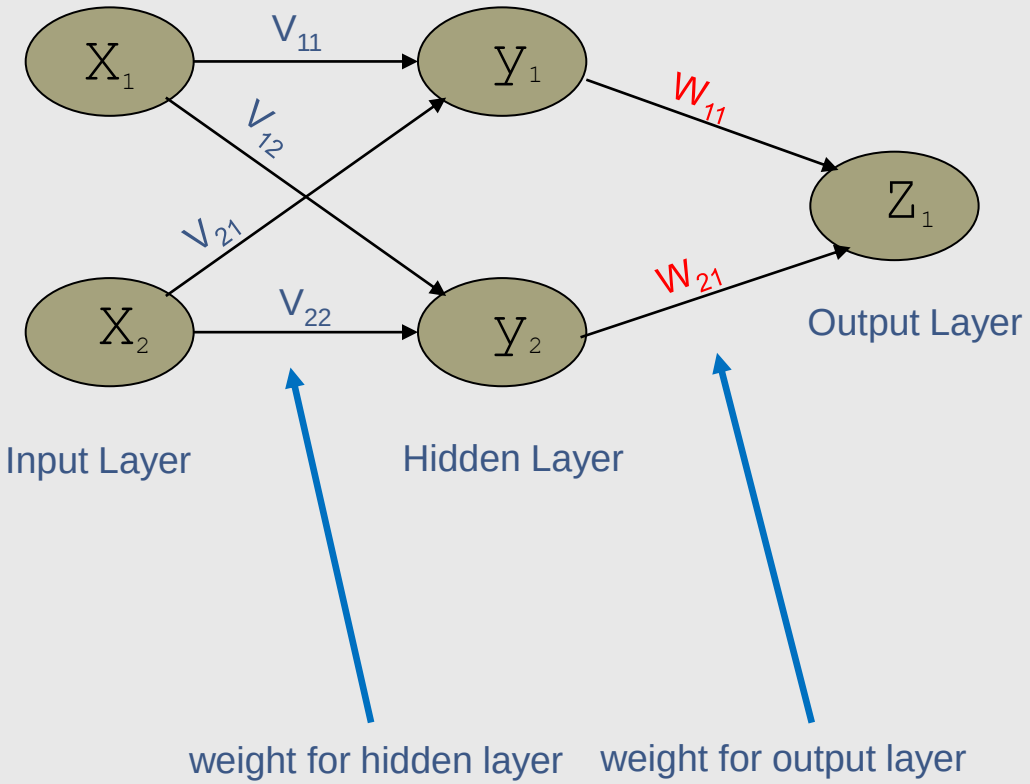
Fig. Multilayer feed-forward network in $(\ell - m - n)$ configuration.

Notes:

توضيح كيفية ترتيب مصفوفة الاوزان سواء كان الوزن V او W

Weight Matrix

$$W = \begin{bmatrix} W_{11} & W_{12} & W_{13} & W_{14} \\ W_{21} & W_{22} & W_{23} & W_{24} \\ W_{31} & W_{32} & W_{33} & W_{34} \\ W_{41} & W_{42} & W_{43} & W_{44} \end{bmatrix}$$



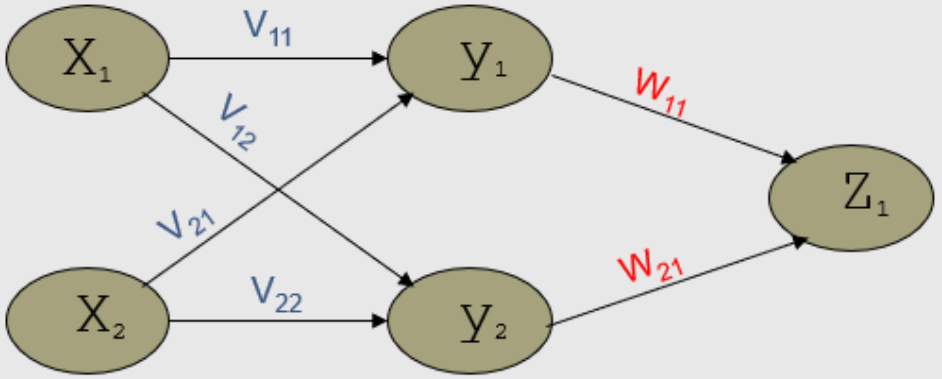
$$V_{ij} = \begin{bmatrix} V_{11} & V_{12} \\ V_{21} & V_{22} \end{bmatrix} \qquad W_{ij} = \begin{bmatrix} W_{11} \\ W_{21} \end{bmatrix}$$

