Principles and Applications of Digital Image Processing

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Homework 1

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Part 1: (50%) Histogram of an Image

Design a software program to read the special .64 image file described in our lecture. Translate the .64 text file into a 64x64 image with 32 gray levels and store the data in a 2-dimensional array. Process the image array to obtain the histogram of the image.

Test you program with the following .64 files and plot the histogram of each image.

LISA.64, LINCOLN.64, JET.64, LIBERTY.64.

You may plot the image histogram directly in your software program or plot the histogram with any plotting software such as EXCEL or MATLAB. Designing a function in your program to display the image on the screen is encouraged.

Ans:

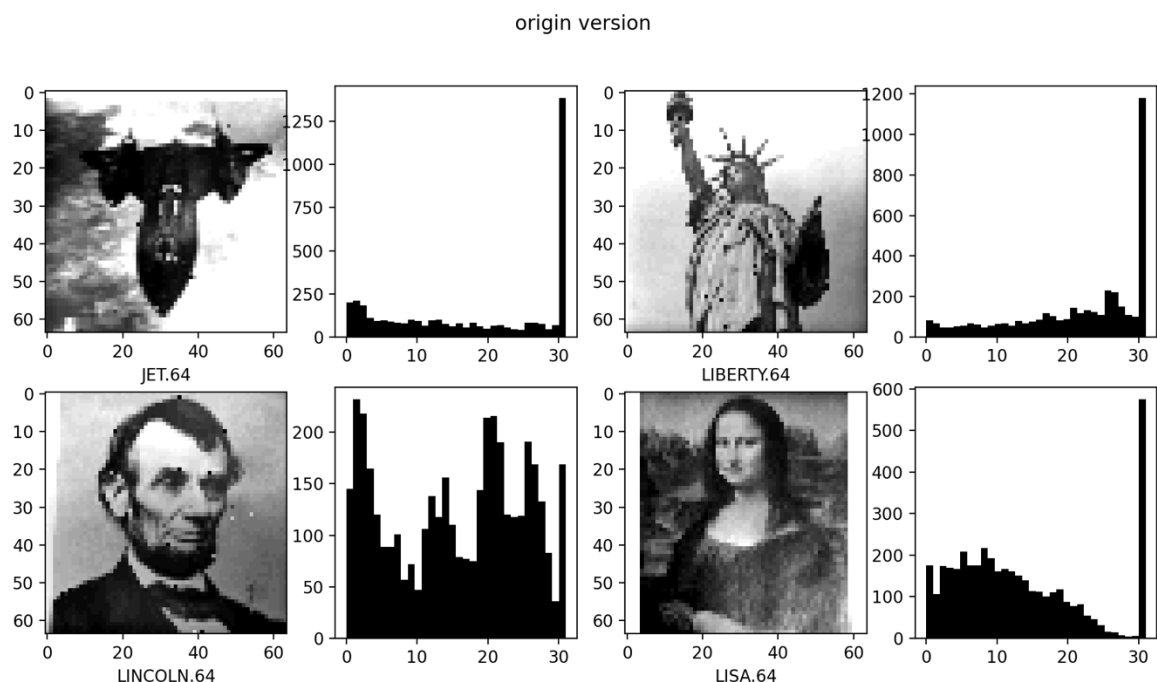本次作業利用 matplotlib 套件將二維矩陣轉換為圖片，呈現出灰階圖片以及該影像 histogram，如圖 1 所示。

圖 1

Part 2: (50%) Arithmetic Operations of an Image Array

Design a software program that will perform the basic tasks of arithmetic operations on an image or two images. Use the .64 image for this program. The assigned image processing operations are as follows:

