Point Processing

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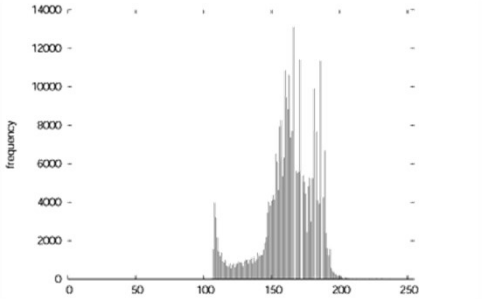
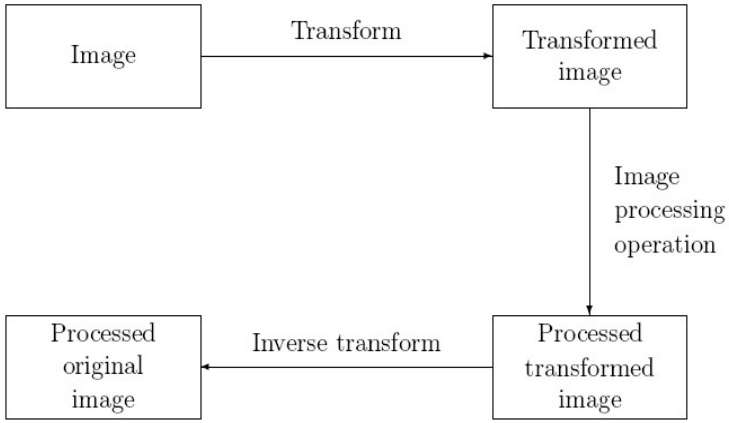
Transforms





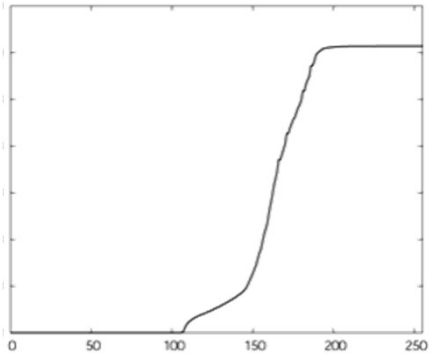
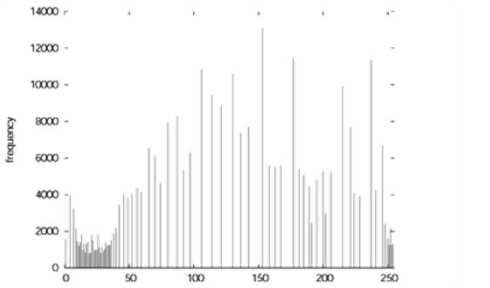


Figure 2.1: Schema for transform processing



Arithmetic operations

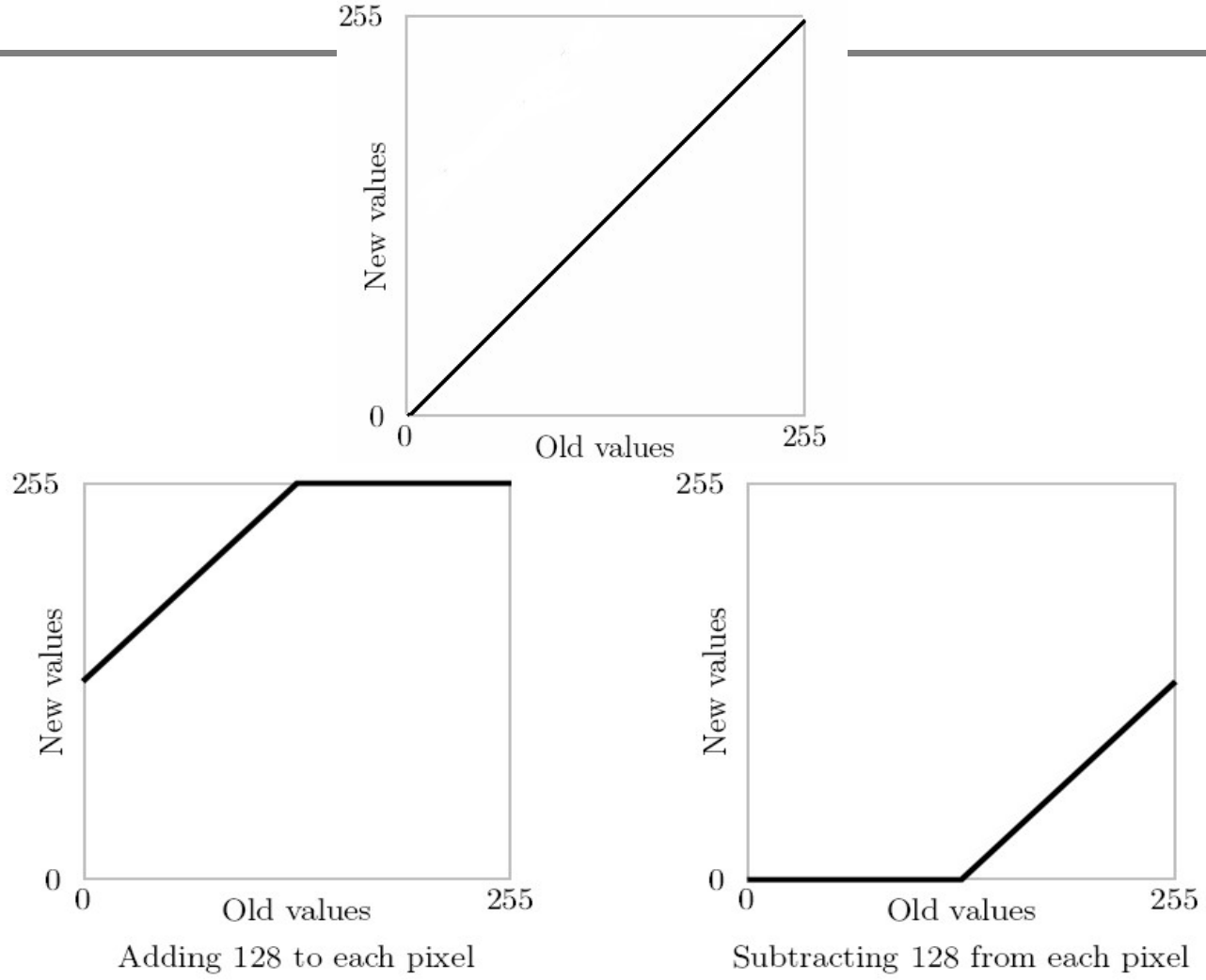
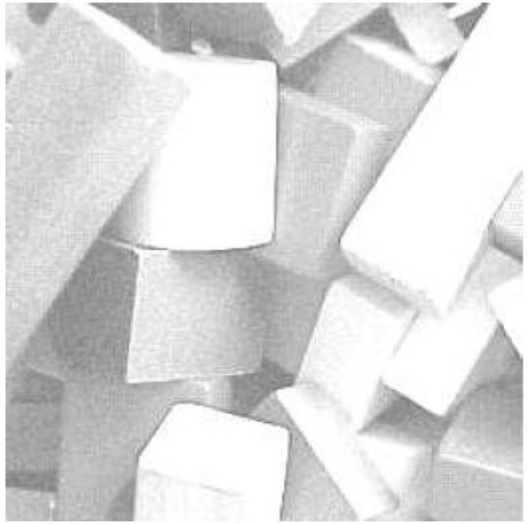
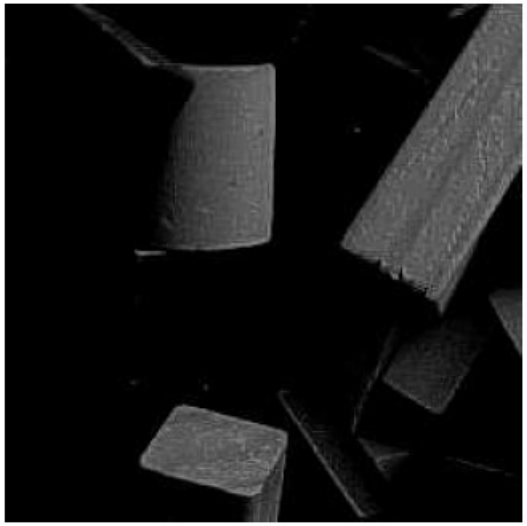


