

A Brief Introduction to ML

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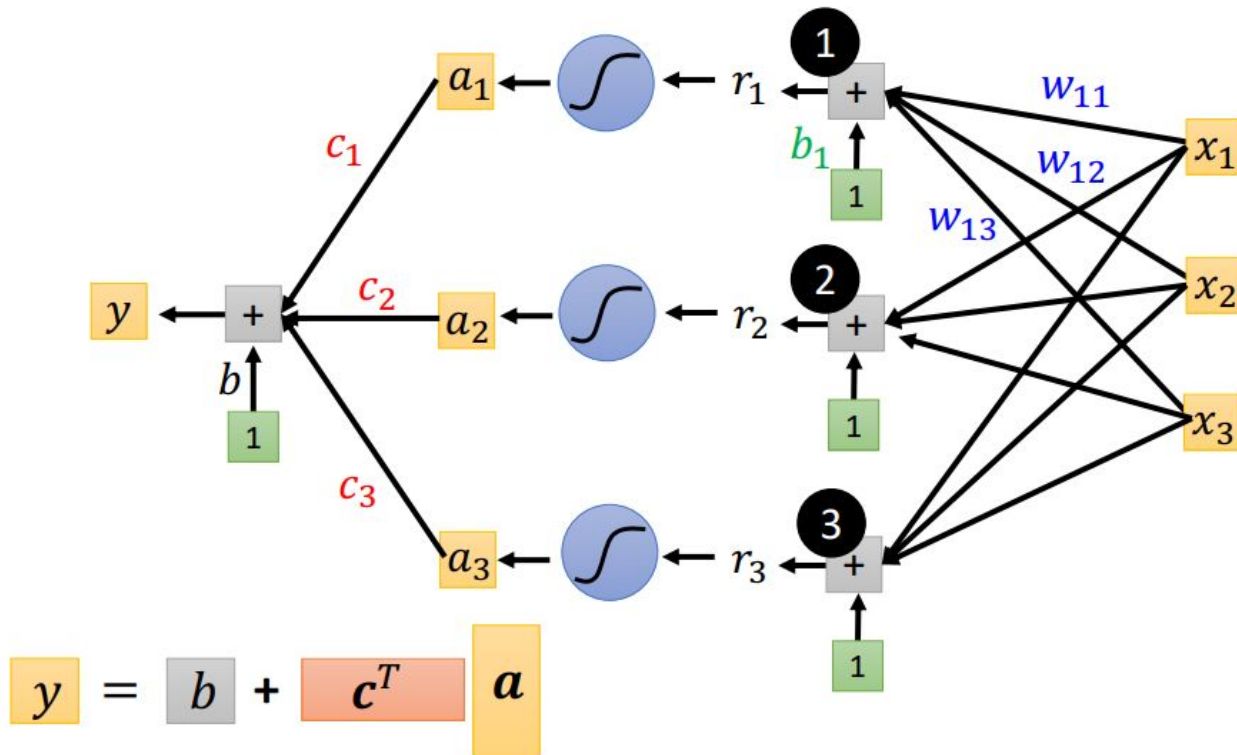
credit:https://speech.ee.ntu.edu.tw/~hylee/ml/ml2021-course-data/classification_v2.pdf

Regression

$$y = b + \sum_i c_i \operatorname{sigmoid}\left(b_i + \sum_j w_{ij} x_j\right) \quad \begin{array}{l} i: 1,2,3 \\ j: 1,2,3 \end{array}$$

How to do
classification?

How to indicate the
output class?