1. Add or subtract a constant value to each pixel in the image.
   對每張圖片每一個 pixel 的灰階加上常數，加的值越多圖片越亮，常數超過 31 整張圖會變成白色。加上負數會使圖片變暗，常數小於 -31 整張圖會呈現黑色。 圖 2 為每個 pixel 加上 10 之展示，圖 3 為每個 pixel 加上-8 之展示。
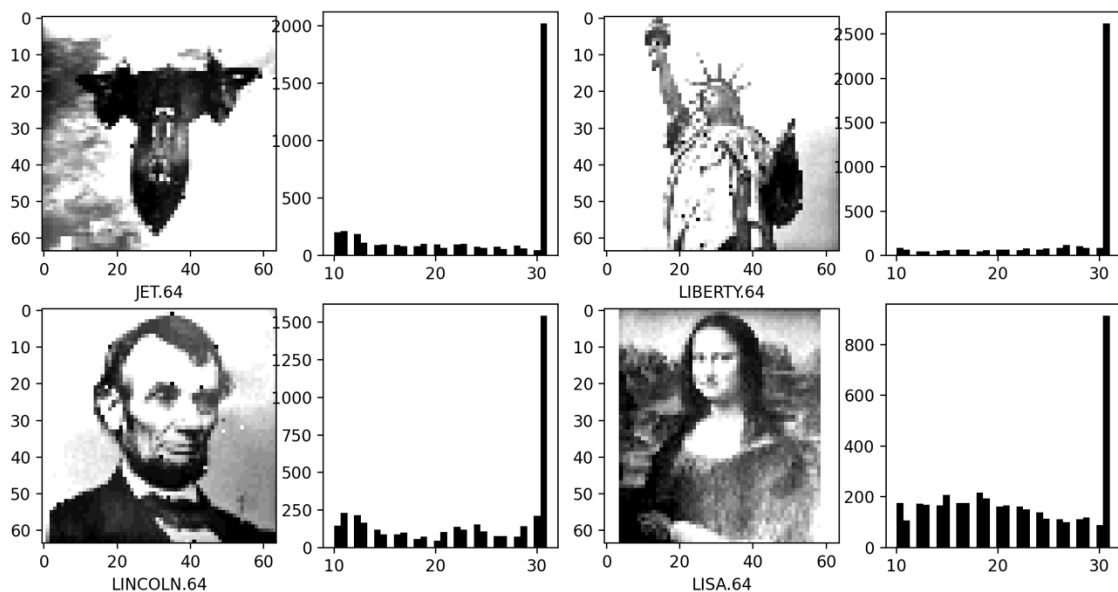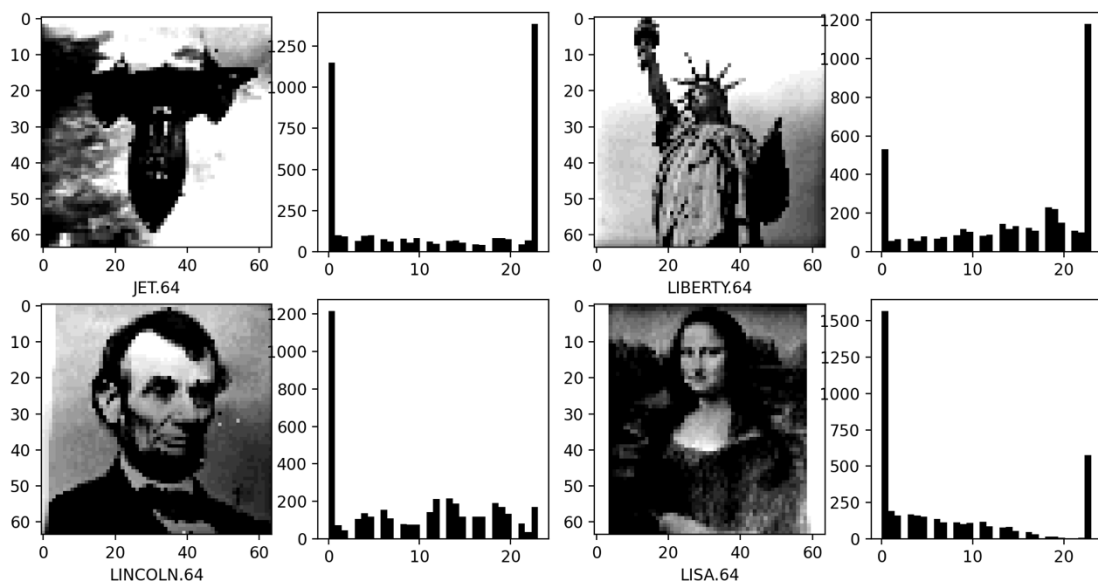

