

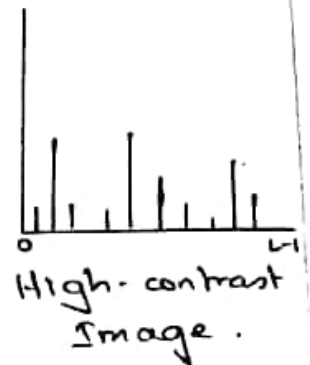
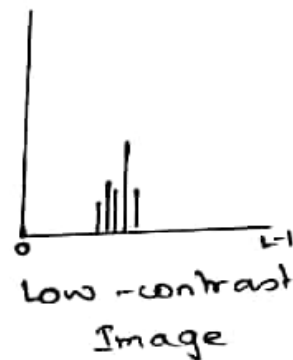
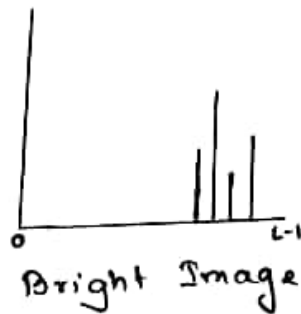
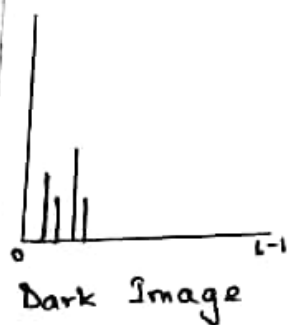
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Subject: Image Processing (CS703D)

- 1a) An image histogram is a graph of pixel intensity (on the x-axis) versus number of pixels (on the y-axis). The x-axis has all the available gray levels, and the y-axis indicates the number of pixels that have a particular gray level value in the image. A darker image will have most of the frequency values in the first half of the histogram. A brighter image will have most of the frequency values in the second half (brighter range) of the histogram. In a low contrast image the range of ~~cont~~ histogram values will be small. In a high contrast image there will be a huge spread in histogram values.

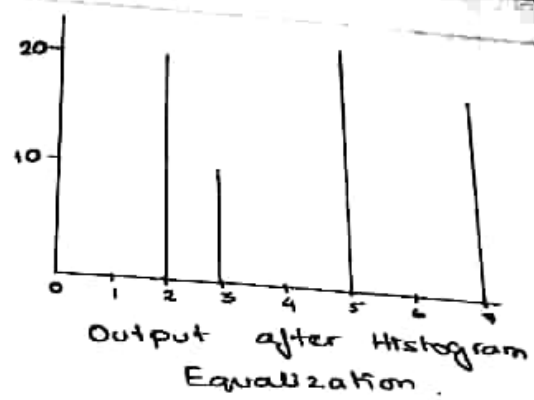
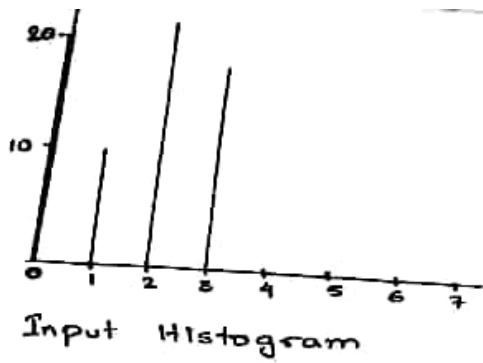


1b)

Gray Level	No. of pixels	Cumulative Frequency	Cumulative Frequency $\times \frac{L-1}{MN}$	g_k
0	20	20	2	2
1	10	30	3	3
2	22	52	5.2	5
3	18	70	7	7
4	0	70	7	7
5	0	70	7	7
6	0	70	7	7
7	0	70	7	7

where, $L-1$ (Max. intensity level) = 7

MN (Total no. of pixels) = 70



2a) A mean filter is used to smoothen an image and reduce gaussian noise by reducing the variation in pixel value from one pixel to the next. The larger the size of the kernel or window, the more pronounced the effect of smoothing is, so it is possible to use a single larger windowed filter instead of smaller ones.