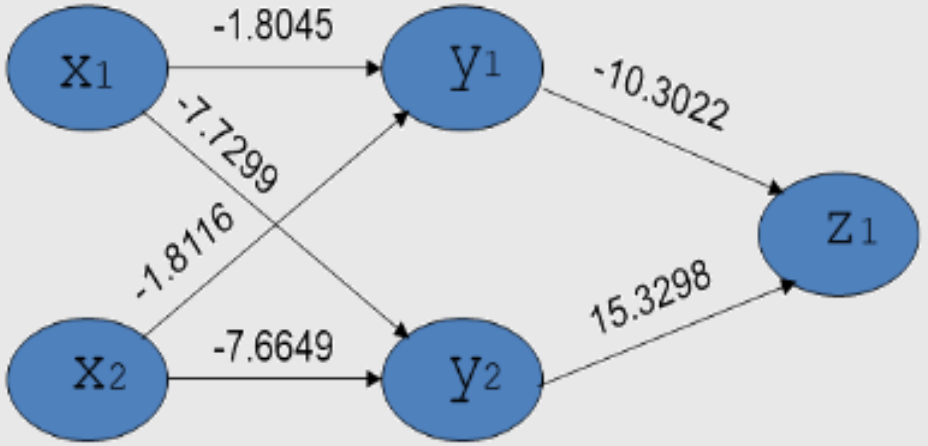
Example

Consider Network Architecture in below figure, Find the value of (Z_1) using Sigmoid function when inputs:

Inputs		Goal outputs	Z_1
X_1	X_2	$O_{desired}$	O_{actual}
0	0	1	?
0	1	0	?
1	0	0	?
1	1	1	?

$$V_{ij} = \begin{bmatrix} -1.8045 & -7.7299 \\ -1.8116 & -7.6649 \end{bmatrix} \qquad W_{ij} = \begin{bmatrix} -10.3022 \\ 15.3298 \end{bmatrix}$$

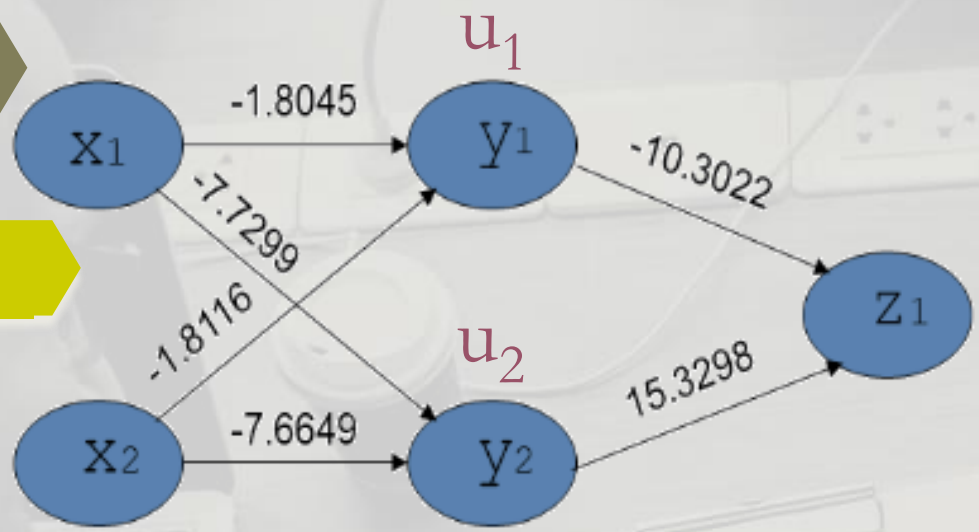




$$V_{ij} = \begin{bmatrix} V_{11} & V_{12} \\ V_{21} & V_{22} \end{bmatrix} \qquad W_{ij} = \begin{bmatrix} W_{11} \\ W_{21} \end{bmatrix}$$

