Digital Signal Analysis and Applications
Lecture5: Convolution + Correlation + Stats

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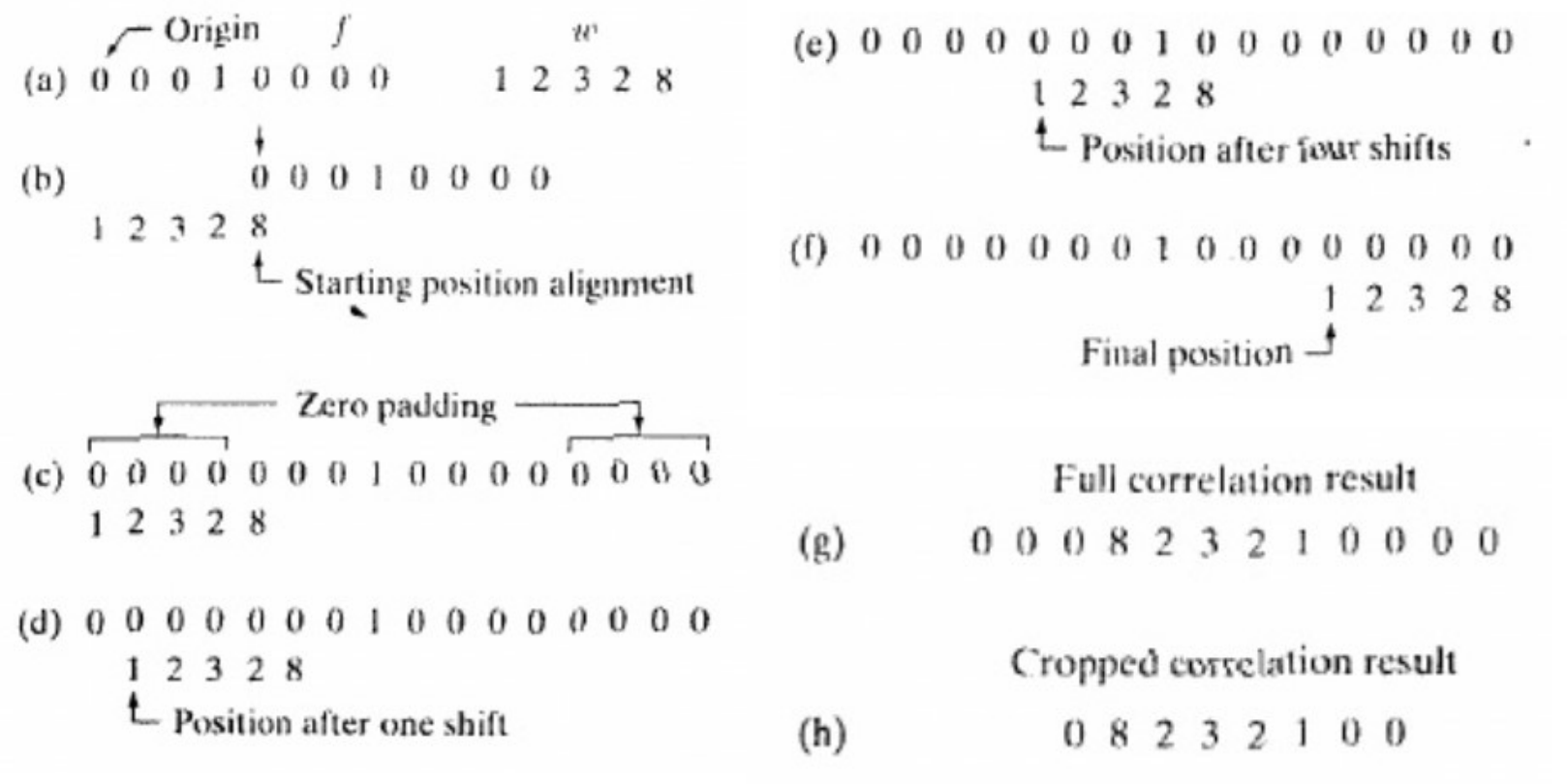
