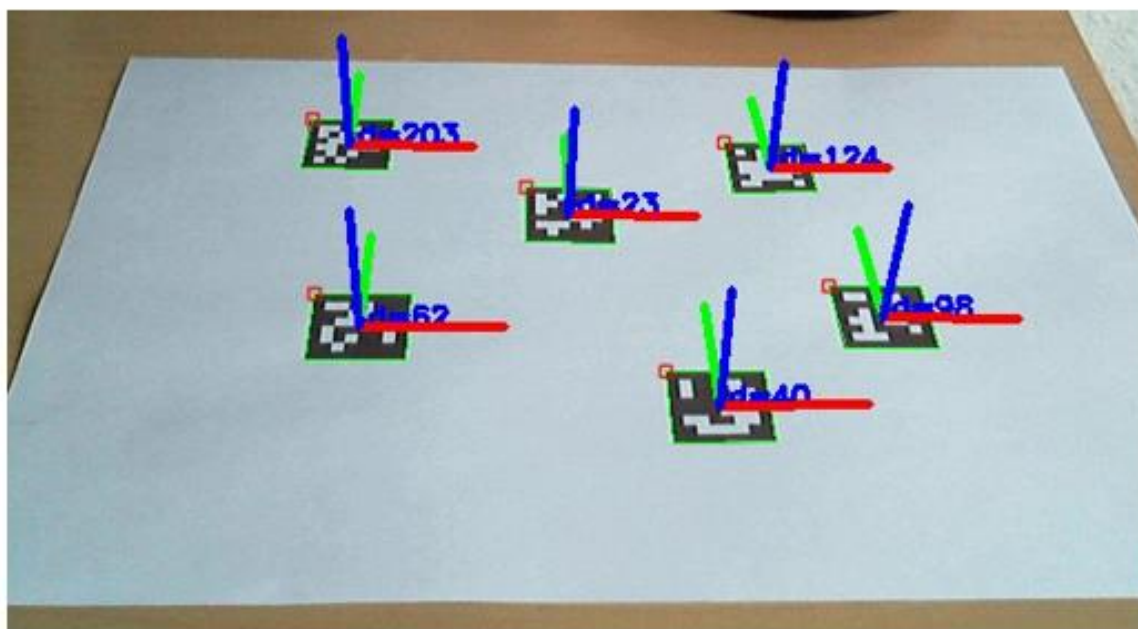
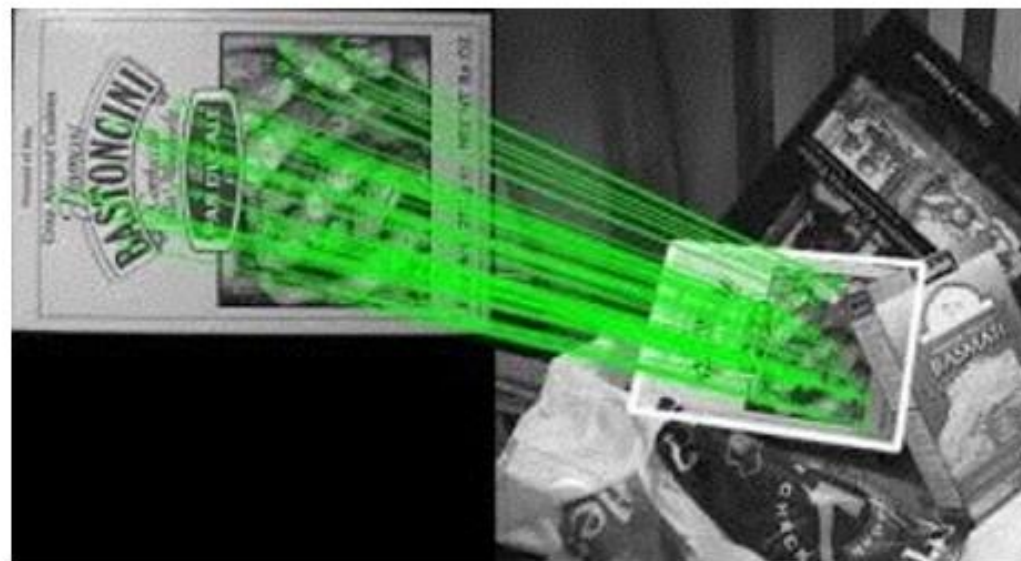


# OPENCV BASICS



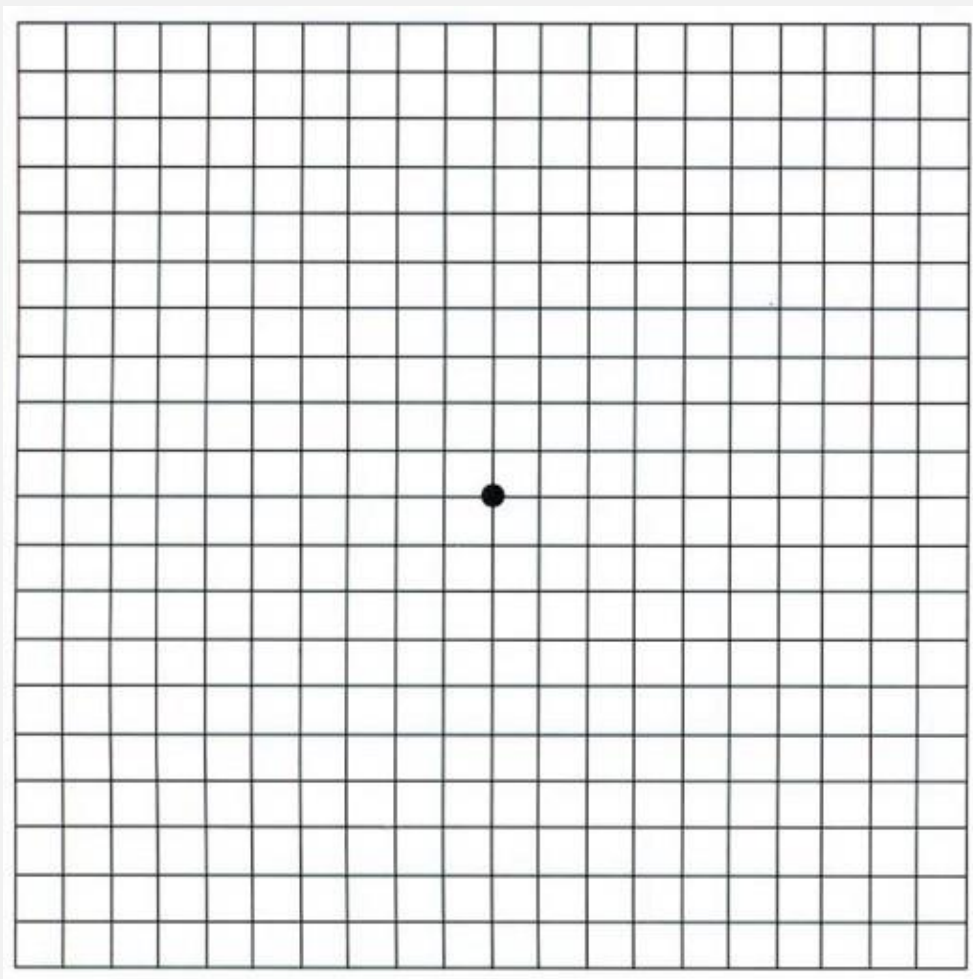
- core. The Core Functionality
- imgproc. Image Processing
- imgcodecs. Image file reading and writing
- videoio. Media I/O
- highgui. High-level GUI and Media I/O
- video. Video Analysis
- calib3d. Camera Calibration and 3D Reconstruction
- features2d. 2D Features Framework
- objdetect. Object Detection
