Image Enhancement

Image Enhancement

- The principal objective of image enhancement is to process a given image so that the result is more suitable than the original image for a specific application.
- It emphasizes or sharpens image features such as edges, boundaries, or contrast to make a graphic display more helpful for display and analysis.
- The enhancement doesn't increase the inherent information content of the data, but it increases the dynamic range of the chosen features so that they can be detected easily.

Processing Domains

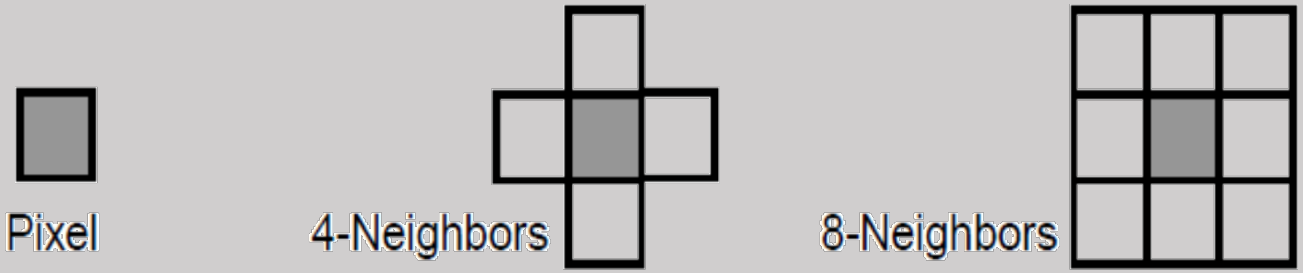
We distinguish two domains

- Spatial or Pixel domain
- Frequency Domain

Spatial/ Pixel Domain

Operations on single pixel at a time

Operations on groups of pixels (neighborhoods)



Spatial/ Pixel Domain

- Most spatial domain enhancement operations can be reduced to the form

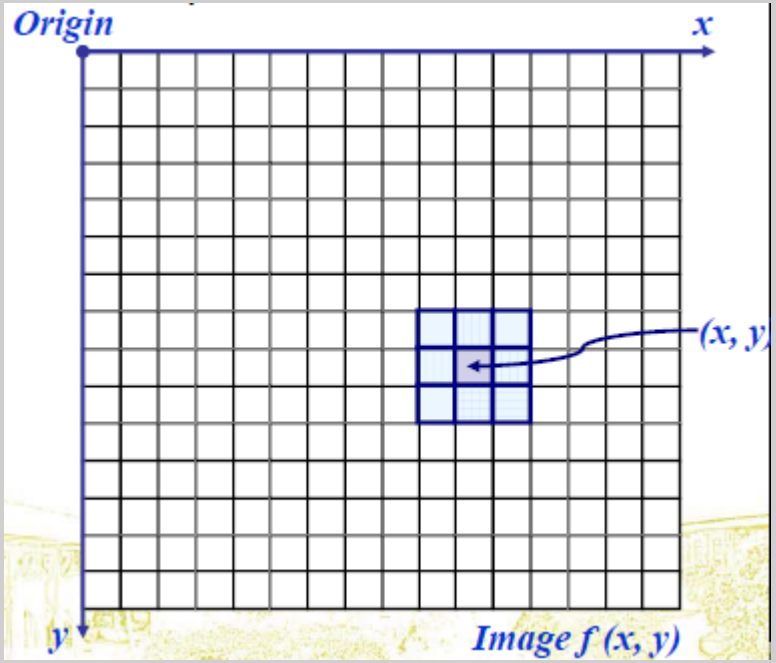
$$g(x, y) = T[f(x, y)]$$

where

$f(x, y)$ is the input image

$g(x, y)$ is the processed image

T is some operator defined over some neighborhood of (x, y)



Point Processing

- The simplest spatial domain operations occur when the neighborhood is simply the pixel itself
- In this case *T* is referred to as a *grey level transformation function* or a *point processing operation*
- Point processing operations take the form