Figure 2.2: Adding and subtracting a constant

Arithmetic operations

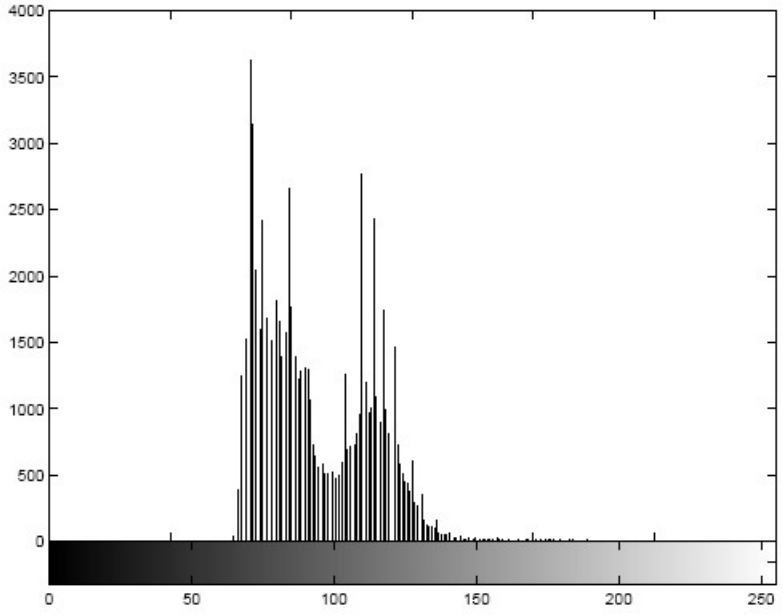


b1: Adding 128



b2: Subtracting 128

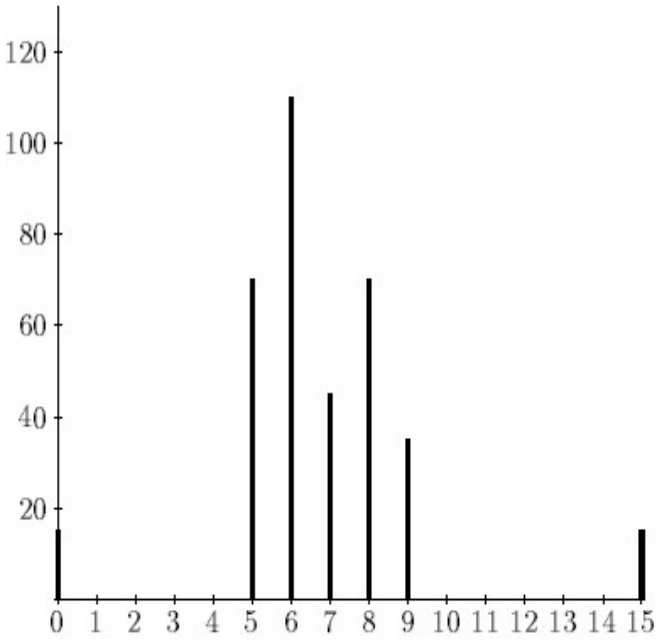
Histograms

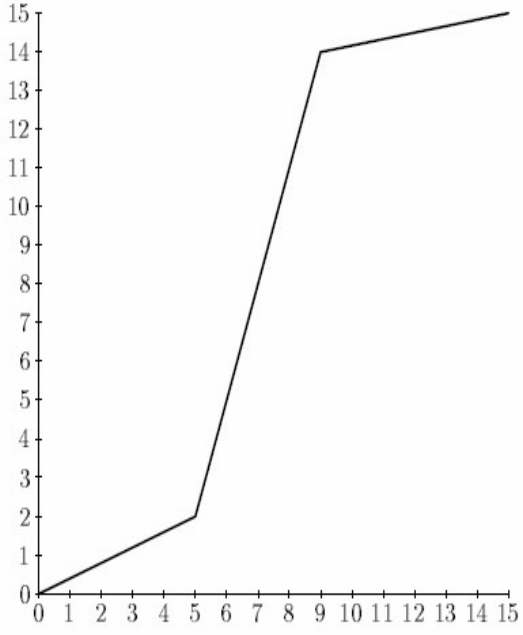


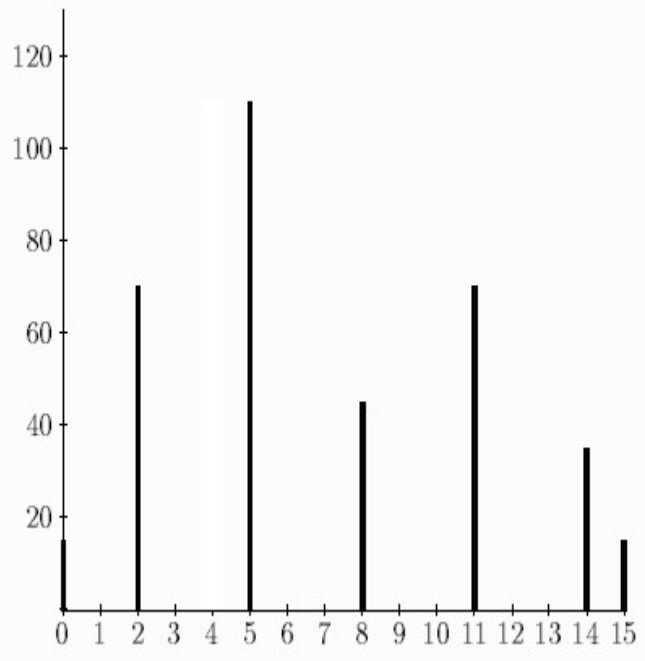
Histogram Stretching

Grey level i	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