Input 1

$X_1=0,\ X_2=0$



Inputs		Goal outputs	Z_1
X_1	X_2	$O_{desired}$	O_{actual}
0	0	1	
0	1	0	
1	0	0	
1	1	1	

u_1

$u_1 = \sum V_{ij} * X_j$

$= (V_{11}*X_1+V_{21}*X_2)$

$= ((-1.8045 * 0) +(-1.8116 *0))$

$= (0+0)$

$= 0$

u_2

$u_2 = \sum V_{ij} * X_j$

$= (V_{12}*X_1+V_{22}*X_2)$

$= ((-7.7299 * 0) + (-7.6649 *0))$

$= (0+0)$

$= 0$

Sigmoid function

$F(u) = 1/(1+e^{-vq})$

$F(u) = 1/(1+e^{-u_1})$

$F(u_1) = y_1 = 1/(1+e^0)$

$= 1/(1+1)$

$= 0.5$

note: $e^0 = 1$

Sigmoid function

$F(u) = 1/(1+e^{-vq})$

$F(u) = 1/(1+e^{-u_2})$

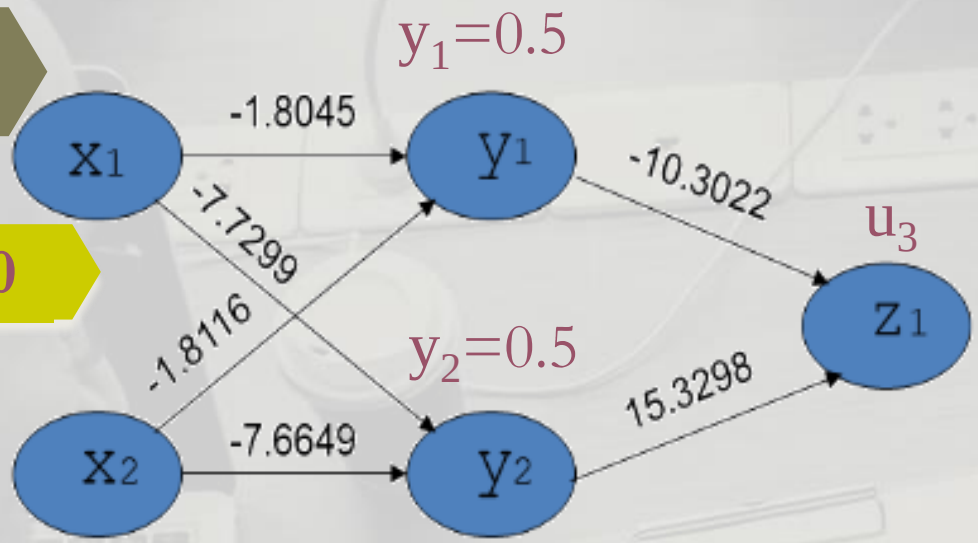
$F(u_2) = y_2 = 1/(1+e^0)$

$= 1/(1+1)$

$= 0.5$

Input 1

$X_1=0,\ X_2=0$



Inputs		Goal outputs	Z_1
X_1	X_2	$O_{desired}$	O_{actual}
0	0	1	0.925
0	1	0	
1	0	0	
1	1	1	

