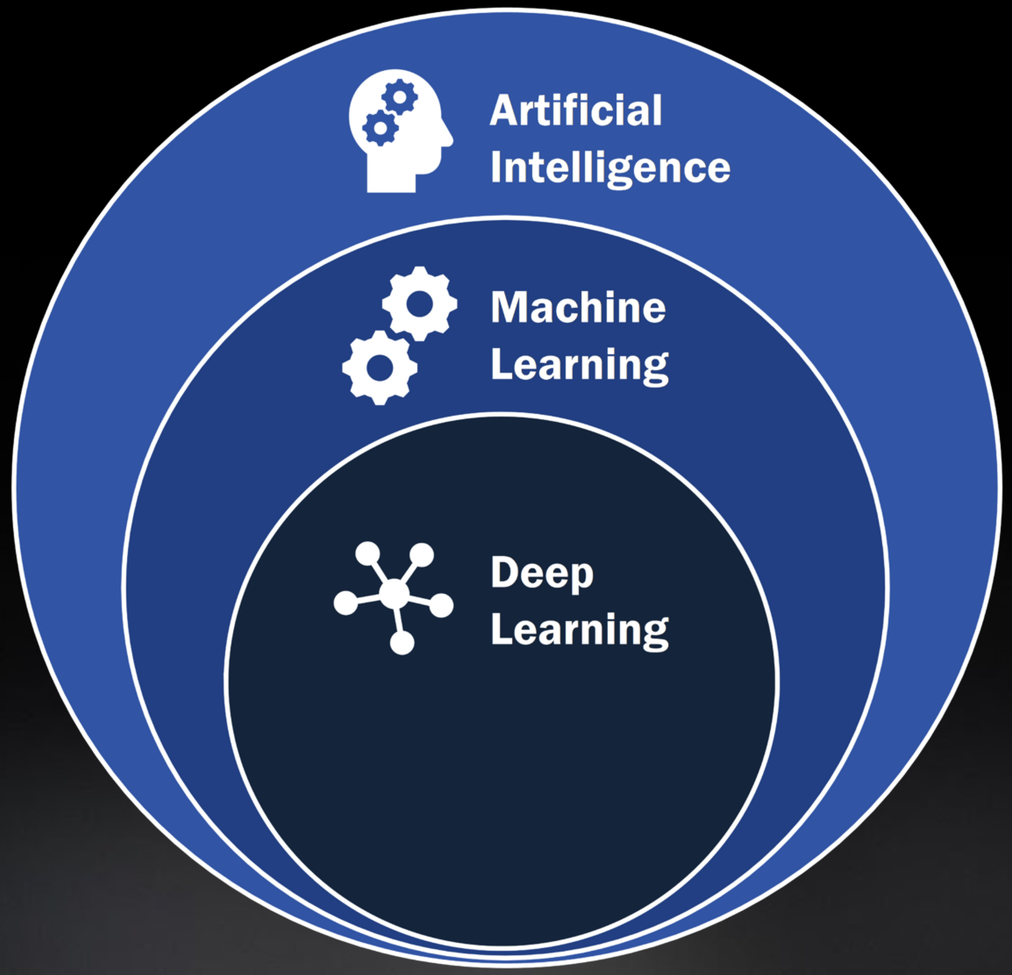
Deep Learning Overview

深度學習概述

人工智慧(AI), 機器學習(ML), 深度學習(DL) 之間的關係？



深度學習概述

AI = A SOFTWARE that write SOFTWARE

HAND-WRITTEN FUNCTION

```
Function1(T,P,Q)
update_mass()
update_momentum()
update_energy()
do_macrophysics()
do_microphysics()
y = get_precipitation()
return y
```

