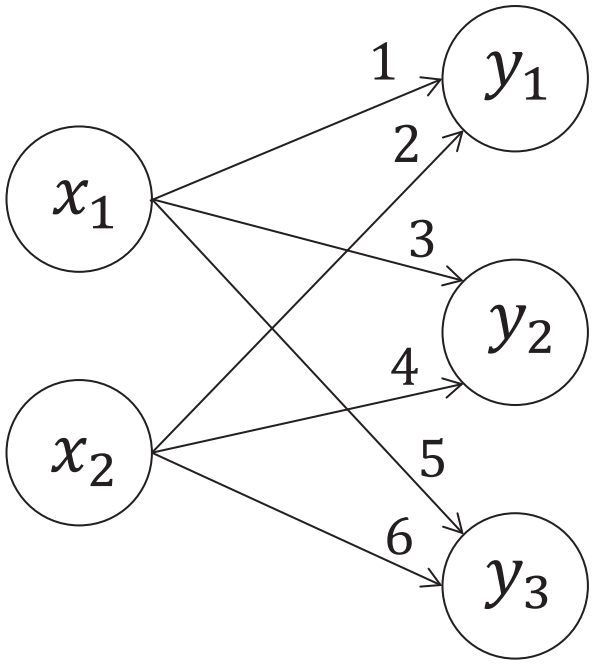
NNの出力を計算する

P58



$y_1=$ ☐

$y_2=$ ☐

$y_3=$ ☐

1

NNの出力を計算する

P58

$y_1 =$

$y_2 =$

$y_3 =$

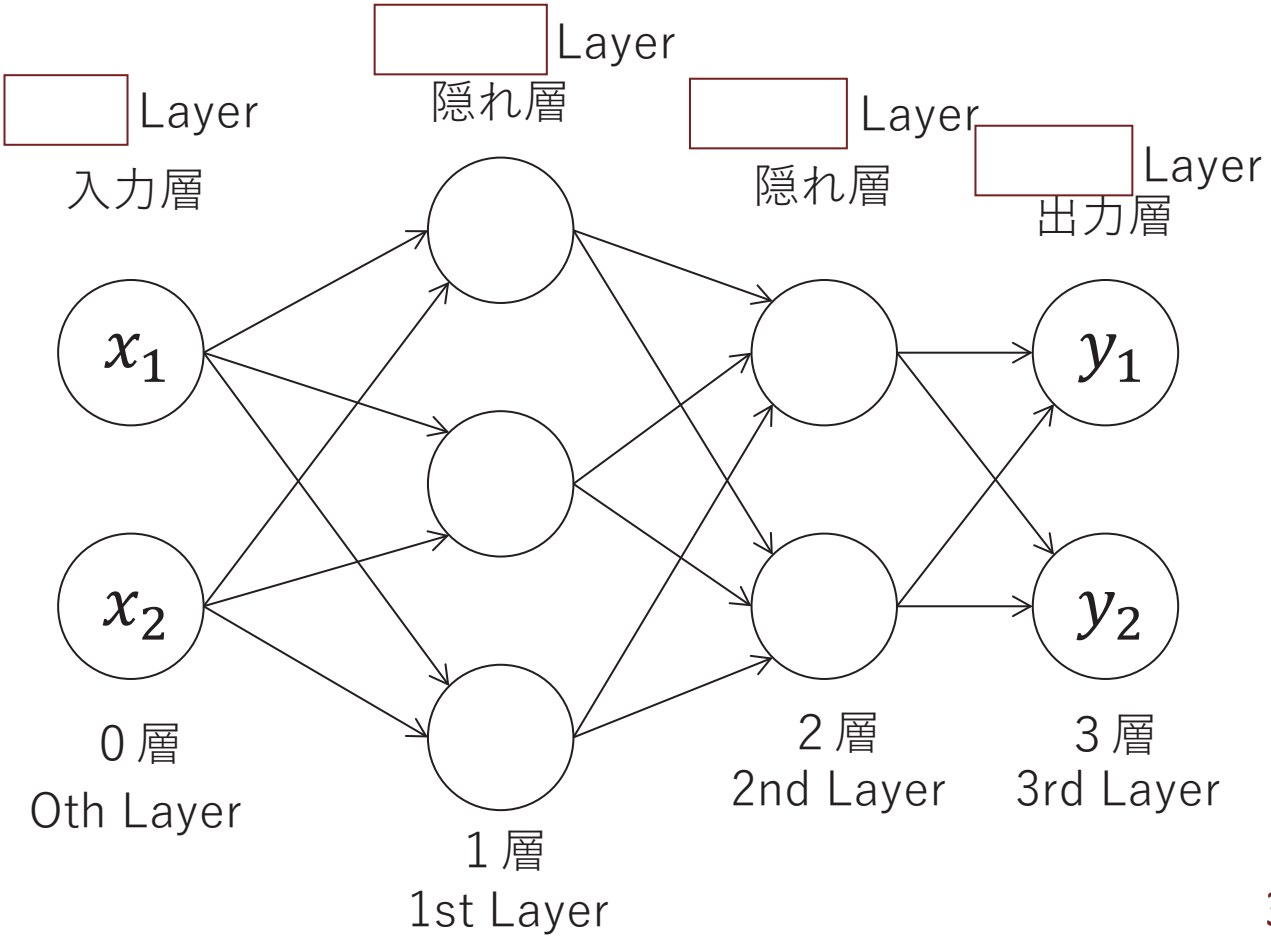
$$\begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix} = \begin{pmatrix} & \\ & \\ & \end{pmatrix} \begin{pmatrix} \\ \\ \end{pmatrix}$$

