（一）拍攝三張灰階 8-bit 640*480 圖片

1. 圖片檔案：1-1.png, 1-2.png, 1-3.png
2. 構圖原因：

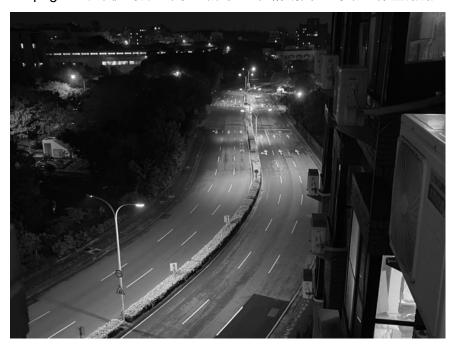   1-1.png：在後疫情的時代，雖然有些人還是習慣戴著口罩，但還是有蠻多人不戴了

   1-2.png：在經歷疫情間禁止內用的時間後，現在越來越多人會在學校餐廳內用了

（一）拍攝三張灰階 8-bit 640*480 圖片

1-3.png：如今深夜時分的寶山路，就跟疫情期間的馬路一樣空蕩蕩

3. 我是使用手機拍攝照片，做裁切後使用 matlab 將原始圖檔轉為灰階 8-bit 640*480 的圖片，轉換的 matlab 程式碼如下：

```matlab
% read images from current folder
classroom = imread('classroom.jpeg');
restaurant = imread('restaurant.jpeg');
road = imread('road.jpeg');

% resize the images into 640*480
classroom_s = imresize(classroom, [480, 640]);
restaurant_s = imresize(restaurant, [480, 640]);
road_s = imresize(road, [480, 640]);

% convert the images to 8-bit gray level images
classroom_gray = im2gray(classroom_s);
restaurant_gray = im2gray(restaurant_s);
road_gray = im2gray(road_s);

% save the gray scale images
imwrite(classroom_gray, '1-1.png');
imwrite(restaurant_gray, '1-2.png');
imwrite(road_gray, '1-3.png');
```

（二）將（一）之各張圖片加入 random noise

1. 使用 matlab 來幫圖片加入 random noise
2. 圖片檔案與對應（一）的原始圖片：
    1-1.png -> 2-1-1.png, 2-1-2.png, 2-1-3.png
    1-2.png -> 2-2-1.png, 2-2-2.png, 2-2-3.png
    1-3.png -> 2-3-1.png, 2-3-2.png, 2-3-3.png
3. 加入雜訊之步驟如下：使用 matlab 中的 imnoise 來幫圖片增加 noise, 並透過改變 gaussian noise 的 variance 來產生不同程度的 noise, 程式碼實作如下：

```matlab
% read images from current folder
classroom = imread('1-1.png');
restaurant = imread('1-2.png');
road = imread('1-3.png');

% add different degree of noise to images
% modify the variance from 0.01 to 0.03
classroom_1 = imnoise(classroom, 'gaussian');
classroom_2 = imnoise(classroom, 'gaussian', 0, 0.02);
classroom_3 = imnoise(classroom, 'gaussian', 0, 0.03);

restaurant_1 = imnoise(restaurant, 'gaussian');
restaurant_2 = imnoise(restaurant, 'gaussian', 0, 0.02);
restaurant_3 = imnoise(restaurant, 'gaussian', 0, 0.03);

road_1 = imnoise(road, 'gaussian');
road_2 = imnoise(road, 'gaussian', 0, 0.02);
road_3 = imnoise(road, 'gaussian', 0, 0.03);

% save the noisy images
imwrite(classroom_1, '2-1-1.png');
imwrite(classroom_2, '2-1-2.png');
imwrite(classroom_3, '2-1-3.png');

imwrite(restaurant_1, '2-2-1.png');
imwrite(restaurant_2, '2-2-2.png');
imwrite(restaurant_3, '2-2-3.png');

imwrite(road_1, '2-3-1.png');
imwrite(road_2, '2-3-2.png');
imwrite(road_3, '2-3-3.png');
```

（三）將（二）之含雜訊圖片消除雜訊

1. 使用 matlab 來消除 random noise
2. 圖片檔案與對應（二）的原始圖片：

   2-1-1.png -> 3-1-1.png, 2-1-2.png -> 3-1-2.png, 2-1-3.png -> 3-1-3.png

   2-2-1.png -> 3-2-1.png, 2-2-2.png -> 3-2-2.png, 2-2-3.png -> 3-2-3.png

   2-3-1.png -> 3-3-1.png, 2-3-2.png -> 3-3-2.png, 2-3-3.png -> 3-3-3.png

3. 消除雜訊的步驟如下：使用 neighborhood size 為 8*8 的 wiener2() 來消除 noise

```matlab
% read images from current folder
classroom_1 = imread('2-1-1.png');
classroom_2 = imread('2-1-2.png');
classroom_3 = imread('2-1-3.png');
restaurant_1 = imread('2-2-1.png');
restaurant_2 = imread('2-2-2.png');
restaurant_3 = imread('2-2-3.png');
road_1 = imread('2-3-1.png');
road_2 = imread('2-3-2.png');
road_3 = imread('2-3-3.png');

% apply wiener2 on a image to remove noise
classroom_1 = wiener2(classroom_1,[8 8]);
classroom_2 = wiener2(classroom_2,[8 8]);
classroom_3 = wiener2(classroom_3,[8 8]);
restaurant_1 = wiener2(restaurant_1,[8 8]);
restaurant_2 = wiener2(restaurant_2,[8 8]);
restaurant_3 = wiener2(restaurant_3,[8 8]);
road_1 = wiener2(road_1,[8 8]);
road_2 = wiener2(road_2,[8 8]);
road_3 = wiener2(road_3,[8 8]);

% save the noise removed images
imwrite(classroom_1, '3-1-1.png');
imwrite(classroom_2, '3-1-2.png');
imwrite(classroom_3, '3-1-3.png');
imwrite(restaurant_1, '3-2-1.png');
imwrite(restaurant_2, '3-2-2.png');
imwrite(restaurant_3, '3-2-3.png');
imwrite(road_1, '3-3-1.png');
imwrite(road_2, '3-3-2.png');
imwrite(road_3, '3-3-3.png');
```

（四）將（一）之圖片進行 **Histogram Equalization**

1. 使用 matlab 對圖片進行 histogram equalization
2. 圖片檔案與對應（一）的原始圖片：

   1-1.png -> 4-1.png

   1-2.png -> 4-2.png

   1-3.png -> 4-3.png

3. Histogram Equalization 實作細節說明：對圖片套用 histeq()

```matlab
% read images from current folder
classroom = imread('1-1.png');
restaurant = imread('1-2.png');
road = imread('1-3.png');

% perform histogram equalization to the images
classroom = histeq(classroom);
restaurant = histeq(restaurant);
road = histeq(road);

% save the images
imwrite(classroom, '4-1.png');
imwrite(restaurant, '4-2.png');
imwrite(road, '4-3.png');
```