Convert expert knowledge into a function

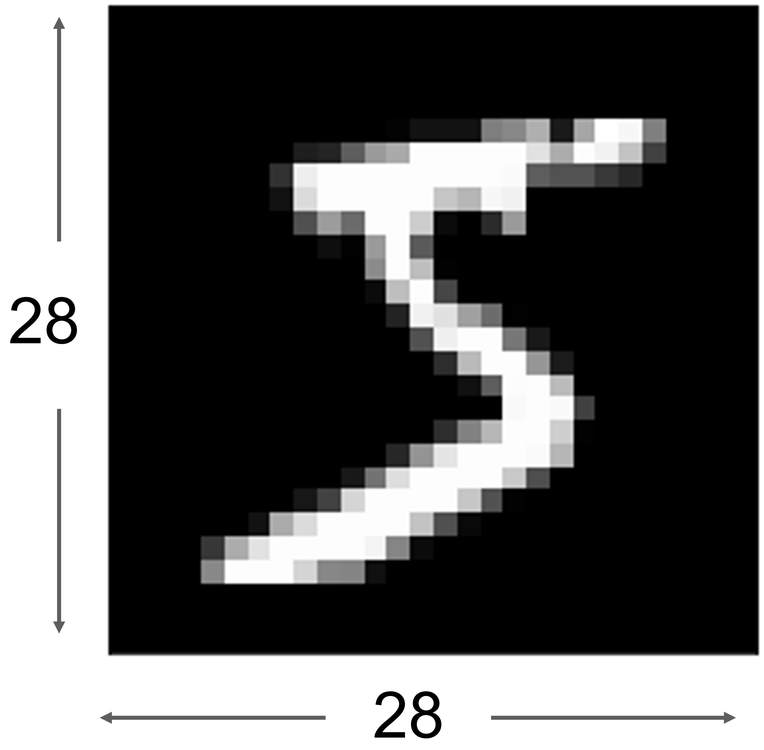
LEARNED FUNCTION

```
Function1(T,P,Q)
A = relu( w1 * [T,P,Q] + b1)
B = relu( w2 * A      + b2)
C = relu( w3 * B      + b3)
D = relu( w4 * C      + b4)
E = relu( w5 * D      + b5)
y = sigmoid(w6 * E    + b6)
return y
```

