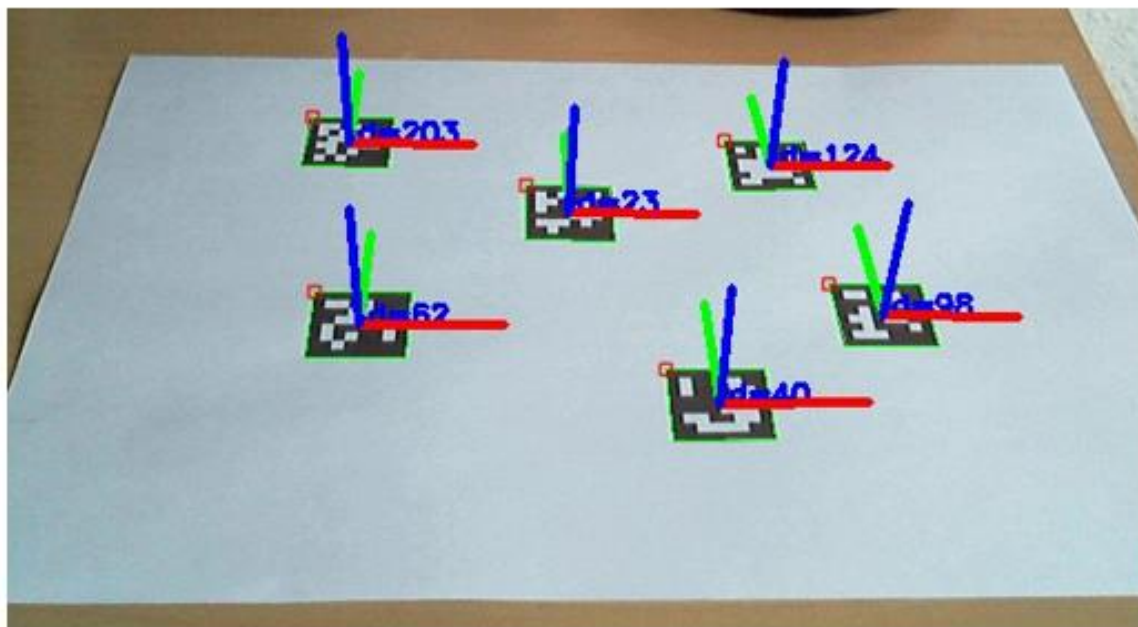
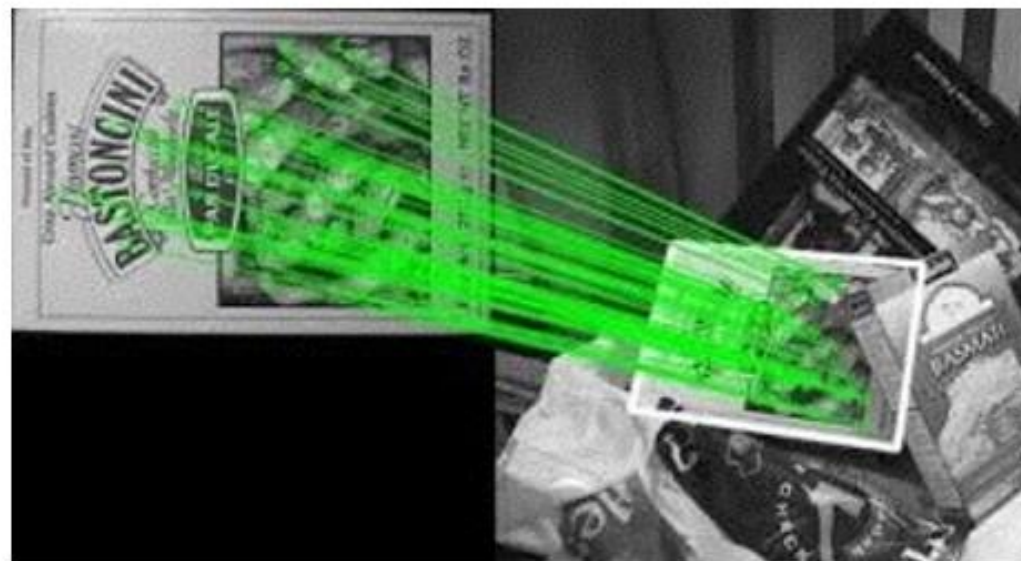