u_3

$u_3 = \sum W_{ij} * y_j$

$= (W_{11}*y_1+W_{21}*y_2)$

$= ((-10.3022 * 0.5) + (15.3298 *0.5))$

$= (-5.1511+7.6649)$

$= 2.5138$

Sigmoid function

$F(u) = 1/ (1+e^{-vq})$

$F(u) = 1/ (1+e^{-u_3})$

$F(u_3) = Z_1 = 1/ (1+e^{-2.5138})$

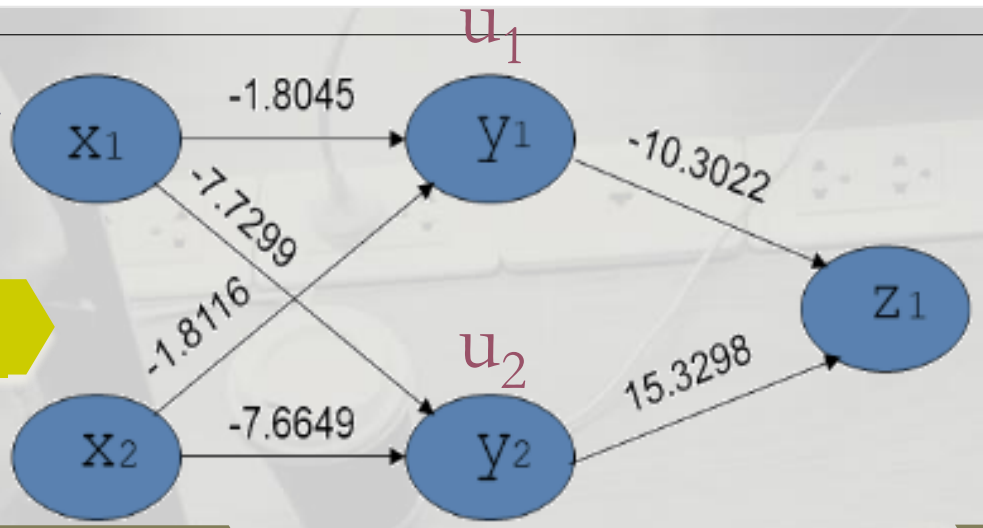
$= 1/ 1.0809$

$= 0.925$

note: $e^{-2.5138} = 0.0809$

Input 2

$X_1=0,\ X_2=1$



Inputs		Goal outputs	Z_1
X_1	X_2	$O_{desired}$	O_{actual}
0	0	1	0.925
0	1	0	
1	0	0	
1	1	1	