Reverse-engineer a function from inputs / outputs

mnist 資料準備

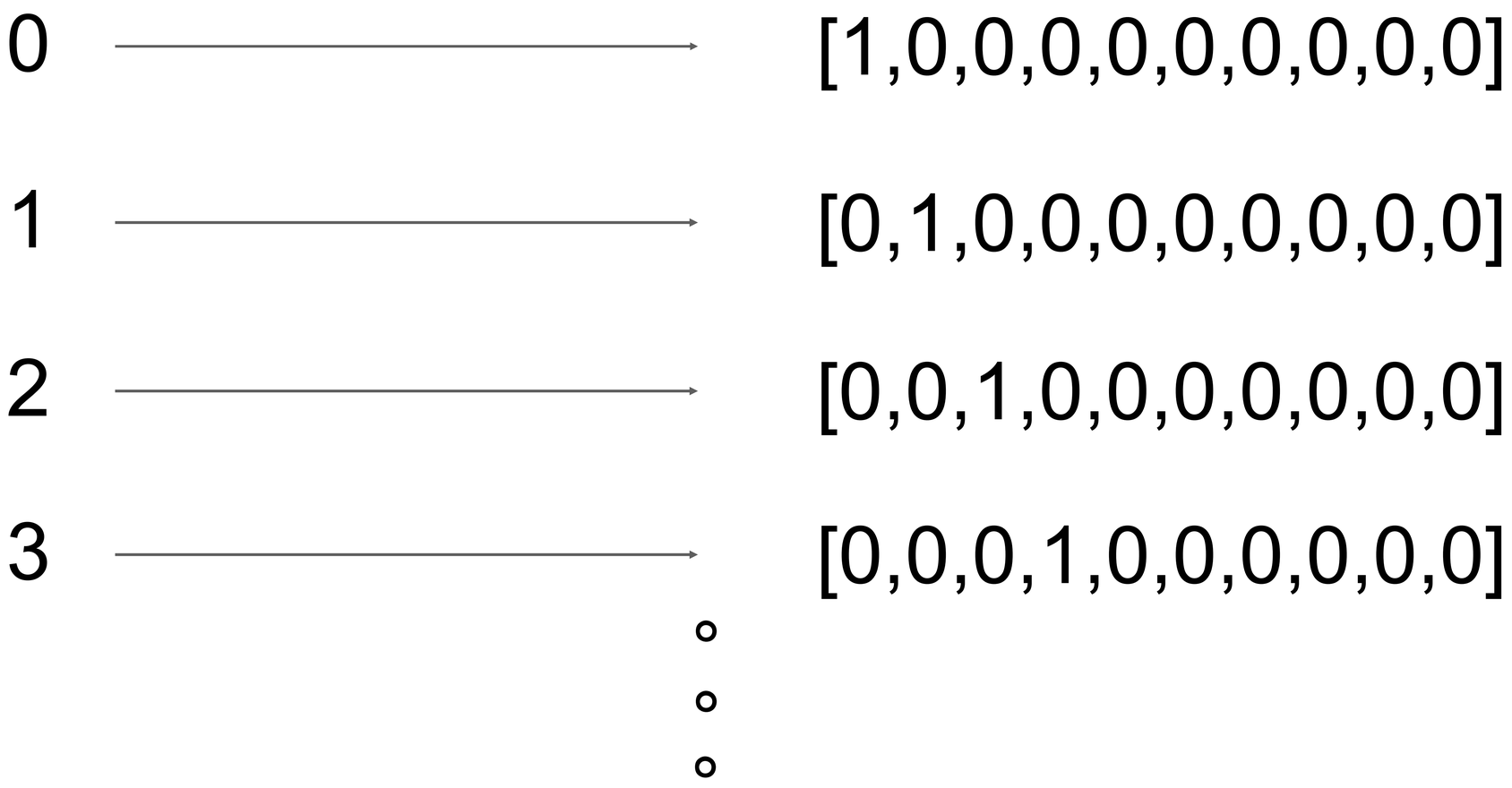
以陣列形式輸入



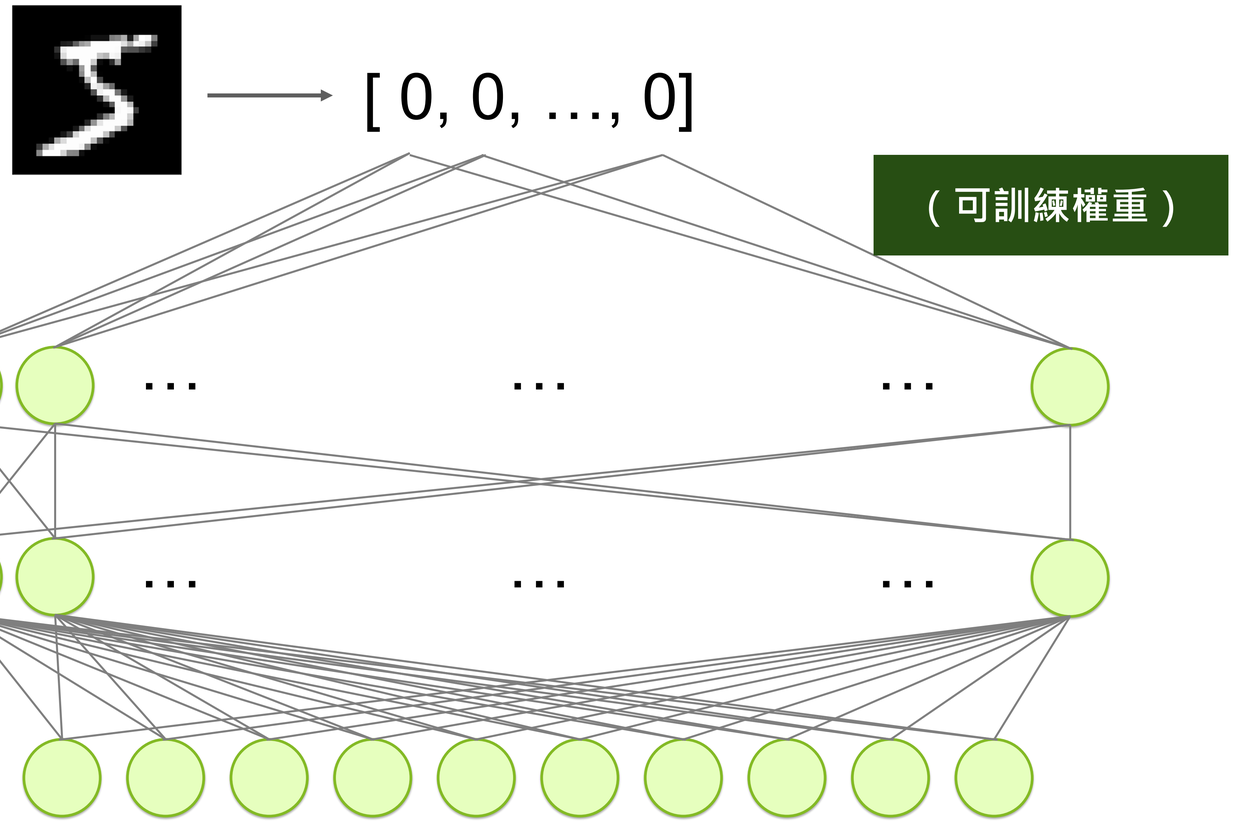
[0,0,0,24,75,184,185,78,32,55,0,0,0…]

