暑期課程
基本影像處理 day5-2

指導教授：顏淑惠、林慧珍
http://163.13.127.10
http://pria.cs.tku.edu.tw

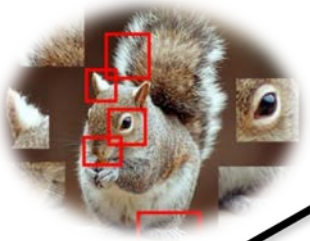
指導教授：涂瀞珽
http://mail.tku.edu.tw/cttu

2015.07.03 updated

Course Outline

- Image Enhancement (影像增強)
  - Histogram (直方圖)
  - Contrast Enhancement (對比強化)
- A short introduction to Pattern Recognition
- Histogram of Oriented Gradients (方向梯度直方圖)

A short introduction to Pattern Recognition



Feature detection/extraction
特徵偵測/擷取

Feature description
特徵描述

Input image/video

Comparison/Recognition/Classification
比較/辨識/分類

Output results

Feature extraction (特徵擷取)

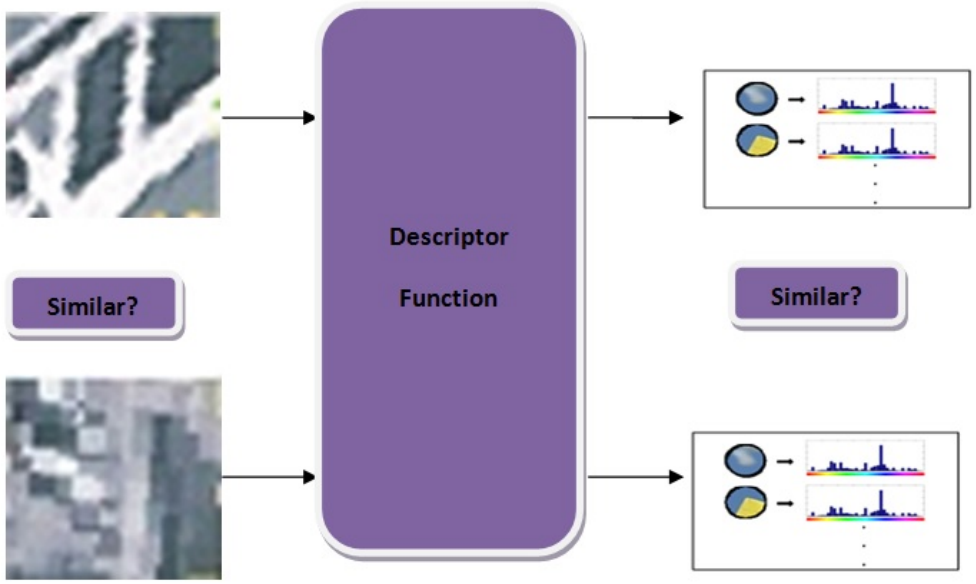
- Feature?
  - color, edge, corner, circle, gradients...etc.

Feature extraction

- 常用的特徵
  - Color
  - Corner
  - Gradients
  - Face feature: eyes, nose, philtrum, mouth
    - Haar-like feature
  - SIFT
  - …etc.