Y= ☐

2

3層ニューラルネットワーク

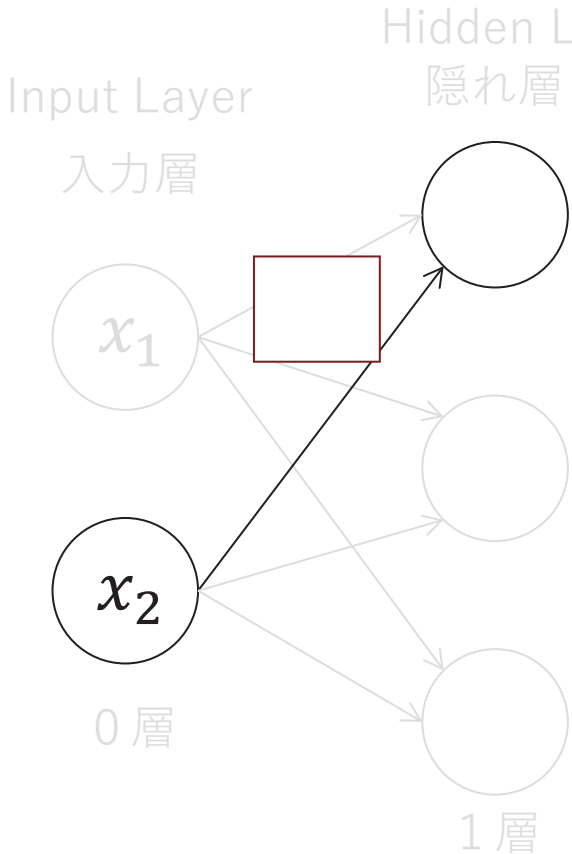
P59



3

記号の意味

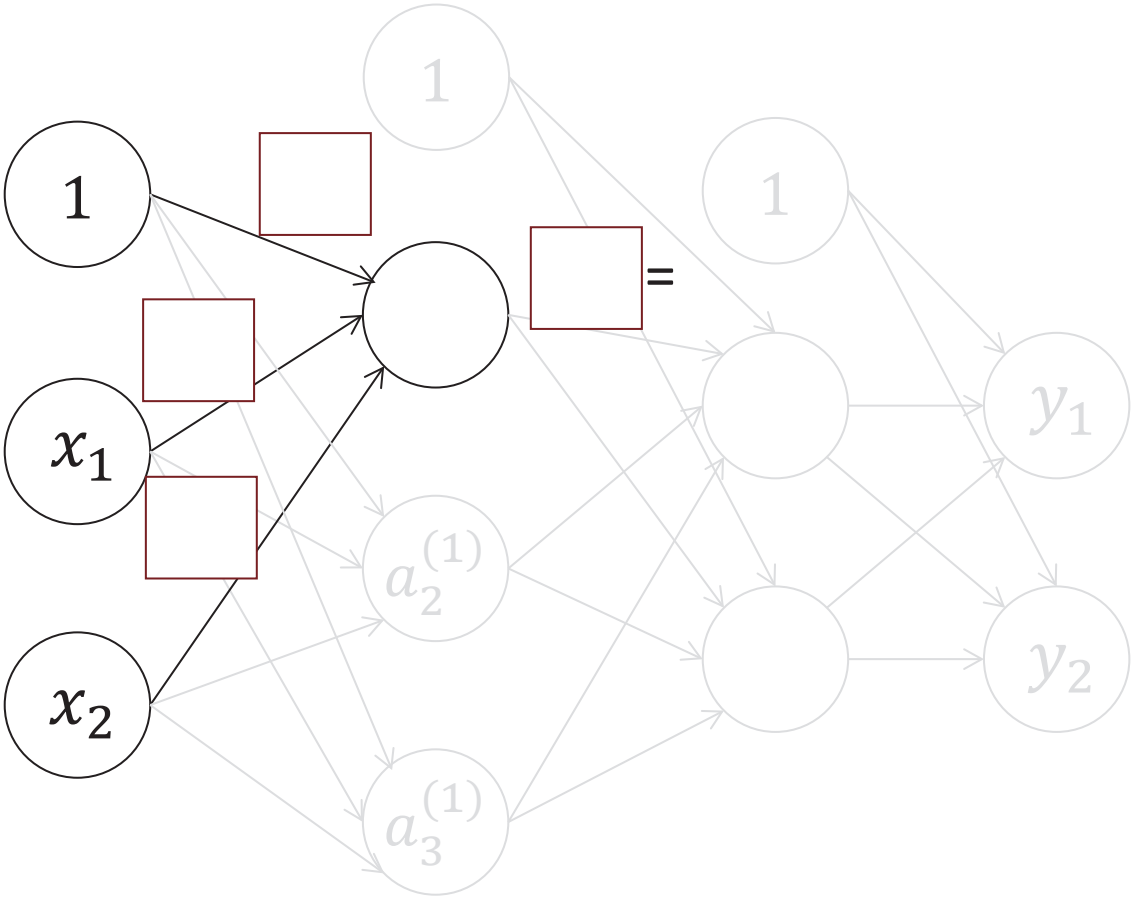
P60



4

入力層から第１層への信号伝達

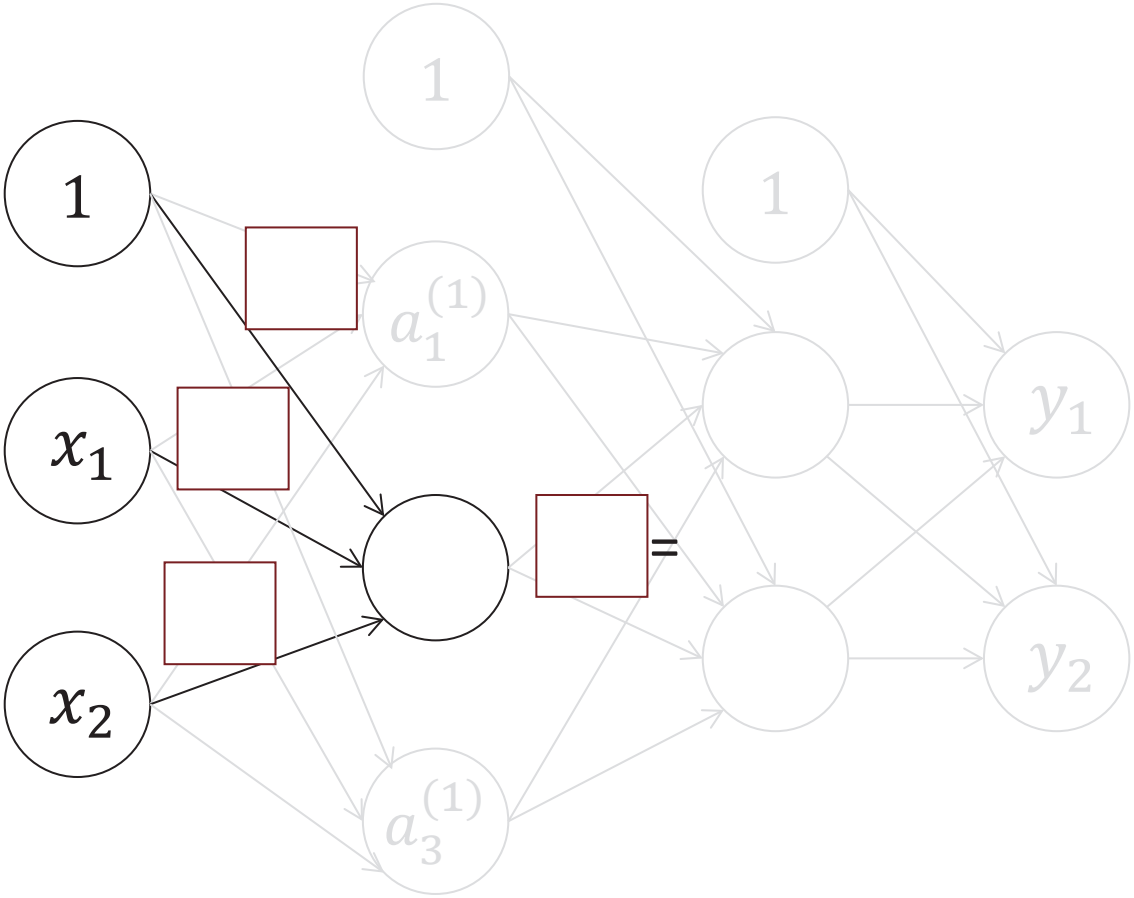
P60



5

入力層から第１層への信号伝達

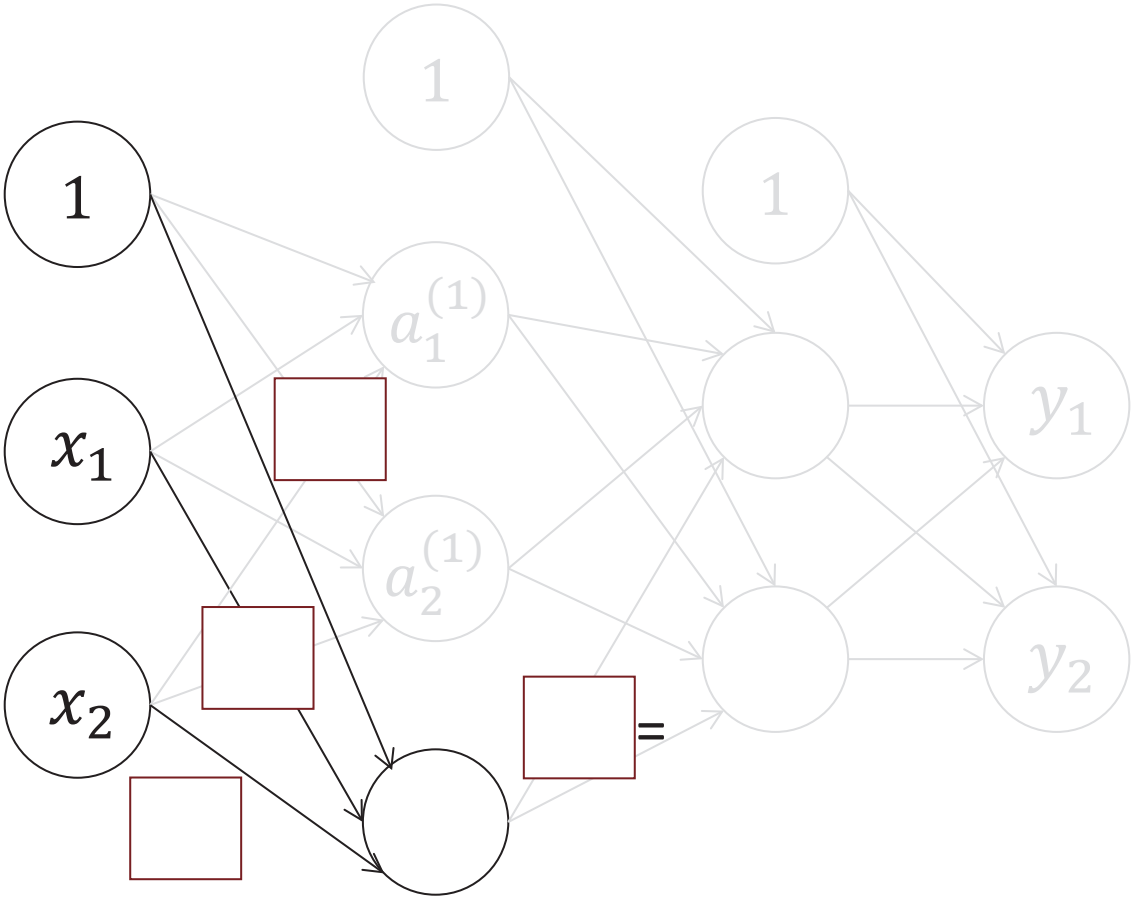
P60



6

入力層から第１層への信号伝達

P60



7

ベクトルの基本

■□ベクトルで考える！

$$V=\begin{pmatrix} \\ \end{pmatrix} \qquad V=\begin{pmatrix} \\ \\ \end{pmatrix}$$

■スペースを節約したければ□ベクトルで書く

□=( ) □=( )

8

ベクトルの基本

■演算

$$\mathrm{U}=\begin{pmatrix}u_1\\u_2\end{pmatrix}\quad \mathrm{V}=\begin{pmatrix}v_1\\v_2\end{pmatrix}$$

$$\mathrm{U}^{\mathrm{T}}\mathrm{V}=$$

$$\mathrm{U}\,\mathrm{V}^{\mathrm{T}}=$$

入力層から1層への信号の伝達

P61

$$a_1^{(1)}=w_{11}^{(1)}x_1+w_{12}^{(1)}x_2+b_1^{(1)}$$

$$a_2^{(1)}=w_{21}^{(1)}x_1+w_{22}^{(1)}x_2+b_2^{(1)}$$

$$a_3^{(1)}=w_{31}^{(1)}x_1+w_{32}^{(1)}x_2+b_3^{(1)}$$