mnist 資料準備

類別目標（One-Hot Encoding）



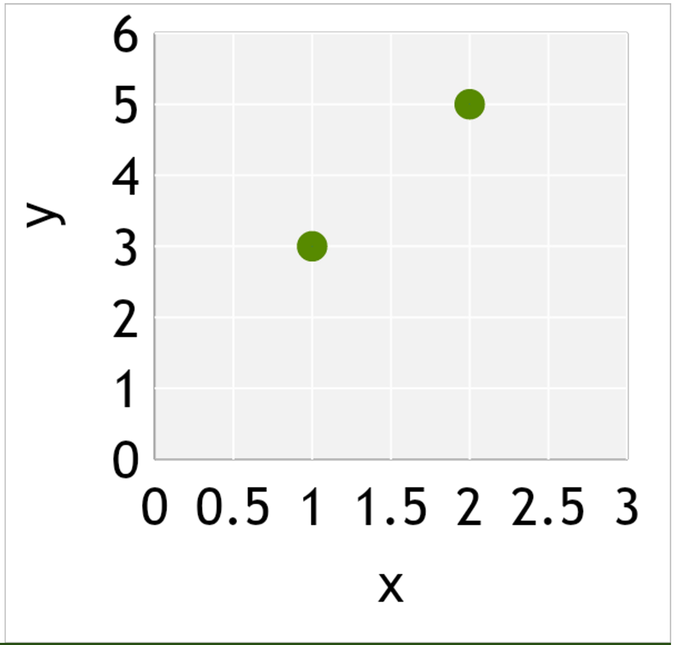
未經訓練的模型


[0, 0, …, 0]
(可訓練權重)
(784,)
(512,)
(512,)
(10,)
各層
大小
(Neuron)
全連接（Fully-Connected）
密連接（Dense）

