

A series of thin, black, intersecting lines forming a complex web of polygons across the top half of the slide.

Procesamiento y Análisis de Imágenes

NONLINEAR FILTERS

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¿WHAT IS A NONLINEAR FILTER?

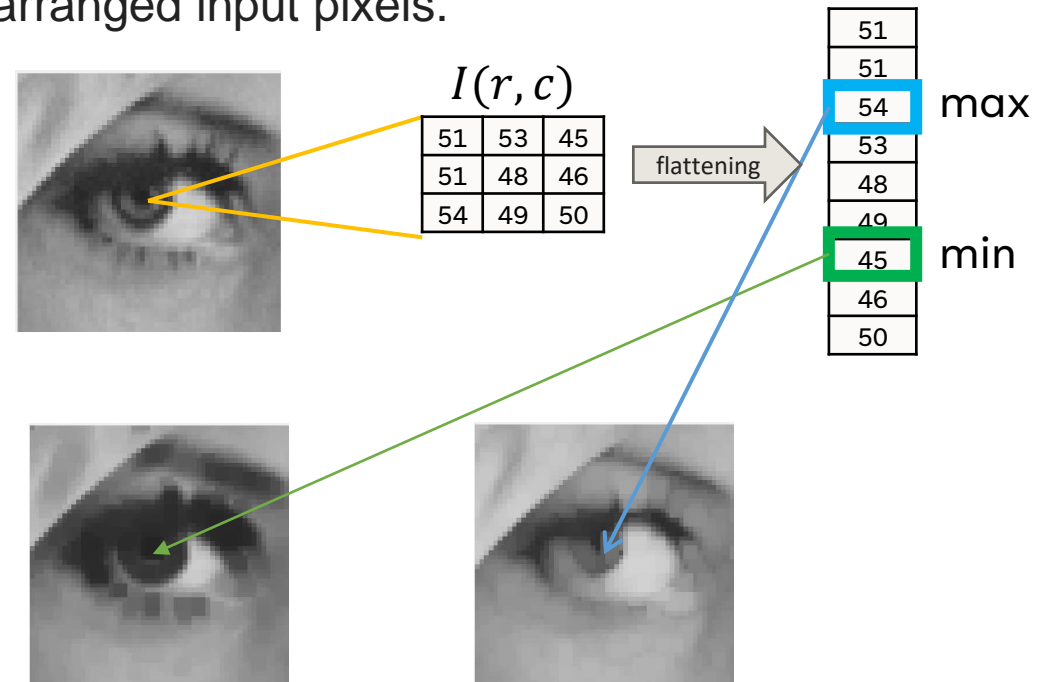
The general idea in non-linear image filtering is that instead of using the spatial mask in a convolution process, the mask is used to obtain the neighboring pixel values, and then ordering mechanisms produce the output pixel. That is, as the mask is shifted about the image, the order of the pixels in the windowed section of the image is rearranged, and the output pixel is generated from these rearranged input pixels.

Max and Min Filters

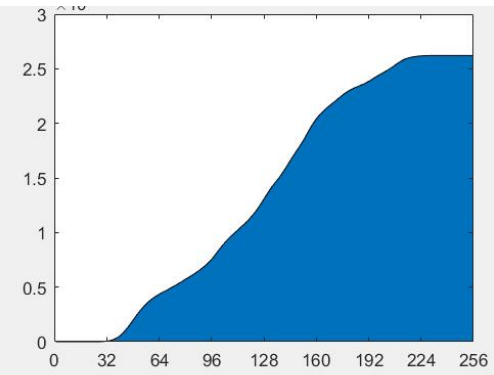
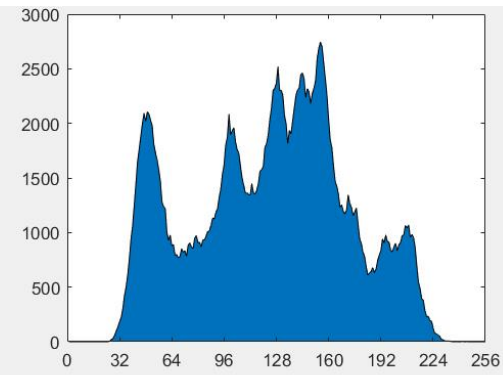
$$I'(u, v) = \min_{(r, c) \in R} \{I(r, c)\}$$

