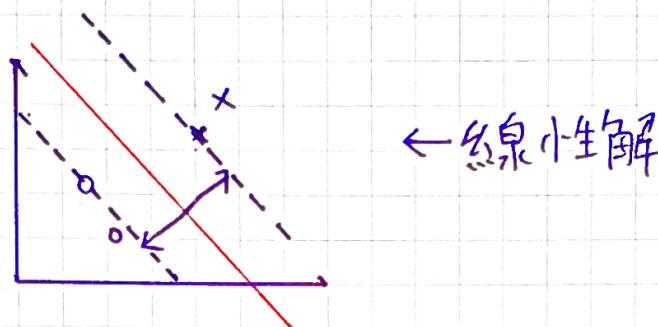
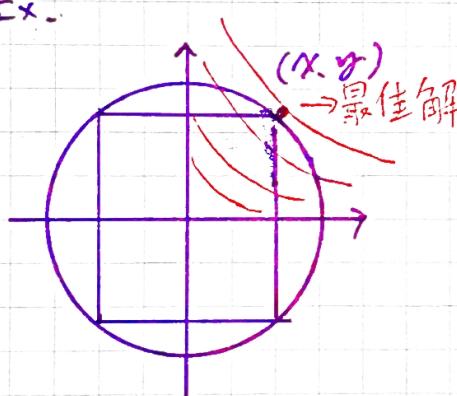


△ SVM

$y = \vec{w} \cdot \vec{x} + b$, 找 \vec{w}, b 之最佳解



Ex.



$$L = \frac{x^2}{a} + \frac{y^2}{b} = 1$$

矩形面積 maximize 求最佳 $(x-y)$

sol: Object Function

$$f(x-y) = 4xy = k$$

Constraint

$$g(x-y) = \frac{x^2}{a} + \frac{y^2}{b} = 1$$

Reduction: 問題轉換

Abstraction: 抽象化

多維度誤差

λ : Lagrange multiplier

在 $\nabla f(x-y) = \nabla g(x-y)$, λ 有 max Area Δ 若 $\nabla g \neq 0$ f.g 一階可微

V.S

$$\begin{aligned} \nabla h(x-y) &= \nabla f(x-y) + \lambda \nabla g(x-y) \\ \text{極值在 } \frac{\partial h}{\partial x} &= 0, \frac{\partial h}{\partial y} = 0 \end{aligned}$$

gradient (vector)

$$\nabla f(x,y) = \left\langle \frac{\partial f}{\partial x}, \frac{\partial f}{\partial y} \right\rangle = \langle f_x, f_y \rangle$$

$$\nabla f(x,y) = \langle 4y, 4x \rangle$$

$$\nabla g(x,y) = \left\langle \frac{2x}{a}, -\frac{2y}{b} \right\rangle$$

$$\begin{cases} 4y = \frac{2}{a}x - ①, y = \frac{1}{2a}x \\ 4x = \frac{2}{b}y - ② \end{cases}$$

$$g(x,y) = \frac{x^2}{a} + \frac{y^2}{b} = 1 - ③$$

$$\frac{x^2}{a} + \frac{\frac{1}{4a}x^2}{b} = 1 \Rightarrow x = ?$$

$$\nabla f(x, y) = \left\langle \frac{\partial f}{\partial x}, \frac{\partial f}{\partial y} \right\rangle = \langle f_x, f_y \rangle$$

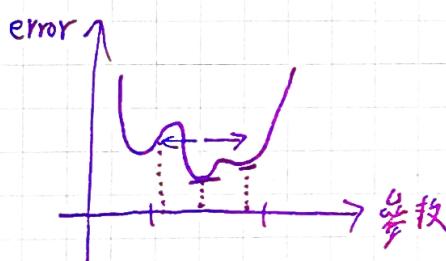
↑ 簡便

$$\begin{aligned} \nabla f(x, y) &= \langle 4y, 4x \rangle \\ \nabla g(x, y) &= \left\langle \frac{2x}{a}, \frac{2y}{b} \right\rangle \end{aligned} \quad \left. \begin{array}{l} \text{解聯立} \\ \Rightarrow \frac{x^2}{a} + \frac{x^2}{4a^2} x^2 = 1 \end{array} \right\}$$