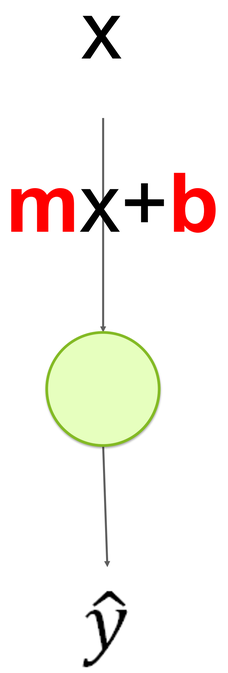
簡化的模型

$$y = mx + b$$

x	y
1	3
2	5



觀測資料



$m = ?$

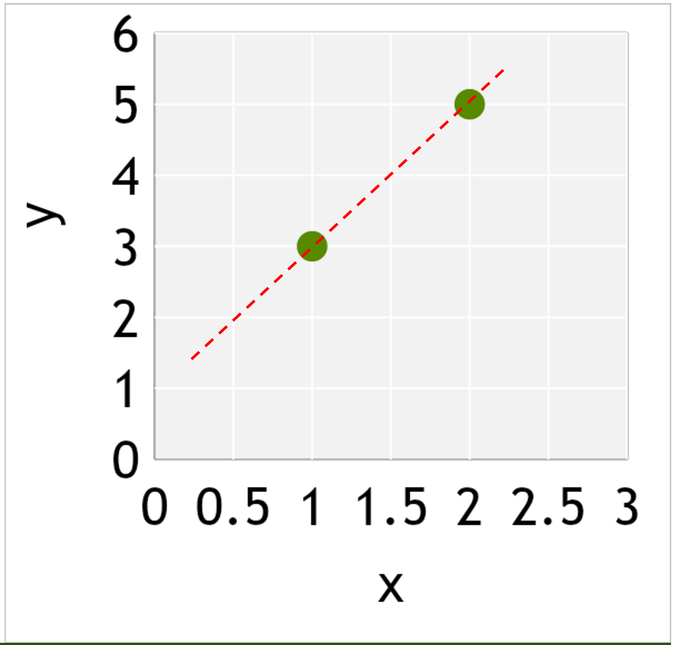
$b = ?$

類神經網路（簡化）

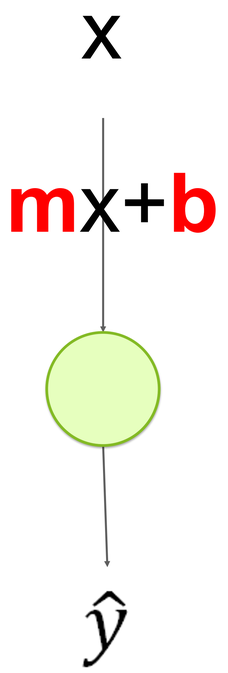
簡化的模型

$$y = mx + b$$

x	y
1	3
2	5



觀測資料



$m = ?$

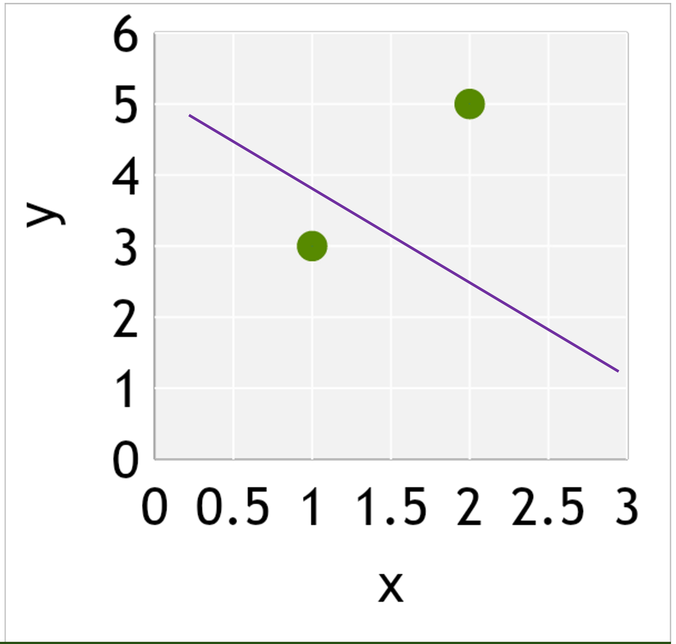
$b = ?$

類神經網路（簡化）

