Q1) ~~Input~~ ASSUMPTION → L = 4 (i.e. k = 0, 1, 2, 3)

r → Input s → target

Lets find the transformation $s = T(r)$

k	n_k(I/P)	$p_r(k)$	$CDF_r(k)$	n_k(Target)	$p_s(k)$	$(CDF_s(k))$
0	4	0.25	0.25	7	7/16	0.4375
1	4	0.25	0.50	3	3/16	0.625
2	4	0.25	0.75	2	2/16	0.75
3	4	0.25	1.	4	4/16	1
	(16)			(16)		

∴

r	T(r)
0	0
1	0
2	2
3	3

⇒ Histogram Matched version of INPUT MATRIX

$$\begin{bmatrix} 3 & 3 & 0 & 0 \\ 3 & 2 & 0 & 2 \\ 2 & 0 & 0 & 0 \\ 3 & 0 & 0 & 2 \end{bmatrix}$$

Q2)

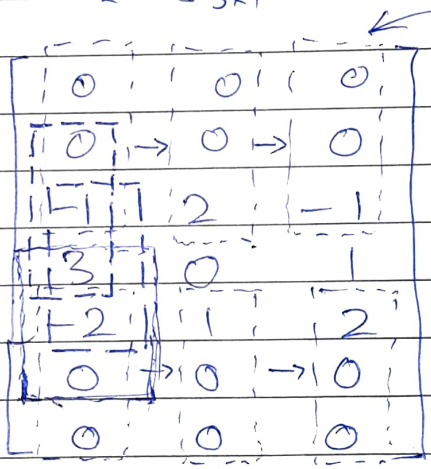
Image: $\begin{bmatrix} -1 & 2 & -1 \\ 3 & 0 & 1 \\ -2 & 1 & 2 \end{bmatrix}_{3\times3}$ (-1 is origin)

Filter: $\begin{bmatrix} -1 \\ 0 \\ 1 \end{bmatrix}_{3\times1}$

Output = $(3+3-1) \times (3+1-1) = 5 \times 3$

Rotated Filter: $\begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix}_{3\times1}$ → origin (0)

Padded Input:



Placing the filter and taking weighted sums.
Shifting by 1 Row or 1 column at a time.

7×3

Output: $\begin{bmatrix} 1 & -2 & 1 \\ -3 & 0 & -1 \\ 1 & 1 & -3 \\ 3 & 0 & 1 \\ -2 & 1 & 2 \end{bmatrix}_{5\times3}$

Corresponds to the origin in input image.