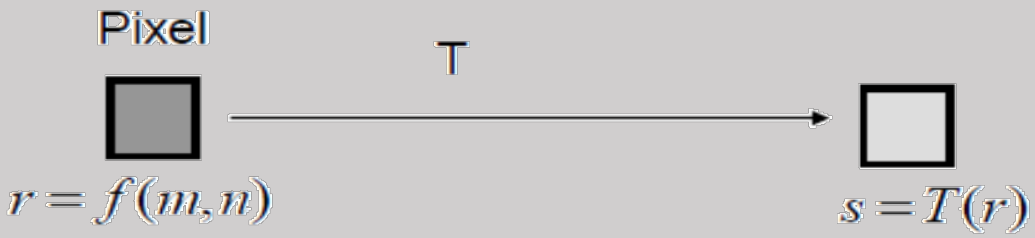
$$s = T(r)$$

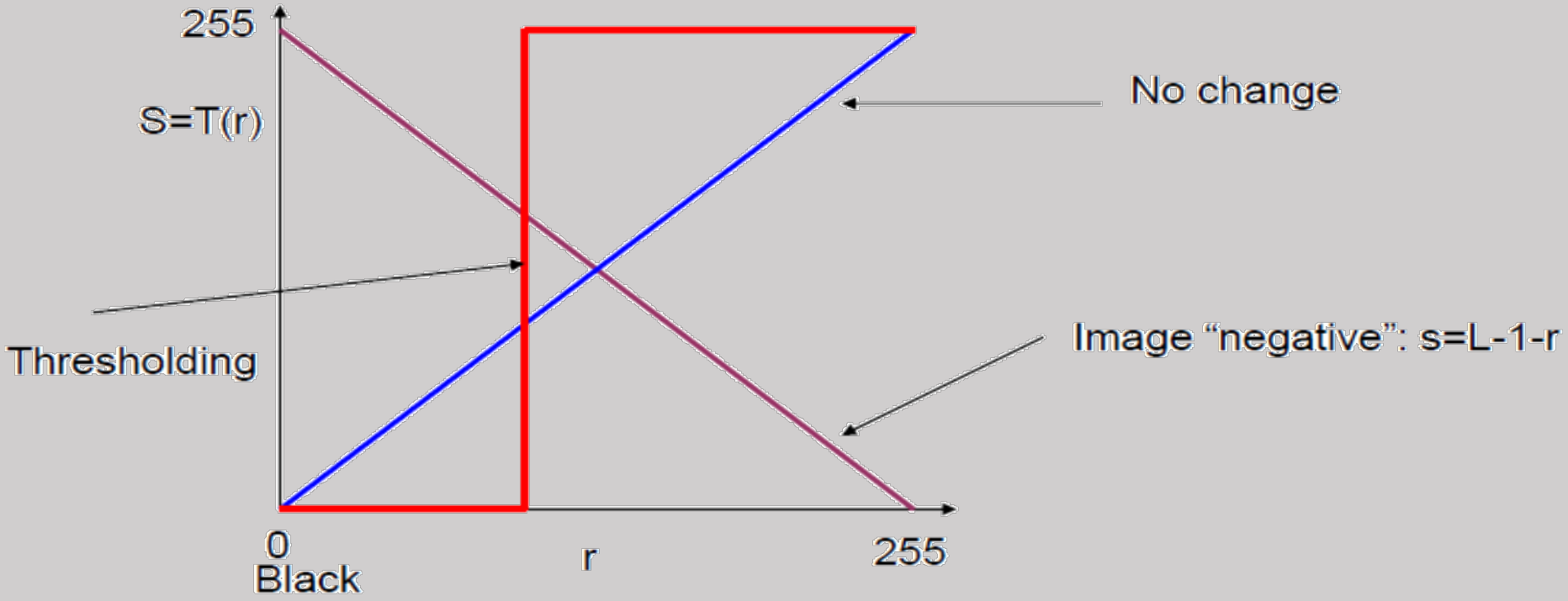
where

s refers to the processed image pixel value

r refers to the original image pixel value

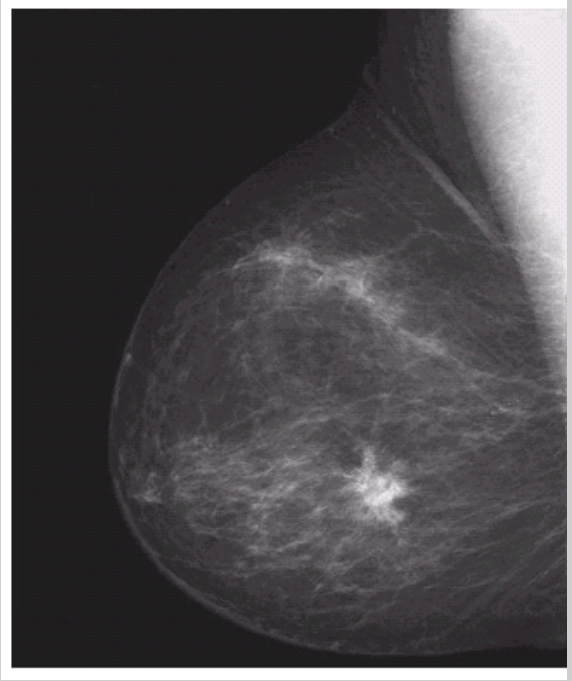
Point Processing



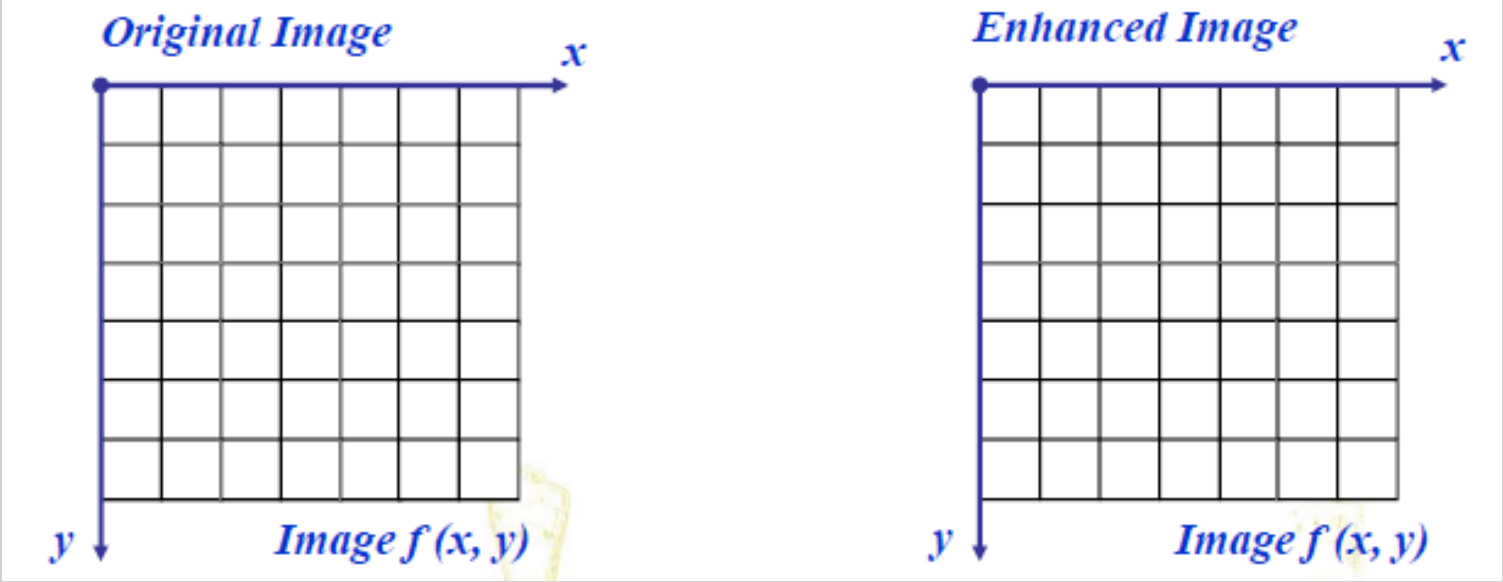


Point Processing – Image Negative

- Negative images are useful for enhancing white or grey detail embedded in dark regions of an image



Point Processing – Image Negative

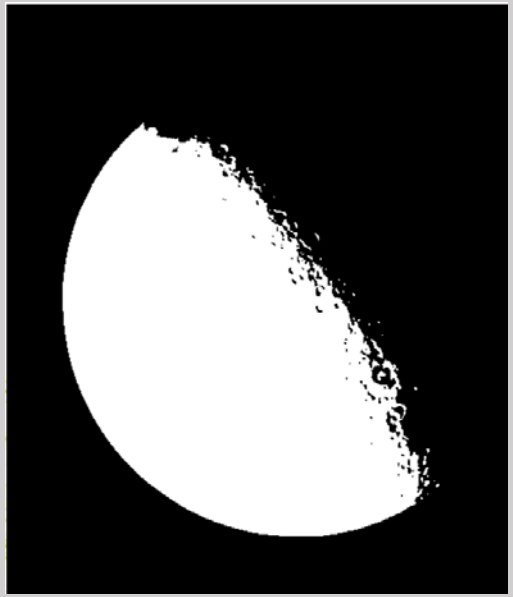


s = Max_Intensity - r

Point Processing – Thresholding

- Thresholding transformations are particularly useful for segmentation in which we want to isolate an object of interest from a background

$$s = \begin{cases} 1.0 & r > \text{threshold} \\ 0.0 & r <= \text{threshold} \end{cases}$$



Clamping

- Deals with pixel values outside displayable range
- If (a > 255) a = 255;
- If (a < 0) a = 0;
- Function below will **clamp** (force) all values to fall within range [*a,b*]

$$f(p) = \begin{cases} a & \text{if } p < a \\ p & \text{if } a \leq p \leq b \\ b & \text{if } p > b \end{cases}$$

Some Simple Operations

Image Transpose

- The transpose image B (M x N) of A (N x M) can be obtained as

$$B(j\ ,\ i) = A(i\ ,\ j)$$

Some Simple Operations

Image Vertical Flip

- The vertical flipped image B ($N \times M$) of A ($N \times M$) can be obtained as $B(i, M - 1 - j) = A(i, j)$ ($i = 0 \ldots\ldots N - 1$; $j = 0 \ldots\ldots M - 1$).