$$\mathrm{A}^{(1)}=\begin{pmatrix}\\\\\end{pmatrix}\quad \mathrm{X}=\begin{pmatrix}\\\end{pmatrix}\quad \mathrm{B}^{(1)}=\begin{pmatrix}\\\\\end{pmatrix}$$

入力層から1層への信号の伝達

P61

$$a_1^{(1)} = w_{11}^{(1)} x_1 + w_{12}^{(1)} x_2 + b_1^{(1)}$$

$$a_2^{(1)} = w_{21}^{(1)} x_1 + w_{22}^{(1)} x_2 + b_2^{(1)}$$

$$a_3^{(1)} = w_{31}^{(1)} x_1 + w_{32}^{(1)} x_2 + b_3^{(1)}$$

$$\mathrm{W}^{(1)} = \begin{pmatrix} & \\ & \\ & \end{pmatrix}$$

入力層から1層への信号の伝達

P61

$$a_1^{(1)} = w_{11}^{(1)} x_1 + w_{12}^{(1)} x_2 + b_1^{(1)}$$

$$a_2^{(1)} = w_{21}^{(1)} x_1 + w_{22}^{(1)} x_2 + b_2^{(1)}$$

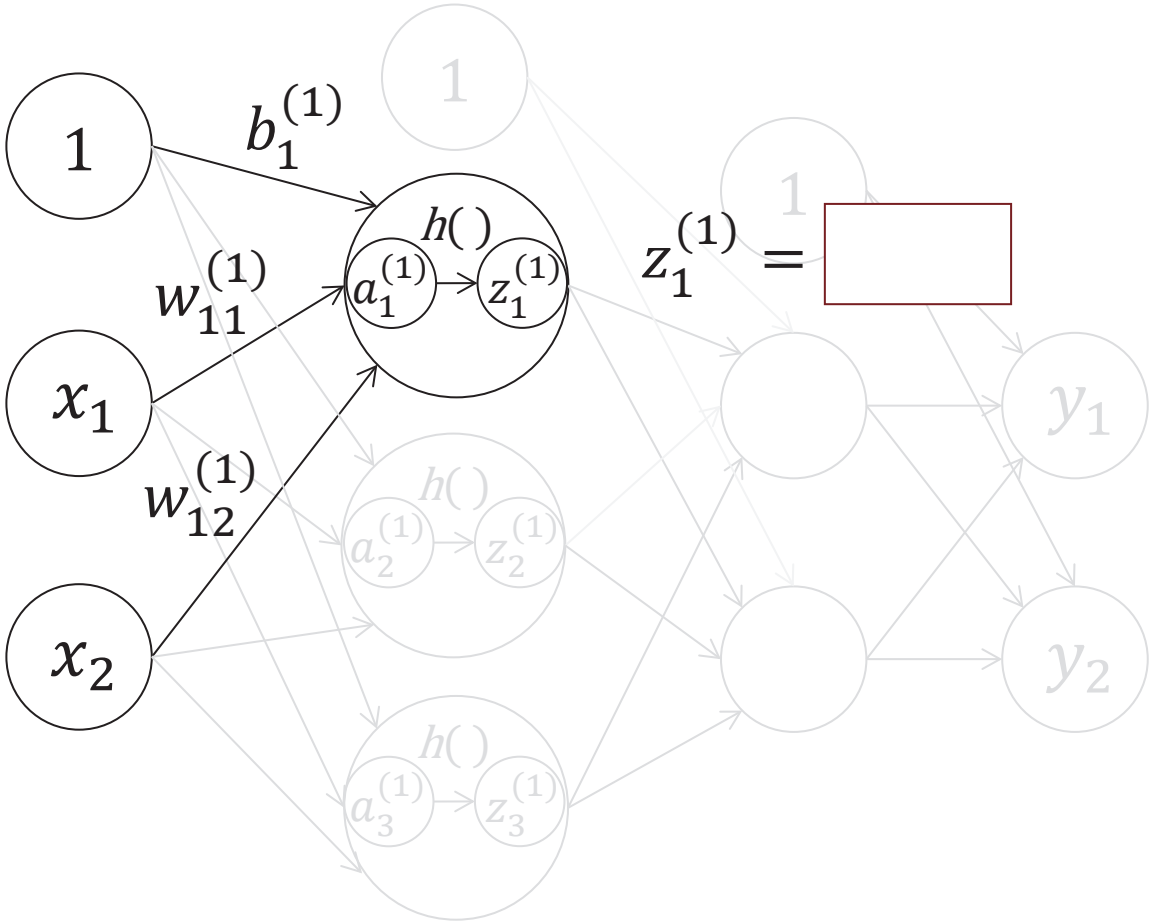
$$a_3^{(1)} = w_{31}^{(1)} x_1 + w_{32}^{(1)} x_2 + b_3^{(1)}$$

$$\begin{pmatrix} a_1^{(1)} \\ a_2^{(1)} \\ a_3^{(1)} \end{pmatrix} = \begin{pmatrix} & \\ & \\ & \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} + \begin{pmatrix} b_1^{(1)} \\ b_2^{(1)} \\ b_3^{(1)} \end{pmatrix}$$