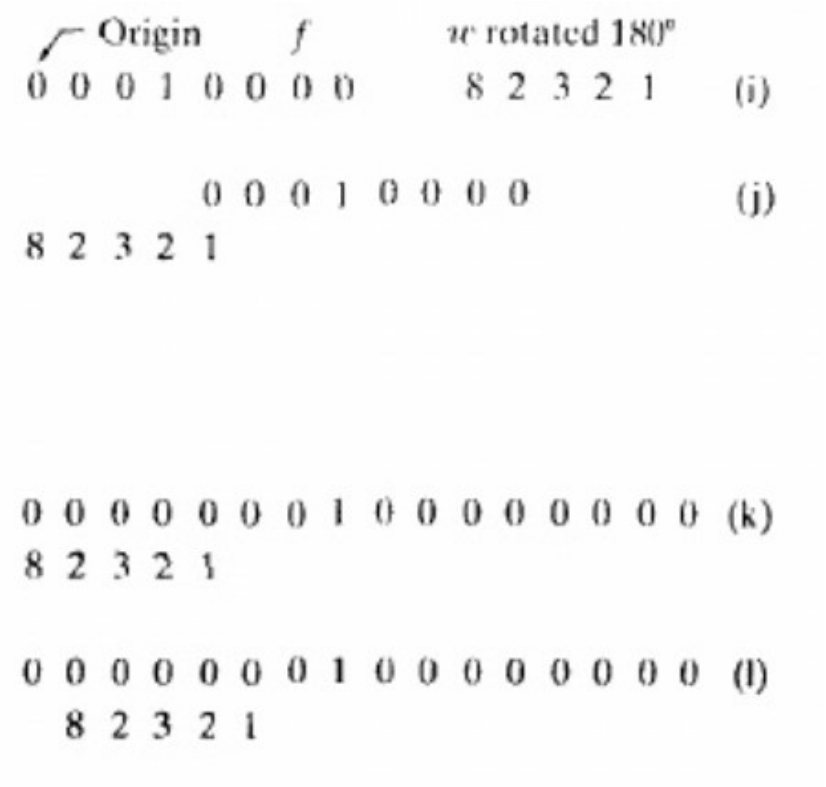
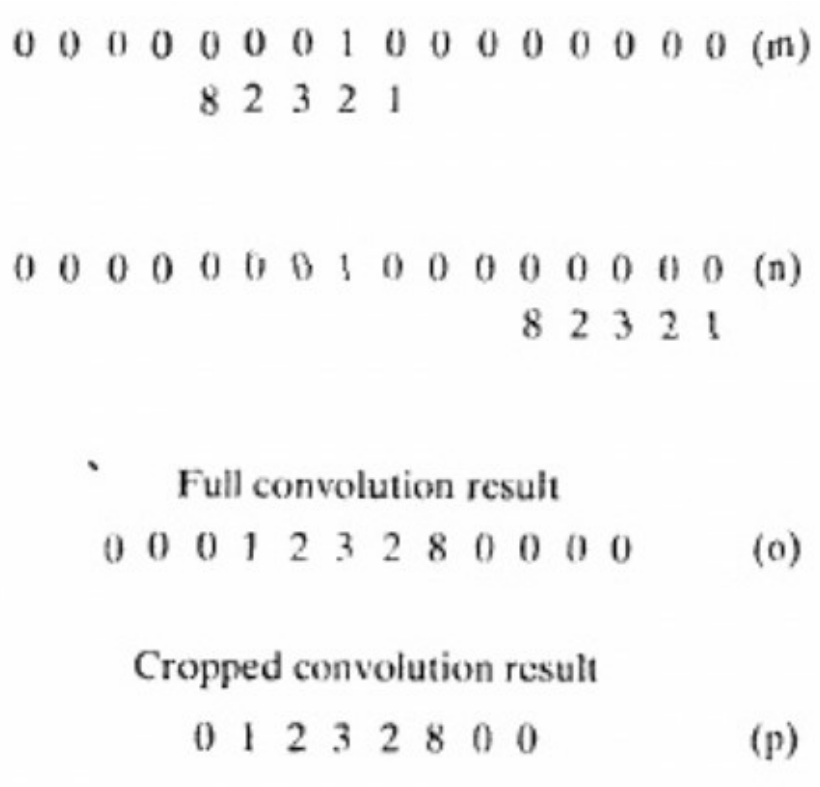
Correlation



Convolution





Convolution vs Correlation (2D)