non convex \Rightarrow 非凸函數
 \Rightarrow 多個凸矣

△ non-Convex problem

Object function

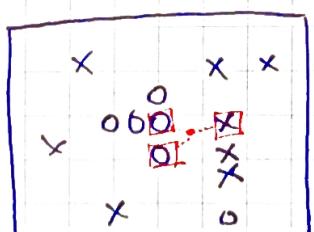


△ classification 分類

Supervised : 監督式

Unsupervised : 非監督式

△ Knn : K nearest neighbor \Rightarrow Supervised



pros. Easy

cons. complexity

if $k=3$ $\begin{matrix} o=2 \\ x=1 \end{matrix}$, New Point is o

$k=5$ $\begin{matrix} o=2 \\ x=3 \end{matrix}$, New Point is x

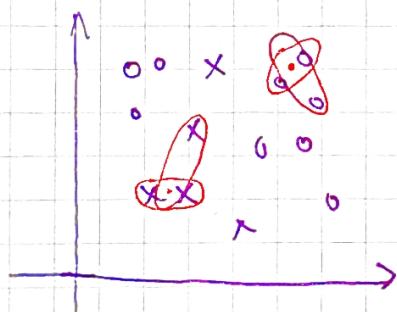
算 距 離

$$\begin{aligned}
 P_0(x_0, y_0) &\Rightarrow \langle x_1, x_2, x_3 \rangle \\
 P_1(x_1, y_1) &\Rightarrow \langle y_1, y_2, y_3 \rangle \Rightarrow \sqrt{\sum_i (x_i - y_i)^2} = 2\text{norm} \\
 P_2(x_2, y_2) & \\
 \vdots & \Rightarrow \sum_i |x_i - y_i| = 1\text{norm} \\
 & \quad \| \vec{v} \|_1
 \end{aligned}$$