$$I'(u, v) = \max_{(r, c) \in R} \{I(r, c)\}$$

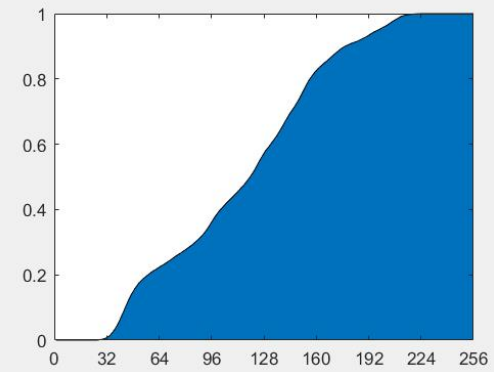
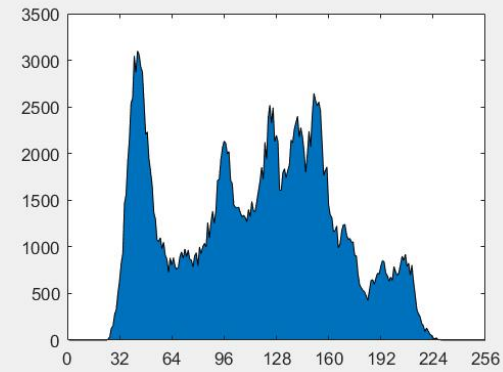
R denotes the filter region (window of the image), usually a square of size 3x3 pixels



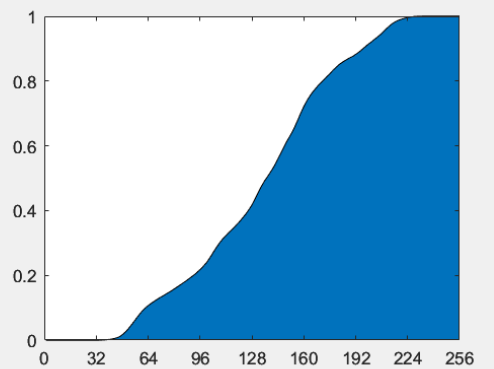
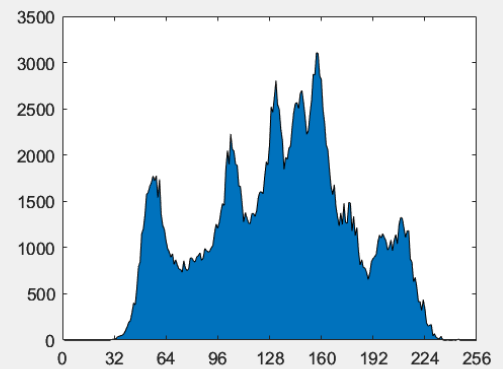
Original
image