n_i	15	0	0	0	0	70	110	45	70	35	0	0	0	0	0	15

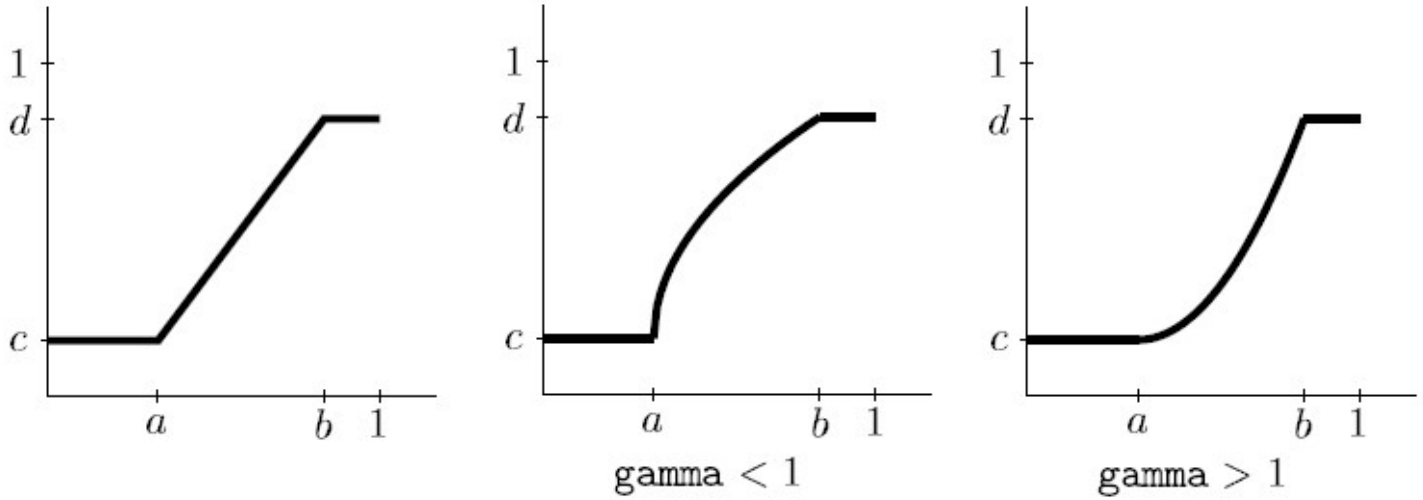
i	5	6	7	8	9
j	2	5	8	11	14





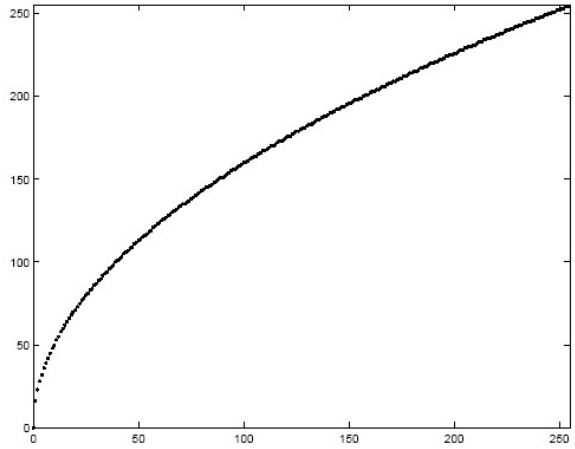


Other-Gamma Value

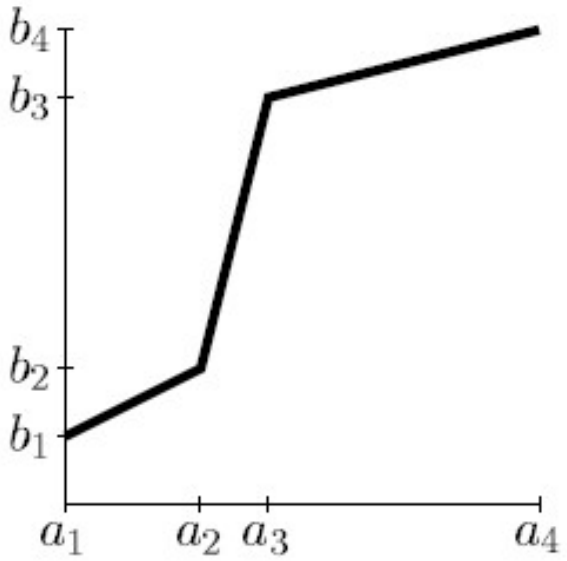


$$y = \left(\frac{x-a}{b-a}\right)(d-c)+c \qquad y = \left(\frac{x-a}{b-a}\right)^{\gamma}(d-c)+c$$

