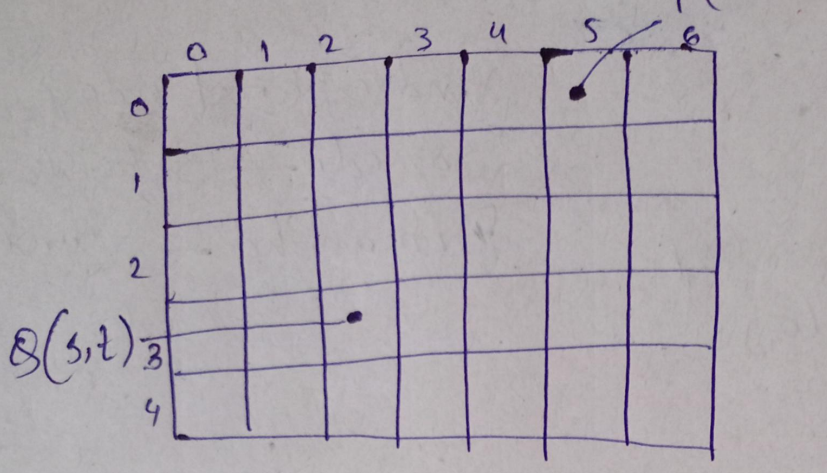
15/1/2025



$$D_e(P,Q) = \sqrt{(x-s)^2 + (y-t)^2}$$

$$= \sqrt{(0-3)^2 + (5-2)^2}$$

$$= \sqrt{9+9} = \sqrt{18} = 3\sqrt{2} \text{ unit}$$ (Ans)

This is euclidian distance.

// D_4 distance

$$D_4(P,Q) = |x-s| + |y-t|$$

$$= |0-3| + |5-2|$$

$$= 3+3 = 6 \text{ unit}$$ (Ans)

// Chessboard distance

$$D_8(P,Q) = \max(|x-s|, |y-t|)$$

$$= \max(3, 3) = 3 \text{ unit}$$ (Ans)

