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FACULTY OF EGINEERING

Digital Image Processing
LECTURE-31

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OUTLINE

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Skeleton

The notion of a skeleton S(A) of a set A is intuitively defined, we deduce from this figure that:

a) If z is a point of S(A) and (D)z is the largest disk centered in z and contained in A (one cannot find a larger disk that fulfils this terms) – this disk is called “maximum disk”.

b) The disk (D)z touches the boundary of A at two or more different places.

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Skeleton

•The skeleton of A is defined by terms of erosions and openings:

$$S(A) = \bigcup_{k=0}^{K} S_k(A)$$

•with

$$S_k(A) = (A \ominus kB) - (A \ominus kB) \circ B$$

•Where B is the structuring element and indicates k successive erosions of A:

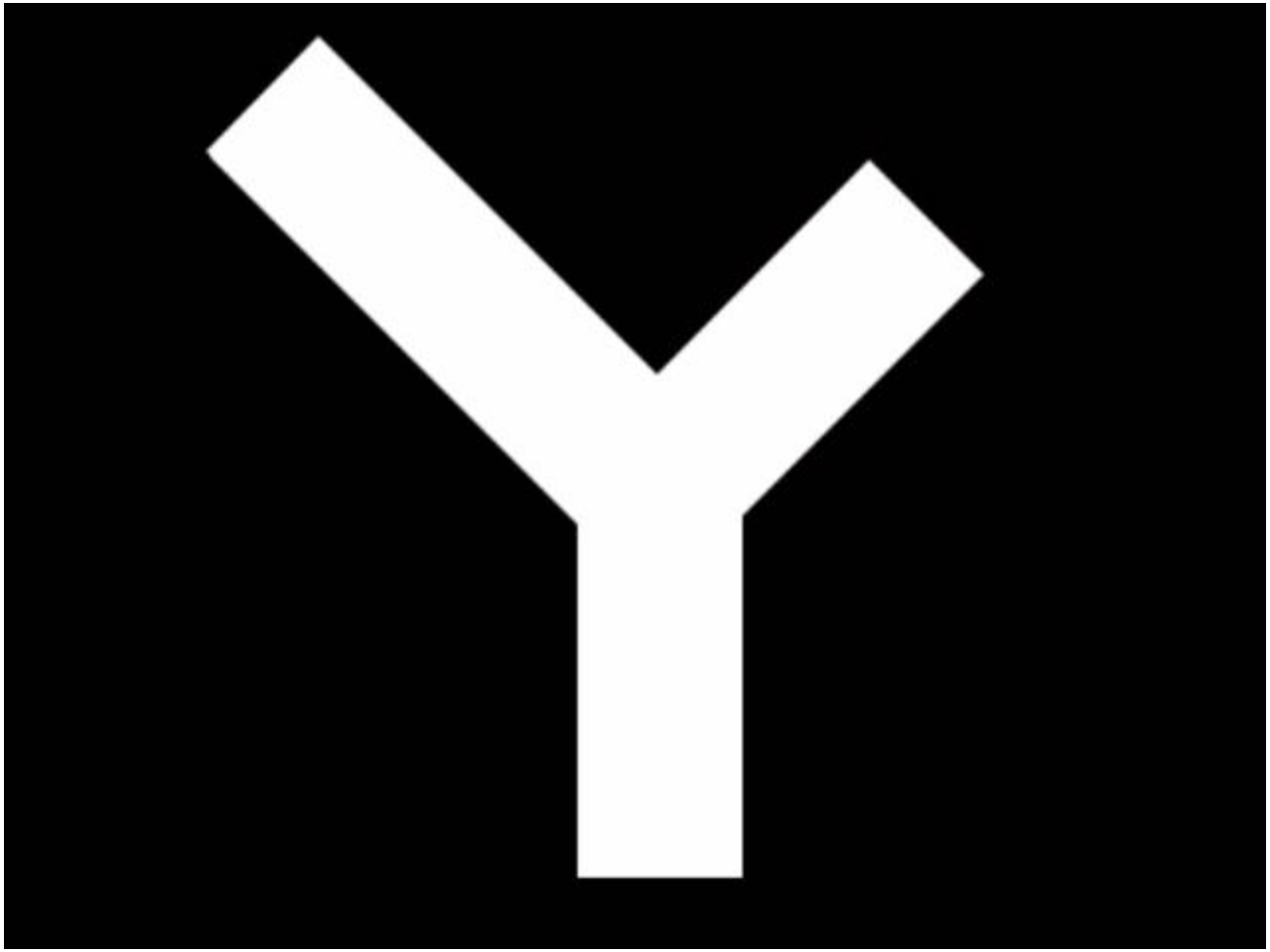
$$(A \ominus kB) = (\dots((A \ominus B) \ominus B) \ominus \dots) \ominus B$$

•k times, and K is the last iterative step before A erodes to an empty set, in other words:

$$K = \max\{k | (A \ominus kB) \neq \emptyset\}$$

•in conclusion S(A) can be obtained as the union of skeleton subsets Sk(A).

