我將 HW3主程式放在 HW3.py，我自己寫的 function 寫在 function.py 供主程 式匯入使用。 我在 requirements.txt 裡面寫了環境信息。

**第一題**

1.a

Baboon加入 salt and pepper noise 結果如下。

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| Fig.1 baboon noise 10% | Fig.2 baboon noise 30% | Fig.3 baboon noise 50% | Fig.4 baboon noise 70% | Fig.5 baboon noise 90% |

peppers加入 salt and pepper noise 結果如下。

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| Fig.6 peppers noise 10% | Fig.7 peppers noise 30% | Fig.8 peppers noise 50% | Fig.9 peppers noise 70% | Fig.10 peppers noise 90% |

1.b

mean filtering

在這題中我會先將輸入的圖片近行copy padding ，這麼做的目的在之後輸出圖片會與輸入圖片大小一致以便後續進行PSNR的比較，如果在5\*5的mean filter範圍內都沒有找到非雜訊的像素點我會讓在該點直接填入0 。去雜訊前與去雜訊後的PSNR數值比較表如下。

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PSNR | Before denoising | | | | | After denoising | | | | |
| 10 | 30 | 50 | 70 | 90 | 10 | 30 | 50 | 70 | 90 |
| Baboon | 15.47 | 10.80 | 8.59 | 7.13 | 6.03 | 20.38 | 20.37 | 20.19 | 19.83 | 14.70 |
| Peppers | 15.39 | 10.59 | 8.32 | 6.90 | 5.82 | 23.43 | 23.34 | 23.195 | 22.82 | 15.97 |

1.c

Gaussian filtering

去雜訊前與去雜訊後的PSNR數值比較表如下。

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PSNR | Before denoising | | | | | After denoising | | | | |
| 10 | 30 | 50 | 70 | 90 | 10 | 30 | 50 | 70 | 90 |
| Baboon | 15.49 | 10.78 | 8.59 | 7.10 | 6.02 | 19.97 | 18.51 | 17.16 | 15.87 | 14.66 |
| Peppers | 15.30 | 10.56 | 8.40 | 6.89 | 5.81 | 22.76 | 19.53 | 17.19 | 15.10 | 13.51 |

1.d

Adaptive median filtering

我的 kernel size 從 1\*1開始如果在kernel 範圍內找不到非雜訊的像素點則kernel 向外擴大2 ，直到找到非雜訊像素點或碰到邊界，如果碰到邊界後依然找不到非雜訊像素點我會讓該點像素以0帶入。去雜訊前與去雜訊後的PSNR數值比較表如下。

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PSNR | Before denoising | | | | | After denoising | | | | |
| 10 | 30 | 50 | 70 | 90 | 10 | 30 | 50 | 70 | 90 |
| Baboon | 15.60 | 10.79 | 8.58 | 7.11 | 6.03 | 28.91 | 23.91 | 21.45 | 19.43 | 17.17 |
| Peppers | 15.39 | 10.52 | 8.36 | 6.87 | 5.77 | 39.75 | 33.11 | 29.66 | 25.79 | 21.05 |

**第二題**

2.a

Fig.11是利用我自己寫的sobel程式對pepper.bmp提取邊線  
Fig.12是利用我自己寫的sobel程式對pepper\_0.04.bmp提取邊線

|  |  |
| --- | --- |
|  |  |
| Fig.11 peppers after sobel | Fig.12 peppers\_0.04 after sobel |

2.b

Fig.11是先利用高斯模糊進行去雜訊，再利用我自己寫的sobel程式對pepper.bmp提取邊線，之後使用Laplacian進行邊緣檢測。  
Fig.12是先利用高斯模糊進行去雜訊，再利用我自己寫的sobel程式對pepper\_0.04.bmp提取邊線，之後使用Laplacian進行邊緣檢測。

|  |  |
| --- | --- |
|  |  |
| Fig.13 peppers\_sobel\_b | Fig.14 peppers\_004\_sobel\_b |