OPENCV BASICS



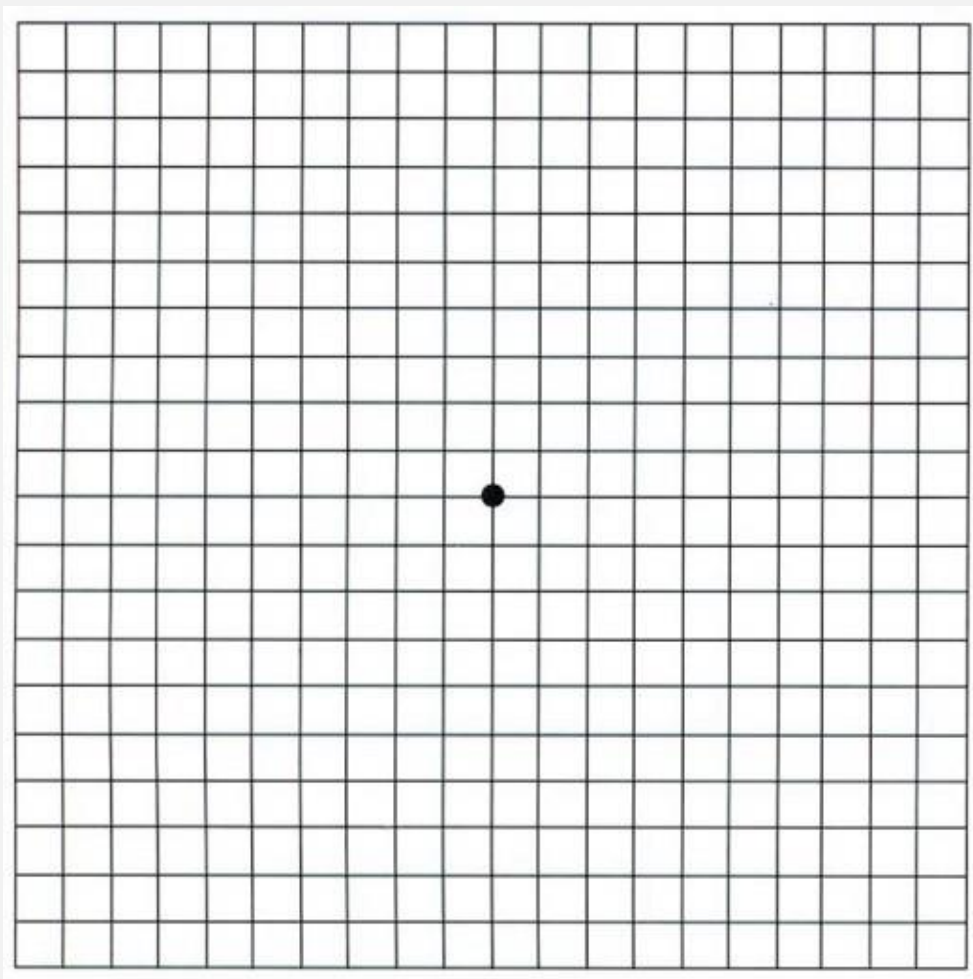
- core. The Core Functionality
- imgproc. Image Processing
- imgcodecs. Image file reading and writing
- videoio. Media I/O
- highgui. High-level GUI and Media I/O
- video. Video Analysis
- calib3d. Camera Calibration and 3D Reconstruction
- features2d. 2D Features Framework
- objdetect. Object Detection
- ml. Machine Learning
- flann. Clustering and Search in Multi-Dimensional Spaces
- photo. Computational Photography
- stitching. Images stitching
- cuda. CUDA-accelerated Computer Vision
- cudaarithm. CUDA-accelerated Operations on Matrices
- cudabgsegm. CUDA-accelerated Background Segmentation
- cudacodec. CUDA-accelerated Video Encoding/Decoding
- cudafeatures2d. CUDA-accelerated Feature Detection and Description
- cudafilters. CUDA-accelerated Image Filtering
- cudaimgproc. CUDA-accelerated Image Processing
- cudaoptflow. CUDA-accelerated Optical Flow
- cudastereo. CUDA-accelerated Stereo Correspondence
- cudawarping. CUDA-accelerated Image Warping
- shape. Shape Distance and Matching
- superres. Super Resolution
- videostab. Video Stabilization
- viz. 3D Visualizer
- bioinspired. Biologically inspired vision models and derivated tools
- cvv. GUI for Interactive Visual Debugging of Computer Vision Programs
- datasets. Framework for working with different datasets
- face. Face Recognition
- Binary descriptors for lines extracted from an image
- optflow. Optical Flow Algorithms
- reg. Image Registration
- rgbd. RGB-Depth Processing
- Saliency API
- surface_matching. Surface Matching

feature detection



pattern
recognition

MAT



rows: 長

cols: 寬

type: 像素型態

channels: 通道數

NORMAL:

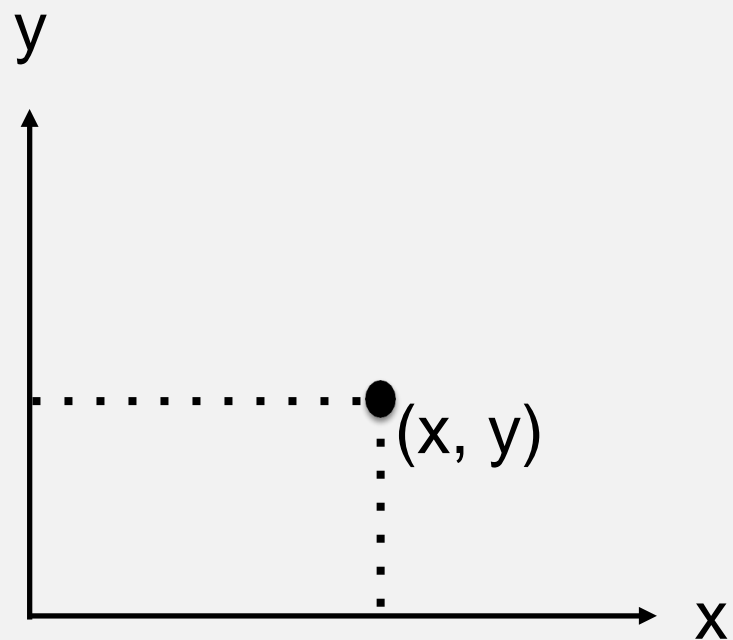


image:

```
0/0---X--->  
|  
|  
Y  
|  
|  
v
```

```
0/0---column--->  
|  
|  
row  
|  
|  
v
```

MAT VALUE ACCESS

	Column 0	Column 1	Column ...	Column m
Row 0	0,0	0,1	...	0, m
Row 1	1,0	1,1	...	1, m
Row ...	...,0	...,1	...	..., m
Row n	n,0	n,1	n,...	n, m

3-channel : B, G, R

	Column 0			Column 1			Column ...			Column m		
Row 0	0,0	0,0	0,0	0,1	0,1	0,1	...	...	...	0, m	0, m	0, m
Row 1	1,0	1,0	1,0	1,1	1,1	1,1	...	...	...	1, m	1, m	1, m
Row ...	...,0	...,0	...,0	...,1	...,1	...,1	...	...	...	..., m	..., m	..., m
Row n	n,0	n,0	n,0	n,1	n,1	n,1	n,...	n,...	n,...	n, m	n, m	n, m

```
1  import numpy as np
2  import cv2
3
4  #read
5  image = cv2.imread("image.jpg")
6  #show
7  cv2.imshow("My Image", image)
8
9  #按下按鍵關閉顯示視窗
10 cv2.waitKey(0)
11 cv2.destroyAllWindows()
12
13 #save
14 cv2.imwrite("output.jpg", image)
```

標頭引入

```
import numpy as np  
import cv2
```


讀寫圖片

讀取:

```
img = cv2.imread('image.jpg')
```

儲存:

```
cv2.imwrite('output.jpg', img)
```

顯示圖片

顯示影像:

```
# 顯示圖片  
cv2.imshow('My Image', img)
```

等待按鍵輸入:

```
# 按下任意鍵則關閉所有視窗  
cv2.waitKey(0)  
cv2.destroyAllWindows()
```

開一個指定大小的黑圖 複製圖片

```
blank_image = np.zeros((height,width,3), np.uint8)
```

```
newImage = myImage.copy()
```