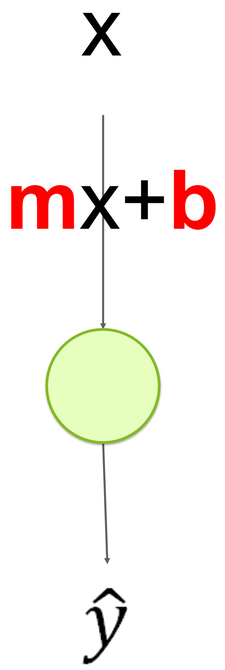
簡化的模型

$$y = mx + b$$

x	y	y^
1	3	4
2	5	3



觀測資料



類神經網路（簡化）

隨機初始

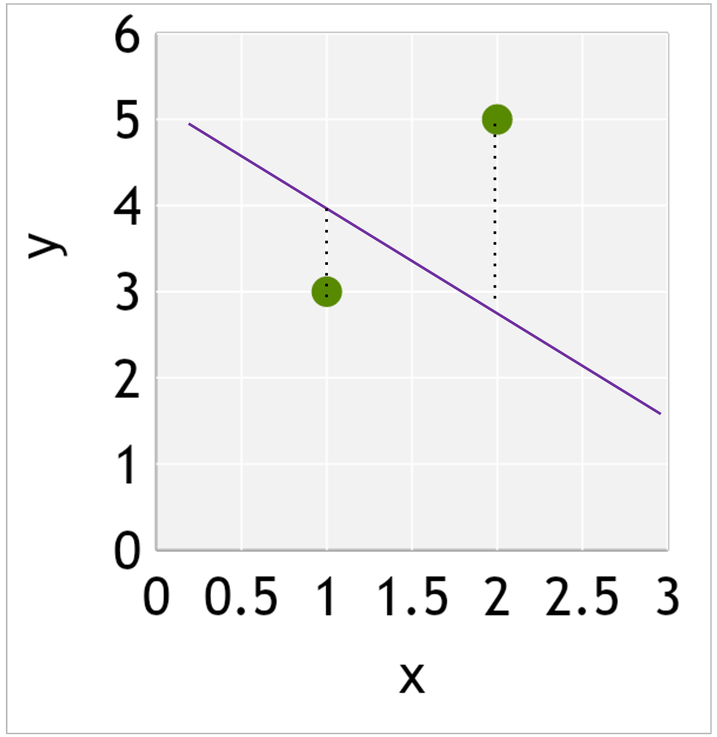
$$m = -1$$

$$b = 5$$

簡化的模型

$$y = mx + b$$

x	y	y^	err^2
1	3	4	1
2	5	3	4
		MSE =	2.5
		RMSE =	1.6

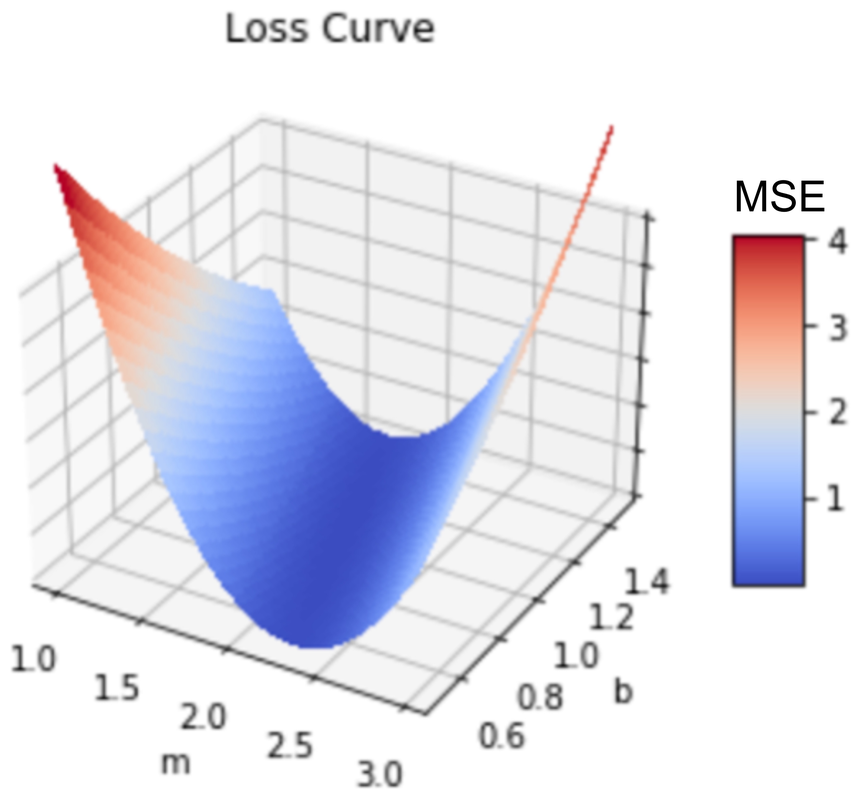


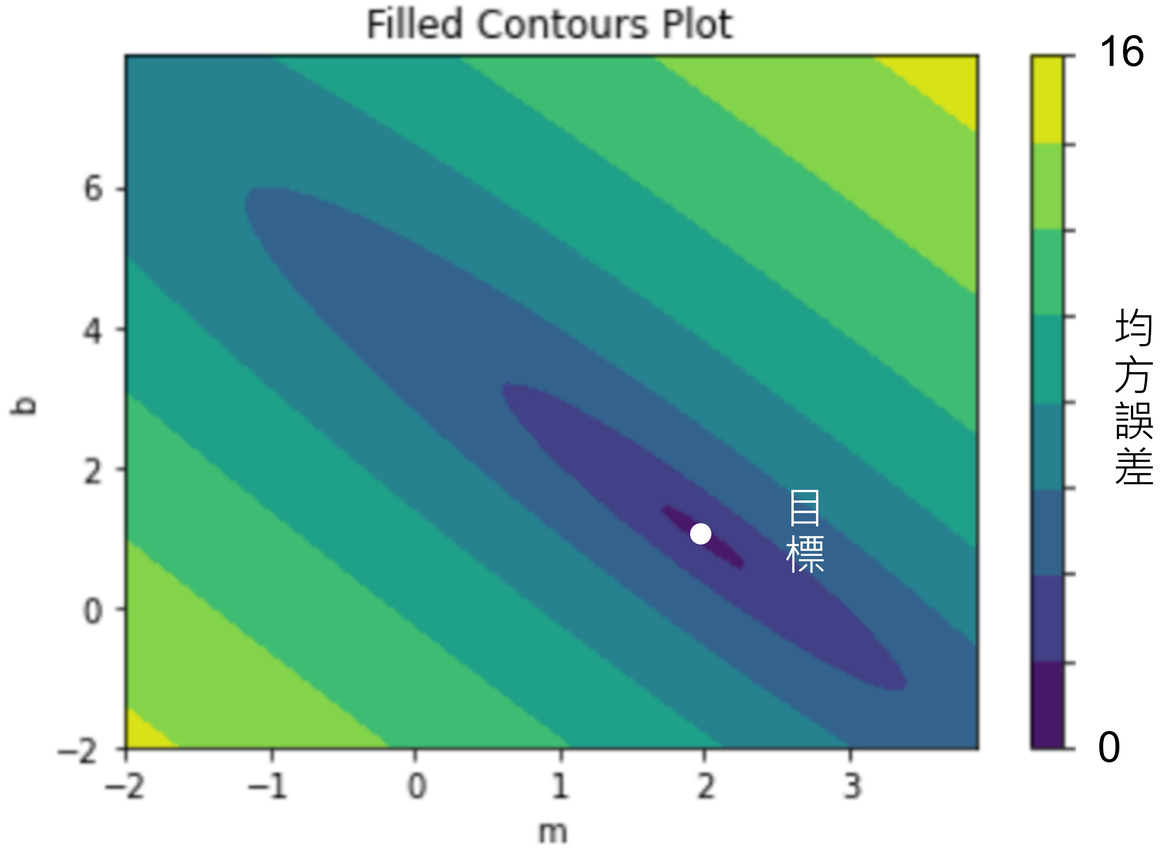
