RAMA UNIVERSITY

www.ramauniversity.ac.in

FACULTY OF EGINEERING

Digital Image Processing
LECTURE-24

Mr. Dhirendra

Assistant Professor

Computer Science & Engineering

OUTLINE

- Morphology Introduction
- Basic Concepts in Set Theory
- Logic Operations Involving Binary Pixels and Images
- Patch similarity: Use of PCA for denoising
- Dilation
- Dilation Examples
- MCQ
- References

Morphology Introduction

• **Morphology "** – a branch in biology that deals with the form and structure of animals and plants.

•**"Mathematical Morphology"** – as a tool for extracting image components, that are useful in the representation and description of region shape.

•The language of mathematical morphology is – Set theory.

•Unified and powerful approach to numerous image processing problems.

•In binary images , the set elements are members of the 2-D integer space – Z2. where each element (x,y) is a coordinate of a black (or white) pixel in the image.

Basic Concepts in Set Theory

Subset

$A \subseteq B$

Union

$A \cup B$

Intersection

$A \cap B$

disjoint / mutually exclusive $A \cap B = \emptyset$

Complement $A^c \equiv \{ w \mid w \notin A \}$

Difference $A - B \equiv \{ w \mid w \in A, w \notin B \} = A \cap B^c$

Reflection $\mathcal{B} \equiv \{ w \mid w = -b, \quad \forall b \in B \}$

Translation $(A)z \equiv \{ c \mid c = a + z, \quad \forall a \in A \}$

Logic Operations Involving Binary Pixels and Images

•The principal logic operations used in image processing

• are: AND, OR, NOT (COMPLEMENT).

•These operations are functionally complete.

•Logic operations are preformed on a pixel by pixel basis between corresponding pixels (bitwise).

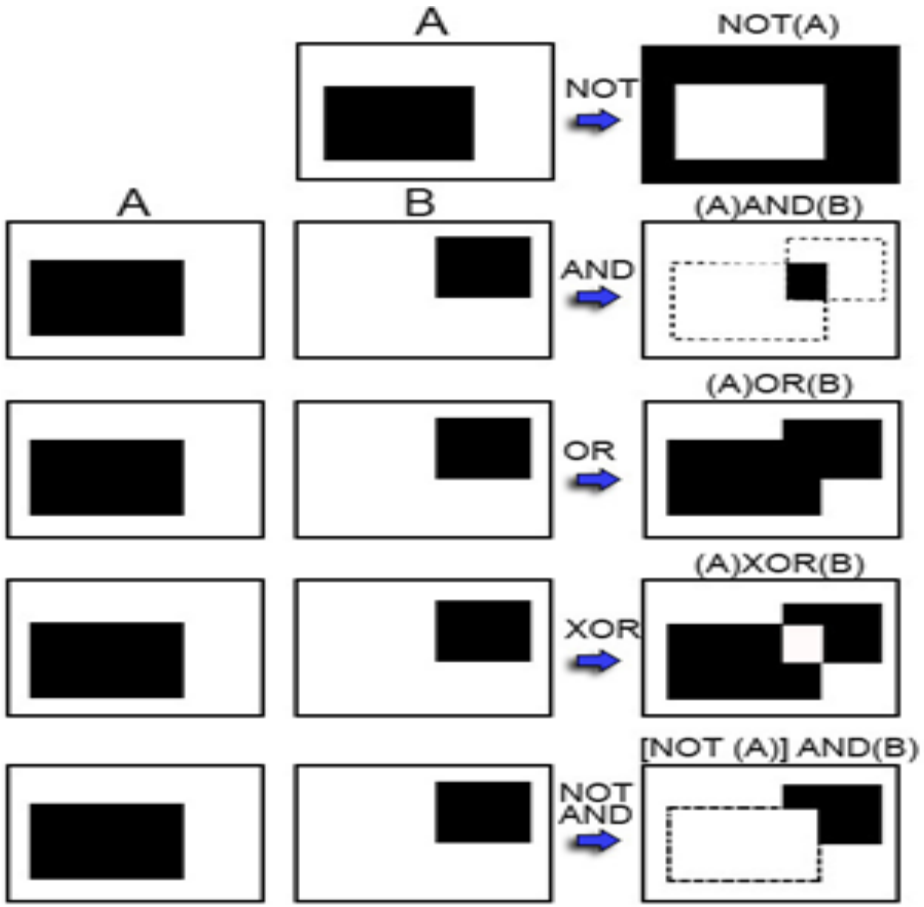
•Other important logic operations :

• XOR (exclusive OR), NAND (NOT-AND)

•Logic operations are just a private case for a binary set operations, such : AND – Intersection , OR – Union,

• NOT-Complement.