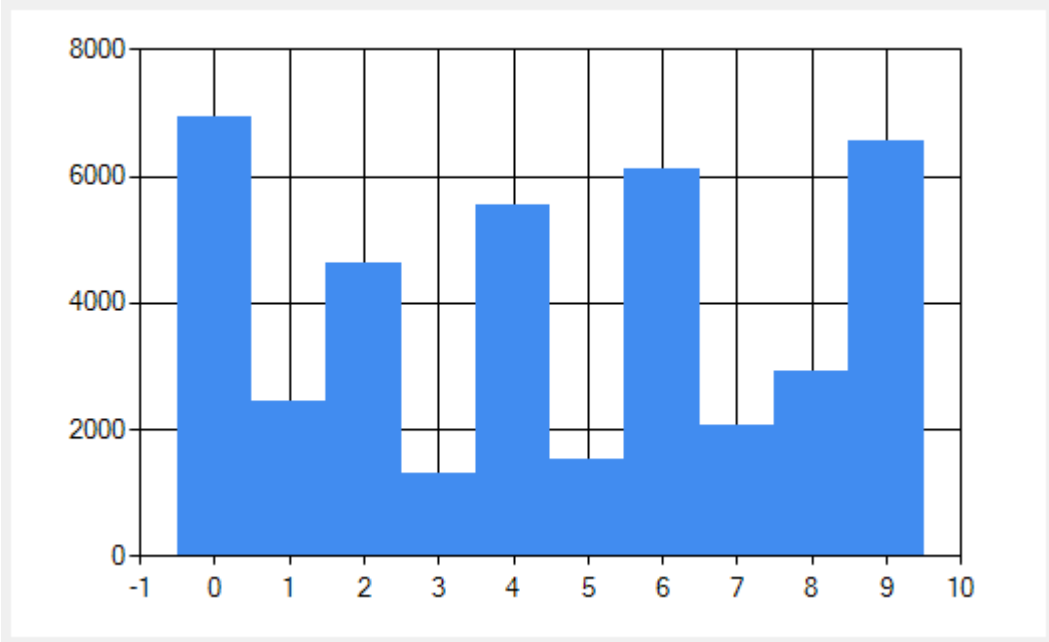
Feature description

- Descriptor?
  - 對特徵做分析統計, 將特徵點資訊描述成可供記錄和比對的資料
  - ex: Histogram (直方圖)



Histogram

- x = data_bin;
- histogram[x]++; //數量統計
- histogram[x]+=magnitude; //像素強度累積



Histogram

Chart: VC統計圖元件

Series: 資料序列

拉好chart元件後, 兩種控制series方式:

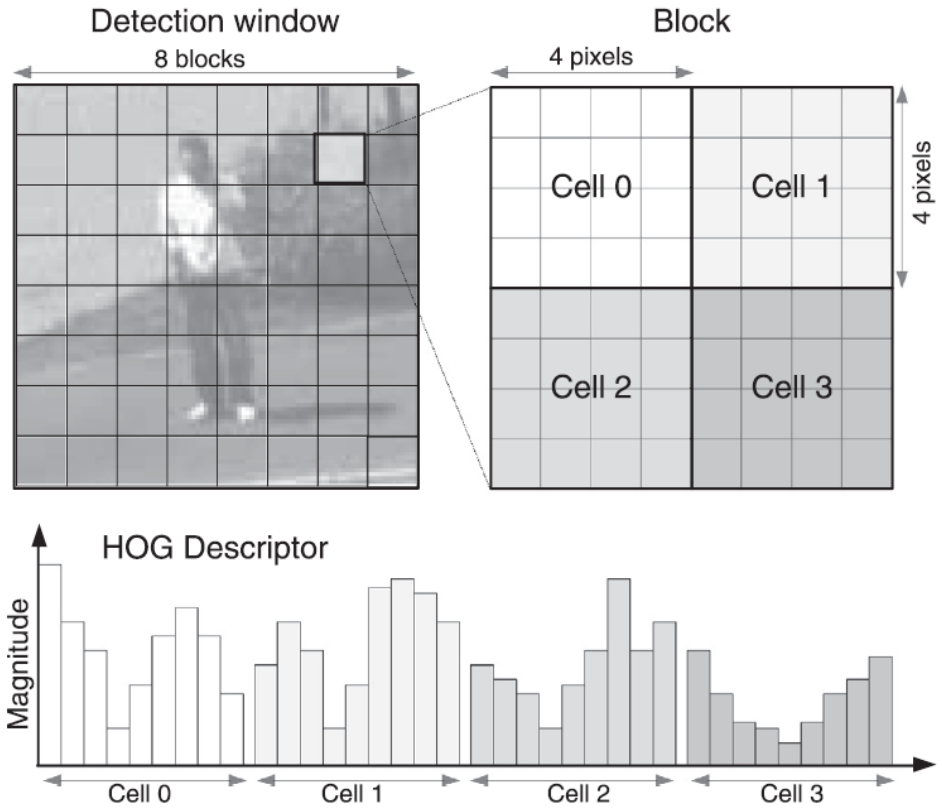
```
//chart1->Series[0]                                  //用index控制series
//chart1->Series["Series1"]                          //用name控制series

//設定
chart1->Series[0]->IsVisibleInLegend = false;        //去掉右邊的series1圖例
chart1->Series[“Series1”]->CustomProperties = L“PointWidth=1”;  //資料條寬度設為1倍

chart1->Series[0]->Points->Clear();                  //清除Series1內的資料

chart1->Series[“Series1”]->Points->AddXY(1, 30);  //加入data
chart1->Series["Series1"]->Points->AddXY(1, 20); //會取最大的 y, 故不要重覆x
chart1->Series["Series1"]->Points->AddXY(2, 10);
chart1->Series["Series1"]->Points->AddXY(3, 50);
chart1->Series[0]->Points->AddXY(4, 10);
chart1->Series[0]->Points->AddXY(5, 0);
chart1->Series[0]->Points->AddXY(6, 30);
```

