

Meet Dodiya

T.E-I.T-07

DOB: 4/3/24

ODP: 27/2/24 MOD: 2 Image Enhancement

IP.

Assignment No: 02

Q1. Apply averaging filter on the given image. Use pixel replication for padding.

4	8	9
12	15	18
30	32	46

⇒ Step 1: pixel replication

4	4	8	9	9
4	4	8	9	9
12	12	15	18	18
30	30	32	46	46
30	30	32	46	46

Step 2: Applying averaging filter.

$$\text{Avg value of pixel 4} = \frac{1}{9} [4+4+8+4+4+8+12+12+15] = 7.8 \approx 8$$

$$\text{Avg value of pixel 8} = \frac{1}{9} [4+8+9+4+8+9+12+15+18] = 9.6 \approx 10$$

$$\text{Avg value of pixel 9} = \frac{1}{9} [8+9+9+8+9+9+15+18+18] = 11.4 \approx 11$$

$$\text{Avg value of pixel 12} = \frac{1}{9} [4+4+8+12+12+15+30+30+32] = 16.3 \approx 16$$

$$\text{Avg value of pixel 15} = \frac{1}{9} [4+8+9+12+15+18+30+32+46] = 19.3 \approx 19$$

$$\text{Avg value of pixel 18} = \frac{1}{9} [8+9+9+15+18+18+32+46+46] = 22.3 \approx 22$$

$$\text{Avg value of pixel 30} = \frac{1}{9} [12+12+15+30+30+32+30+30+32] = 24.7 \approx 25$$

avg value of pixel 32 =  $\frac{1}{9} [12 + 15 + 18 + 30 + 32 + 46 + 30 + 32 + 46] = 29$

avg value of pixel 46 =  $\frac{1}{9} [15 + 18 + 18 + 32 + 46 + 46 + 32 + 46 + 46]$   
 $= 33.2 \approx 33$

Step 3: Image Generated after averaging filter

4	8	9		8	10	11
12	15	18	$\Rightarrow$	16	19	22
30	32	46		25	29	33

Q2. Compute the median value of the marked pixel in the given image in  $3 \times 3$  and rewrite the image.

$\Rightarrow$

2	4	6
10	<u>25</u>	14
1	3	5

Median of  $[1, 2, 3, 4, \underline{5}, 6, 10, 14, 25] = 5$

2	4	6
10	5	14
1	3	5

Q3. What is the effect on output image if the histogram equalization is applied  $t$  times?

$\Rightarrow$  1) When histogram equalization is applied  $t$  multiple times or  $t$  times, the effect depends on the initial histogram and the characteristics of the image.

2) Initial Iterations: The effect is prominent as the histogram tends to spread out the intensities more evenly. It increases in the contrast of the image.

3) Subsequent Iterations: As histogram equalization is applied repeatedly, the effect diminishes. Further iterations may lead to over-enhancement, causing artifacts or unnatural-looking images.

4) Convergence: After certain number of iterations, the histogram may converge to a stable state. Where further iterations produce little to no noticeable change in the image.

Q4. Identify the noise in the given image and remove it by filtering.

=>

25	15	20	21
19	155	25	26
20	23	24	0

1) The pixel with the value 155 stands out larger than its neighbours and it represents noise outlier.

2) We will remove 155 by using median filter method.  
for 155 median is [20, 15, 19, 20, 20, 23, 24, 25, 25, 155]  
median is 23

3) Therefore, we replaced 155 with 23

25	15	20	21
19	23	25	26
20	23	24	0



Q5. Apply histogram equalization to following image.

