# ① Histogram Equilization

Perform Histogram equalization for an 8×8 image shown below.

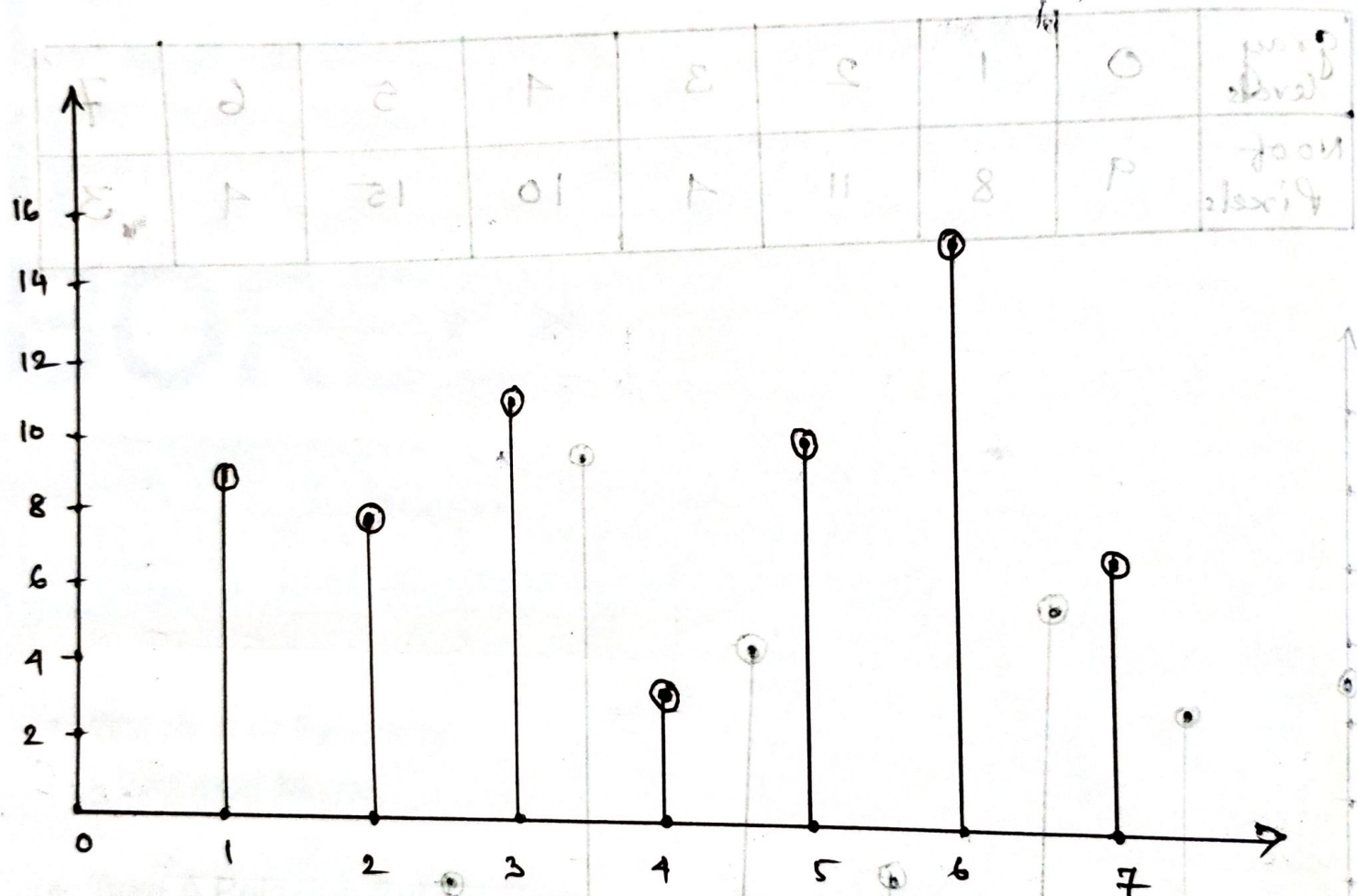| gray levels | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| No of Pixels | 9 | 8 | 11 | 4 | 10 | 15 | 4 | 3 |
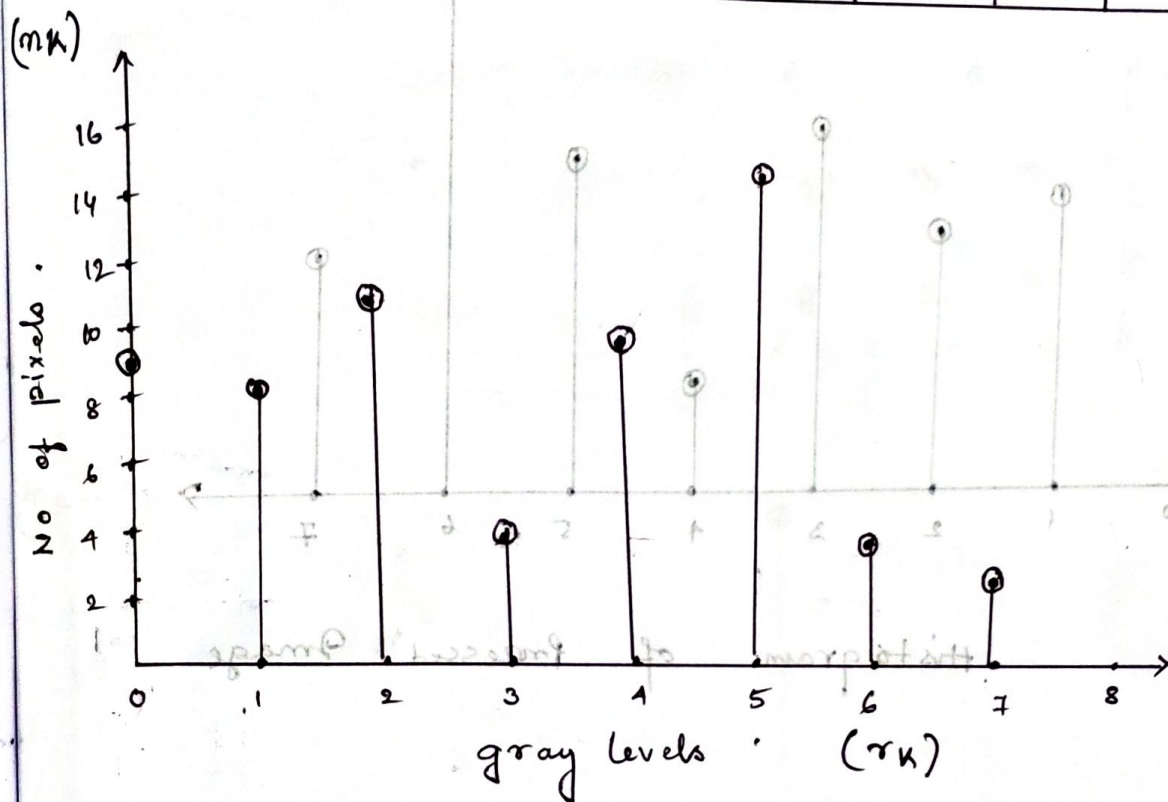