2b) The values of the shaded pixels after applying median filter is as follows:

pixel^{with} intensity 130 \rightarrow median(10, 20, 30, 35, 130, 30, 20, 20, 30)
 \rightarrow median(10, 20, 20, 20, 30, 30, 30, 35, 130)
 \rightarrow 30 (New value)

pixel with intensity 30 \rightarrow median(20, 30, 25, 30, 30, 170, 20, 30, 30)
 \rightarrow median(20, 20, 25, 30, 30, 30, 30, 30, 170)
 \rightarrow 30 (New value)

pixel with intensity 170 \rightarrow median(30, 25, 30, 30, 170, 25, 30, 30, 25)
 \rightarrow median(25, 25, 25, 30, 30, 30, 30, 30, 170)
 \rightarrow 30 (New value)

pixel with intensity 25 \rightarrow median(25, 30, 20, 30, 25, 20, 30, 25, 25)
 \rightarrow median(20, 20, 25, 25, 25, 25, 30, 30, 30)
 \rightarrow 25 (New value)

3a) The values of the shaded pixels after applying sobel operator are as follows:

$$\begin{aligned} \text{pixel with intensity } 130 &\rightarrow |-10 - 40 - 30 + 20 + 40 + 30| \\ &\quad + |-10 - 70 - 20 + 30 + 60 + 30| \\ &\rightarrow |10| + |20| \\ &\rightarrow \underline{30} \text{ (New value)} \end{aligned}$$

$$\begin{aligned} \text{pixel with intensity } 30 &\rightarrow |-20 - 60 - 25 + 20 + 60 + 30| \\ &\quad + |-20 - 60 - 20 + 25 + 340 + 30| \\ &\rightarrow |5| + |295| \\ &\rightarrow 300 \\ &\rightarrow \underline{255} \text{ (New value) (After clipping)} \end{aligned}$$

$$\begin{aligned} \text{pixel with intensity } 170 &\rightarrow |-30 - 50 - 30 + 30 + 60 + 25| \\ &\quad + |-30 - 50 - 30 + 30 + 50 + 25| \\ &\rightarrow |5| + |465| \\ &\rightarrow 470 \\ &\rightarrow \underline{255} \text{ (New value)} \end{aligned}$$

$$\begin{aligned} \text{pixel with intensity } 25 &\rightarrow |-25 - 60 - 20 + 30 + 50 + 25| \\ &\quad + |-25 - 50 - 30 + 20 + 40 + 25| \\ &\rightarrow |0| + |480| \\ &\rightarrow 480 \\ &\rightarrow \underline{255} \text{ (New value)} \end{aligned}$$

3b) The values of the shaded pixels after applying unsharp masking are as follows:

$$\begin{aligned} \text{pixel with intensity } 130 &\rightarrow 2 * f(x,y) - \bar{f}(x,y) = 2 * 130 - 36 \\ &\rightarrow \underline{224} \text{ (New value)} \end{aligned}$$

$$\begin{aligned} \text{pixel with intensity } 30 &\rightarrow 2 * f(x,y) - \bar{f}(x,y) = 2 * 30 - 64 \\ &\rightarrow -4 \rightarrow \underline{0} \text{ (New value)} \end{aligned}$$

$$\begin{aligned} \text{pixel with intensity } 170 &\rightarrow 2 * f(x,y) - \bar{f}(x,y) = 2 * 170 - 41 \\ &\rightarrow 299 \rightarrow \underline{255} \text{ (New value)} \end{aligned}$$

$$\begin{aligned} \text{pixel with intensity } 25 &\rightarrow 2 * f(x,y) - \bar{f}(x,y) = 2 * 25 - 57 \\ &\rightarrow (-1) \rightarrow \underline{0} \text{ (New value)} \end{aligned}$$