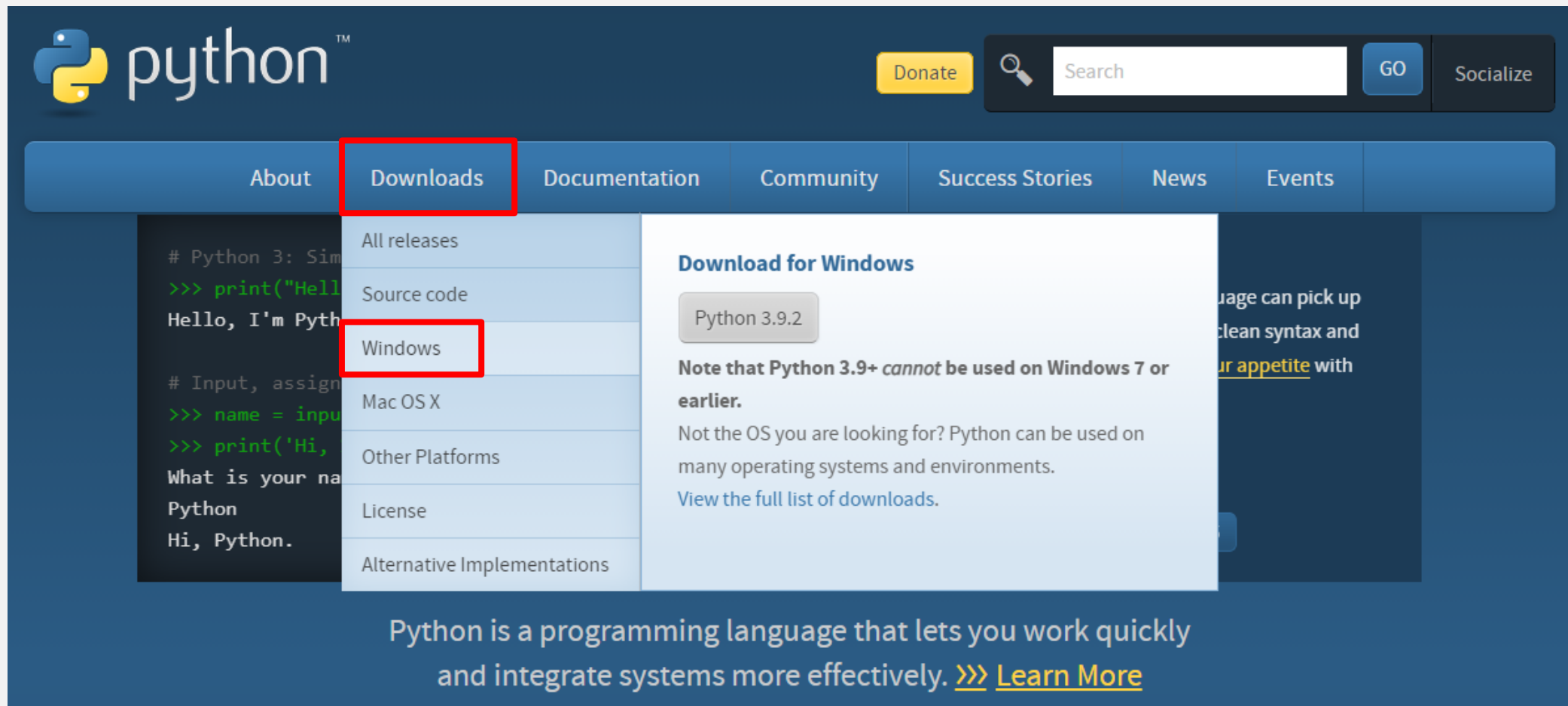
操作像素

`image[row, col, channel]`

WINDOWS10
PYTHON 3 & OPENCV

I. 下載PYTHON

到官網點選Downloads



The screenshot shows the Python.org homepage. The navigation bar at the top includes links for About, Downloads, Documentation, Community, Success Stories, News, and Events. The 'Downloads' link is highlighted with a red box. A dropdown menu is open below it, showing options: All releases, Source code, Windows, Mac OS X, Other Platforms, License, and Alternative Implementations. The 'Windows' option is also highlighted with a red box. To the right of the dropdown, a section titled 'Download for Windows' is visible, featuring a button for 'Python 3.9.2' and a note that Python 3.9+ cannot be used on Windows 7 or earlier. The background of the page features a dark blue header with the Python logo and a search bar, and a footer with the text 'Python is a programming language that lets you work quickly and integrate systems more effectively. >>> [Learn More](#)'.

python™

Donate

Search

GO

Socialize

About Downloads Documentation Community Success Stories News Events

All releases

Source code

Windows

Mac OS X

Other Platforms

License

Alternative Implementations

Download for Windows

Python 3.9.2

Note that Python 3.9+ cannot be used on Windows 7 or earlier.

