

Morphological Image Processing

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Morphology

- **Morphology** in biology: **Form** and **structure** of animals and plants.
- **Mathematical morphology**: a tool for extracting image components
 - The representation and description of region shape
 - Boundaries
 - Skeleton
 - Convex Hull
 - Applications: Extract “**meaning**” from an image
 - Morphological filtering, thinning and pruning

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Preliminaries

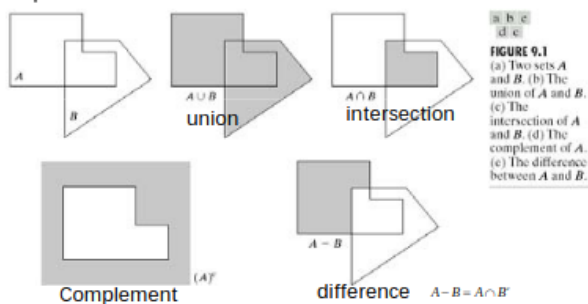
Set Theory

- **Set Theory**: Set = Object in image
- **Binary Image**:
 - $\{(x_1, y_1), (x_2, y_2), \dots\}$
 - Z^2 tuple: The set of all black pixels is a complete morphological description of image
- **Gray-scale Image**:
 - $\{(x_1, y_1, I_1), (x_2, y_2, I_2), \dots\}$
 - Z^3 tuple
- **Higher dimensional tuple**:
 - Contain other image attributes:
 - Color, Time varying component

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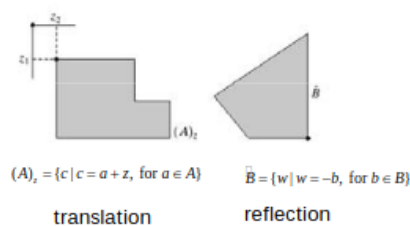
Set Theory



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Set Theory



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Logic Operations Involving Binary Image

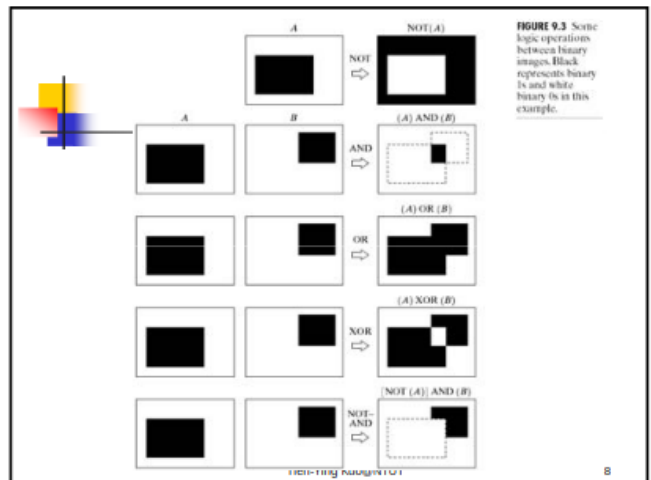
- AND, OR and NOT:
 - functionally complete: can be combined to form any other logic operation
 - In binary image: AND=intersection,...

TABLE 9.1
The three basic logical operations

p	q	$p \text{ AND } q$ (also $p \cdot q$)	$p \text{ OR } q$ (also $p + q$)	$\text{NOT } (p)$ (also \bar{p})
0	0	0	0	1
0	1	0	1	1
1	0	0	1	0
1	1	1	1	0

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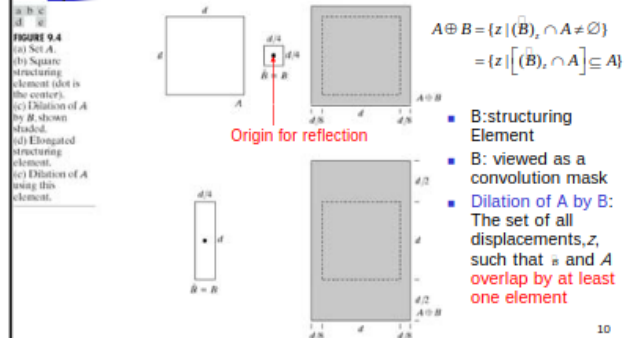
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Dilation and Erosion (binary image)

Dilation



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Dilation

- Application: Bridging Gaps
 - Known: Max break length=2 pixel
 - To Design B
 - Result directly in a binary image
 - Better than LPF: I/P binary \Rightarrow O/P gray-scale

Historically, certain computer programs were written using only two digits rather than four to define the applicable year. Accordingly, the company's software may recognize a date using "00" as 1900 rather than the year 2000.

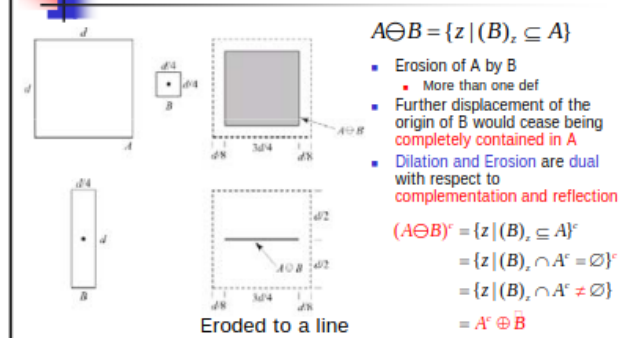
Historically, certain computer programs were written using only two digits rather than four to define the applicable year. Accordingly, the company's software may recognize a date using "00" as 1900 rather than the year 2000.

FIGURE 9.5 (a) Sample text of poor resolution with broken characters (magnified view). (b) Structuring element. (c) Dilation of (a) by (b). Broken segments were joined.



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Erosion



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