Histogram Specification / or Histogram mapping

10 marks

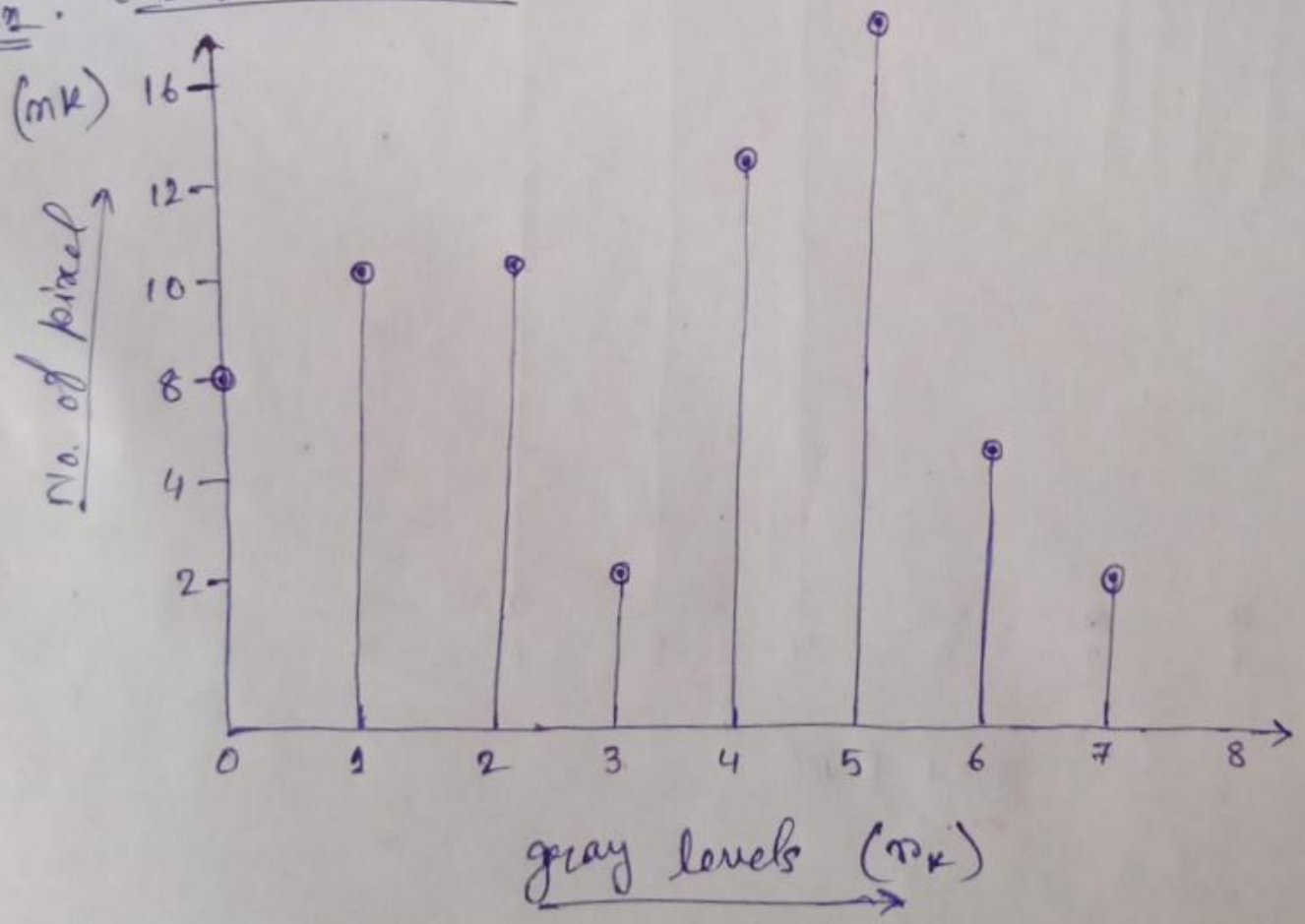
Original Image

gray level	0	1	2	3	4	5	6	7
No of pixel	8	10	10	2	12	16	4	2

Desired Image / Target Image

gray level	0	1	2	3	4	5	6	7
No of pixel	0	0	0	0	20	20	16	8

Sol: Original Image:

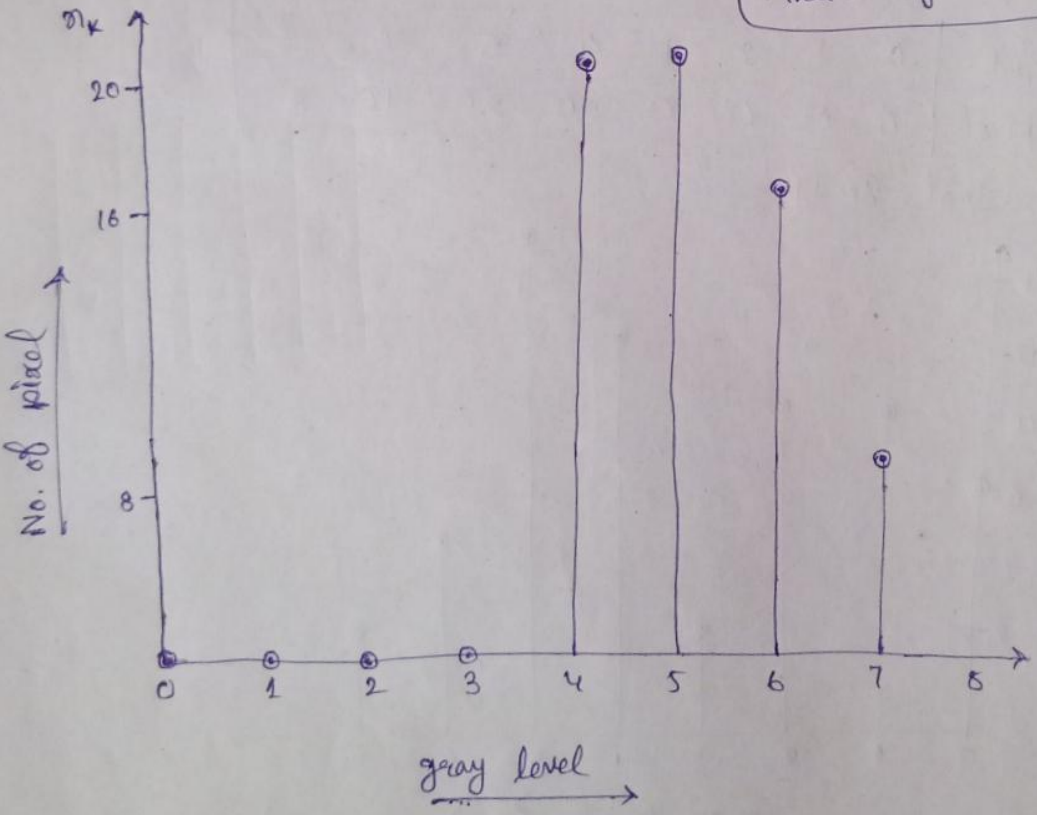


Histogram of original image

gray levels r_k	No. of pixels n_k	$P(r_k) = n_k/n$ (PDF)	S_k CDF	$S_k \times 7$	Histogram equilized level
0	8	0.125	0.125	0.875	1
1	10	0.156	0.281	1.967	2
2	10	0.156	0.437	3.059	3
3	2	0.031	0.468	3.276	3
4	12	0.188	0.656	4.592	5
5	16	0.25	0.906	6.342	6
6	4	0.063	0.969	6.783	7
7	2	0.031	1	7	7
	$n = 64$				