Not the OS you are looking for? Python can be used on many operating systems and environments.

[View the full list of downloads.](#)

Python is a programming language that lets you work quickly and integrate systems more effectively. >>> [Learn More](#)

I. 下載PYTHON

選擇python 3

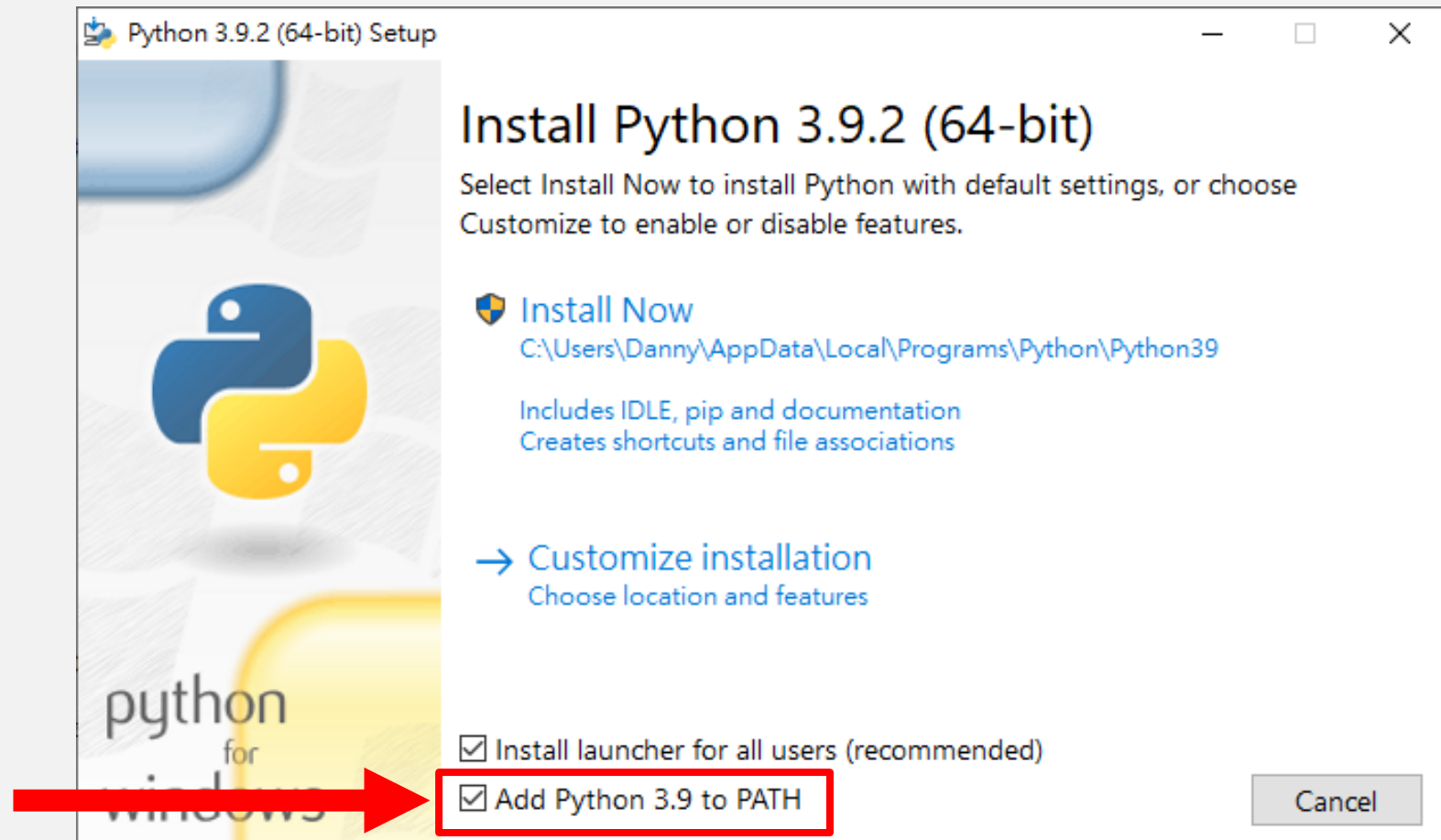
Python Releases for Windows

- 
- [Latest Python 3 Release - Python 3.9.2](#)
 - [Latest Python 2 Release - Python 2.7.18](#)