$$\mathrm{A}^{(1)} = \mathrm{W}^{(1)}\mathrm{X} + \mathrm{B}^{(1)}$$

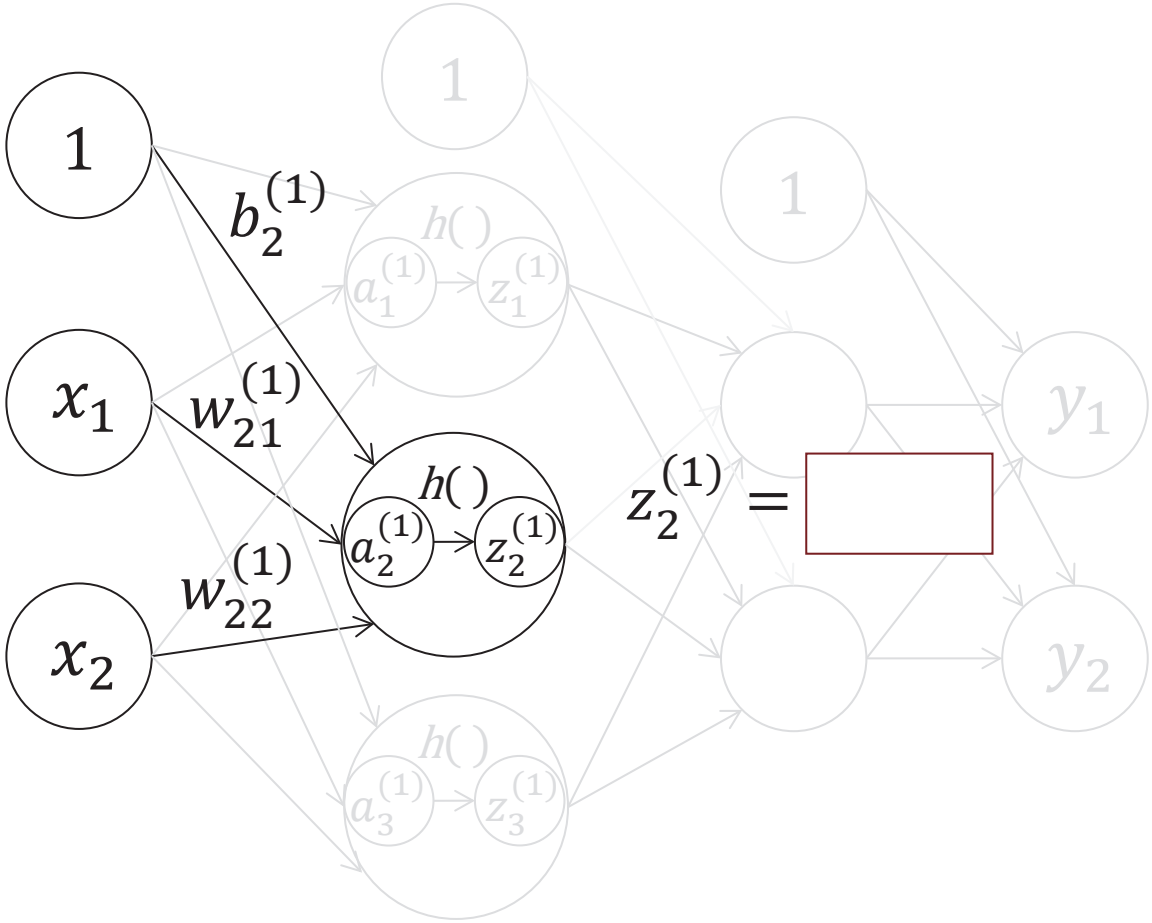
1層の活性化関数

P62

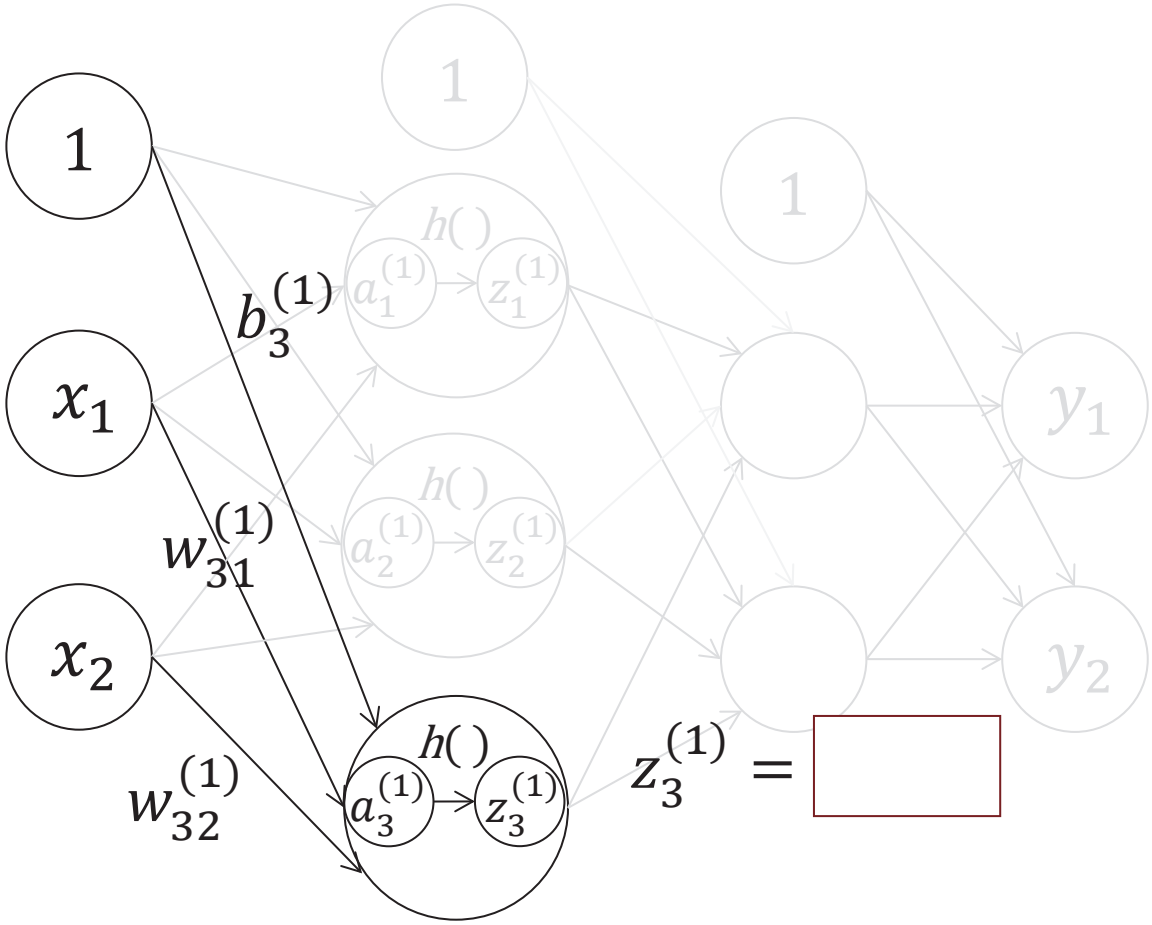


1層の活性化関数

P62

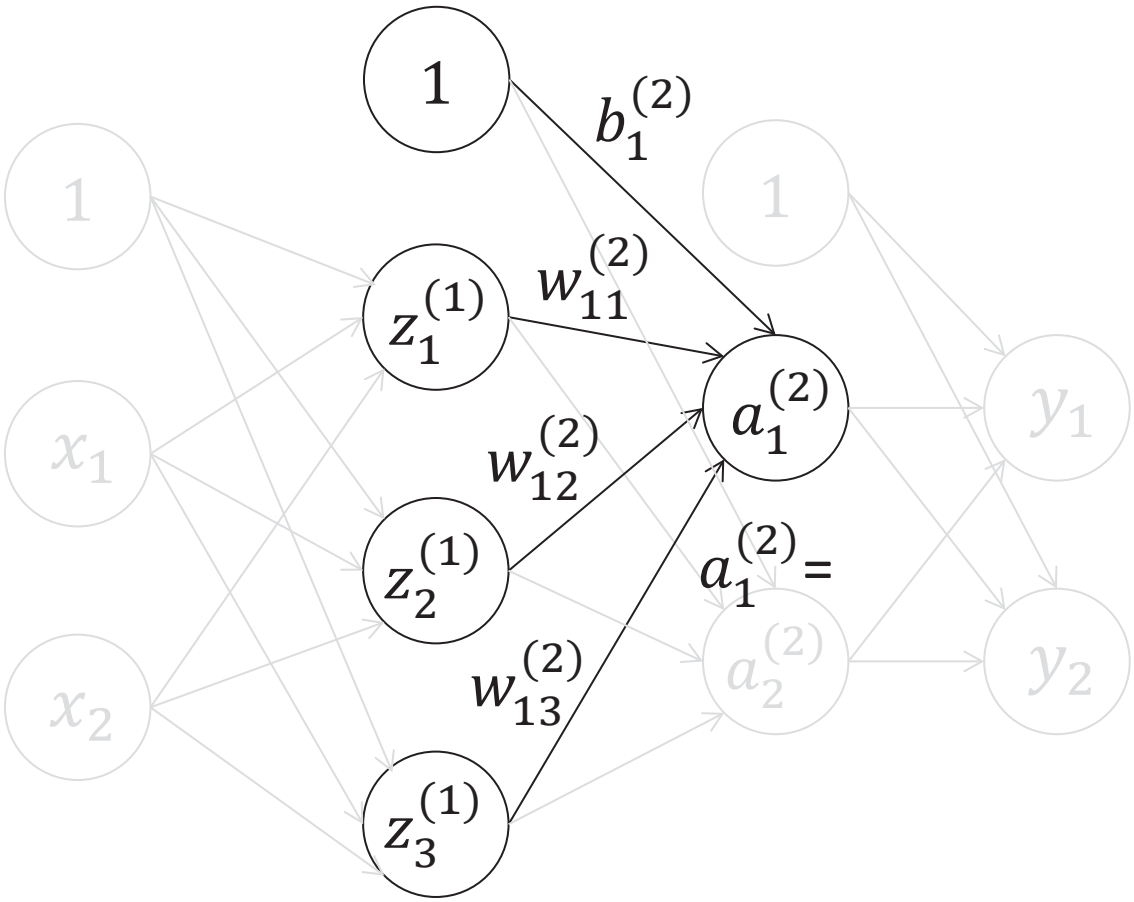


1層の活性化関数



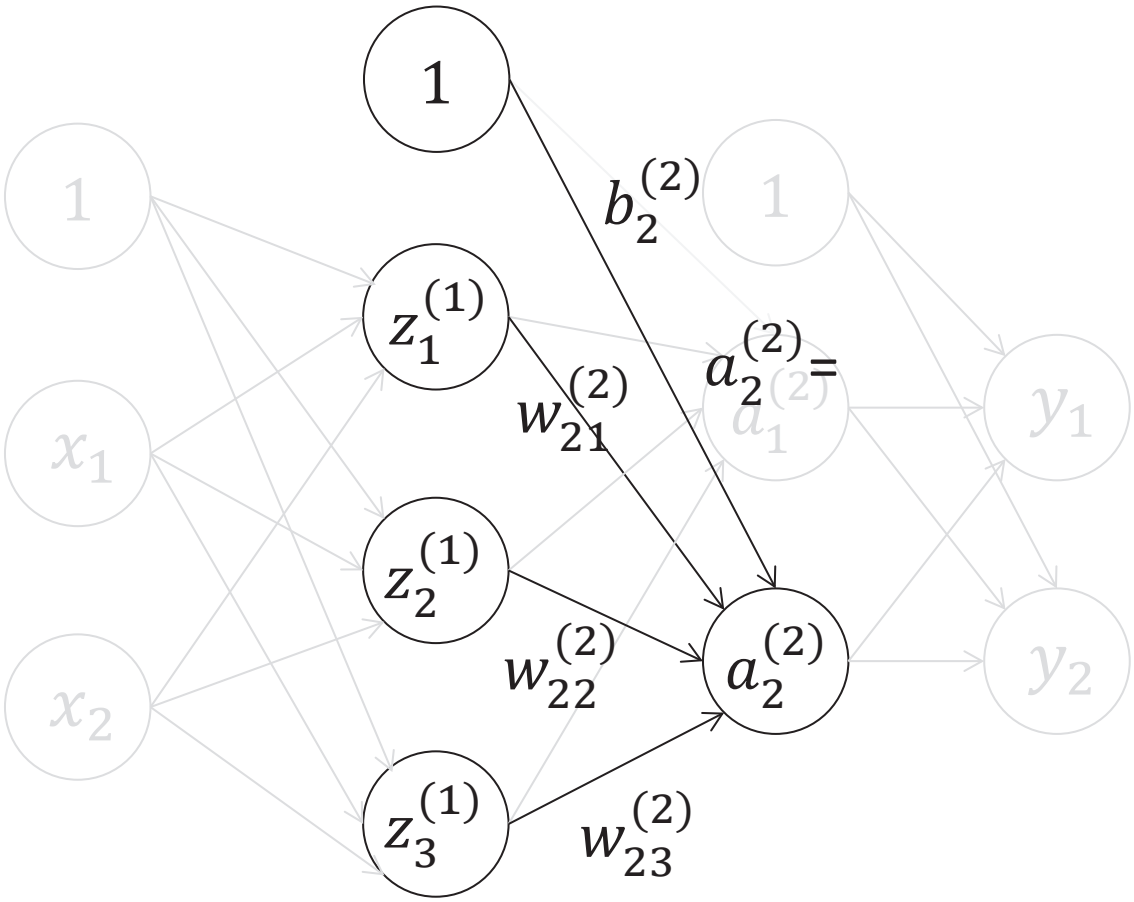
15

1層から2層への信号伝達



16

1層から2層への信号伝達



1層から2層への信号伝達

$$a_1^{(2)} = w_{11}^{(2)} z_1^{(1)} + w_{12}^{(2)} z_2^{(1)} + w_{13}^{(2)} z_3^{(1)} + b_1^{(2)}$$

$$a_2^{(2)} = w_{21}^{(2)} z_1^{(1)} + w_{22}^{(2)} z_2^{(1)} + w_{23}^{(2)} z_3^{(1)} + b_2^{(2)}$$

$$\mathrm{A}^{(2)} = \begin{pmatrix} \end{pmatrix} \quad \mathrm{Z}^{(1)} = \begin{pmatrix} \end{pmatrix} \quad \mathrm{B}^{(2)} = \begin{pmatrix} \end{pmatrix}$$

1層から2層への信号伝達

$$a_1^{(2)} = w_{11}^{(2)} z_1^{(1)} + w_{12}^{(2)} z_2^{(1)} + w_{13}^{(2)} z_3^{(1)} + b_1^{(2)}$$

$$a_2^{(2)} = w_{21}^{(2)} z_1^{(1)} + w_{22}^{(2)} z_2^{(1)} + w_{23}^{(2)} z_3^{(1)} + b_2^{(2)}$$