Gamma Value

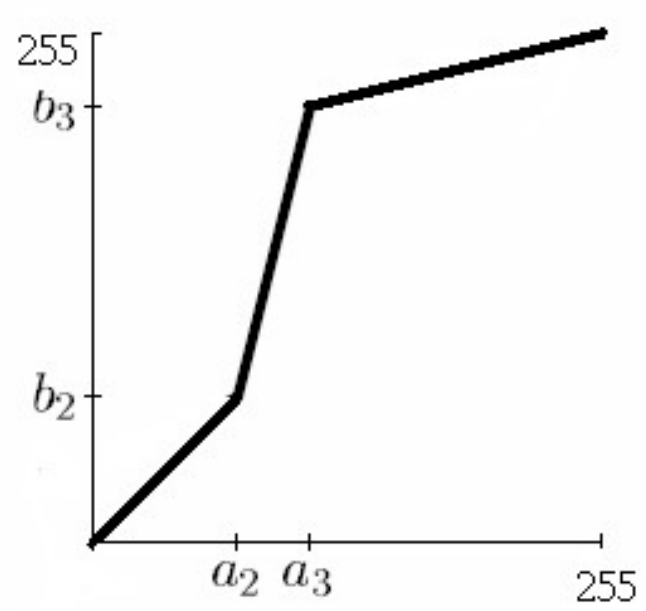


Linear Stretching Function

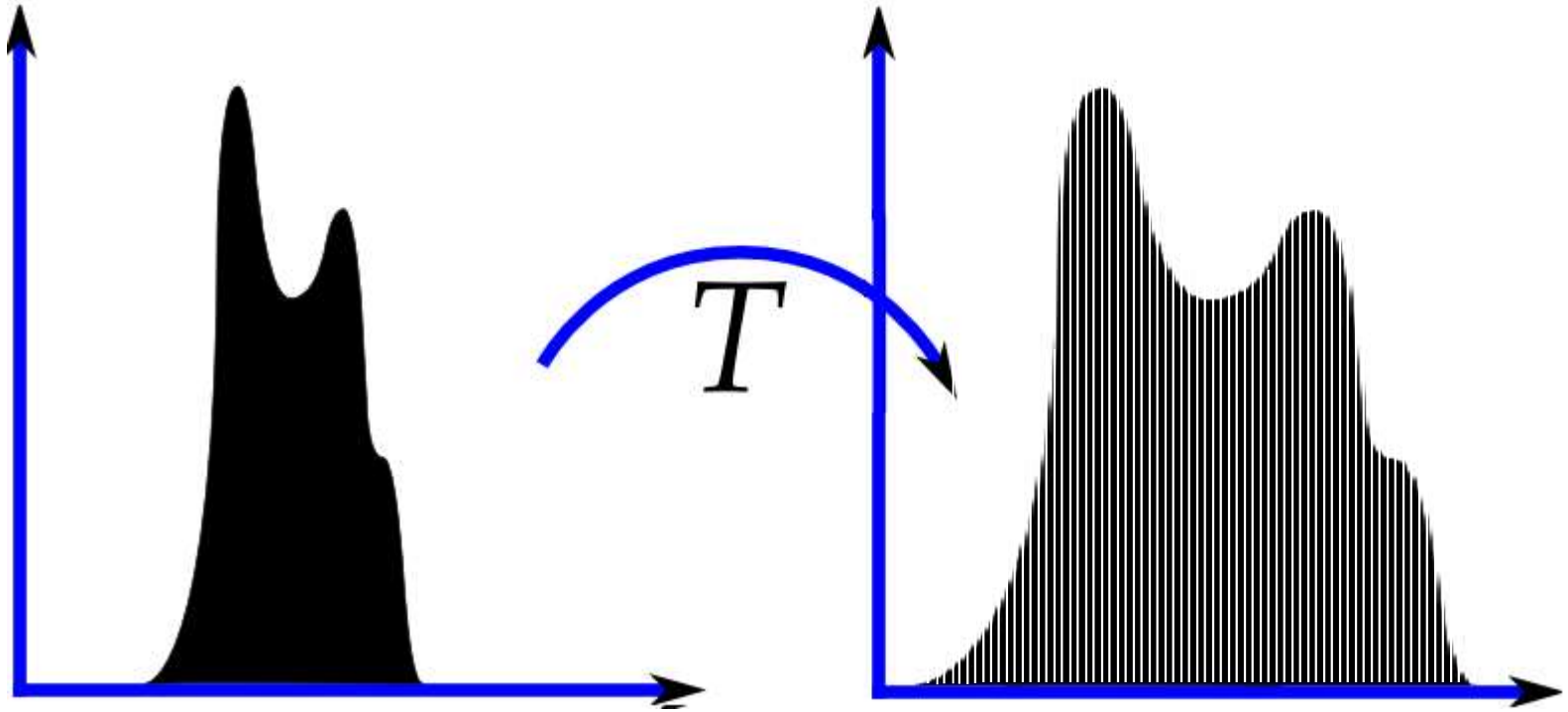


$$y = \frac{b_{i+1} - b_i}{a_{i+1} - a_i}(x - a_i) + b_i$$

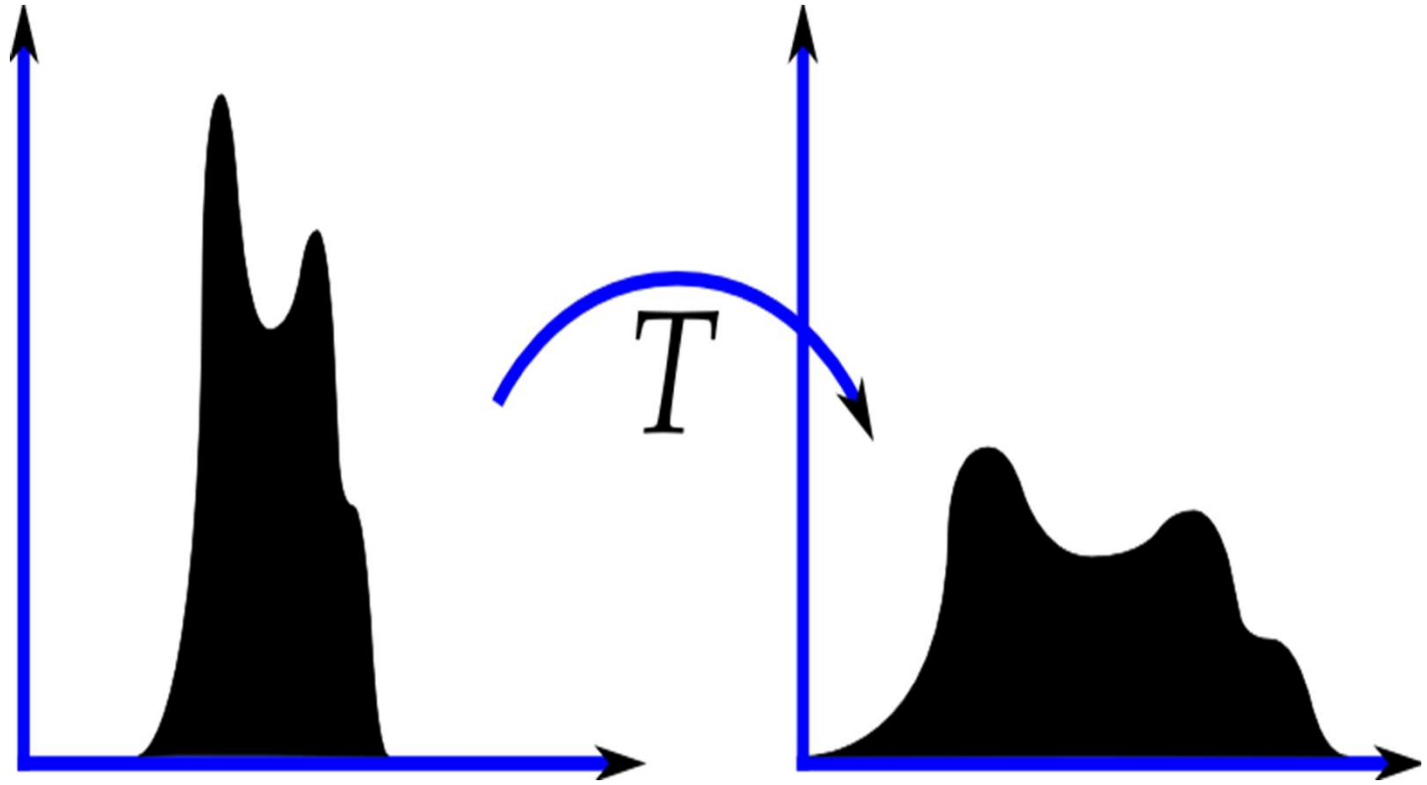
Given (a_2, b_2) and (a_3, b_3)