2. 安裝軟體

- 點選並安裝
- 加入環境變數

 python-3.9.2-amd64.exe



3. 安裝OPENCV

- pip install opencv-python==4.4.0.46
- Test :

```
1  import cv2
2
3  img = cv2.imread('kobe.jpg')
4
5  cv2.imshow('My Image', img)
6  cv2.waitKey(0)
7  cv2.destroyAllWindows()
8  |
```

4. 安裝NUMPY

- `pip install numpy`

```
Collecting numpy  
  Downloading numpy-1.22.2-cp38-cp38-win_amd64.whl (14.7 MB)  
    | ████████████████████████████████████████ 14.7 MB 6.4 MB/s  
Installing collected packages: numpy  
Successfully installed numpy-1.22.2
```

HOMEWORK I

將圖片分成九宮格
對每一格進行指定的操作

原圖

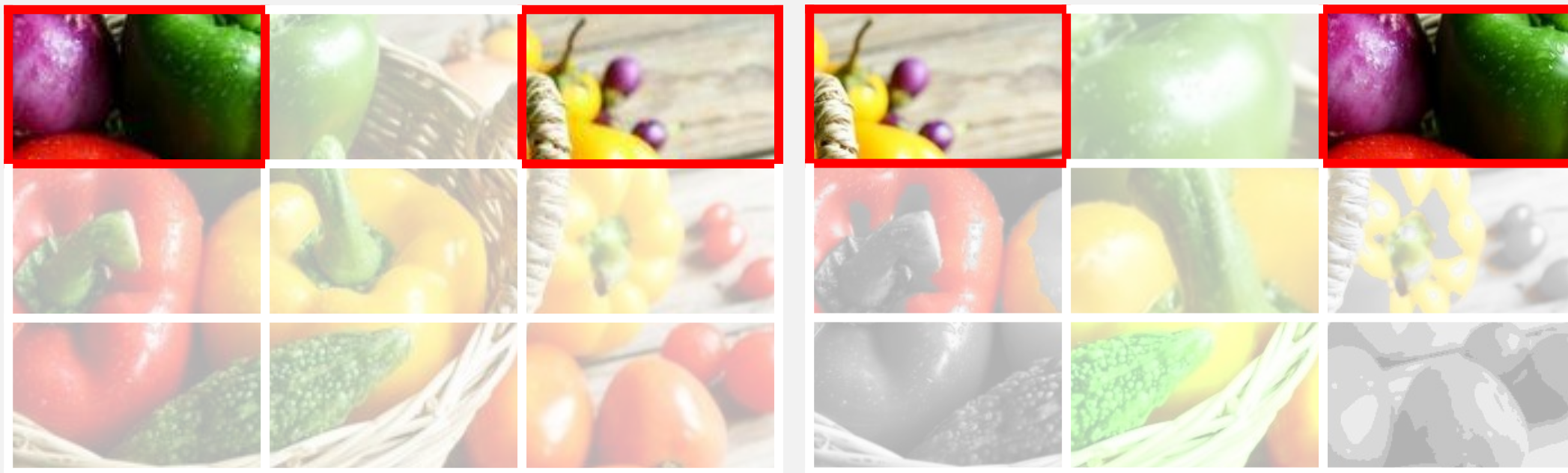


結果示意圖



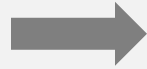
EXCHANGE POSITION

- 交換指定兩格的內容 (20%)



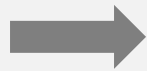
GRAY SCALE

- 將此格轉成灰階影像 (10%)
 - Hint: $(R + G + B) / 3$, 如果影像有3個channel, 則3個channel設一樣的值



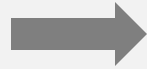
INTENSITY RESOLUTION

- 將此格轉為灰階影像，再把灰階的Intensity resolution降為4 ($256 \rightarrow 4$) (10%)