$$\mathrm{W}^{(2)} = \begin{pmatrix} & & \\ & & \end{pmatrix}$$

1層から2層への信号伝達

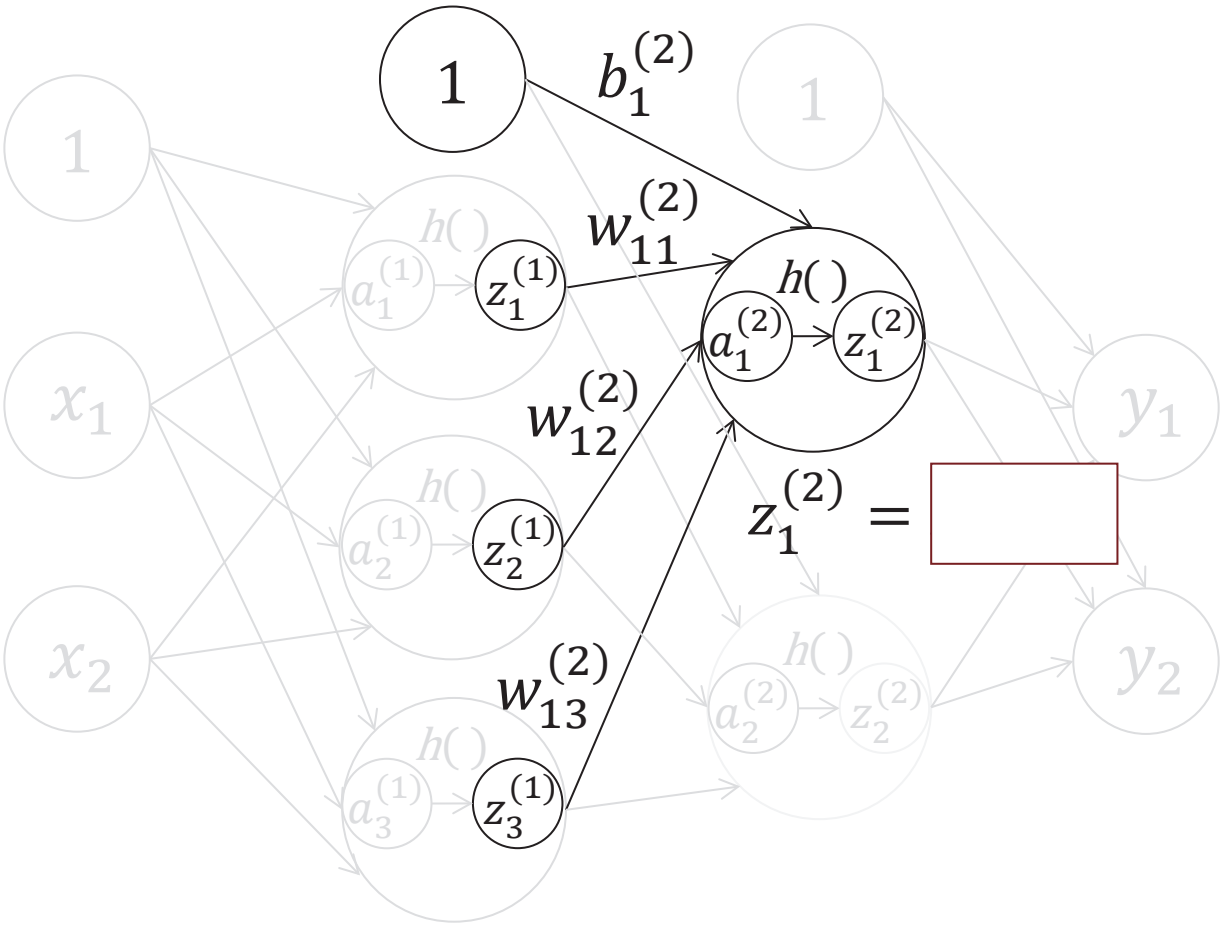
$$a_1^{(2)} = w_{11}^{(2)} z_1^{(1)} + w_{12}^{(2)} z_2^{(1)} + w_{13}^{(2)} z_3^{(1)} + b_1^{(2)}$$

$$a_2^{(2)} = w_{21}^{(2)} z_1^{(1)} + w_{22}^{(2)} z_2^{(1)} + w_{23}^{(2)} z_3^{(1)} + b_2^{(2)}$$

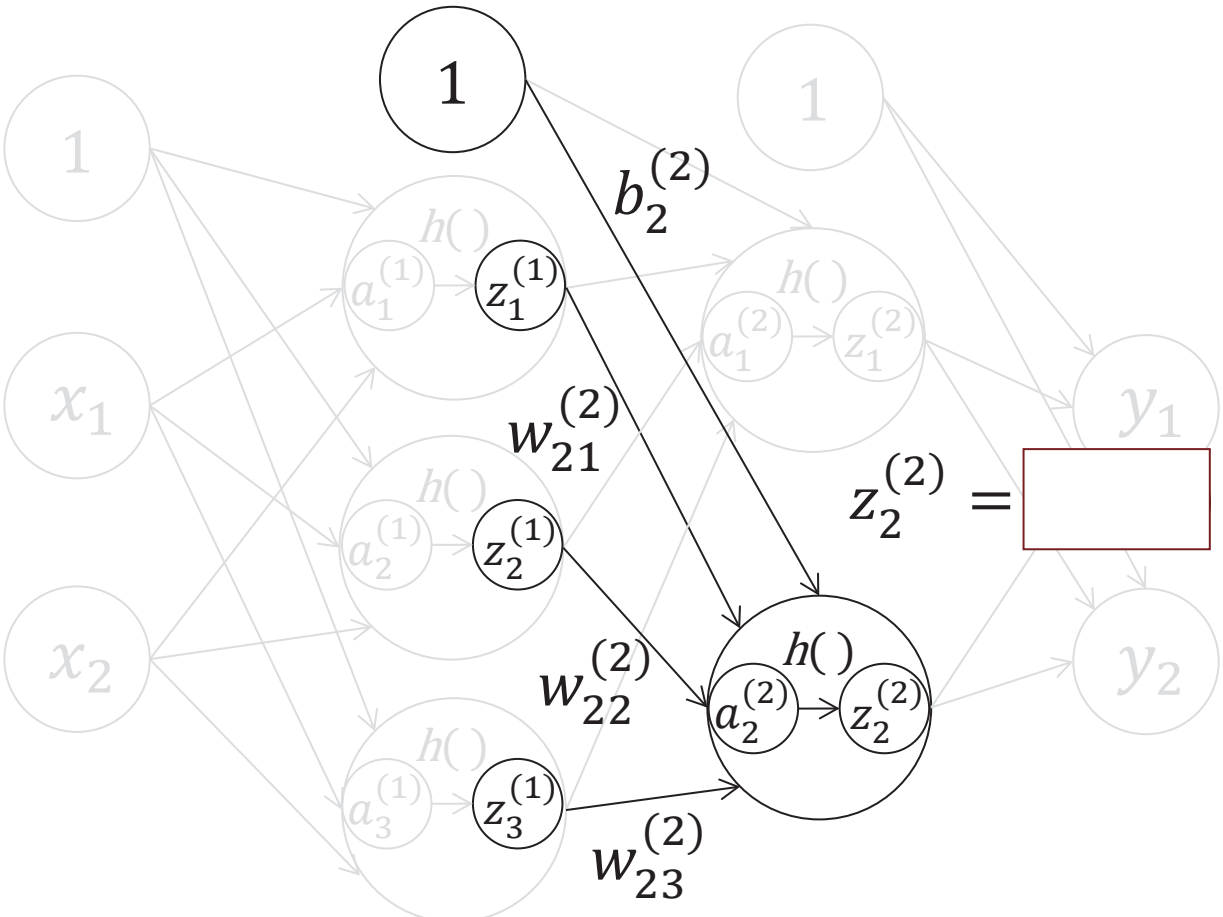
$$\begin{pmatrix} a_1^{(2)} \\ a_2^{(2)} \end{pmatrix} = \begin{pmatrix} & & \\ & & \end{pmatrix} \begin{pmatrix} z_1^{(1)} \\ z_2^{(1)} \\ z_3^{(1)} \end{pmatrix} + \begin{pmatrix} b_1^{(2)} \\ b_2^{(2)} \end{pmatrix}$$