Mean Square Error
（最小平方誤差）

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(y - \hat{y})^2$$

$$RMSE = \frac{1}{n}\sqrt{\sum_{i=1}^{n}(y - \hat{y})^2}$$

損失曲線 (Loss Landscape)





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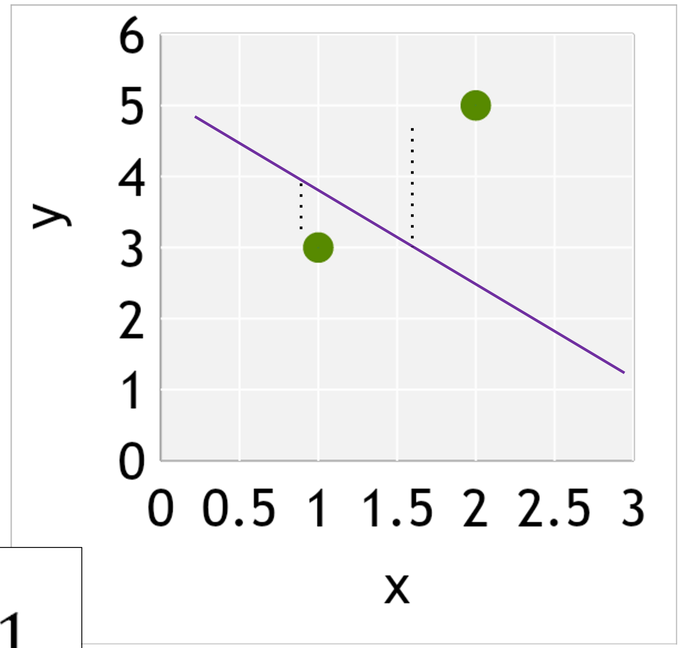
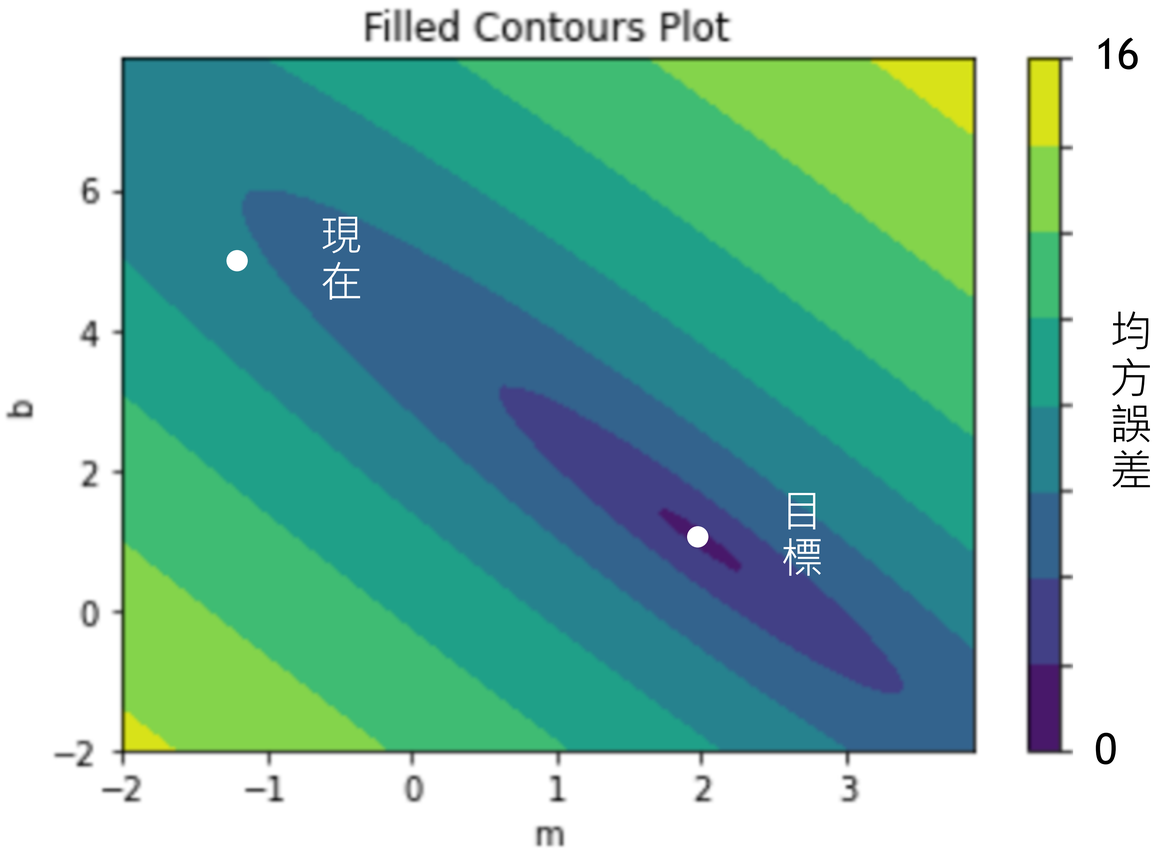