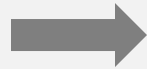


COLOR FILTER

- 紅色濾鏡: 只保留此格圖片的紅色區塊，其餘轉為灰階 (10%)
 - Hint: $R > 150$ and $R * 0.6 > B$ and $R * 0.6 > G$

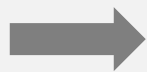


- 黃色濾鏡: 只保留此格圖片的黃色區塊，其餘轉為灰階 (10%)
 - Hint: $(G + R) * 0.3 > B$ and $\text{abs}(G - R) < 50$



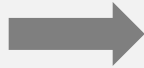
CHANNEL OPERATION

- 將此格的綠色值放大2倍 (10%)



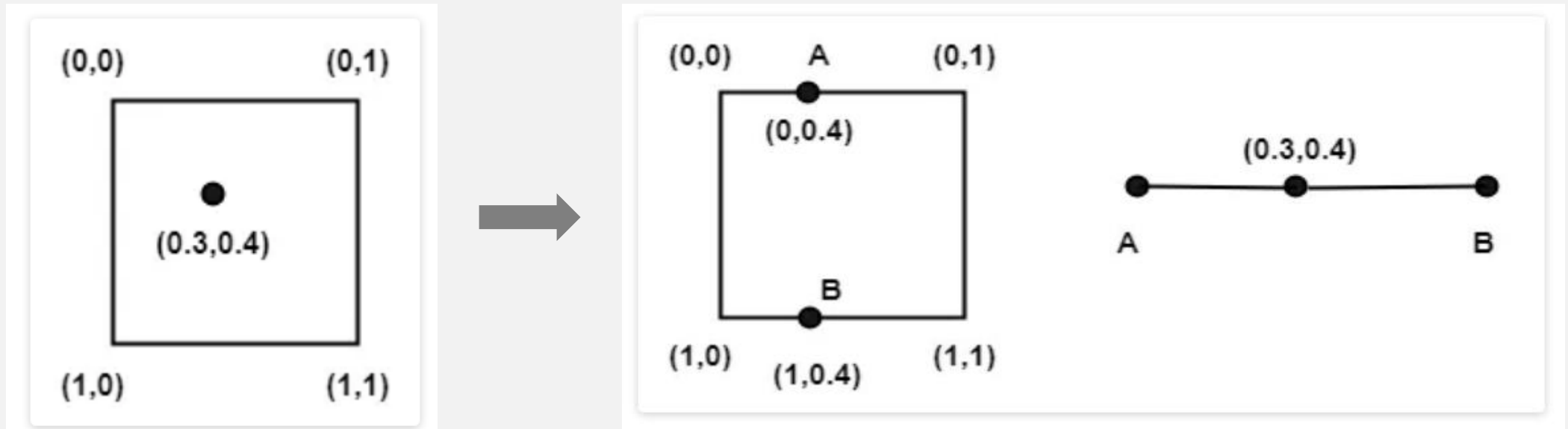
BILINEAR INTERPOLATION

- 將此格用 **Bilinear interpolation** 放大2倍，只需保留放大後左上角和原格子大小相同的部分 (10%)



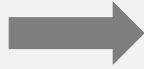
BILINEAR INTERPOLATION

- 根據輸出影像的像素位置，找到輸入影像中最鄰近的四個點，再利用雙線性內插法求出輸出影像的像素強度。



BICUBIC INTERPOLATION

- 將此格用 **Bicubic interpolation** 放大2倍，只需保留放大後左上角和原格子大小相同的部分 (10%)



BICUBIC INTERPOLATION

- 三次樣條插值 (Cubic spline interpolation)
- 如果一個函數 $f(x)$ 在 $x=0$ 和 $x=1$ 的位置上的函數值已知，利用一個三次方的多項式去計算這條曲線在 $[0,1]$ 上的值

$$f(x) = ax^3 + bx^2 + cx + d$$

$$f'(x) = 3ax^2 + 2bx + c$$

$$f(0) = d$$

$$f(1) = a + b + c + d$$

$$f'(0) = c$$

$$f'(1) = 3a + 2b + c$$



$$a = 2f(0) - 2f(1) + f'(0) + f'(1)$$

$$b = -3f(0) + 3f(1) - 2f'(0) - f'(1)$$

$$c = f'(0)$$

$$d = f(0)$$

BICUBIC INTERPOLATION

- 假設我們有四個值，分別 p_0, p_1, p_2, p_3 分別代表 $x=-1, x=0, x=1$ 和 $x=2$ 位置的函數值, 此時並不知道他的導數，因此用這條直線的斜率來近似替代這個位置導數

$$\begin{aligned}f(0) &= p_1 \\f(1) &= p_2 \\f'(0) &= \frac{p_2 - p_0}{2} \\f'(1) &= \frac{p_3 - p_1}{2}\end{aligned}$$