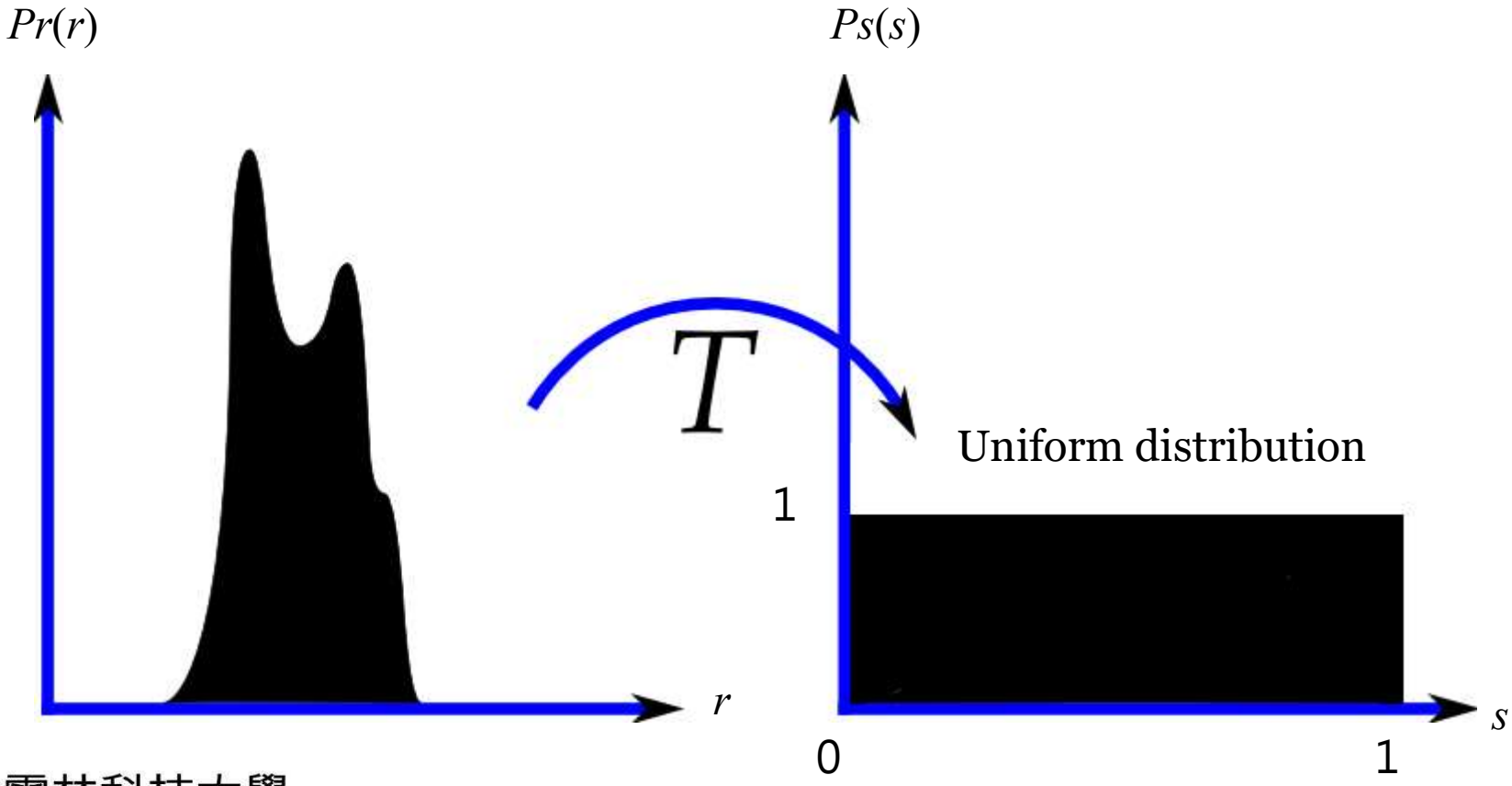
Histogram Equalization



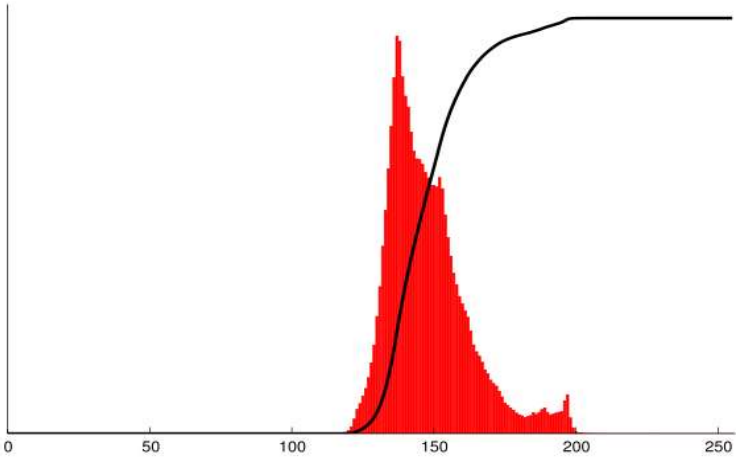
Histogram Equalization

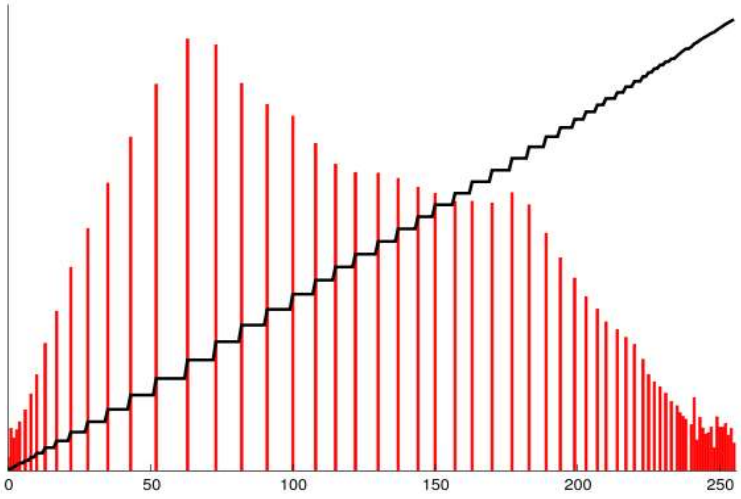


Histogram Equalization

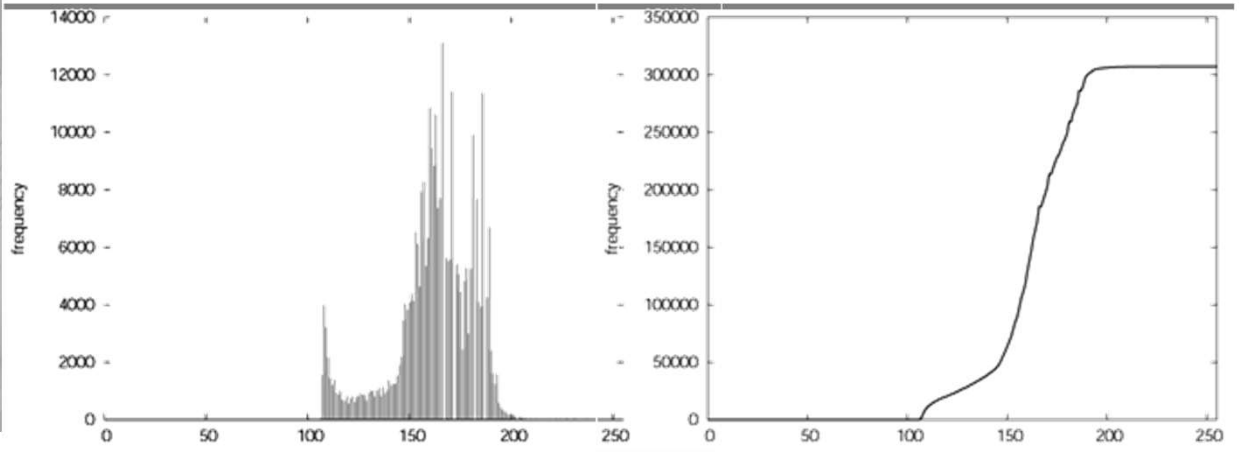


Example-1





Example-2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frequency
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150
200
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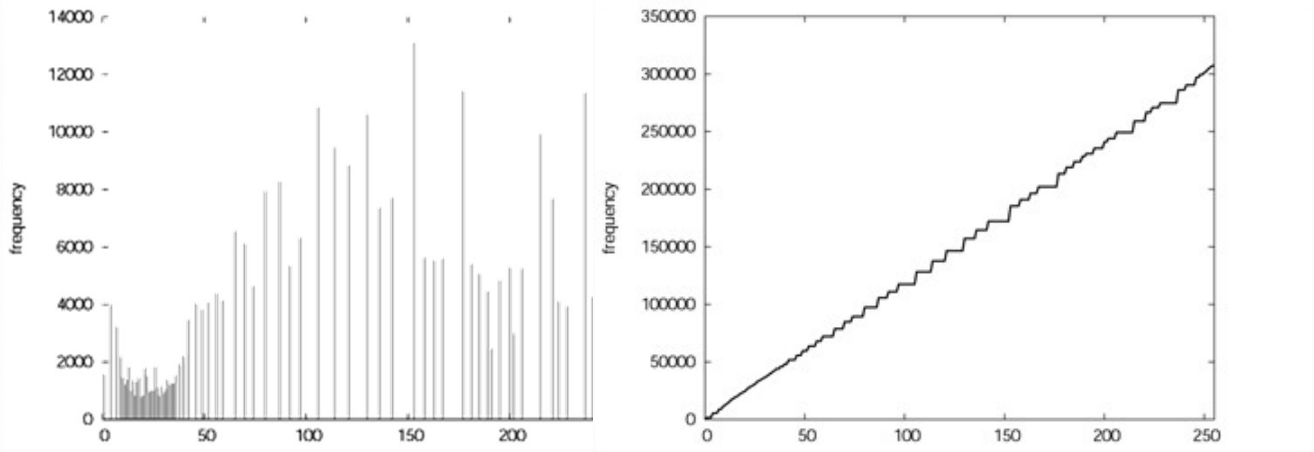