$$\mathrm{A}^{(2)} = \mathrm{W}^{(2)}\mathrm{Z}^{(1)} + \mathrm{B}^{(2)}$$

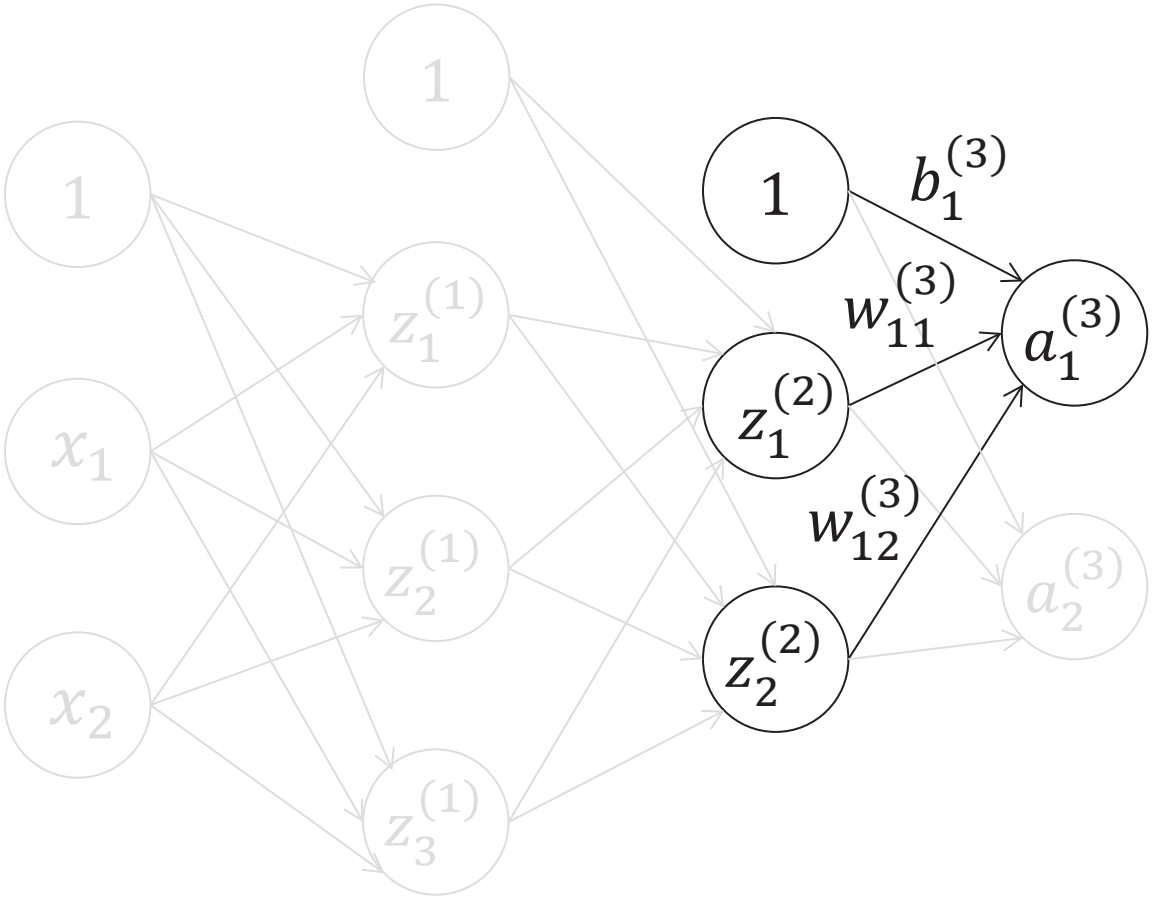
第２層目の活性化関数



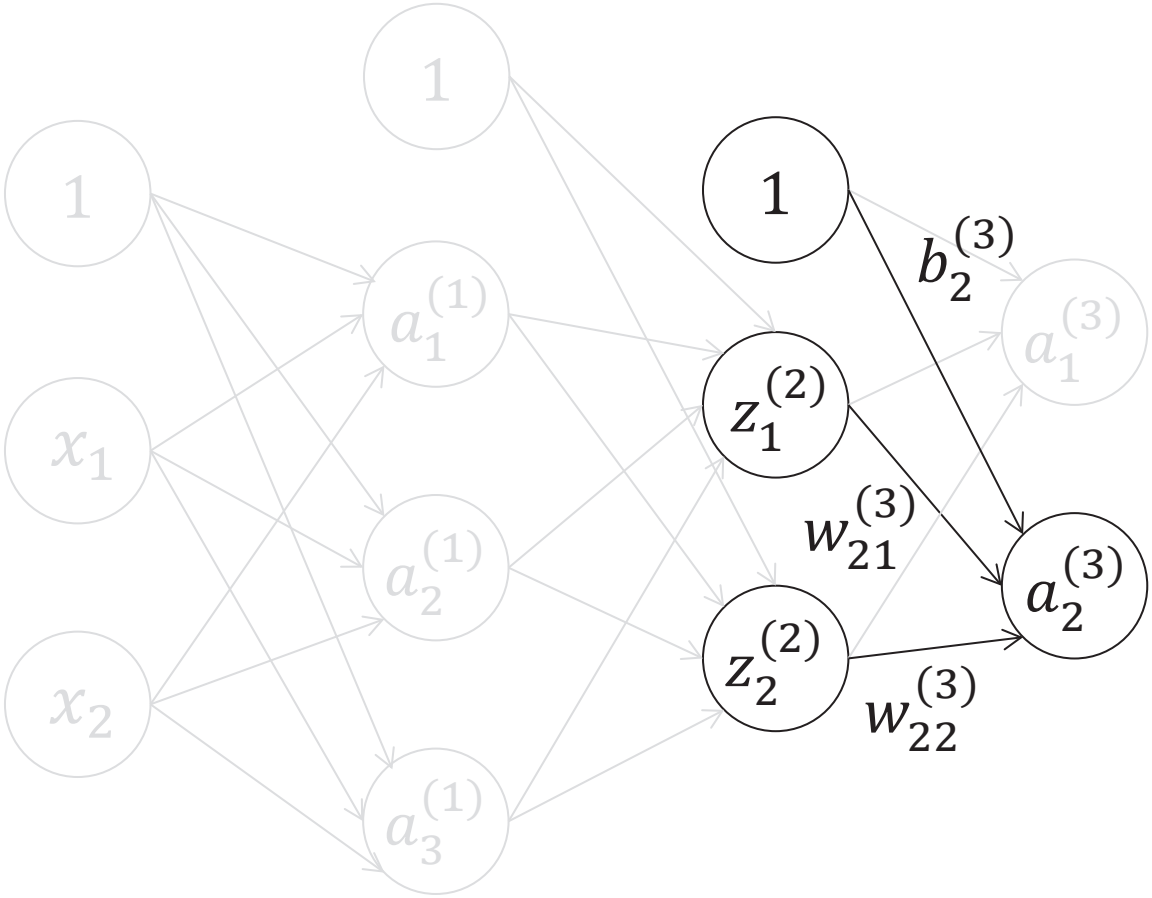
第２層目の活性化関数



2層から出力層への信号伝達



2層から出力層への信号伝達



2層から出力層への信号伝達

$$a_1^{(3)} = w_{11}^{(3)} z_1^{(2)} + w_{12}^{(3)} z_2^{(2)} + b_1^{(3)}$$

$$a_2^{(3)} = w_{21}^{(3)} z_1^{(2)} + w_{22}^{(3)} z_2^{(2)} + b_2^{(3)}$$

$$\mathrm{A}^{(3)} = \begin{pmatrix} a_1^{(3)} \\ a_2^{(3)} \end{pmatrix} \quad \mathrm{Z}^{(2)} = \begin{pmatrix} z_1^{(2)} \\ z_2^{(2)} \end{pmatrix} \quad \mathrm{B}^{(2)} = \begin{pmatrix} b_1^{(3)} \\ b_2^{(3)} \end{pmatrix}$$

$$\mathrm{W}^{(3)} = \begin{pmatrix} w_{11}^{(3)} & w_{12}^{(3)} \\ w_{21}^{(3)} & w_{22}^{(3)} \end{pmatrix}$$