Min Filter



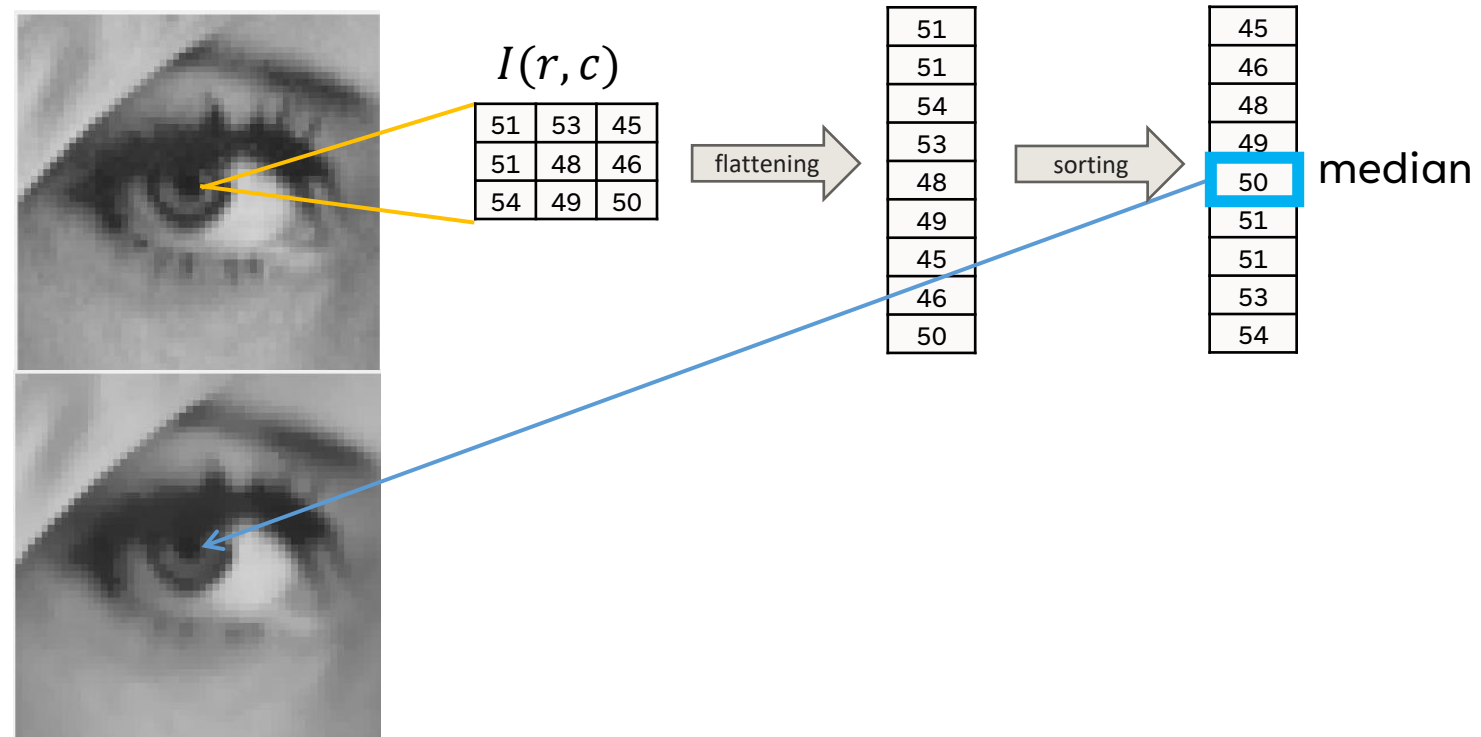
Max Filter



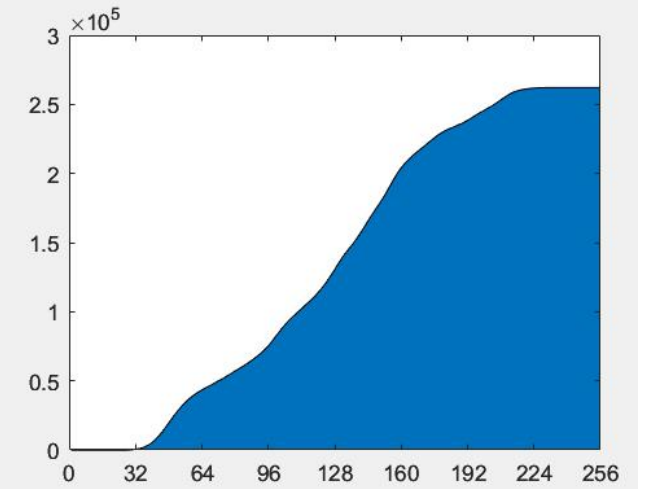
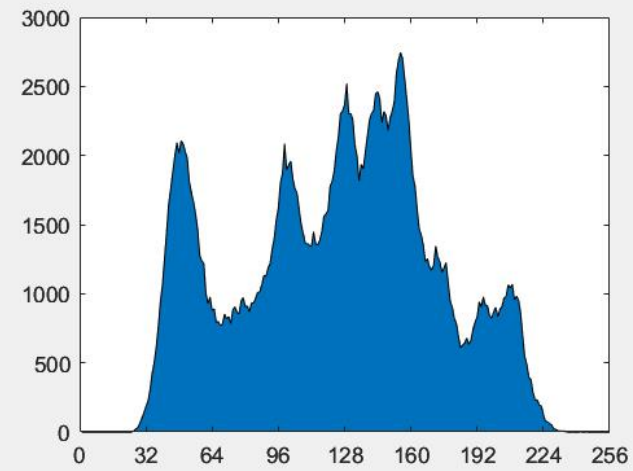
Median Filter