Why $S_k \times 7$? → Here we are assuming 8 bits (0-7) 7 is 3 bits digits. $7 \rightarrow 111$. So, $2^3 = 8$. Let, $8 = L$. But in formula we have to use $(L-1)$. That's why it is $S_k \times (L-1)$

Desired Image



Histogram of desired image —

gray levels r_k	No. of pixels n_k	$P(r_k) = n_k/n$ (PDF)	S_k CDF	$S_k \times 7$	Histogram equilized level
0	0	0	0	0	0
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	20	0.313	0.313	2.191	2
5	20	0.313	0.626	4.403	4
6	16	0.25	0.876	6.132	6
7	8	0.125	1.001	7.007	7
	$n = 64$				

Mapping

Gray level	H(O)	H(D)	Mapping
0	2	0	4 ✓
1	2	0	4 ✓
2	3	0	5 ✓
3	3	0	5 ✓
4	5	2	6 ✓
5	6	4	6 ✓
6	7	6	7 ✓
7	7	7	7 ✓

Modified Image:

Gray level	0	1	2	3	4	5	6	7
No. of pixels	0	0	0	0	18	12	28	6

gray level slicing

① With Background

$a \leq r \leq b$

where $a = 3$, $b > 6$ (given)

Ex. 1

pixel

f(x,y)	0	1	2	3	4
0	·	·	·	·	·
1	·	·	·	253	·
2	·	·	250	~~253~~	·
3		2			
4	0				

Ex. 2

$3 \leq r \leq 6 = (7)$

~~otherwise 0~~ Otherwise r

1	4	2	7	5
3	2	4	5	2
2	6	5	7	0
4	6	6	5	1
0	2	3	2	1

⇓

1	7	2	7	7
7	2	7	7	2
2	7	7	7	0
7	7	7	7	1
0	2	7	2	1

② Without Background

$3 \leq r \leq 6 = (7)$

Otherwise 0

1	4	2	7	5
3	2	4	5	2
2	6	5	7	0
4	6	6	5	1
0	2	3	2	1

⇓

0	7	0	7	7
7	0	7	7	0
0	7	7	7	0
7	7	7	7	0
0	0	7	0	0

Bit plane Slicing:

167	133	111
144	140	135
159	159	148

Step 1: Binary format for above image is ——

10100111	10000101	01101111
10010000	10001100	10000111
10011111	10011010	10010100

for 1st digit: Binary format of 167

1	0	1	0	0	1	1	1
MSB	7th bit	6th bit	5th bit	4th bit	3rd bit	2nd bit	LSB

Step 2: Bit plane Slicing of above example:

1	1	0
1	1	1
1	1	1

8 bit (MSB bit) plane

0	0	1
0	0	0
0	0	0

7 bit

1	0	1
0	0	0
0	0	0

6 bit

1	0	1
0	0	1
1	1	0

2 bit

0	0	0
1	0	0
1	1	1

5 bit

0	0	1
0	1	0
1	1	0

4 bit

1	1	1
0	1	1
1	0	1

3 bit

1	1	1
0	0	1
1	0	0

LSB plane (1 bit)