- 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:

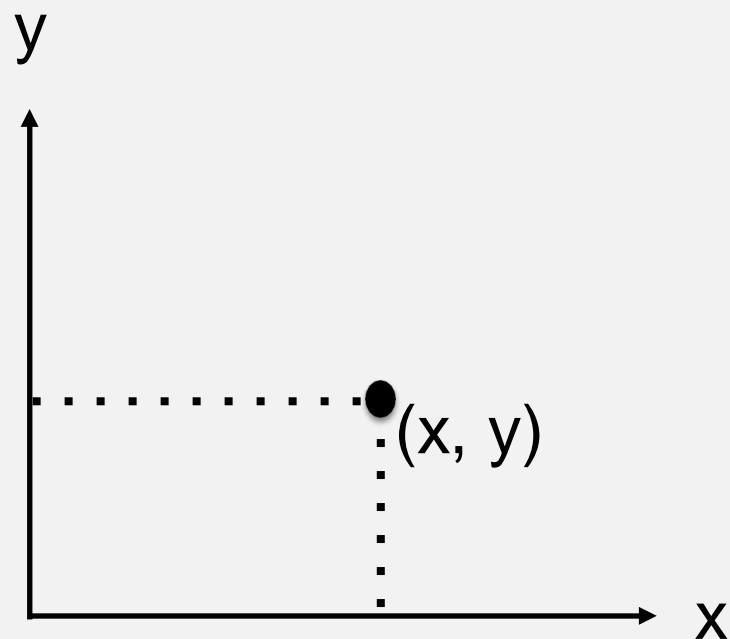


image:

```
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

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

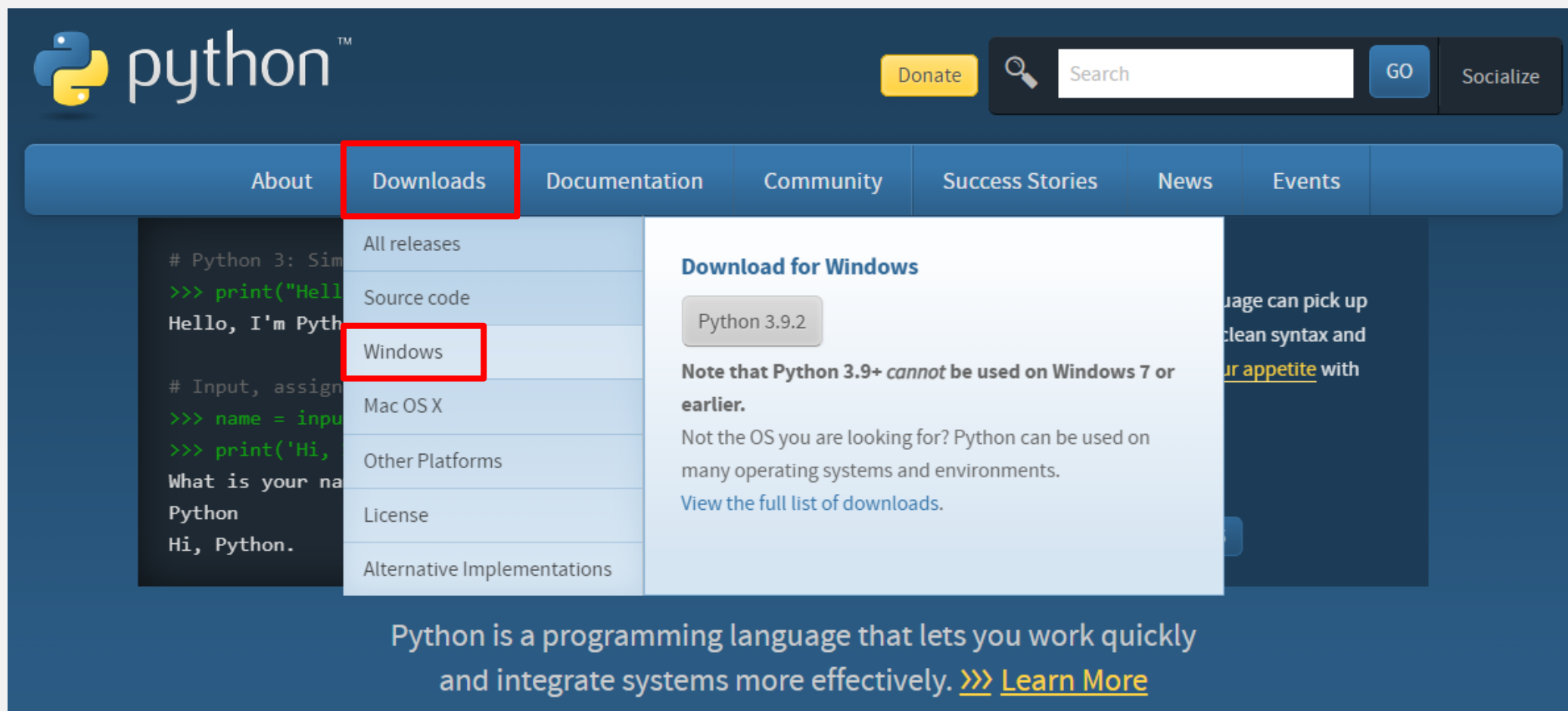
# 操作像素

`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 under 'Downloads', 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™

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Search