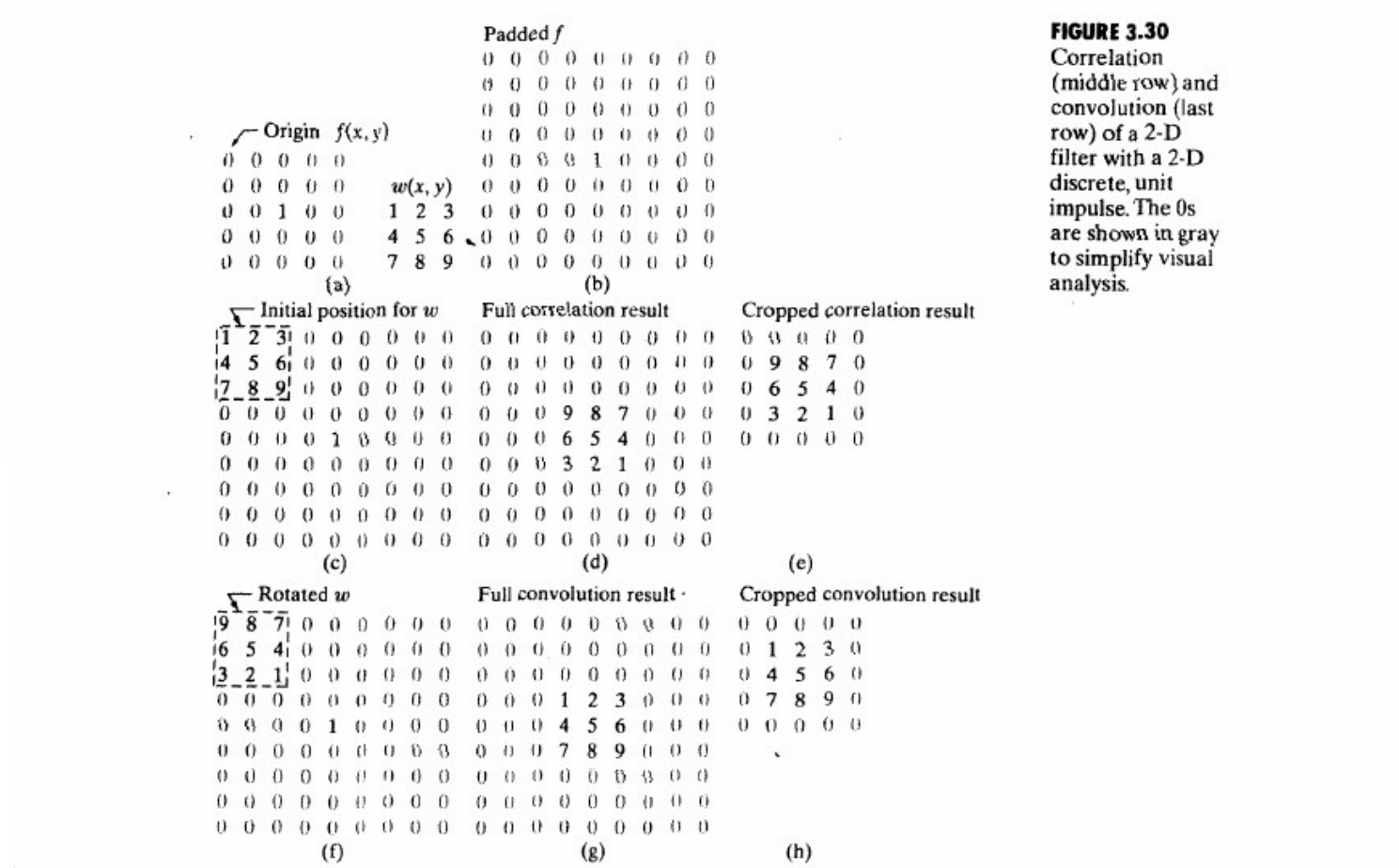


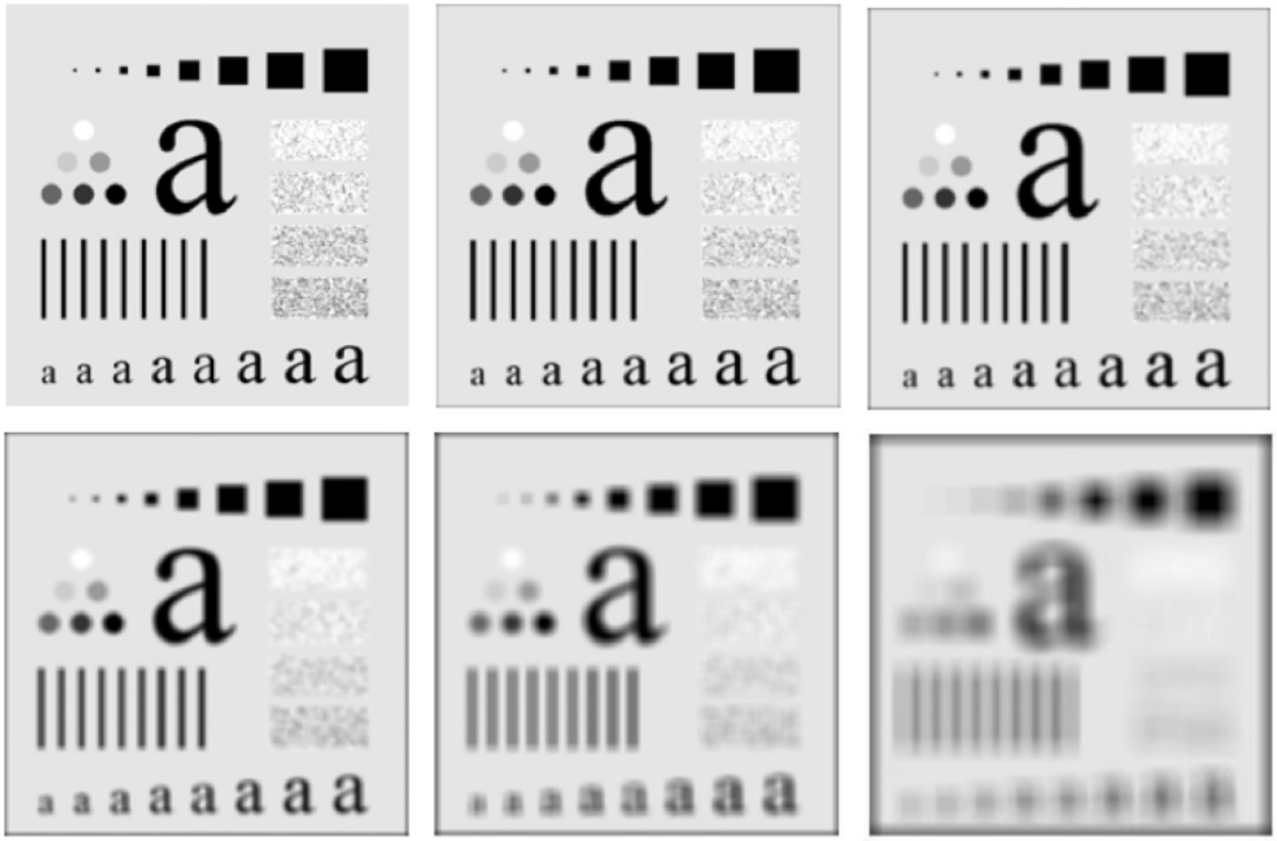
FIGURE 3.30 Correlation (middle row) and convolution (last row) of a 2-D filter with a 2-D discrete, unit impulse. The 0s are shown in gray to simplify visual analysis.

Convolution (2D)

$$w(x,y) \star f(x,y) = \sum_{s=-a}^{a} \sum_{t=-b}^{b} w(s,t) f(x-s, y-t)$$

- Evaluated for all values of displacement variables x and y
- Filter size m × n (notational convenience → m, n are assumed odd)
- a = (m-1)/2 and b = (n-1)/2