Ex: 手寫字辨識

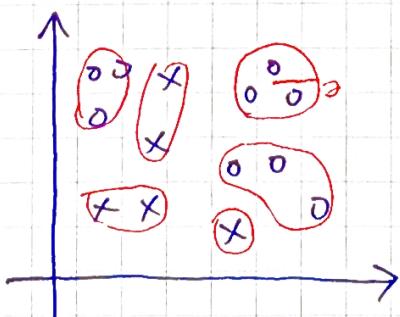
$$\{0, 1, 2, \dots, 9\}$$

△ k-means \Rightarrow un-supervised
需自訂群數



△ GMM

自訂標準差範圍

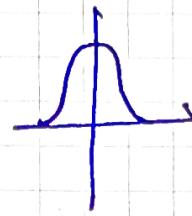


△ Fuzzy C-Means

△ SOM \Rightarrow self organized map

△ 高斯函式

$$\frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$



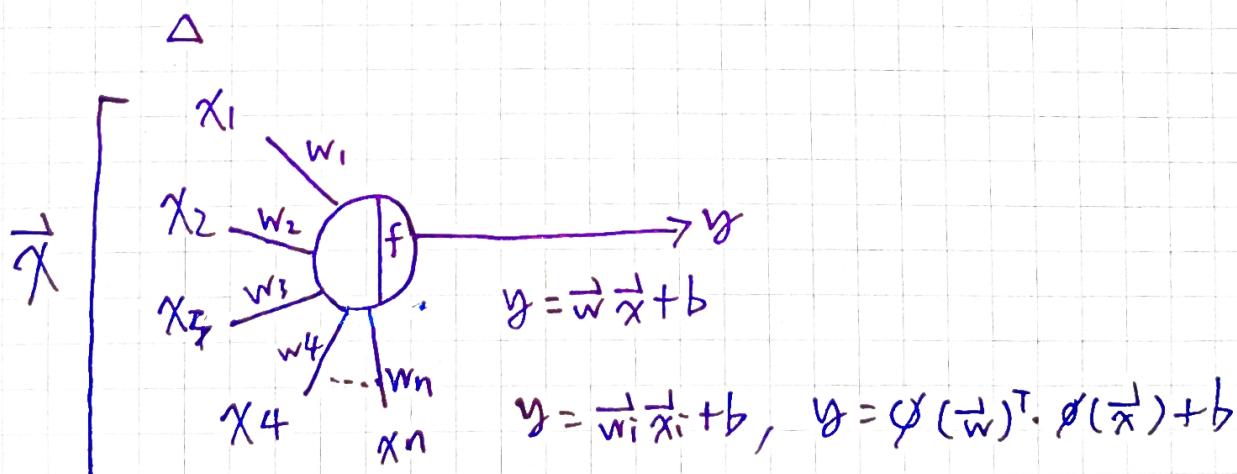
△ mean-shift ∈ unsupervised

△ unsupervised
big-data analytics } \Rightarrow Supervised learning

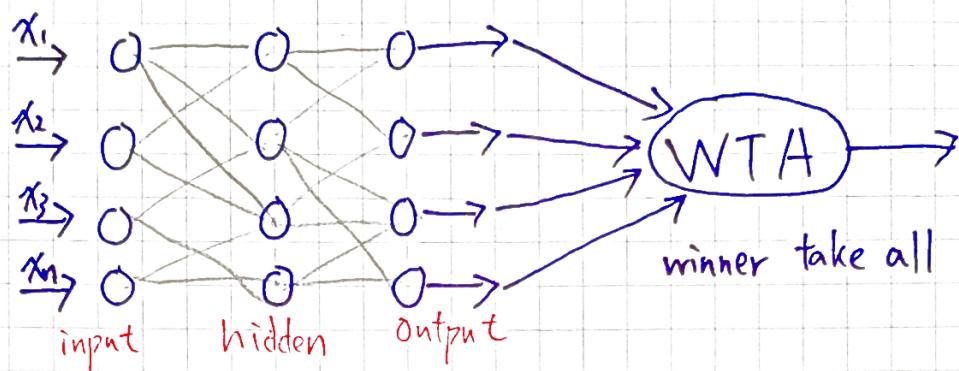
$$y[n] = \underline{x[n]} * \underline{h[n]} = \sum_{k=0}^{N-1} x[k] h[n-k]$$

影像 kernel

$$y[m,n] = \underline{x[m,n]} * \underline{h[m,n]} = \sum_{l=0}^{M-1} \sum_{k=0}^{N-1} x[l,k] h[m-l, n-k]$$