4	4	4	4	4
4	2	5	4	3
3	5	5	5	3
3	4	5	4	3
4	4	4	4	4

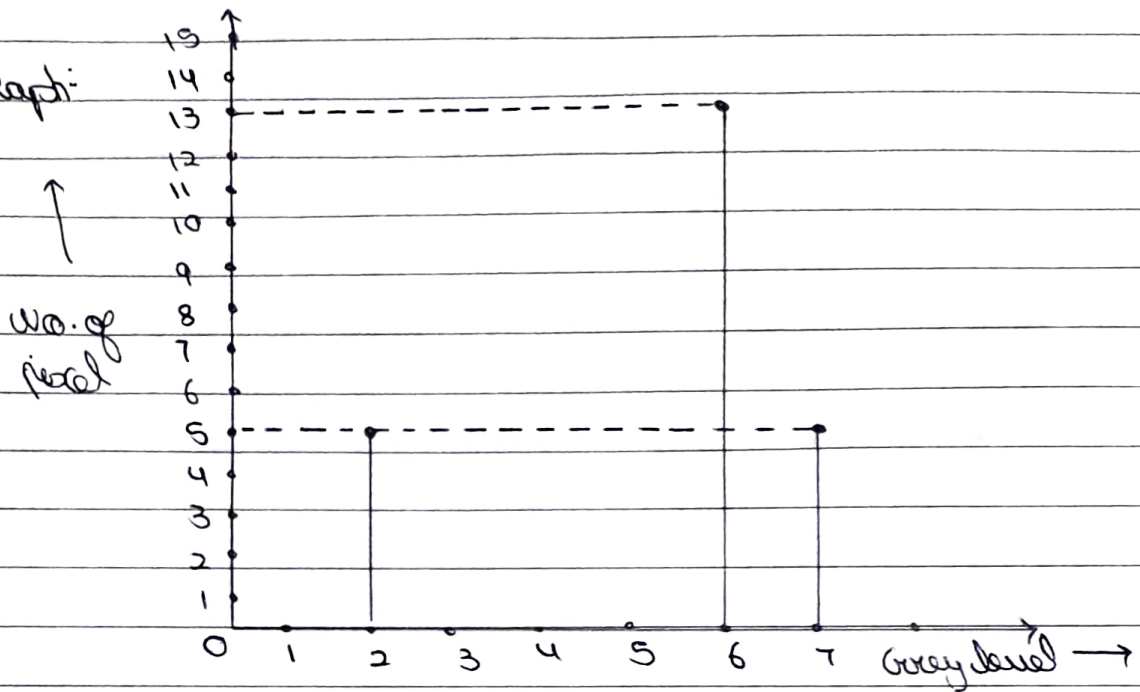
1) max pixel value of image is 5  
 So, number of grey level is  $2^k = 2^3 = 8$  levels.

2) Grey level	0	1	2	3	4	5	6	7
No. of pixel	0	0	1	5	14	5	0	0

Grey level	0	1	2	3	4	5	6	7
Running Sum	0	0	1	6	20	25	25	25
Running Sum	0	0	1	6	20	25	25	25
Total no. of pixel	25	25	25	25	25	25	25	25
Max Grey level	0	0	1	2	4	5	5	5
Running Sum	0	0	1	3	7	12	17	22
Total no. of pixel	25	25	25	25	25	25	25	25

3) mapping:	Grey level	histogram value
	0	0
	1	0
	2	0
	3	2
	4	6
	5	7
	6	7
	7	7

4) Graph:



5) Result:

4	4	4	4	4		6	6	6	6	6
4	2	5	4	3		6	0	7	6	2
8	5	5	5	3	⇒	2	7	7	7	2
3	4	5	4	3		2	6	7	6	2
4	4	4	4	4		6	6	6	6	6

Q6. perform following operations on the image X,

X =

19	0	20	21
20	150	25	26
22	23	24	27

⇒ i) Image negative: 255 - pixel

255-19	255-0	255-20	255-21	236	255	235	234
255-20	255-150	255-25	255-26	235	105	230	229
255-22	255-23	255-24	255-27	233	232	231	228

ii) Bit plane slicing:

convert each pixel value to its binary form.

19	0	20	21
20	150	25	26
22	23	24	27

In binary:

00010011	00000000	00010100	00010101
00010100	10010110	00011001	00011010
00010110	00010111	00011000	00011011

Most significant bit

middle

Least significant bit

0	0	0	0
0	1	0	0
0	0	0	0

0	0	0	0
0	0	0	0
0	0	0	0

1	0	0	0
0	1	0	1
1	1	0	1

1	0	0	1
0	0	1	0
0	1	0	1

iii) Histogram plot:

occurences: 0 → 1

19 → 1

20 → 2

21 → 1

22 → 1

23 → 1

24 → 1

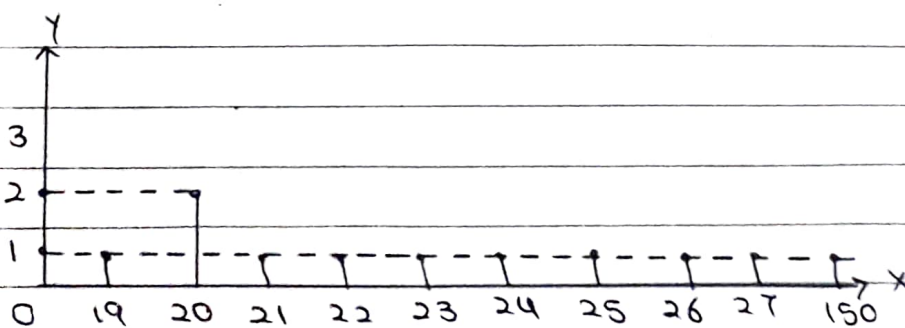
25 → 1

26 → 1

27 → 1

150 → 1

Number of  
occurences



intensity values

iv) Compute the number of bits required to store the image

The maximum value of in matrix is 150, which means it require atleast 8 bits to represent.

Total pixel is 12 — (3 × 4 matrix)

$$\begin{aligned}\therefore \text{Total bits} &= \text{Number of pixels} \times \text{Bits per pixel} \\ &= 12 \times 8 \\ &= 96\end{aligned}$$

So, the image requires 96 bits to store.