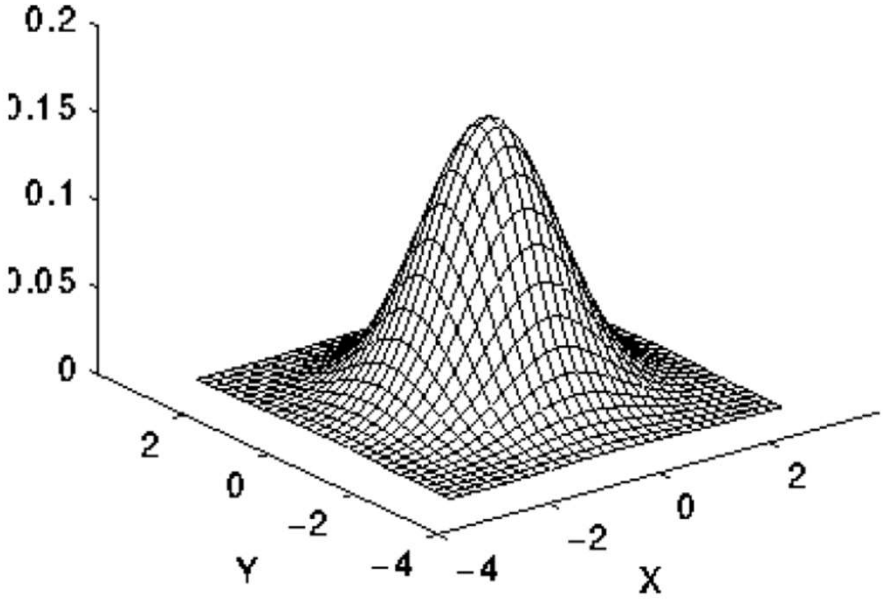
Averaging



$$\frac{1}{9}\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

Square averaging filter mask size: 3,5,9,15,35

Averaging



$$\frac{1}{265}$$

1	4	6	4	1
4	16	26	16	4
6	26	43	26	6
4	16	26	16	4
1	4	6	4	1

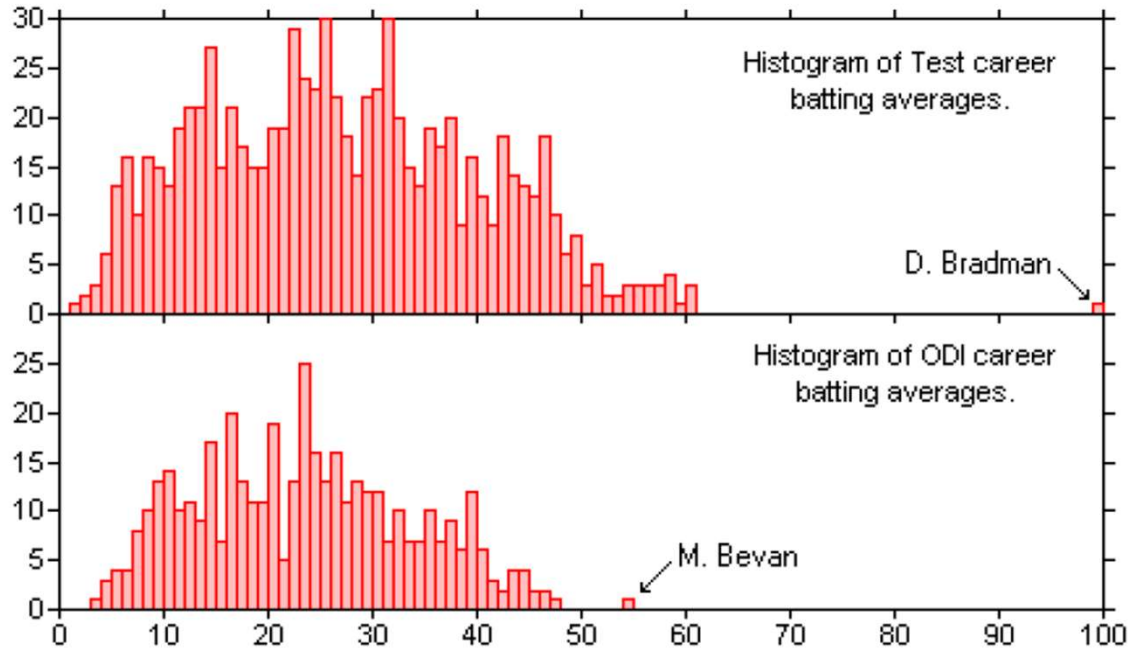
5×5 Gaussian filter, σ=1

Averaging