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frequency
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50
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150
200
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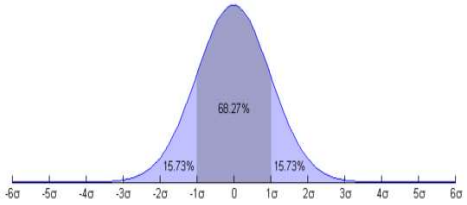
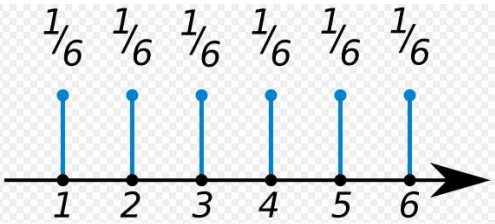
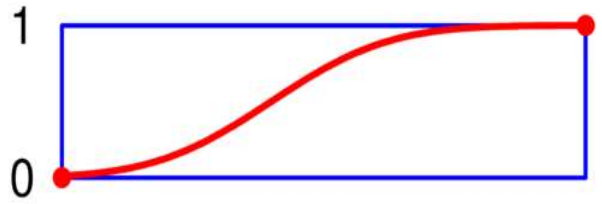
300000
250000
200000
150000
100000
50000
0
frequency
0
50
100
150
200
250

