DIP WRITTEN ANSWERS

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Questions 3,5,6,7,8 (Ordered)

3) Let $A = \begin{bmatrix} 1 & 3 & 2 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$ $B = \begin{bmatrix} -1 & 0 & -1 \\ +1 & 0 & +1 \\ -1 & 0 & +1 \end{bmatrix}$

Let us apply median filter on A & B and A+B

$T(A) = \begin{bmatrix} 3.5 & 4 \\ 6 & 7 \end{bmatrix}$ $T(B) = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

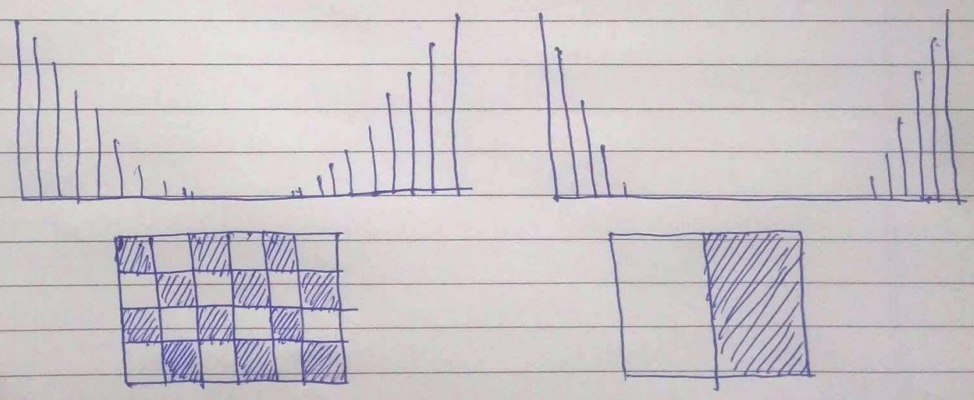
$T(A+B) = \begin{bmatrix} 4 & 4 \\ 5.5 & 7.5 \end{bmatrix}$

So, since $\boxed{T(A) + T(B) \neq T(A+B)}$

Therefore, median filter is not a linear filter, by contradiction.

5) a) The histogram of the blurred images will not be equal.

b)



The main difference is that the checked image will have more intensity values and peaks at 0, 255 will be smaller.

Q6) In the image given the background is black with value 0.

We have to reduce the average intensity of blocks less than $q \times q$ to $1/10^{th}$ of their average intensity value.

Size of smallest mask $= n$

$\bar{Q}$ = avg value of pixels inside the $q \times q$ filter.

$$\Rightarrow \frac{1}{n^2}\left[0 \times (n^2 - q^2) + q^2 \times \bar{Q}\right] \leq \frac{\bar{Q}}{10}$$

which gives,

$$\Rightarrow \boxed{n \geq \sqrt{10}\, q}$$

Now, if the background is of some other colour, say b,

Then $$\frac{1}{n^2}\left[b(n^2 - q^2) + q^2\bar{Q}\right] \leq \frac{\bar{Q}}{10}$$

$$\Rightarrow n^2 \geq q^2\left[\frac{10(\bar{Q} - b)}{(\bar{Q} - 10b)}\right]$$

$$\Rightarrow \boxed{n \geq q\sqrt{\frac{10(\bar{Q} - b)}{(\bar{Q} - 10b)}}}$$

$\overline{f(x,y)}$ = (5×5 Gaussian)

unsharp = $f(x,y) - \overline{f(x,y)}$

where $f(x,y)$ =

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

So, unsharp = $f(x,y) - \overline{f(x,y)}$

$$= \begin{bmatrix} -0.0039 & -0.0156 & -0.02344 & -0.0156 & -0.0039 \\ -0.0156 & -0.0625 & -0.0937 & -0.0625 & -0.0156 \\ -0.02344 & -0.0937 & +0.8598 & -0.0937 & -0.02344 \\ -0.01513 & -0.0625 & -0.0937 & -0.0625 & -0.01513 \\ -0.0039 & -0.0156 & -0.0234 & -0.0156 & -0.0039 \end{bmatrix}$$

Now, to get the final result after unsharping,

$$= \boxed{f(x,y) + \text{unsharp}}$$

only the center value will change in the result, i.e., 1.8598

Laplacian of $f(x) = f(x+1) + f(x-1) - 2f(x)$

(where $f(x)$ is the image)

$\Rightarrow f(x) - (f(x+1) + f(x-1) - 2f(x))$

$\Rightarrow 3f(x) - (f(x+1) + f(x-1))$

$\Rightarrow 4f(x) - (f(x+1) + f(x-1) + f(x))$

$\Rightarrow 3\left(\frac{4}{3}f(x) - \frac{1}{3}(f(x+1) + f(x-1) + f(x))\right)$

→ Lowpass will kernel of size 3.

$\Rightarrow 3\left(\frac{4}{3}f(x) - \text{lowpass}(f(x))\right)$

$\Rightarrow 3\left[Af(x) - \text{lowpass}(f(x))\right]$ (where $A = 4/3$)

∴ Unmask sharpening for $A = 4/3$