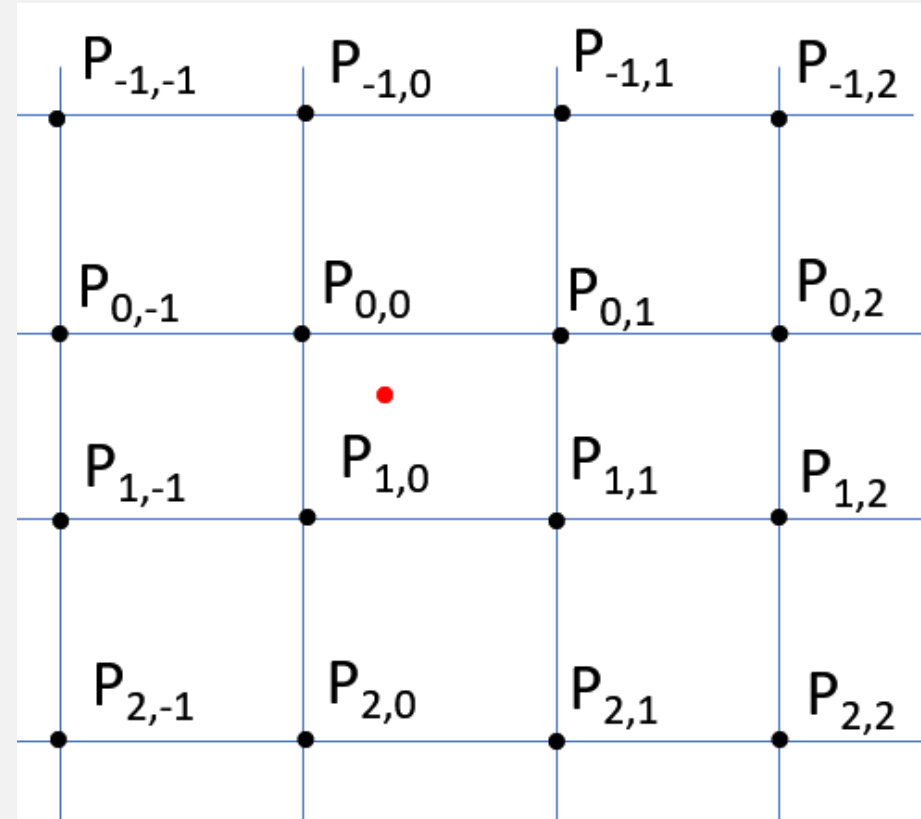


$$\begin{aligned}a &= -\frac{1}{2}p_0 + \frac{3}{2}p_1 - \frac{3}{2}p_2 + \frac{1}{2}p_3 \\b &= p_0 - \frac{5}{2}p_1 + 2p_2 - \frac{1}{2}p_3 \\c &= -\frac{1}{2}p_0 + \frac{1}{2}p_2 \\d &= p_1\end{aligned}$$

$$f(p_0, p_1, p_2, p_3, x) = \left(-\frac{1}{2}p_0 + \frac{3}{2}p_1 - \frac{3}{2}p_2 + \frac{1}{2}p_3\right)x^3 + \left(p_0 - \frac{5}{2}p_1 + 2p_2 - \frac{1}{2}p_3\right)x^2 + \left(-\frac{1}{2}p_0 + \frac{1}{2}p_2\right)x + p_1$$

BICUBIC INTERPOLATION

- 雙三次插值法就是二維的三次樣條插值



GRADING POLICY

- Each grid – 10%
 - Call function: 6%
 - Implement by yourself: 10%
- Report – 10%

SUBMISSION

- Report
 - 包含 Method 、 Result 、 Feedback 三部分
 - 至多3頁
 - Filename: **STUDENT_ID.pdf**
- Code
 - Filename: **STUDENT_ID.zip**
- Deadline: **3/17 Fri. 10:10 a.m.**