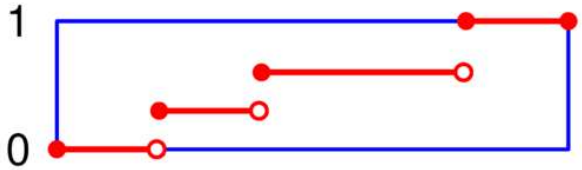
Probability

- Probability Density Function; PDF
- Probability Mass Function; PMF
- Cumulative Distribution Function; CDF
- Cumulative Mass Function; CMF

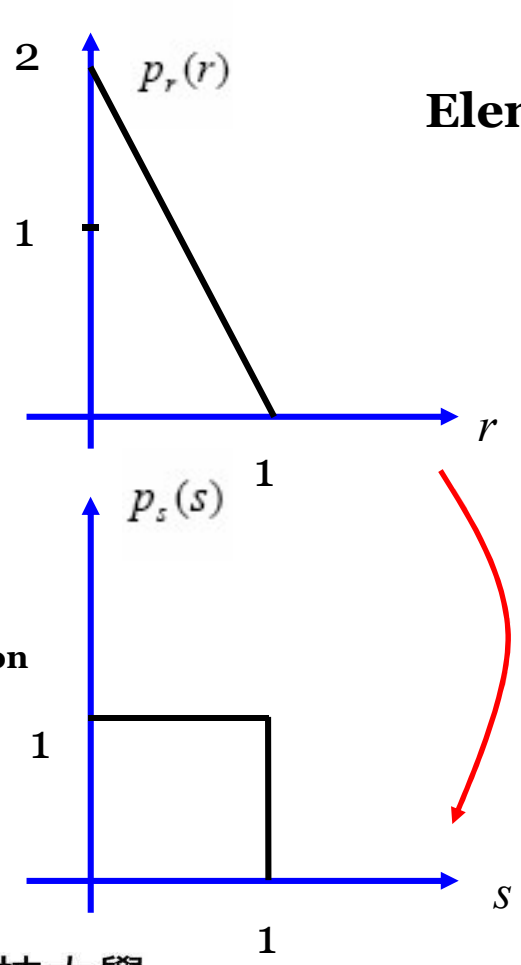








Example



Uniform Distribution

s=$T(r)$

Elementary Probability Theorem

$$p_r(r)=\begin{cases}-2r+2 & 0\le r\le 1\\ 0 & \text{elsewhere}\end{cases}$$

$$s=T(r)=\int_0^r(-2w+2)dw$$

$$=-r^2+2r$$

$$r=T^{-1}(s)=1-\sqrt{1-s}$$

$$p_s(s)=\left[p_r(r)\frac{dr}{ds}\right]_{r=T^{-1}(s)}$$

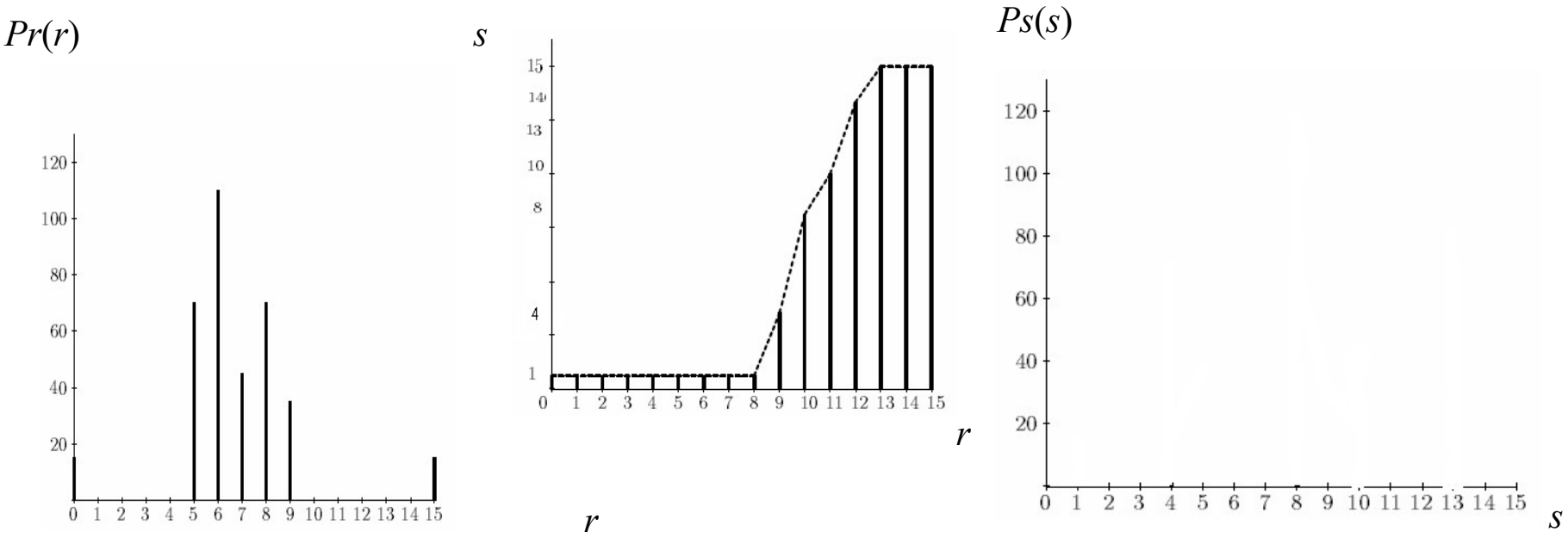
$$=\left[(-2r+2)\frac{dr}{ds}\right]_{r=1-\sqrt{1-s}}$$