It's order-statistic filter, which replaces the value of a pixel by the median of the intensity levels in a predefined neighborhood of that pixel

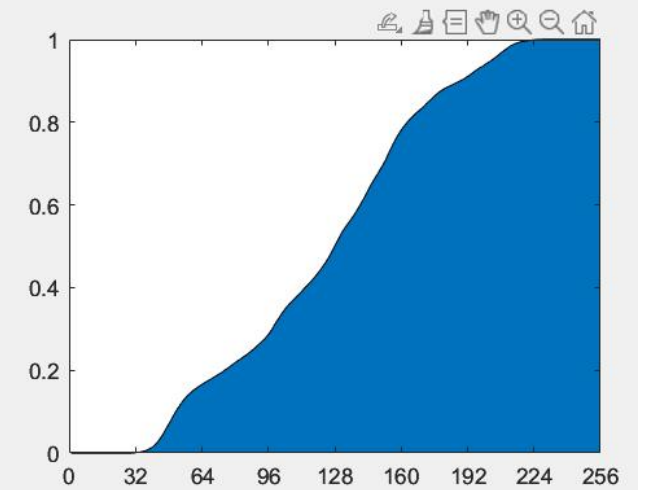
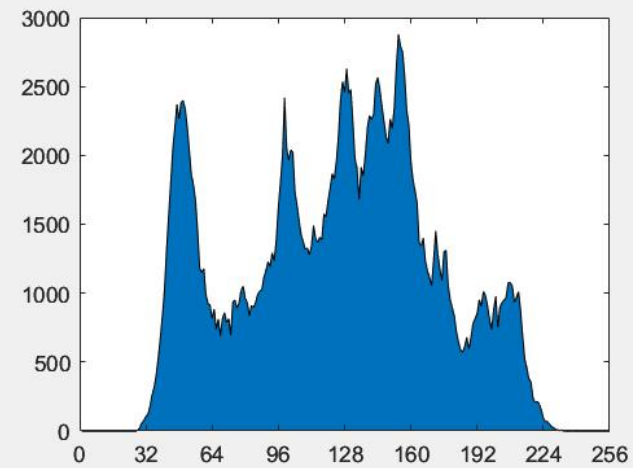
$$I'(u, v) = \text{median}_{(r,c) \in R} \{I(r, c)\}$$