Histogram of Input Image.

| 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 | 9 | 0.141 | 0.141 | 0.987 | 1 |
| 1 | 8 | 0.125 | 0.266 | 1.862 | 2 |
| 2 | 11 | 0.172 | 0.438 | 3.066 | 3 |
| 3 | 4 | 0.0625 | 0.5005 | 3.5035 | 4 |
| 4 | 10 | 0.156 | 0.6565 | 4.5955 | 5 |
| 5 | 15 | 0.234 | 0.8905 | 6.2335 | 6 |
| 6 | 4 | 0.0625 | 0.953 | 6.671 | 7 |
| 7 | 3 | 0.047 | 1 | 1 | 7 |
| | n = 64 | | | | |

| Gray levels | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| No of Pixels | 9 | 8 | 11 | 4 | 10 | 15 | 7 |



Histogram of Processed Image

(2) Perform Histogram equalization for the following image:

$f(x,y)$

| 1 | 2 | 1 | 1 | 1 |
|---|---|---|---|---|
| 2 | 5 | 3 | 5 | 2 |
| 2 | 5 | 5 | 5 | 2 |
| 2 | 5 | 3 | 5 | 2 |
| 1 | 1 | 1 | 2 | 1 |

Max value = 5
5 is of 3 bit
∴ $2^3 = 8$
$L = 8$   $L-1 = 7$

Input Image

| gray levels $(r_K)$ | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| No of pixels $(n_K)$ | 0 | 8 | 8 | 2 | 0 | 7 | 0 | 0 |