$$=\left[(2\sqrt{1-s})\frac{d}{ds}(1-\sqrt{1-s})\right]$$

$$=1\qquad 0\le s\le 1$$

Histogram Equalization

Grey level i	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
n_i	15	0	0	0	0	0	0	0	0	70	110	45	80	40	0	0



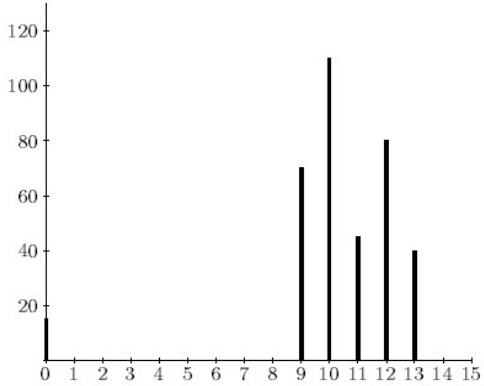
Original grey level i	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Final grey level j	1	1	1	1	1	1	1	1	1	4	8	10	13	15	15	15

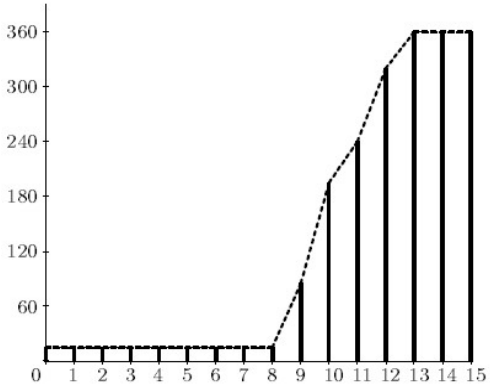
Histogram Equalization

Grey level i	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
n_i	15	0	0	0	0	0	0	0	0	70	110	45	80	40	0	0

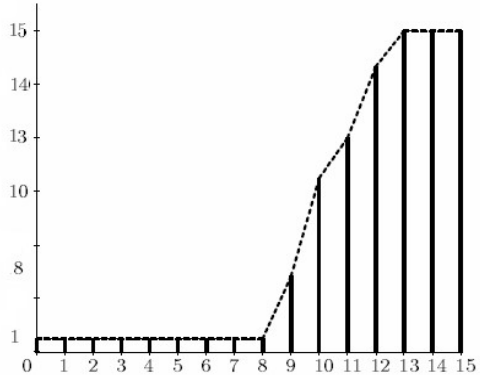
Grey level i	n_i	Σn_i	$(1/24)\Sigma n_i$	Rounded value
0	15	15	0.63	1
1	0	15	0.63	1
2	0	15	0.63	1
3	0	15	0.63	1
4	0	15	0.63	1
5	0	15	0.63	1
6	0	15	0.63	1
7	0	15	0.63	1
8	0	15	0.63	1
9	70	85	3.65	4
10	110	195	8.13	8
11	45	240	10	10
12	80	320	13.33	13
13	40	360	15	15
14	0	360	15	15
15	0	360	15	15

$P_r(r)$





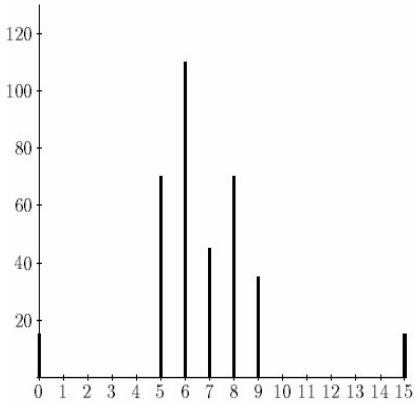
$s=T(r)$

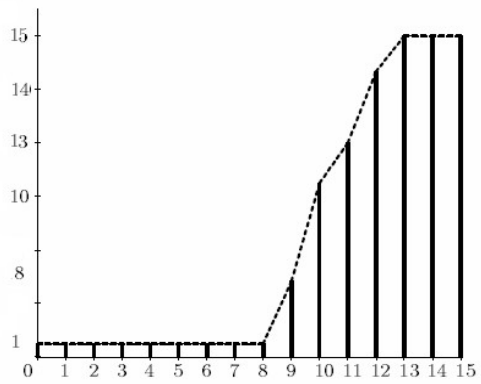


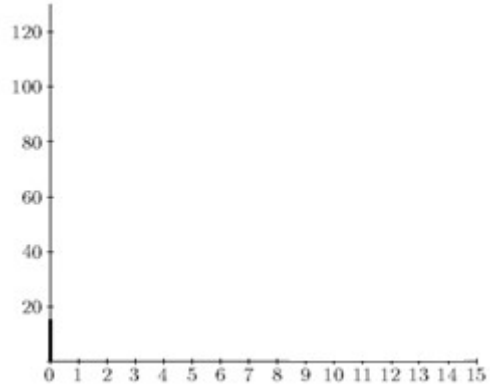
Original grey level i	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Final grey level j	1	1	1	1	1	1	1	1	1	4	8	10	13	15	15	15

Exercise

Grey level i	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
n_i	15	0	0	0	0	0	0	0	0	70	110	45	80	40	0	0







Original grey level i	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Final grey level j	1	1	1	1	1	1	1	1	1	4	8	10	13	15	15	15

Histogram Equalization