Original
image



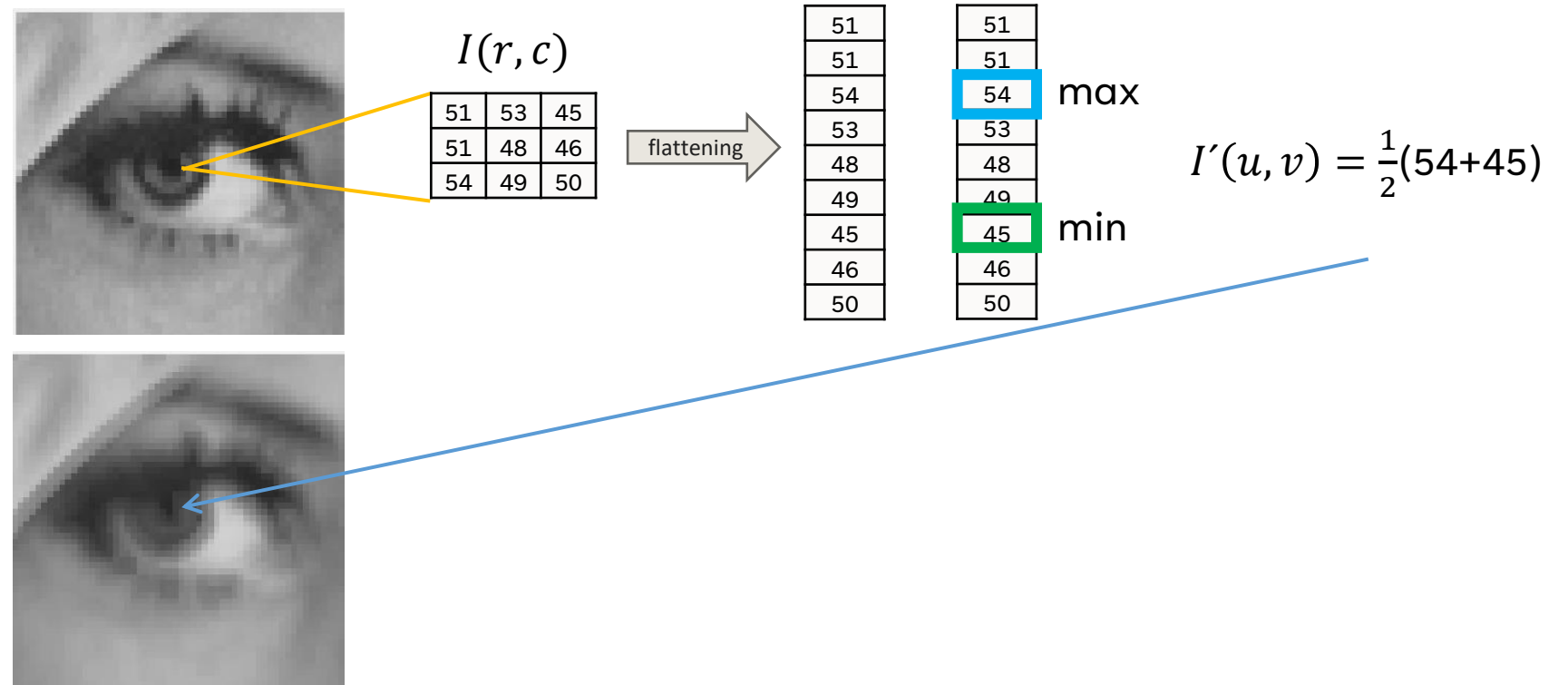
Median
Filter

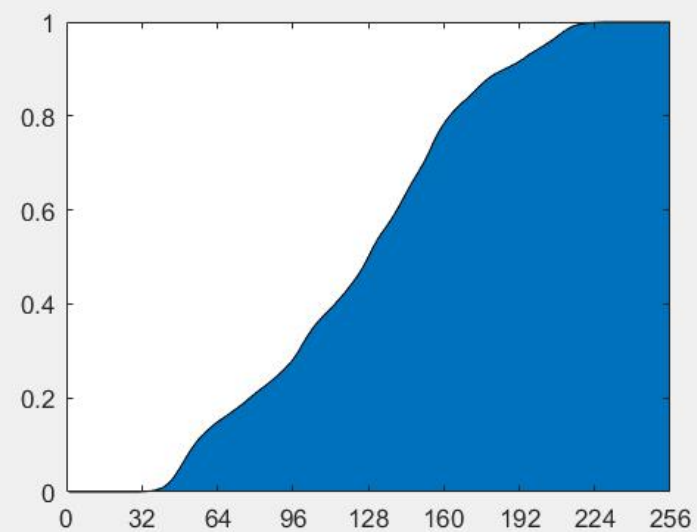