圖 2

圖 3

2. Multiply a constant to each pixel in the image.

對每張圖片每一個 pixel 的灰階乘以值，類似調整對比度。乘的值越多圖片越亮，乘上較大的值會讓圖片只剩下某些原本灰階值為 0 的點仍保留黑色，乘上分數時會讓灰階範圍下降，呈上負值會直接讓整張圖片變為黑色。 圖 4 為每個 pixel 乘上 5 之展示，圖 5 為每個 pixel 乘上-10 之展示，圖 6 為每個 pixel 乘上 1/5 之展示。

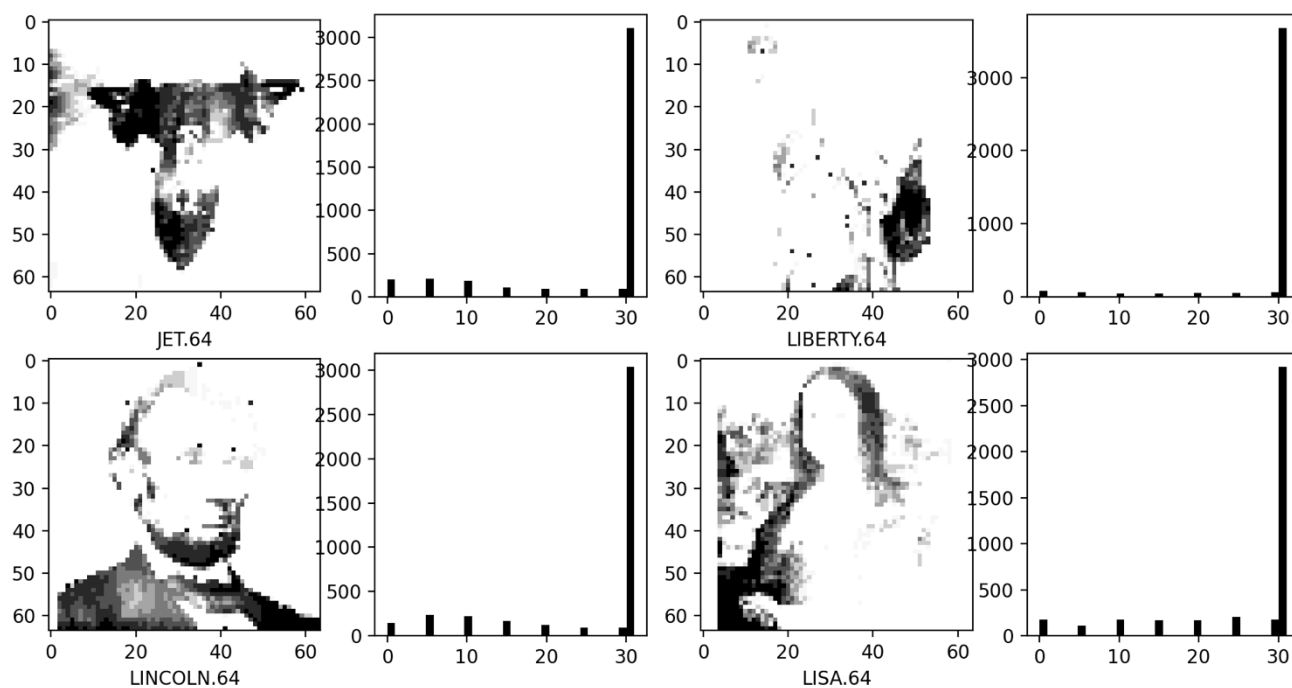multiply five to each pixel version

圖 4

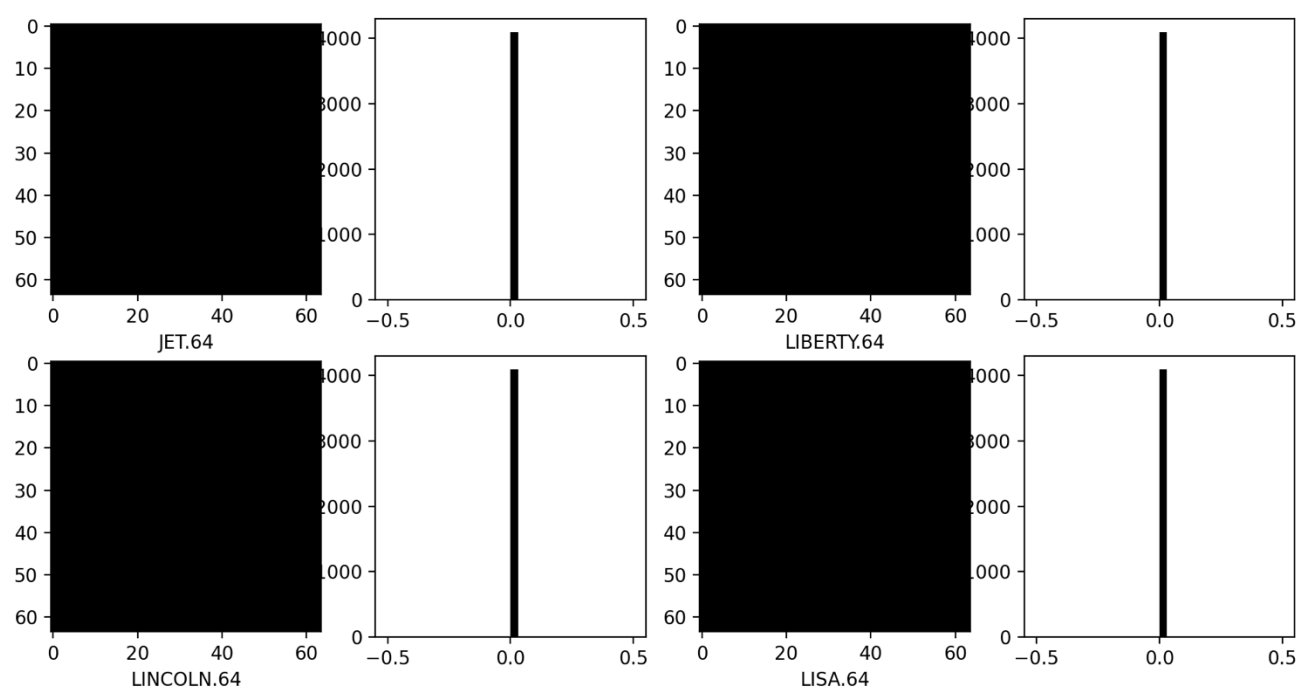multiply -10 to each pixel version

圖 5

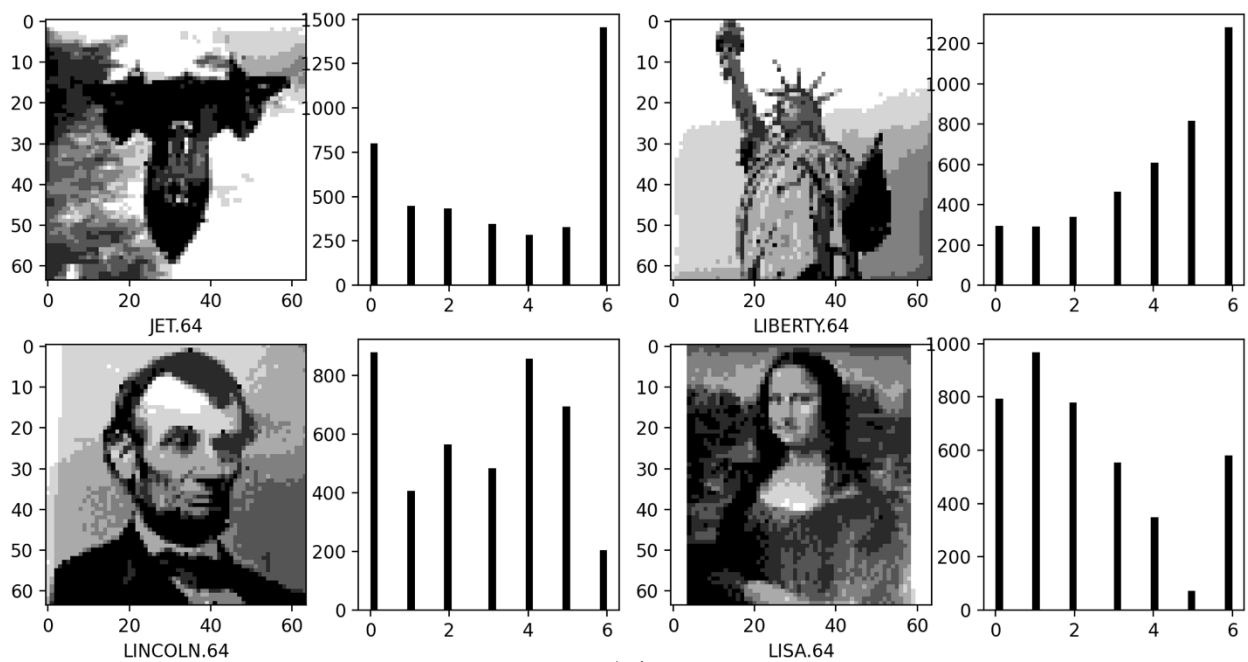multiply one fifth to each pixel version