Course Outline

- Image Enhancement (影像增強)
  - Histogram (直方圖)
  - Contrast Enhancement (對比強化)
- A short introduction to Pattern Recognition
- Histogram of Oriented Gradients (方向梯度直方圖)

Histogram of Oriented Gradients

- 一種廣泛應用於物件偵測的特徵描述方法，針對影像中局部重疊區域並計算該區域內梯度方向的出現次數，建構其方向直方圖作為特徵描述元



Histogram of Oriented Gradients

- Gradients feature
  - Suppose $I(x,y)$ is pixel value at (x, y) in image I
    - $Gx(x,y) = I(x+1, y) - I(x-1, y)$
    - $Gy(x,y) = I(x, y+1) - I(x, y-1)$
  - 梯度強度值 $G(x,y)$ 和梯度方向 $\theta(x,y)$：

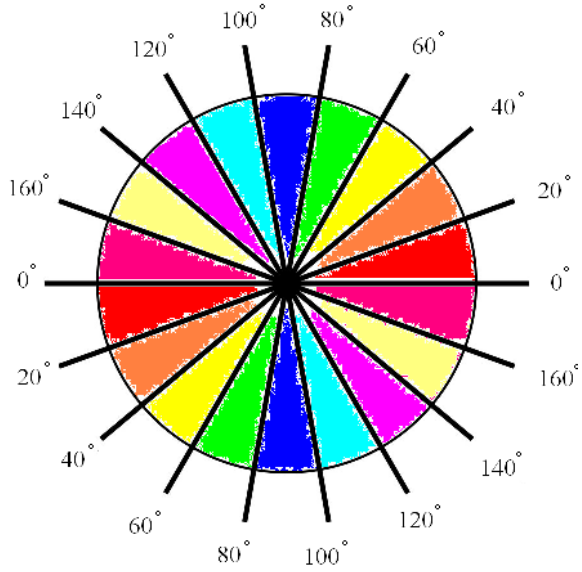
$$G(x,y) = \sqrt{G_x(x,y)^2 + G_y(x,y)^2}$$

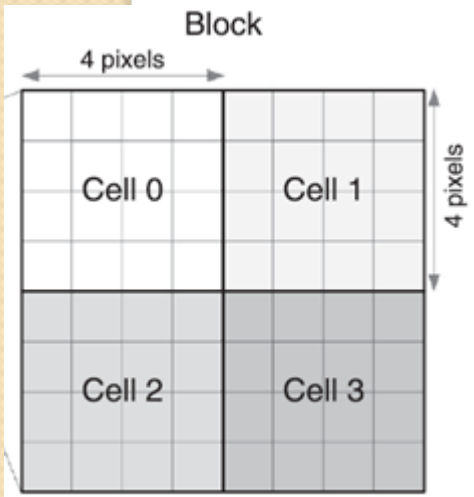
<math.h>
atan( );

$$\theta(x,y) = \begin{cases} tan^{-1}\left(\frac{G_y(x,y)}{G_x(x,y)}\right) & , \ if \ tan^{-1}\left(\frac{G_y(x,y)}{G_x(x,y)}\right) \geq 0 \\ tan^{-1}\left(\frac{G_y(x,y)}{G_x(x,y)}\right) + \pi \ , if \ tan^{-1}\left(\frac{G_y(x,y)}{G_x(x,y)}\right) < 0 \end{cases}$$