29/01/2025

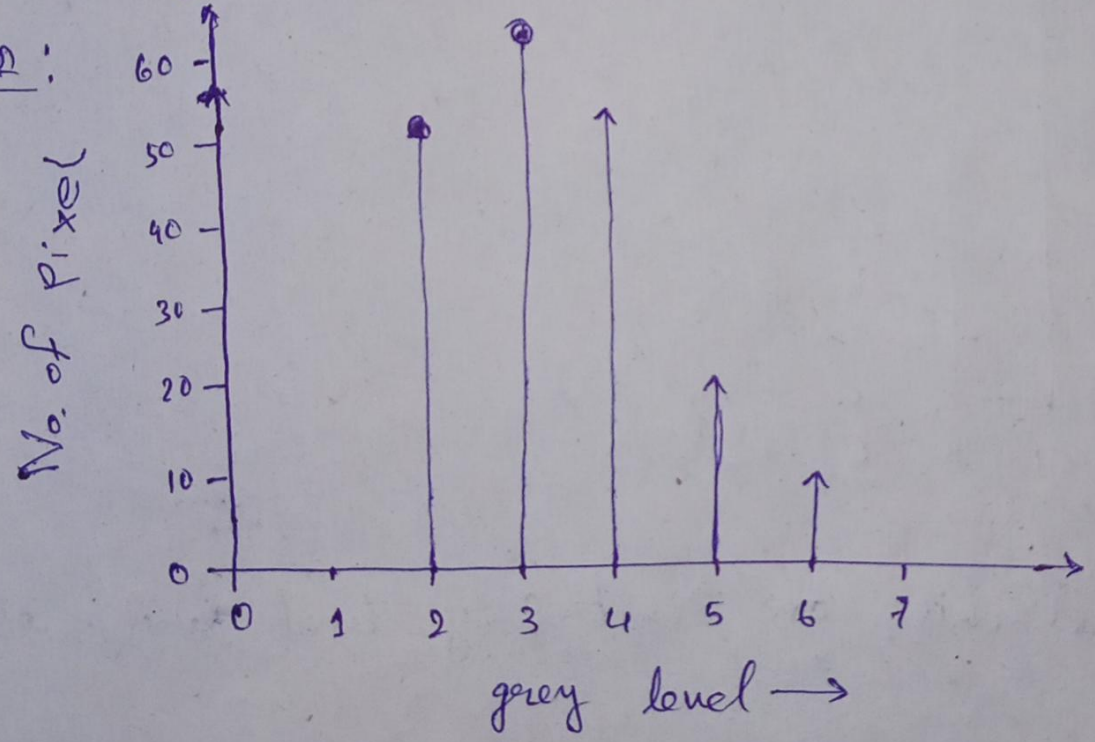
DIP

Histogram streching / Contrast streching

grey level	0	1	2	3	4	5	6	7
No. of pixels	0	0	50	60	50	20	10	0

Perform histogram streching such that the new image has dynamic range [0 → 7].

Sol:



$S_{min} = 0$

$S_{max} = 7$

$r_{min} = 2$

$r_{max} = 6$

Slope, $S = \left(\frac{S_{max} - S_{min}}{r_{max} - r_{min}}\right) * (r - r_{min}) + S_{min}$

when, $r = 2$

$$S_2 = \left(\frac{7-0}{6-2}\right) * (2-2) + 0 = \frac{7}{4} * 0 + 0 = 0$$

when, $r = 3$

$$S_3 = \left(\frac{7-0}{6-2}\right) * (3-2) + 0 = \frac{7}{4} * 1 + 0 = 1.75 \approx 2$$

when, $r = 4$

$$S_4 = \left(\frac{7-0}{6-2}\right) * (4-2) + 0 = \frac{7}{4} * 2 + 0 = 3.5 \approx 4$$

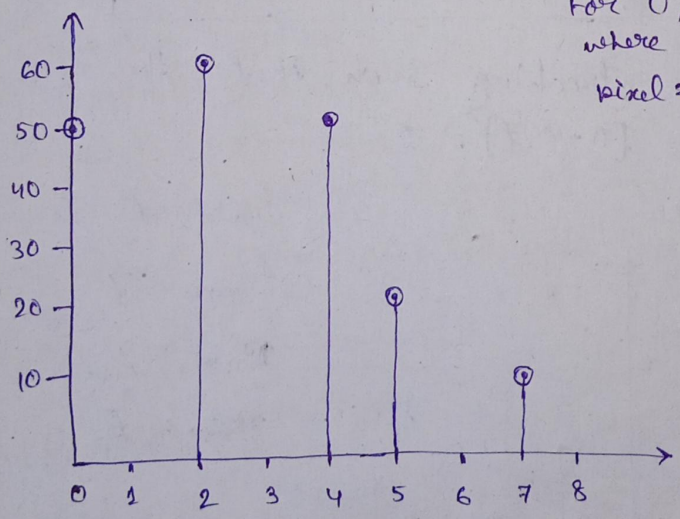
when, $r = 5$

$$S_5 = \left(\frac{7-0}{6-2}\right) * (5-2) + 0 = \frac{7}{4} * 3 = 5.25 \approx 5$$

when, $r = 6$

$$S_6 = \left(\frac{7-0}{6-2}\right) * (6-2) + 0 = \frac{7}{4} * 4 + 0 = 7$$

For 0, $r = 2$ and in graph where grey level = 2 there no. of pixel = 50.



Q1.) Apply contrast streching on 3-bit grey level image of size 4 * 4.

Sol^n:

$f(x, y)$

2	1	2	1
4	5	5	6
3	2	1	4
6	2	1	6