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All releases

Source code

Windows

Mac OS X

Other Platforms

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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

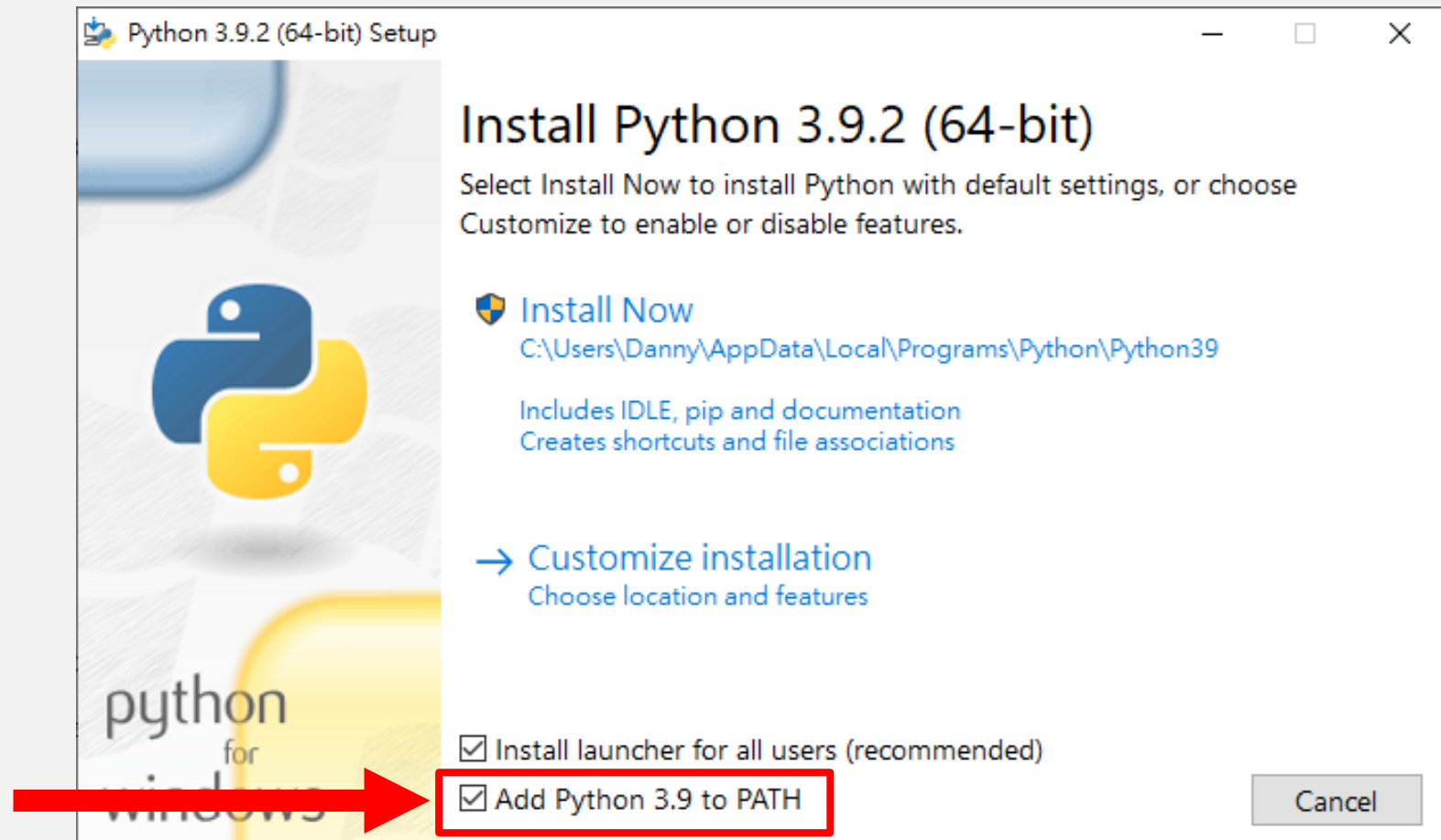
## Python Releases for Windows

- 
- [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

# CONTENT

- 使用不同的插值方法對影像中心順時鐘旋轉30度
- 使用不同的插值方法對影像放大2倍