圖 6

3. Create a new image which is the average image of two input images.

    將 JET 和 LISA 兩圖平均後仍可看出兩圖的輪廓，如圖 7 所示。

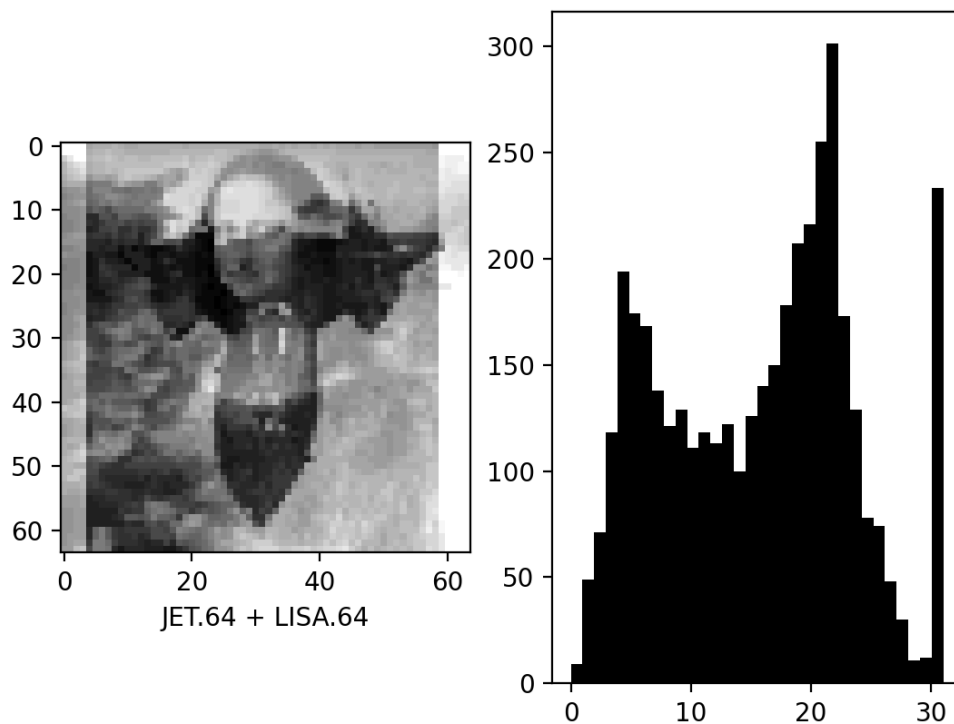average image of two input images version