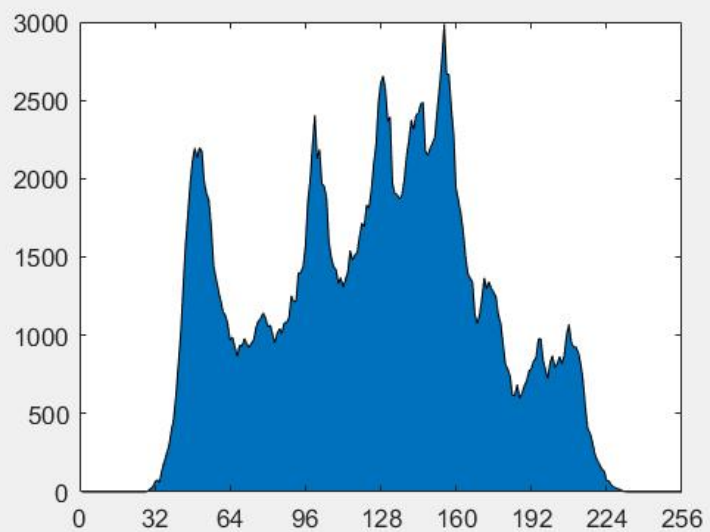
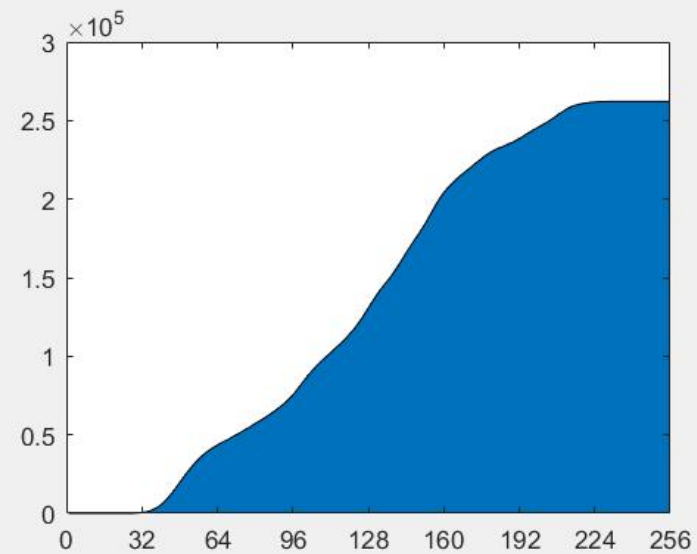
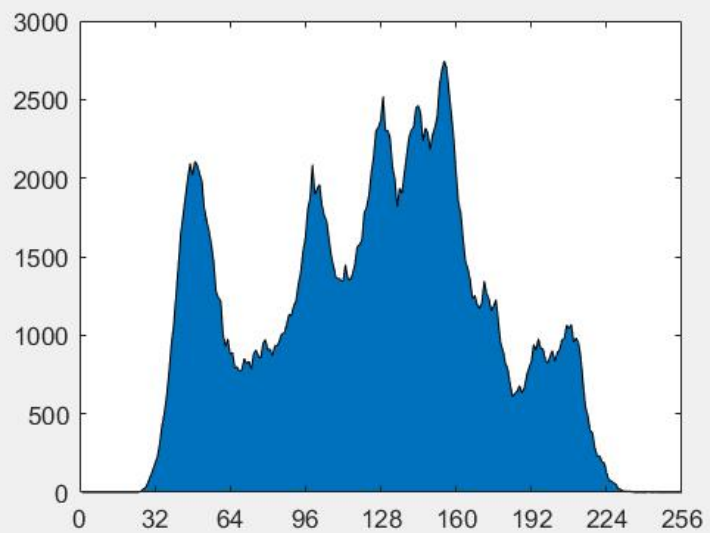