  - Nearest Neighbor Interpolation
  - Bilinear Interpolation
  - Bicubic Interpolation

原圖

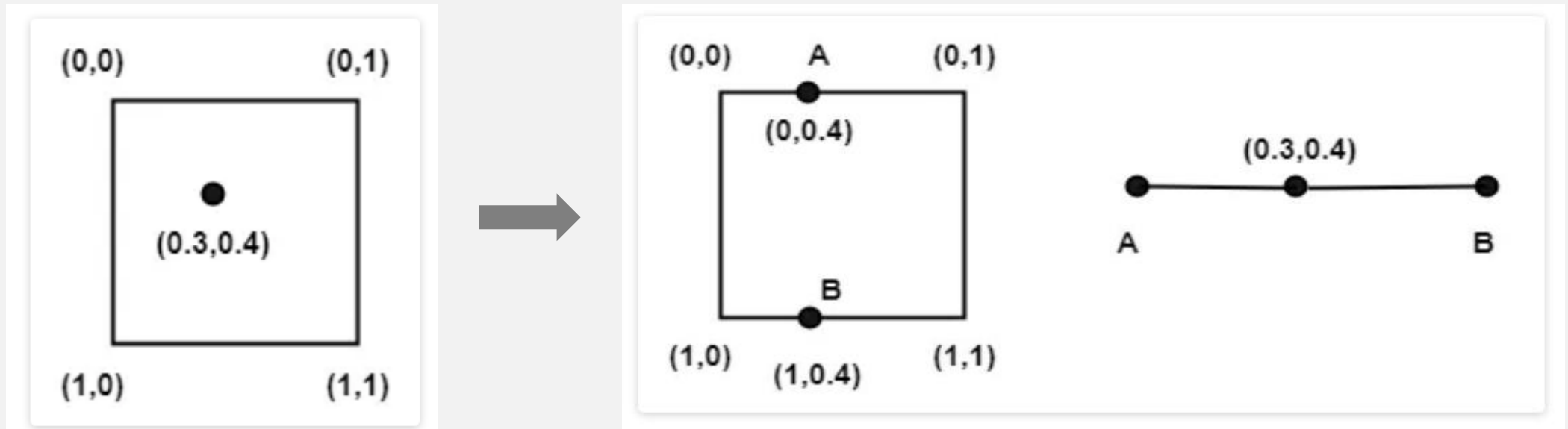


結果示意圖



# 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

- 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

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



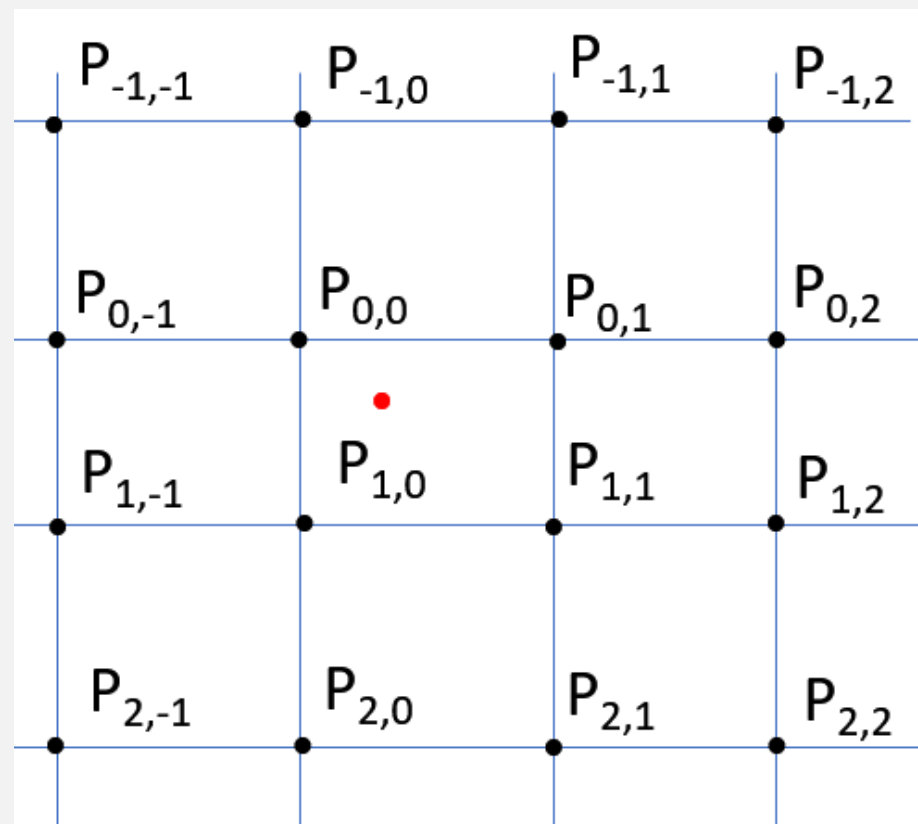
$$\begin{aligned}a &= -\frac{1}{2}p_0 + \frac{3}{2}p_1 - \frac{3}{2}p_2 + \frac{1}{2}p_3 \\b &= p_0 - \frac{5}{2}p_1 + 2p_2 - \frac{1}{2}p_3 \\c &= -\frac{1}{2}p_0 + \frac{1}{2}p_2 \\d &= p_1\end{aligned}$$

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



# BICUBIC INTERPOLATION

- 雙三次插值法就是二維的三次樣條插值
- **Hint:** 記得注意**overflow**的問題
  - `np.clip(img, 0, 255)`
  - `np.array(img, dtype=np.uint8)`



# GRADING POLICY

- Each method – 15%
  - 禁止使用 OpenCV (讀寫照片以外)的函式
- 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: **3/22 Fri. 10:10 a.m.**