JET.64 + LISA.64

圖 7

4. Create a new image $g(x,y)$ in which the value of each pixel is determined by calculating the pixel values of the input image $f(x,y)$ using the following equation:

$$g(x,y) = f(x,y) - f(x-1,y)$$

Calculate the histograms of the processed images from the above arithmetic operations and compare them with the histograms of the original image. Briefly discuss your results.

將影像中的每個 pixel 與左方 pixel 相減可以看出所有 pixel 的灰階都降低許多，整張影像變成黑色系的，但還是可以看出影像的輪廓，如圖 8 所示。
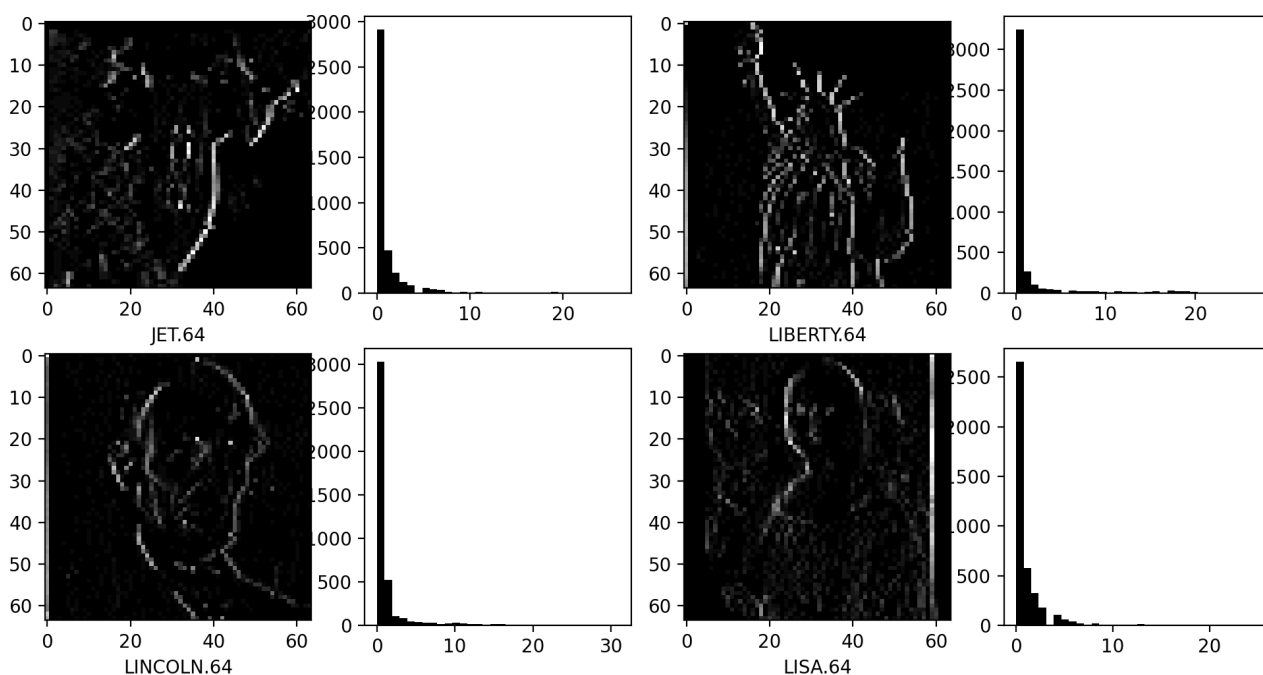
change each pixel by a equation version

圖 8