| gray levels $r_K$ | No of pixels $(n_K)$ | $P(r_K) = n_K/n$ (PDF) | SK CDF | SK×7 | Histogram Equalized level |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 8 | 0.32 | 0.32 | 2.24 | 2 |
| 2 | 8 | 0.32 | 0.64 | 4.48 | 4 |
| 3 | 2 | 0.08 | 0.72 | 5.04 | 5 |
| 4 | 0 | 0 | 0.72 | 5.04 | 5 |
| 5 | 7 | 0.28 | 1 | 7 | 7 |
| 6 | 0 | 0 | 1 | 7 | 7 |
| 7 | 0 | 0 | 1 | 7 | 7 |
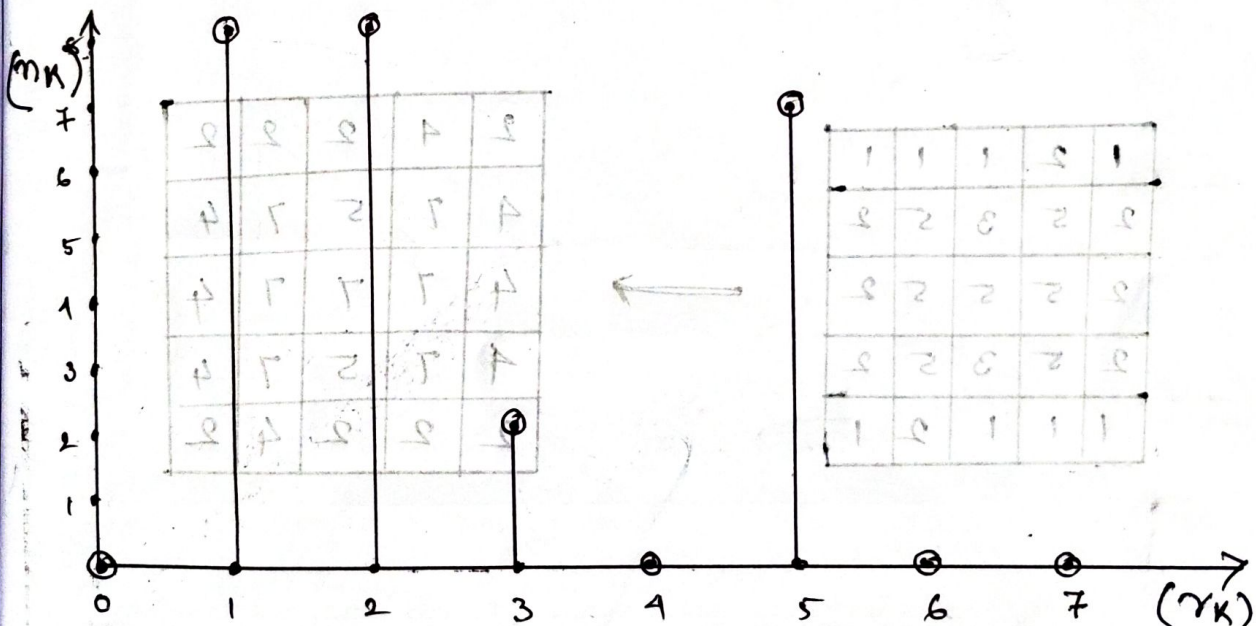
$n = 25$

| gray levels | 0 | | 2 | | 4 | | 5 | | 7 |
|---|---|---|---|---|---|---|---|---|---|
| No of pixels | 0 | 1 | 8 | 1 | 8 | 1 | 2 | | 7 |



gray level $(r_k)$

no of pixels $(n_k)$
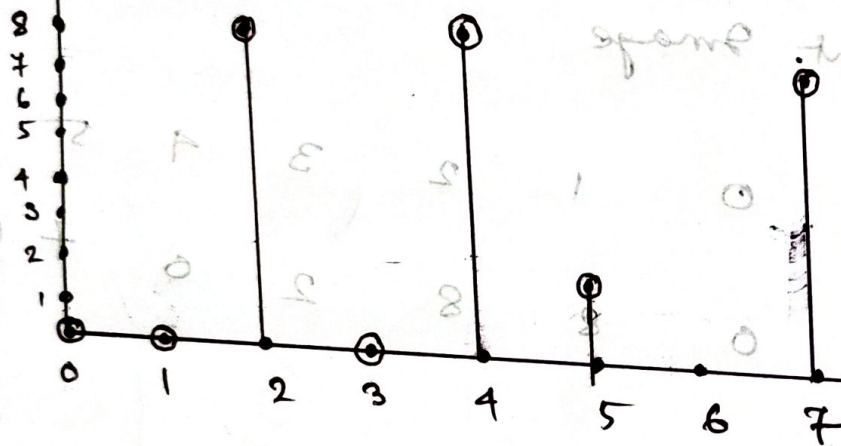
$$
\begin{array}{|c|c|c|c|c|}
\hline
1 & 2 & 1 & 1 & 1 \\
\hline
2 & 5 & 3 & 5 & 2 \\
\hline
2 & 5 & 5 & 5 & 2 \\
\hline
2 & 5 & 3 & 5 & 2 \\
\hline
1 & 1 & 1 & 2 & 1 \\
\hline
\end{array}
\longrightarrow
\begin{array}{|c|c|c|c|c|}
\hline
2 & 4 & 2 & 2 & 2 \\
\hline
4 & 7 & 5 & 7 & 4 \\
\hline
4 & 7 & 7 & 7 & 4 \\
\hline
4 & 7 & 5 & 7 & 4 \\
\hline
2 & 2 & 2 & 4 & 2 \\
\hline
\end{array}
$$