△ MLP multi-Layer Perceptron



倒傳遞演算法

Transfer learning

$$\Delta w = f(e) = \eta \frac{\partial e}{\partial w_{ji}}$$

$$w = w + \Delta w$$

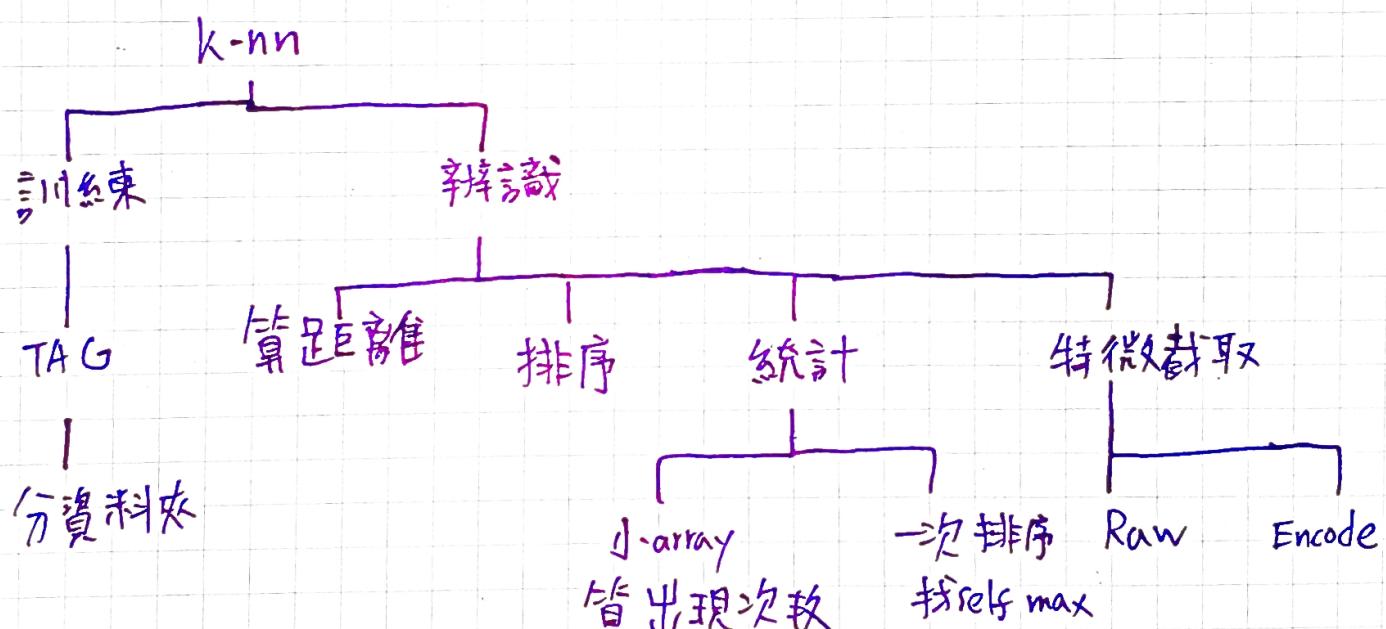
△ kNN

訓練: $\vec{x}_1 \vec{x}_2 \vec{x}_3 \dots \vec{x}_n$
 $\begin{matrix} A \\ B \\ A \\ \dots \\ B \end{matrix}$
 $\underbrace{\quad\quad\quad\quad\quad}_{classes}$

$Sample = [\vec{x}_1 \dots \vec{x}_n]$
 $= \{A, B, C, D\} = C$
 $= \{0, 1, 2, \dots, 9\} = C$

辨識: \vec{s} input 後，在 \vec{x} 找 $k-nn$
 統計 k 個中最多的 class

分析:



設計:

回山凹...凹
 10個Folder

* 算距離

* 算距離
 ⇒ 歐式距離

* 排序
 ⇒ Bubble Sort
 ⇒ Quick Sort

* 統計
 ⇒ 小 Array
 ⇒ NMS

△ 統計

小 array
stat[]
0, 1, 2, ..., 8, 9
3, 1, 9, ..., 2, 6
↑
k個裡面出現的次數
foreach item in k
 $\Rightarrow \text{stat[item]}++;$

NMS
stat[]
0, 1, 2, ..., 9
3, 1, 9, ..., 6
↑
find max

△ 特徵 extraction

raw: Google Bmp or Jpg to Raw

encode: 假設 100×100 的 image
 $M \times N$

$\vec{x}_i = \underbrace{\langle 0, 1, 1, 0, \dots, 1, 0 \rangle}_{10000 \text{ 個}}$
1 代表黑色筆跡 pix
0 白色

辨識:

raw \rightarrow encode \rightarrow distance \rightarrow sort \rightarrow

小 array \rightarrow NMS

* Unit Test Required

Hw: K-means, k-mn

△ 期末作業：物件辨識 3 種以上，照專案管理流程

P.S.: 辨識在 10 行程式碼內, Yolo, CNN

Towards Data Science *reference

流程：溝通介面，設計需求...等

△ 重疊物件辨視

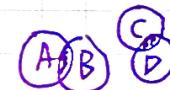
1. 至少 4 種

2. inside testing: 拿 training 內的 sample, 100%

outside testing: 非 training 內的 sample, 85%

3. 重疊情況:

① 2-2



② 3, 1



③ occlusion



4. 加分：

① 速度

② data set 數量

③ 類別數

△重疊物件辨識：