2層から出力層への信号伝達

$$a_1^{(3)} = w_{11}^{(3)} z_1^{(2)} + w_{12}^{(3)} z_2^{(2)} + b_1^{(3)}$$

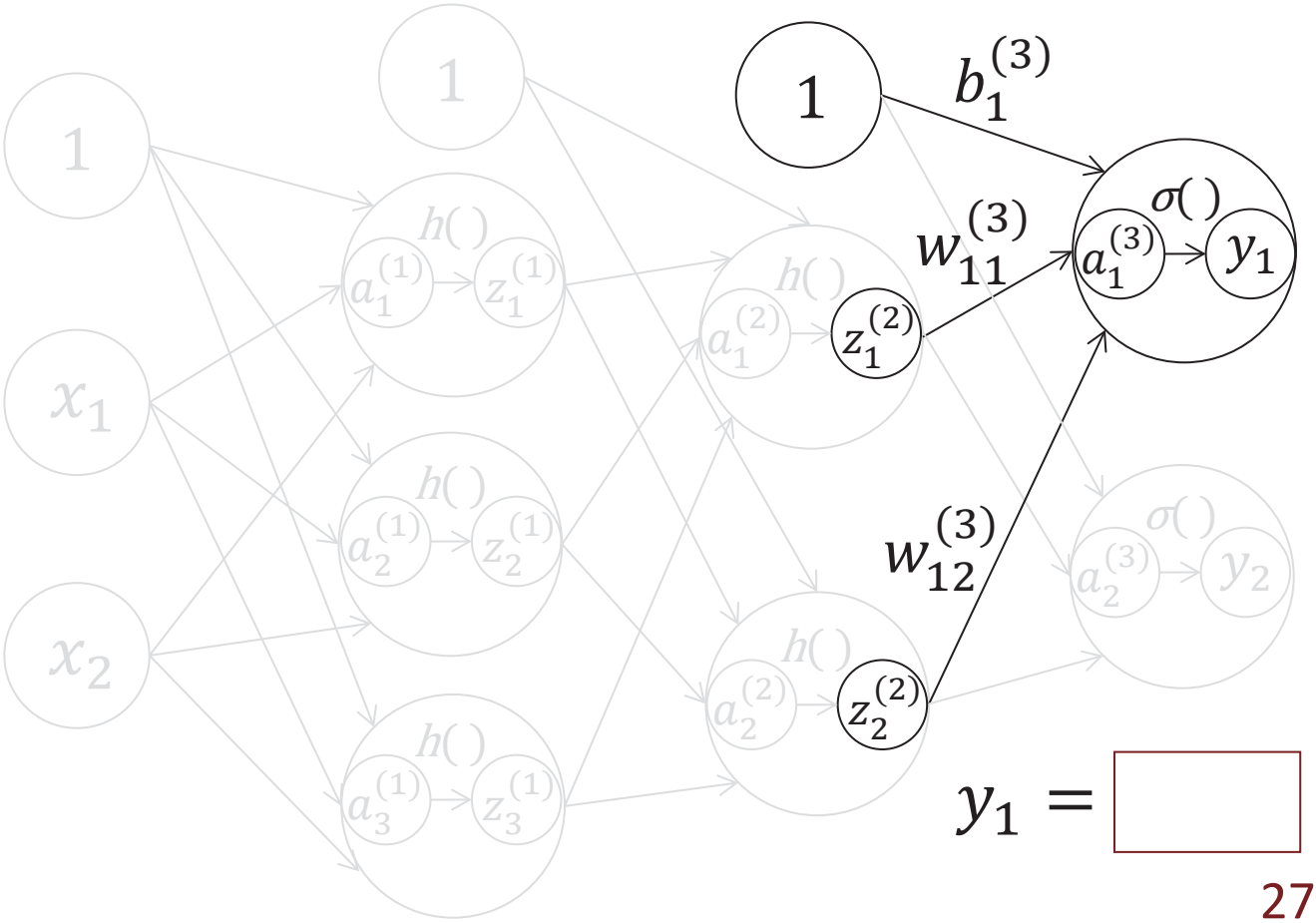
$$a_2^{(3)} = w_{21}^{(3)} z_1^{(2)} + w_{22}^{(3)} z_2^{(2)} + b_2^{(3)}$$

$$\begin{pmatrix} a_1^{(3)} \\ a_2^{(3)} \end{pmatrix} = \begin{pmatrix} w_{11}^{(3)} & w_{12}^{(3)} \\ w_{21}^{(3)} & w_{22}^{(3)} \end{pmatrix} \begin{pmatrix} z_1^{(2)} \\ z_2^{(2)} \end{pmatrix} + \begin{pmatrix} b_1^{(3)} \\ b_2^{(3)} \end{pmatrix}$$

$$\mathrm{A}^{(3)} = \mathrm{W}^{(3)} \mathrm{Z}^{(2)} + \mathrm{B}^{(3)}$$

出力層での計算

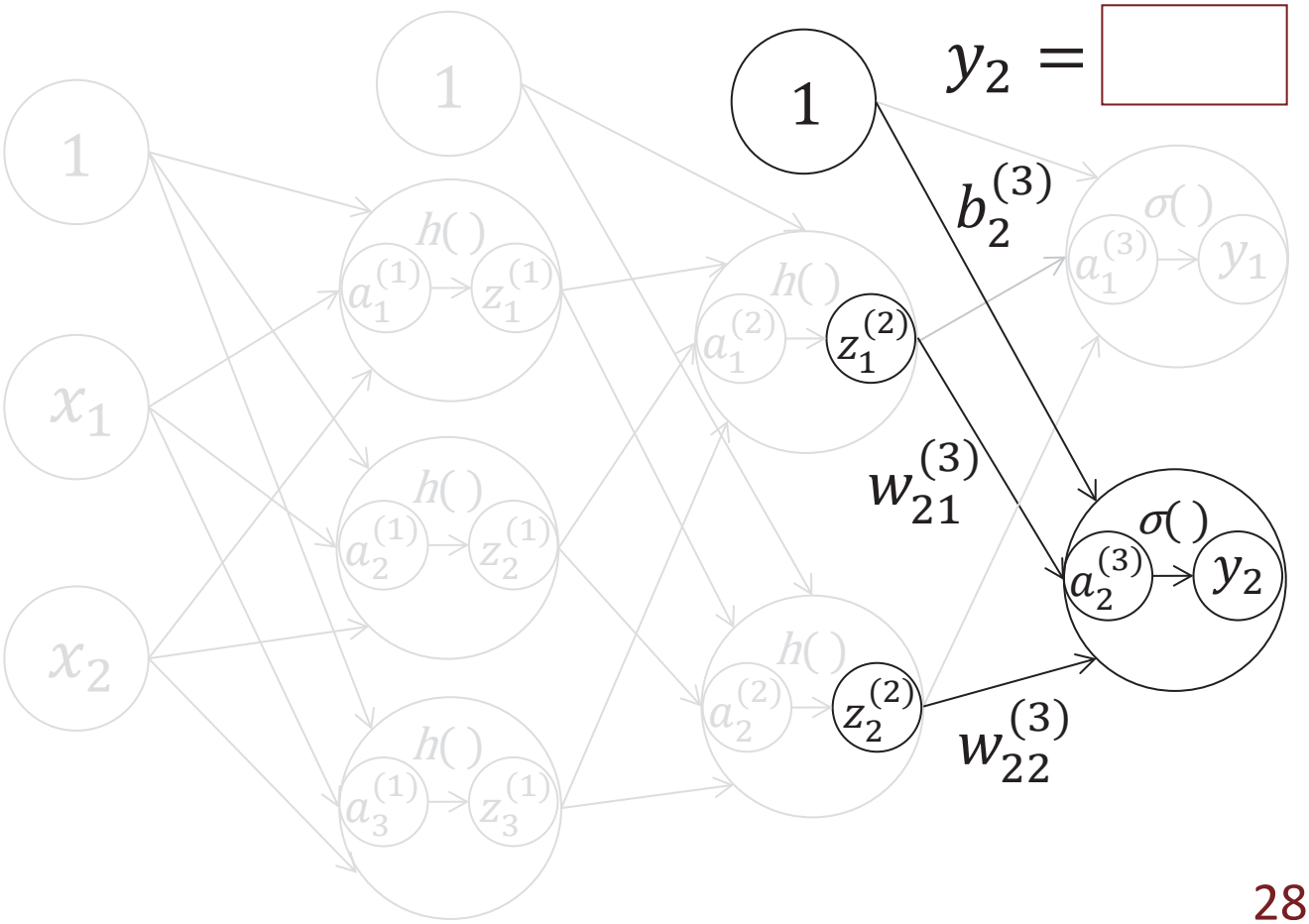
P64



27

出力層での計算

P64



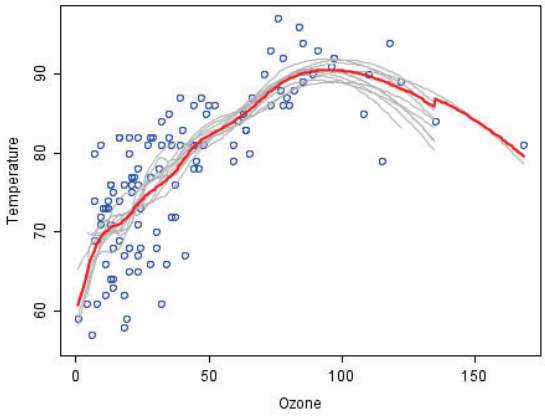
28

出力層の設計

P66

■活性化関数：恒等関数　←　回帰問題

$$y_k = \sigma(a_k) = \square$$



出力層の設計

P67

■活性化関数：ソフトマックス関数　←　分類問題

$$y_k = \sigma(a_k) = \square$$

$$y_1 + \cdots + y_n = 1$$