5×5 Gaussian filter, σ=1

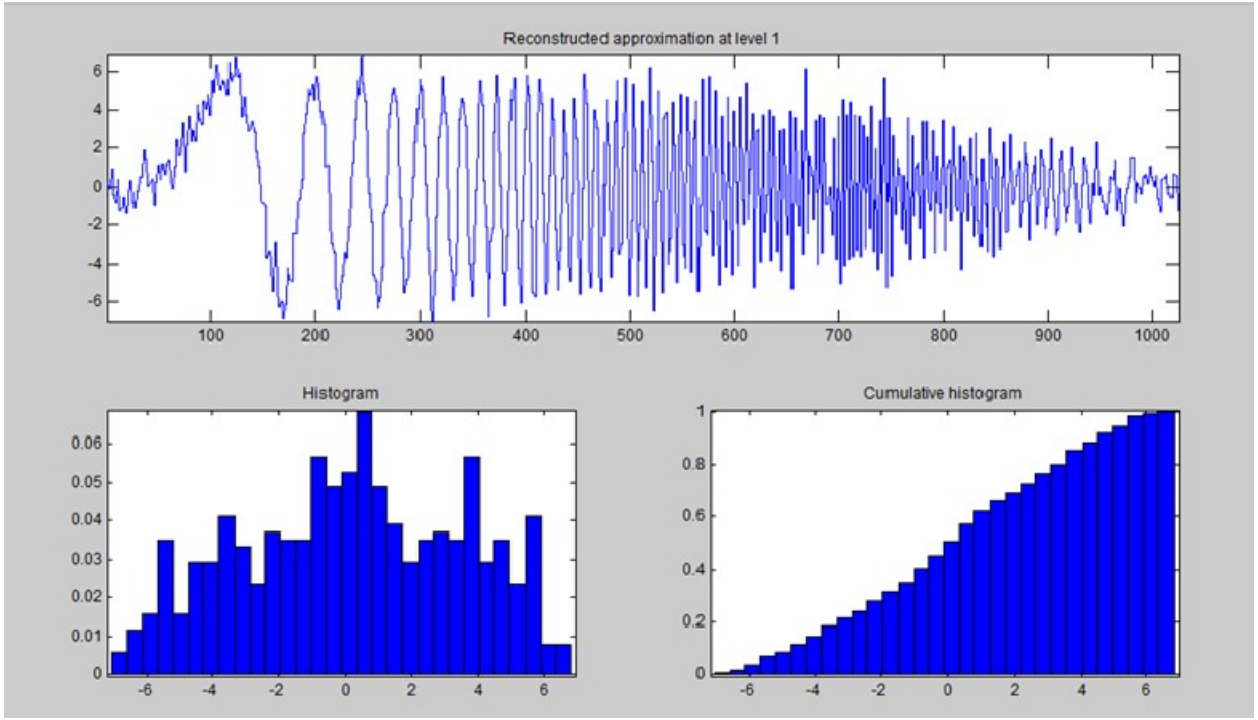
5×5 Gaussian filter, σ=3

Histograms



Courtesy: wikipedia

Histograms


Reconstructed approximation at level 1
Histogram
Cumulative histogram

Histograms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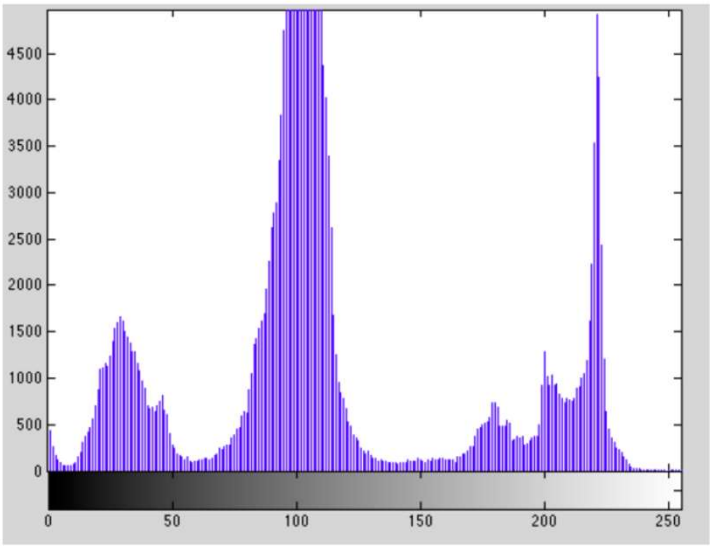
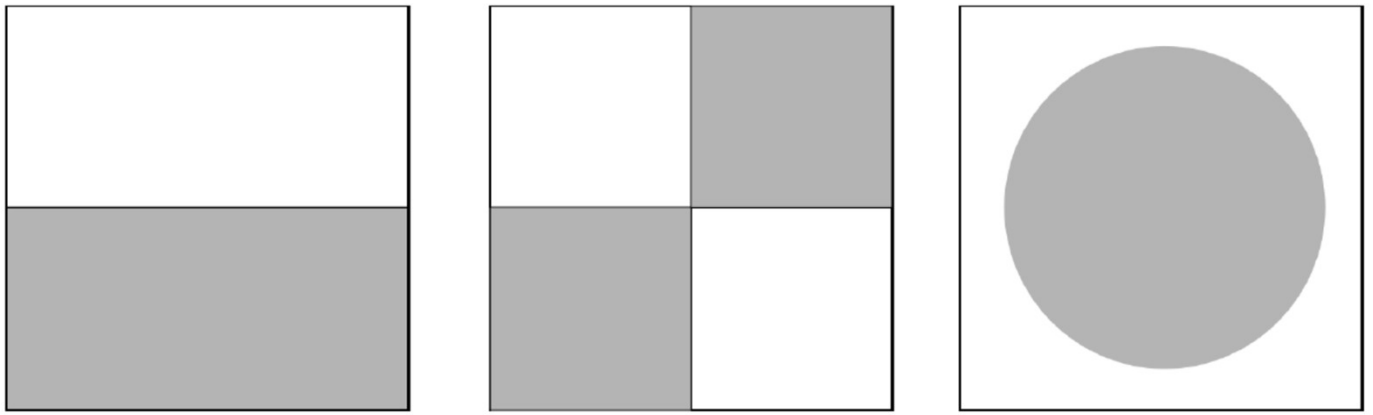