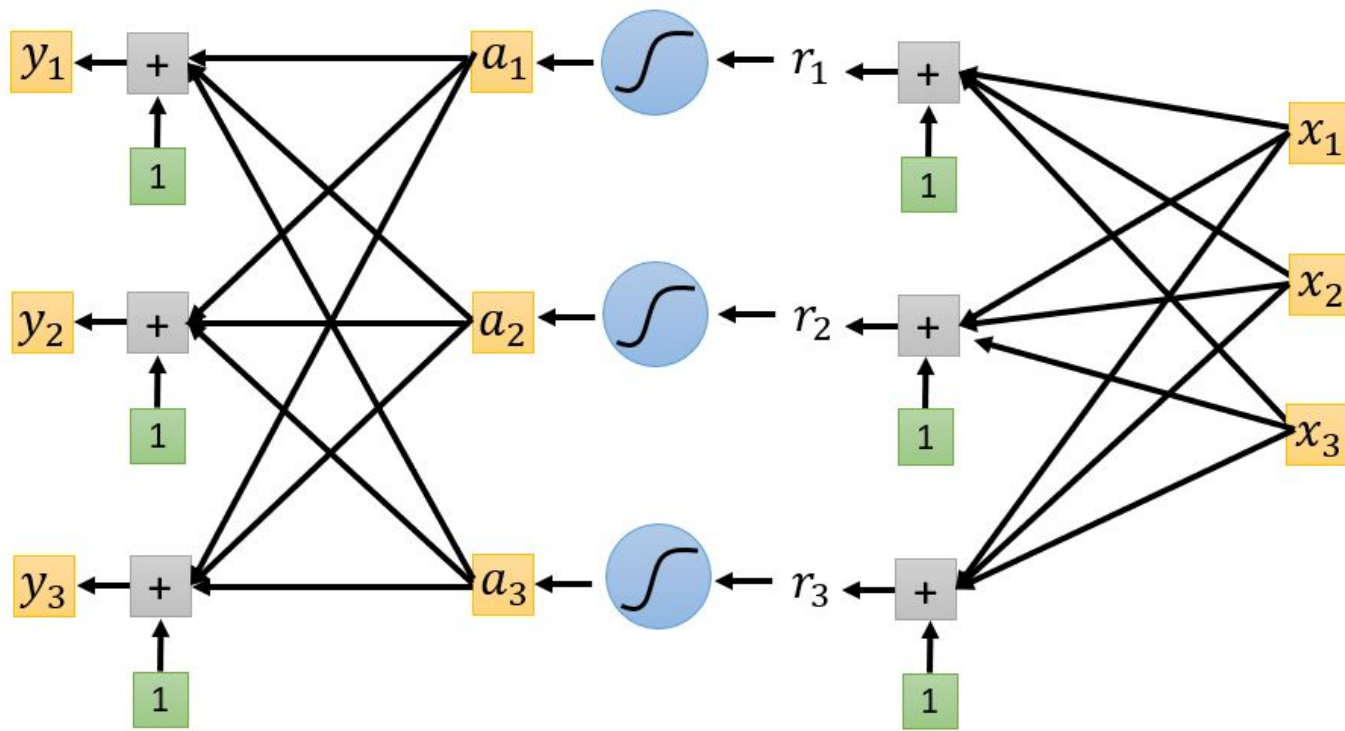
One-hot Vector

Class 1		Class 2		Class 3
$\hat{\mathbf{y}} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$	or	$\begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$	or	$\begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$

Classification

$y=[y_1,y_2,y_3]$

$\hat{y}=[1,0,0]$



Regression

label

$$\hat{y} \longleftrightarrow y = b + c^T \sigma(\underset{\text{feature}}{b} + W x)$$

Classification

feature

$$y = b' + W' \sigma(b + W x)$$

label

$$\hat{y} \longleftrightarrow y' = \text{softmax}(y)$$

0 or 1 Make all values between 0 and 1 Can have any value

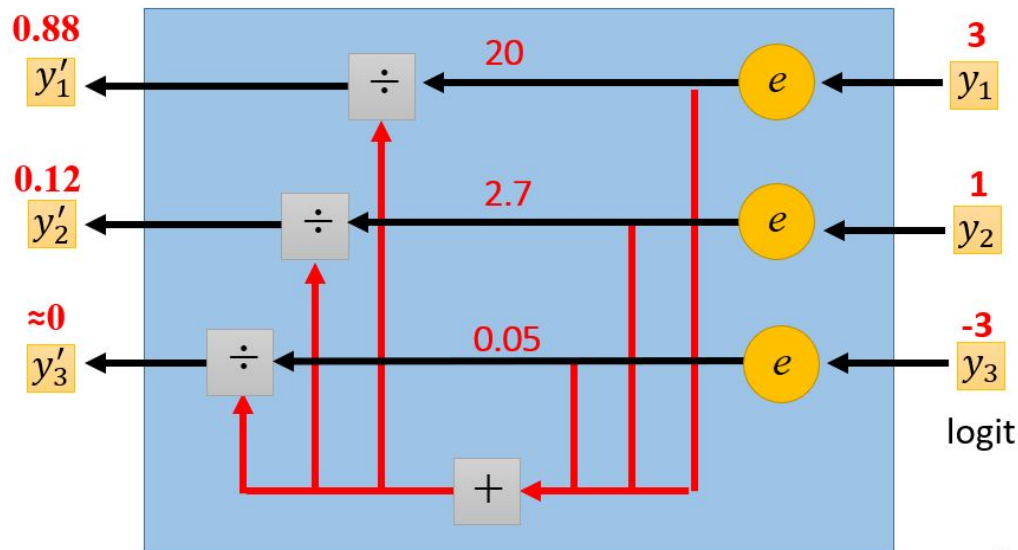
softmax

$y=[0.88,0.12,0]$
 $\hat{y}=[1,0,0]$

Soft-max
$$y'_i = \frac{\exp(y_i)}{\sum_j \exp(y_j)}$$
 $\blacksquare 1 > y'_i > 0$
 $\blacksquare \sum_i y'_i = 1$

Softmax

How about **binary classification**? ☺



Loss Functions

Mean Square Error (MSE) $e = \sum_i (\hat{\mathbf{y}}_i - \mathbf{y}'_i)^2$

Cross-entropy $e = - \sum_i \hat{\mathbf{y}}_i \ln \mathbf{y}'_i$

$\ln(1)=0$, $\ln(0.1)=-2.30258\dots$, $\ln(0.5)=-0.69314\dots$