u_1

$u_1 = \sum V_{ij} * X_j$

$= (V_{11}*X_1+V_{21}*X_2)$

$= ((-1.8045 * 0) +(-1.8116 *1))$

$= (0 + (-1.8116))$

$= -1.8116$

u_2

$u_2 = \sum V_{ij} * X_j$

$= (V_{12}*X_1+V_{22}*X_2)$

$= ((-7.7299 * 0) + (-7.6649 *1))$

$= (0+ (-7.6649))$

$= -7.6649$

Sigmoid function

$F(u) = 1/(1+e^{-vq})$

$F(u) = 1/(1+e^{-u_1})$

$F(u_1) = y_1$

$= 1/(1+e^{-(-1.8116)})$

$= 1/(1+e^{1.8116})$

$= 1/(1+6.1202)$

$= 1/7.1202$

$= 0.140$

Sigmoid function

$F(u) = 1/(1+e^{-vq})$

$F(u) = 1/(1+e^{-u_2})$

$F(u_2) = y_2$

$= 1/(1+e^{-(-7.6649)})$

$= 1/(1+e^{7.6649})$

$= 1/(1+2132.179)$

$= 1/2133.179$

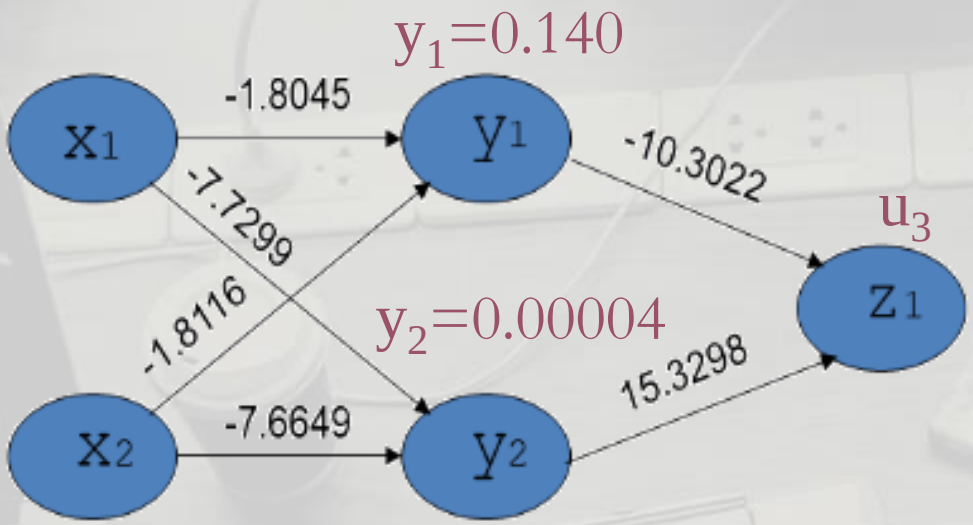
$= 4.687839136^{-04}$

$= 0.00004$

note: $e^{1.8116} = 6.1202$, $e^{7.6649} = 2132.179$

Input 2

$X_1=0,\ X_2=1$



Inputs		Goal outputs	Z_1
X_1	X_2	$O_{desired}$	O_{actual}
0	0	1	0.925
0	1	0	0.1912
1	0	0	
1	1	1	

u_3

$u_3 = \sum W_{ij} * y_j$

$= (W_{11}*y_1 + W_{21}*y_2)$

$= ((-10.3022 * 0.140) + (15.3298 * 0.00004))$

$= (-1.442308 + 6.13192^{-04})$

$= (-1.442308 + 0.00006)$

$= -1.442248$

Sigmoid function

$F(u) = 1/(1+e^{-vq})$

$F(u) = 1/(1+e^{-u_3})$

$F(u_3) = Z_1 = 1/(1+e^{-(-1.442248)})$

$= 1/(1+e^{1.442248})$

$= 1/(1+4.2302)$

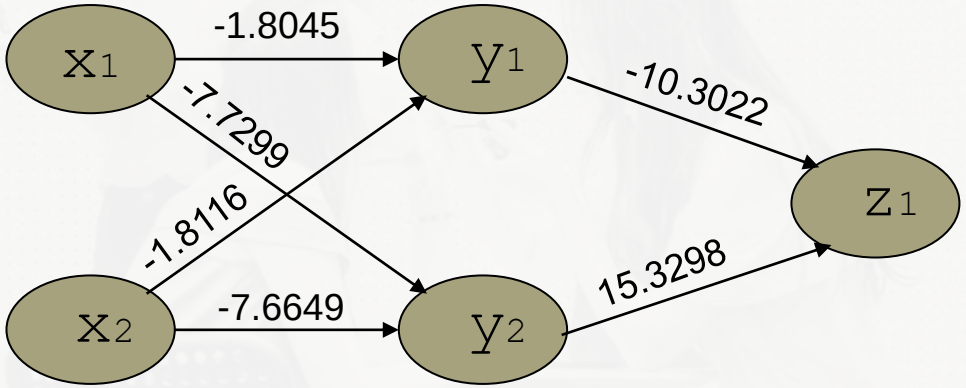
$= 1/5.2302$

$= 0.1912$

note: $e^{1.442248} = 4.2302$

Homework :

Consider Network Architecture in below figure, **Find the value of (Z1) using Sigmoid function** for hidden units (hidden layer) and **linear function** for output units (output layer) when inputs:



Inputs		Goal outputs	Z1
X_1	X_2	$O_{desired}$	O_{actual}
0	0	1	?
0	1	0	?
1	0	0	?
1	1	1	?

Thank You

Any Question?

Dear students.

Please, contact via Google Classroom