Skeleton Example



Dilation – Gray-Scale

•Equation for gray-scale dilation is:

$$(f \oplus b)(s,t) =$$

$$\max\{f(s-x,t-y)+b(x,y)|(s-x),(t-y) \in D_f,(x,y) \in D_b\}$$

•Df and Db are domains of f and b.

•The condition that (s-x),(t-y) need to be in the domain of f and x,y in the domain of b, is analogous to the condition in the binary definition of dilation, where the two sets need to overlap by at least one element.

Dilation – Gray-Scale

•We will illustrate the previous equation in terms of

1-D. and we will receive an equation for 1 variable:

$$(f \oplus b)(s) = \max\{f(s-x) + b(x) | (s-x) \in D_f \text{ and } x \in D_b\}$$

•The requirements the (s-x) is in the domain of f and x is in the domain of b imply that f and b overlap by at least one element.

•Unlike the binary case, f, rather than the structuring element b is shifted.

•Conceptually f sliding by b is really not different than b sliding by f.

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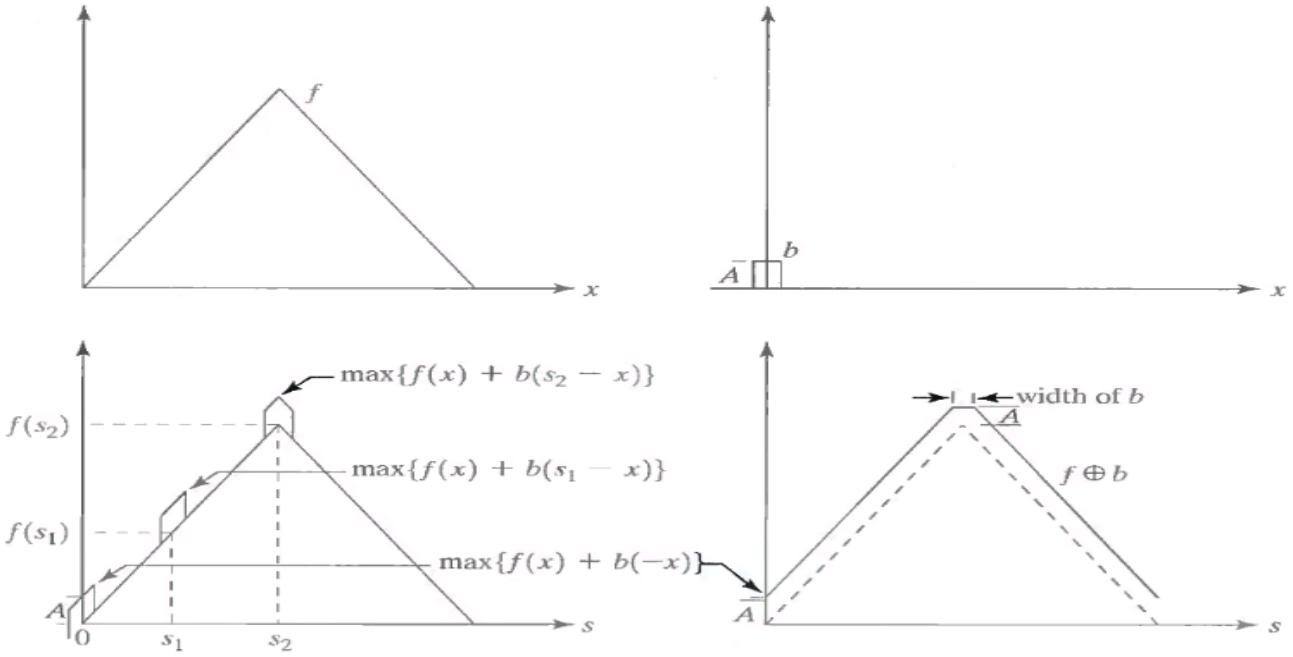
Dilation – Gray-Scale

•The general effects of performing dilation on a gray scale image is twofold:

1. If all the values of the structuring elements are positive than the output image tends to be brighter than the input.

2. Dark details either are reduced or elimanted, depending on how their values and shape relate to the structuring element used for dilation

Dilation – Gray-Scale example



a b
c d

FIGURE 9.27 (a) A simple function. (b) Structuring element of height A. (c) Result of dilation for various positions of sliding b past f. (d) Complete result of dilation (shown solid).

MCQ

1. Which of the following make an image difficult to enhance?
   a) Narrow range of intensity levels
   b) Dynamic range of intensity levels
   c) High noise
   d) All of the mentioned
2. Which of the following is a second-order derivative operator?
   a) Histogram
   b) Laplacian
   c) Gaussian
   d) None of the mentioned
3. Response of the gradient to noise and fine detail is _____ the Laplacian's.
   a) equal to
   b) lower than
   c) greater than
   d) has no relation with

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MCQ

4. Dark characteristics in an image are better solved using _____

a) Laplacian Transform

b) Gaussian Transform

c) Histogram Specification

d) Power-law Transformation

5. What is the smallest possible value of a gradient image?

a) e

b) 1

c) 0

d) -e

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References

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