Midpoint Filter

Computes the midpoint between the maximum and the minimum

$$I'(u, v) = \frac{1}{2} [\max_{(r,c) \in R} \{I(r, c)\} + \min_{(r,c) \in R} \{I(r, c)\}]$$



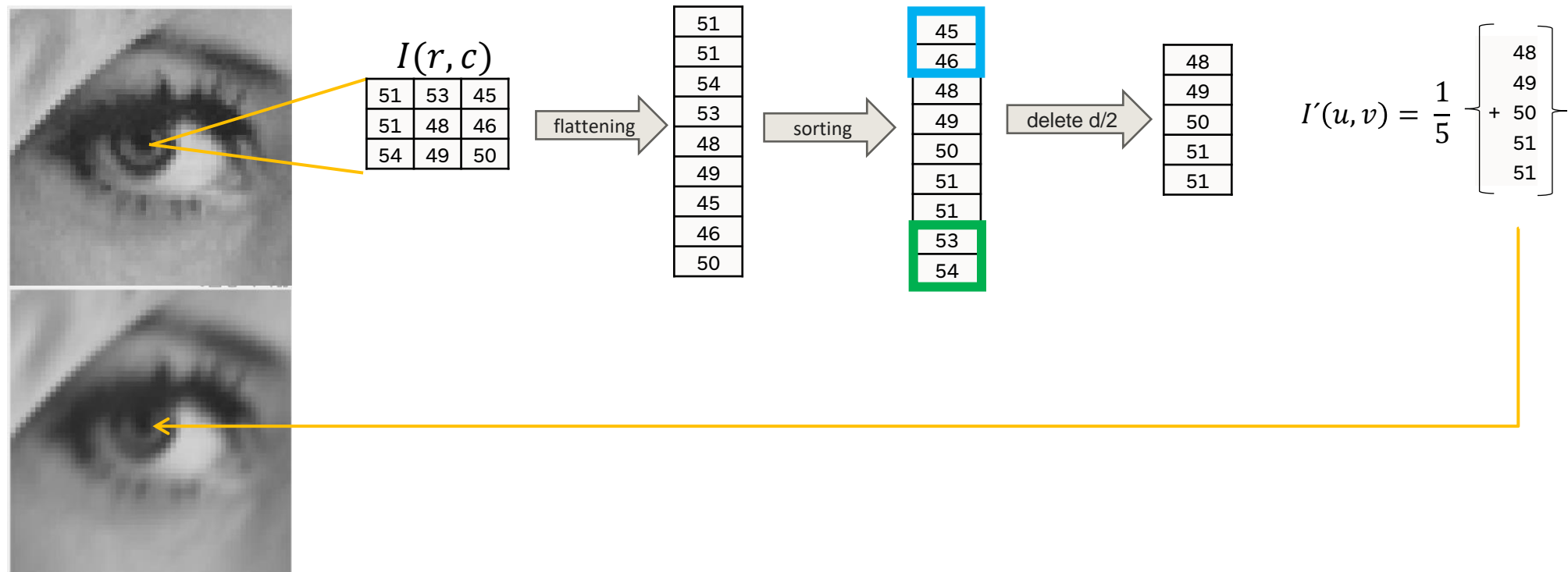


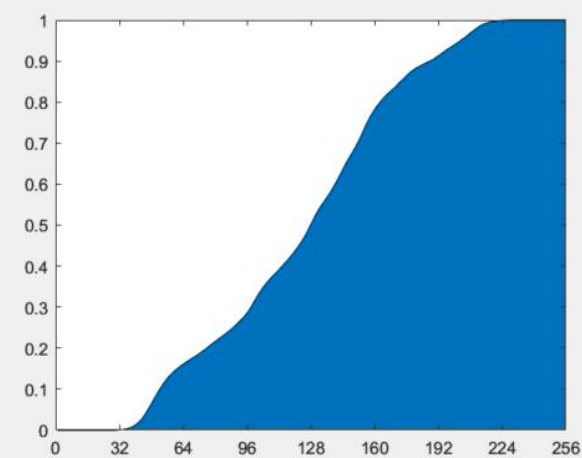
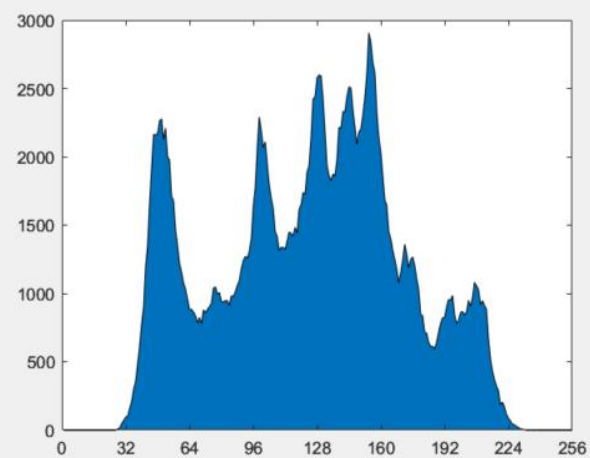
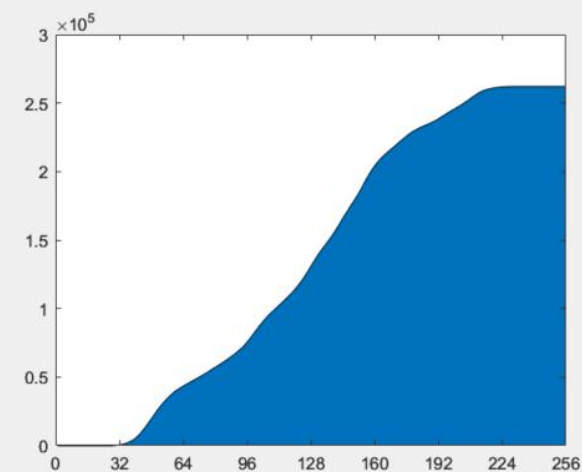
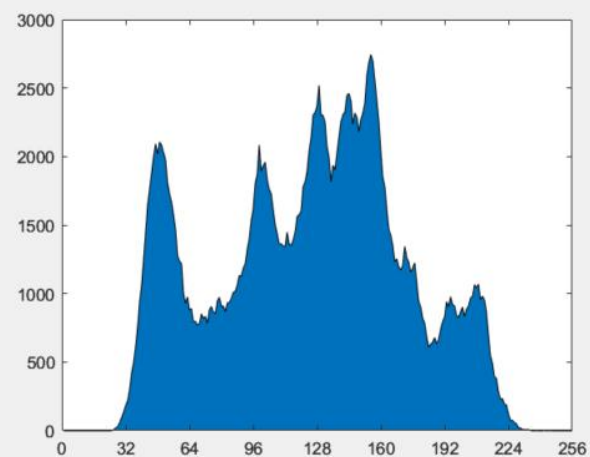
Alpha-Trimmed Mean Filter

Suppose that we delete the $d/2$ lowest and the $d/2$ highest intensity values of $I(r, c)$ in the neighborhood S_{xy} . Let $g_R(r, c)$ represent the remaining $mn - d$ pixels in S_{xy} .

Alpha-trimmed mean filter is the average of these remaining pixels. The form of this filter is

$$I'(u, v) = \frac{1}{mn - d} \sum_{(r, c) \in S_{xy}} g_R(r, c)$$





Weighted Median Filter

It assigns individual weights to the positions in the filter region through weight matrix $W(r, c) \in \mathbb{N}$. To compute the result of the filter, each pixel value $I(r, c)$ involved is inserted $W(r, c)$ times into the extended pixel vector $Q = (p_0, \dots, p_{L-1})$ of length $L = \sum_{(r,c) \in R} W(r, c)$