Patch similarity: Use of PCA for denoising



Dilation

•Dilation is used for expanding an element A by using structuring element B

•Dilation of A by B and is defined by the following equation:

$$A \oplus B = \{z|(\hat{B})_z \cap A \neq \emptyset\} \quad (9.2-1)$$

•This equation is based 0n obtaining the reflection 0f B about its origin and shifting this reflection by z.

•The dilation of A by B is the set of all displacements z, such that $\hat{B}$ and A overlap by at least one element. Based

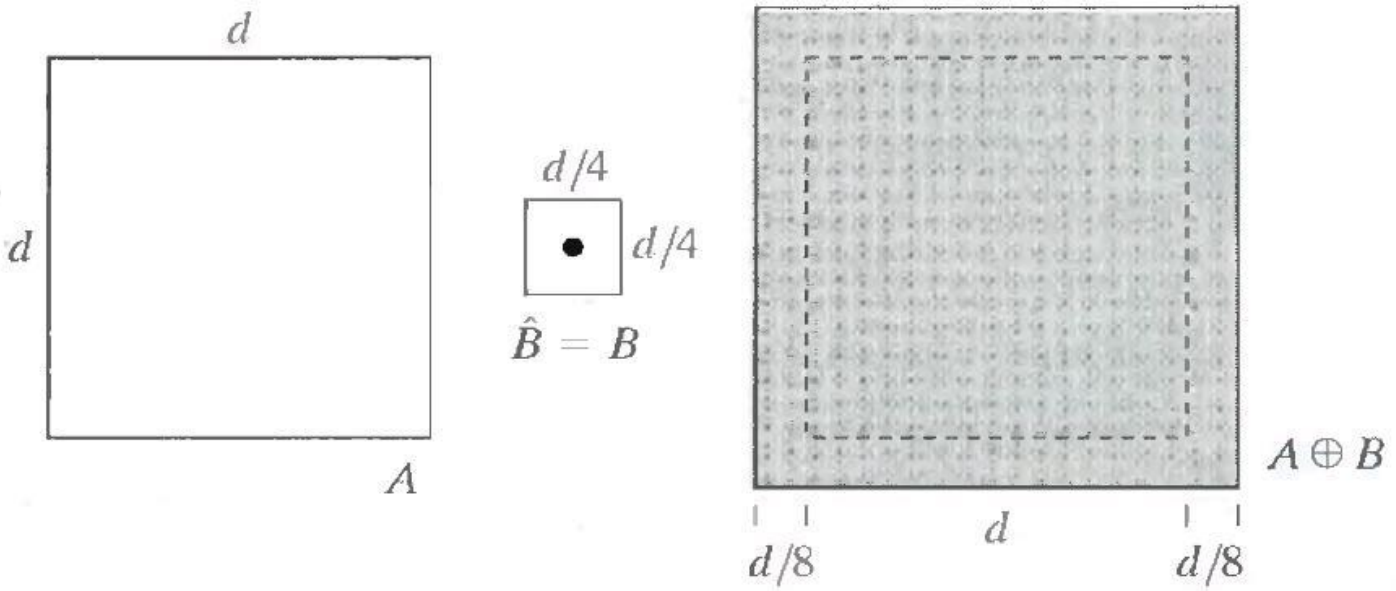
On this interpretation the equation of (9.2-1) can be rewritten as:

$$A \oplus B = \{z|[(\hat{B})z \cap A] \subset A\} \quad (9.2-2)$$

Dilation Example 1

a b c

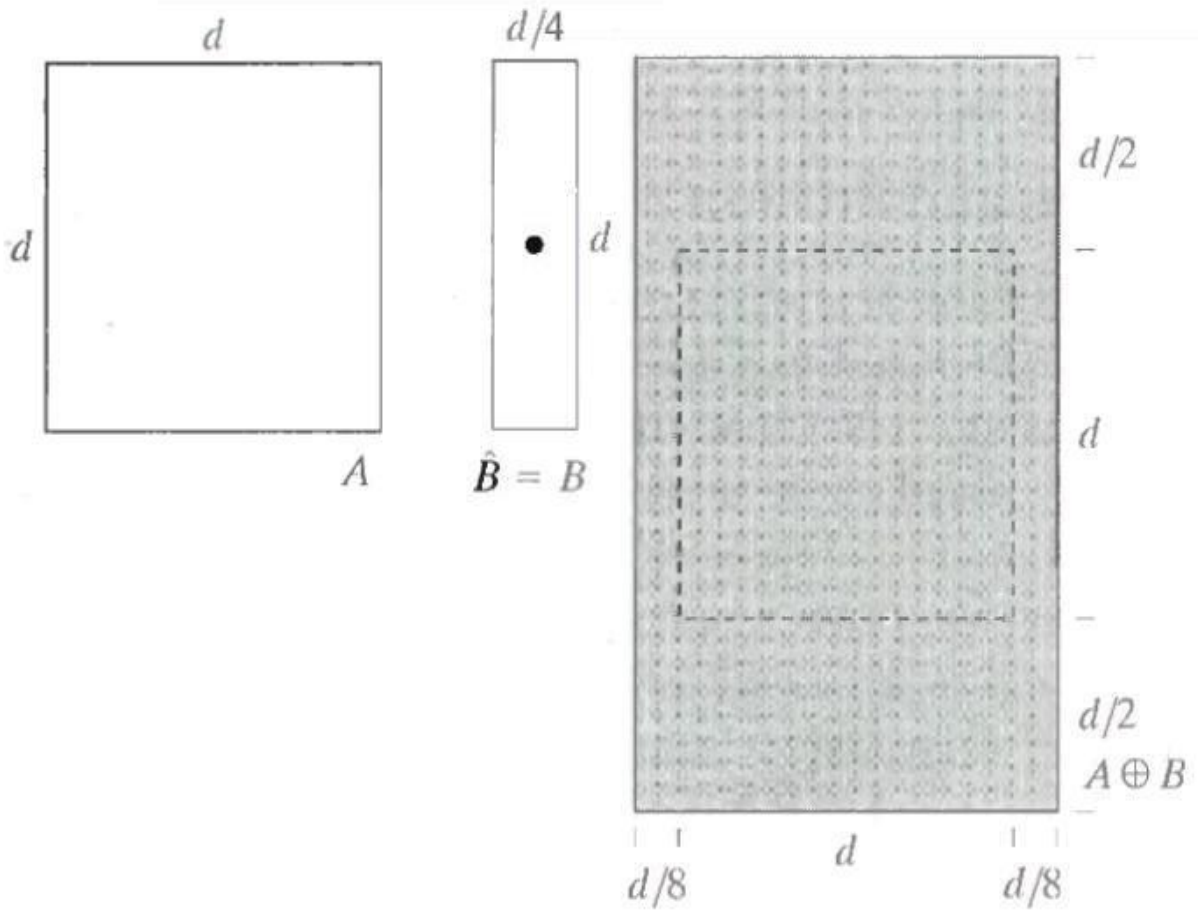
FIGURE 9.4
(a) Set A.
(b) Square structuring element (dot is the center).
(c) Dilation of A by B, shown shaded.



Dilation Example 2

a d e

(d) Elongated structuring element.
(e) Dilation of A using this element.



MCQ

1. The derivative of digital function is defined in terms of difference. Then, which of the following defines the first order derivative ∂f/∂x= _____ of a one-dimensional function f(x)?

   a) f(x+1)-f(x)

   b) f(x+1)+ f(x-1)-2f(x)

   c) All of the mentioned depending upon the time when partial derivative will be dealt along two spatial axes

   d) None of the mentioned

2. The derivative of digital function is defined in terms of difference. Then, which of the following defines the second order derivative ∂2 f/∂x2 = _____ of a one-dimensional function f(x)?

   a) f(x+1)-f(x)

   b) f(x+1)+ f(x-1)-2f(x)

   c) All of the mentioned depending upon the time when partial derivative will be dealt along two spatial axes

   d) None of the mentioned

3. What kind of relation can be obtained between first order derivative and second order derivative of an image having a on the basis of edge productions that shows a transition like a ramp of constant slope?

   a) First order derivative produces thick edge while second order produces a very fine edge

   b) Second order derivative produces thick edge while first order produces a very fine edge

   c) Both first and second order produces thick edge

   d) Both first and second order produces a very fine edge

MCQ

4. What kind of relation can be obtained between first order derivative and second order derivative of an image on the response obtained by encountering an isolated noise point in the image?

a) First order derivative has a stronger response than a second order

b) Second order derivative has a stronger response than a first order

c) Both enhances the same and so the response is same for both first and second order derivative

d) None of the mentioned

View Answer

5. What kind of relation can be obtained between the response of first order derivative and second order derivative of an image having a transition into gray-level step from zero?

a) First order derivative has a stronger response than a second order

b) Second order derivative has a stronger response than a first order

c) Both first and second order derivative has the same response

d) None of the mentioned

References

- https://www.javatpoint.com/digital-image-processing-tutorial
- Henry Sambrooke Leigh, Carols of Cockayne, The Twins Morphological Image Processing (Digital Image Processing – Gonzalez/Woods)
- https://www.geeksforgeeks.org/
- Digital Image Processing 2nd Edition, Rafael C. Gonzalvez and Richard E. Woods. Published by: Pearson Education.
- Digital Image Processing and Computer Vision, R.J. Schalkoff. Published by: JohnWiley and Sons, NY.
- Fundamentals of Digital Image Processing, A.K. Jain. Published by Prentice Hall,Upper Saddle River, NJ.