**School of Computing**
**National University of Singapore**
**Biometrics Course**
**July 2017**

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# Assignment #2

# Part I

This part is to acquaint you with basic Python Image processing.

1. Open IDLE and change current working directory to your working directory, **e.g.**, *e:/myfolder*.

```
import os
os.chdir("e:/myfolder")
```

2. List the files in the current working directory.

```
os.listdir(".")
```

3. Read an display image with PIL.

- Read image.

  ```
  from PIL import Image
  img = Image.open('lena.png')
  ```

- Display image information.

  ```
  print(img.format, img.size, img.mode)
  ```

- Display image.

  ```
  img.show()
  ```

4. Apply simple image processing function.

```
from PIL import ImageEnhance
enhancer = ImageEnhance.Contrast(img)
enhanced_img = enhancer.enhance(2.0)
enhanced_img.show()
```

5. Save image to a file.

```
enhanced_img.save('out.png')
```

6. Image and array conversion.

```
import numpy as np
img_array = np.asarray(img)
img = Image.fromarray(img_array)
```

## Part II

1. A = [1, 3, 2, 4; 2, 2, 3, 1; 3, 2, 4, 5; 4, 2, 0, 1], B = [1, 2, 3; 2, 1, 3; 4, 1, 3]. Please compute the convolution between A and B by hand. They try to verify your answer by Python code. (Hint: from scipy import signal, use signal.convolve). (2)

2. Study Numpy, Scipy, PIL and Matplotlib libraries. Use lena.png to perform following operations and save the images: (5)

- In the image, rotate a rectangular region by 45 degree counter-clockwise, whose vertices are (100,100), (100,400),(400,100),(400,400).
- Perform histogram equalization on lena.png. Use matplotlib to plot the histogram figure for both original image and processed image.
- Perform Max Filtering, Min Filtering, and Median Filter on lena.png.
- Perform Gaussian Blur with radius equal to 3 and 5.

3. Color space conversion. Use Python OpenCV functions to perform following operations on 'bee.png' and save the images. (3)

- Read the image: cv2.imread()
- Convert the image to HSV color space: cv2.cvtColor()
- Perform histogram equalization on V channel by cv2.equalizeHist().
- Convert the result image to BGR color space.
- Show the image by cv2.imshow() and save the image.

4. Make fun of Color. In this task, you will be instructed to change color for certain object in an image. Learn Python OpenCV and HSV color space, and then understand how to change color for object. (5)

- Read the image
- Convert the image to HSV color space
- In a HSV image, H channel controls palette, S channel controls weight of the palette and V controls the lightness. For two similar colors, their H value should be close. In OpenCV, HSV value range is (179, 255, 255), and HSV value for yellow color is (30,255,255). In order to get the region of the flower region in 'bee.png', we can use mask = cv2.inRange(img, (25,0,0),(35,255,255)). Use cv2.imshow() to show the mask and save the mask image by cv2.imwrite().
- Keep the background region in H channel.
  H_bg = cv2.bitwise_and(H, 255-mask)

- Change the flower color to Magenta, whose H value is 150.
  H_roi = cv2.bitwise_and(H+150-30, mask)
- Combine background and new flower in H channel.
  H = cv2.bitwise_or(H_bg, H_roi)
- Construct a new HSV image from new H image and original SV images.
- Convert new HSV image to BGR image.
- Show the image by cv2.imshow() and save the image.

Use your own photo to try the magic! More BGR and HSV value for different colors can be found `http://www.rapidtables.com/convert/color/rgb-to-hsv.htm`. Note a HSV instance (a,b,c) in the website equals to (a/2, 255*b, 255*c) in OpenCV. For this task, submit both mask and results images for bee.png and **your own images**. You may want to change other colors instead of yellow.

## Submission

Please submit all your code for Part II only. The code for each question should be in a separate file, named Qn.py where n is the question number. Zip all files into a single file and name it as XXX_YYY_assignment2.zip, where XXX is your IVLE account (begin with gstCN) and YYY is your name in English. Upload the zip file to IVLE "Submission for Assignment 2".

**Deadline: 20 July 2:00pm.**