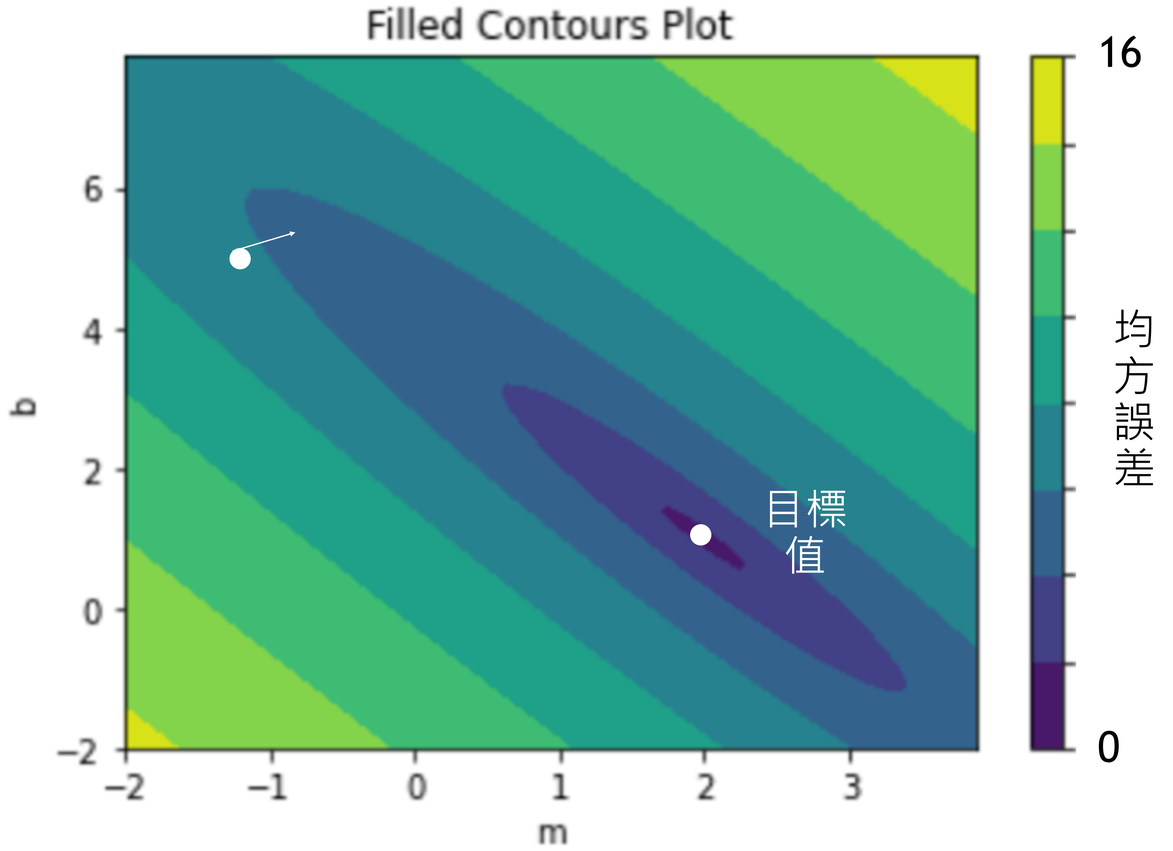
$m = -1$

$\mathrm{b} = 5$



損失曲線 (Loss Landscape)

週期	(Epoch) 以完整資料集進行模型更新
批次	(Batch) 完整資料集的範例
梯度	(Gradient) 哪個方向的損失率降低最多
學習率	(Learning Rate) 移動距離
步驟	(Step) 更新權重參數



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