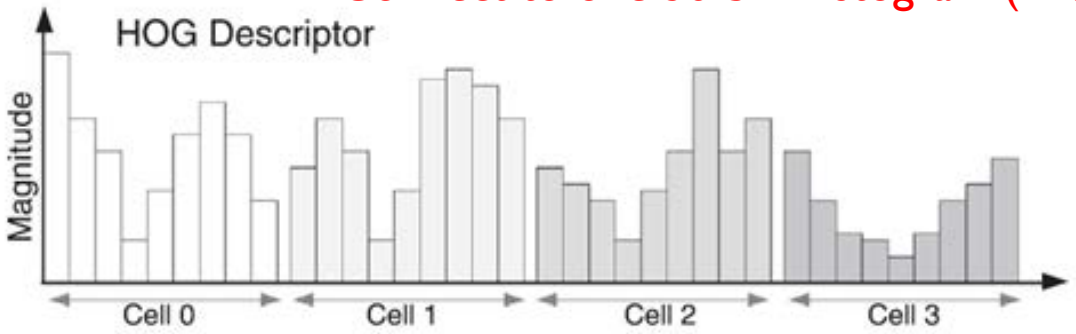
Histogram of Oriented Gradients

- 將梯度方向均分為9個方向
  - 以histogram做統計
    - X軸為梯度方向
    - Y軸為梯度強度累積和
  - Normalization (正規化)
    - 使Y軸值介於0~1.0之間
    - => hist[x] = (hist[x]-min)/(max-min);
      where max=MAX(hist), min=MIN(hist);





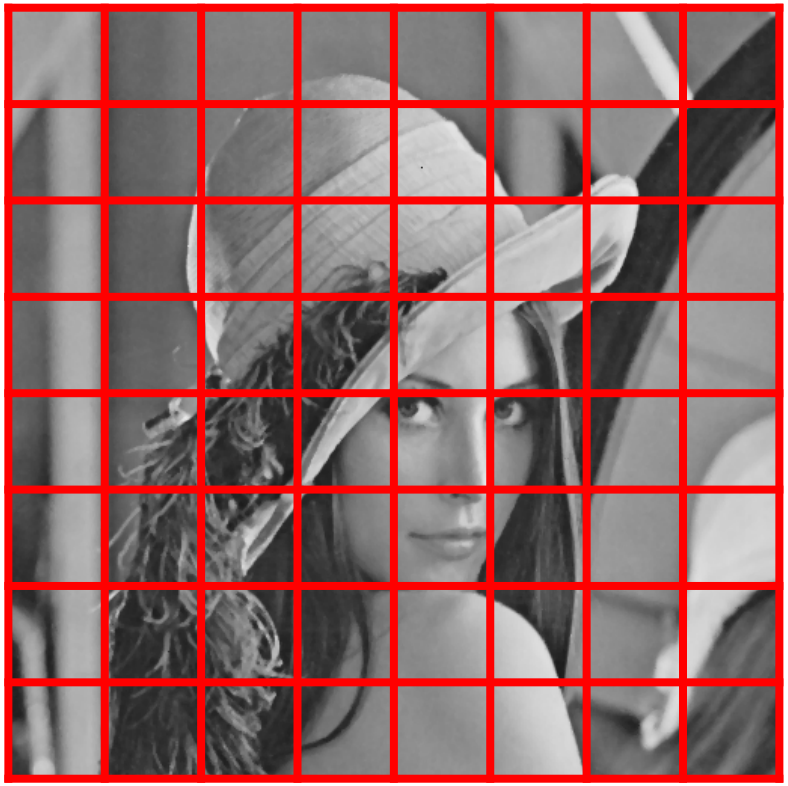
Connect to one 36-bin histogram (4x9)



Homework #5.2

8 cells

8 cells



將image視為一個大Block,
切成8x8=64個cell;
產生一個
576-bin HOG (8x8x9)

show出
陣列值&直方圖(chart元件)

Homework #5.3

- 圖形比對
  - 利用#5.2產生的HOG
    透過Euclidean distance計算影像 *i* 和影像 *j* 的相似程度

$$\underset{j}{\operatorname{argmin}}\, S(\mathrm{i},\mathrm{j}) = \sqrt{\sum_{k=0}^{n-1}\left[H_i(k) - H_j(k)\right]^2}$$

- *k* is number of bins, *H* is HOG of image

- 1. image *i* 為input image, 被比對的影像
- 2. image *j* 為 /training 中的任意一張資料庫影像
- 3. 比對前需做HOG Normalization (*i*, *j*都要做)
- 4. 從資料庫數張image中, 求出距離最近(最相似)的image *j*
- 5. 輸出image *j* (資料庫中最相似的圖)
- 6. 輸出所有比對影像的*S(,)* value