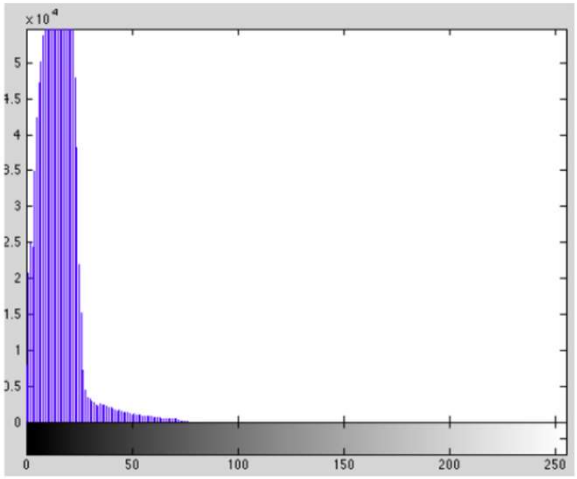
PERMIT
KOMAL


4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
50
100
150
200
250

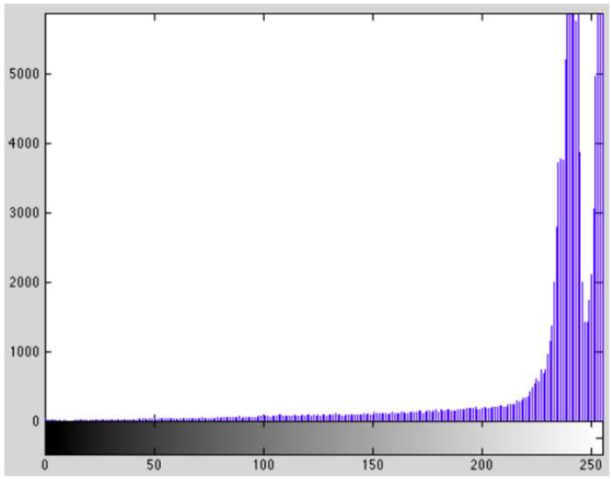
Histograms



Histograms



Histograms


5000
4000
3000
2000
1000
0
0
50
100
150
200
250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Histograms