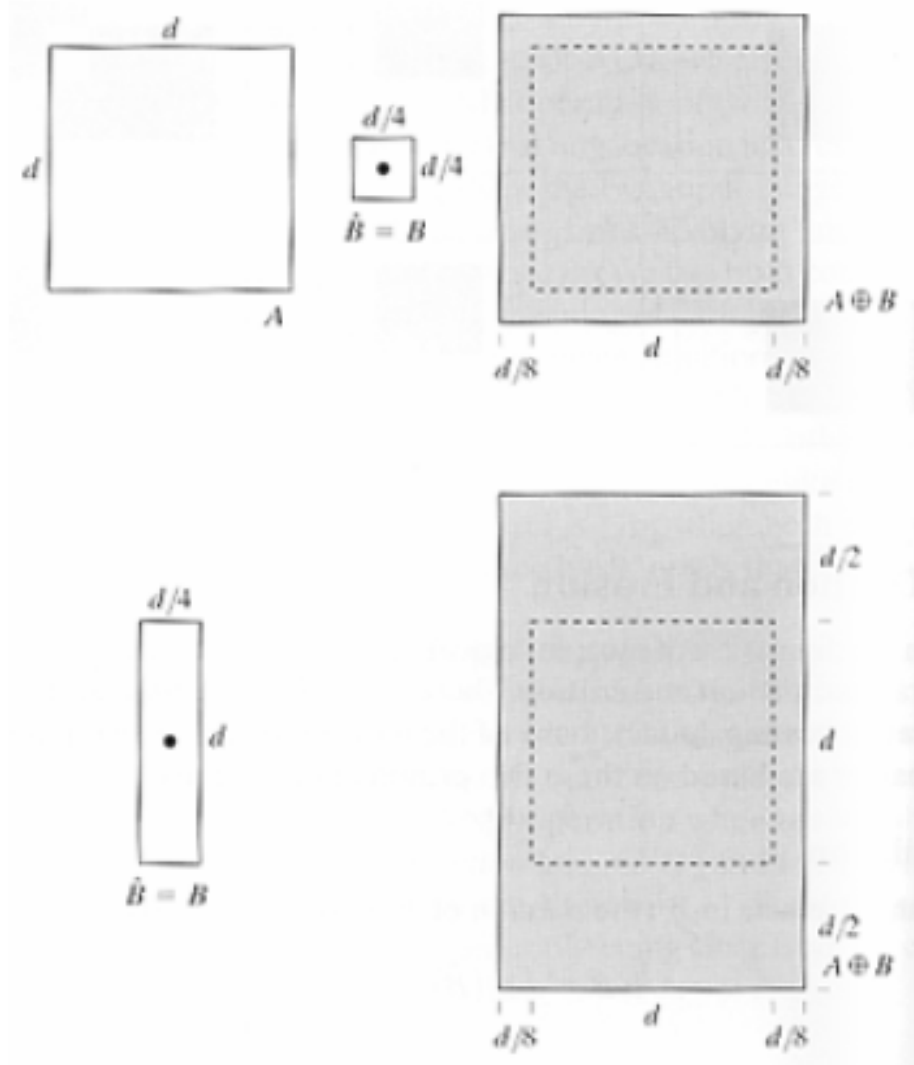# Morphological Operators
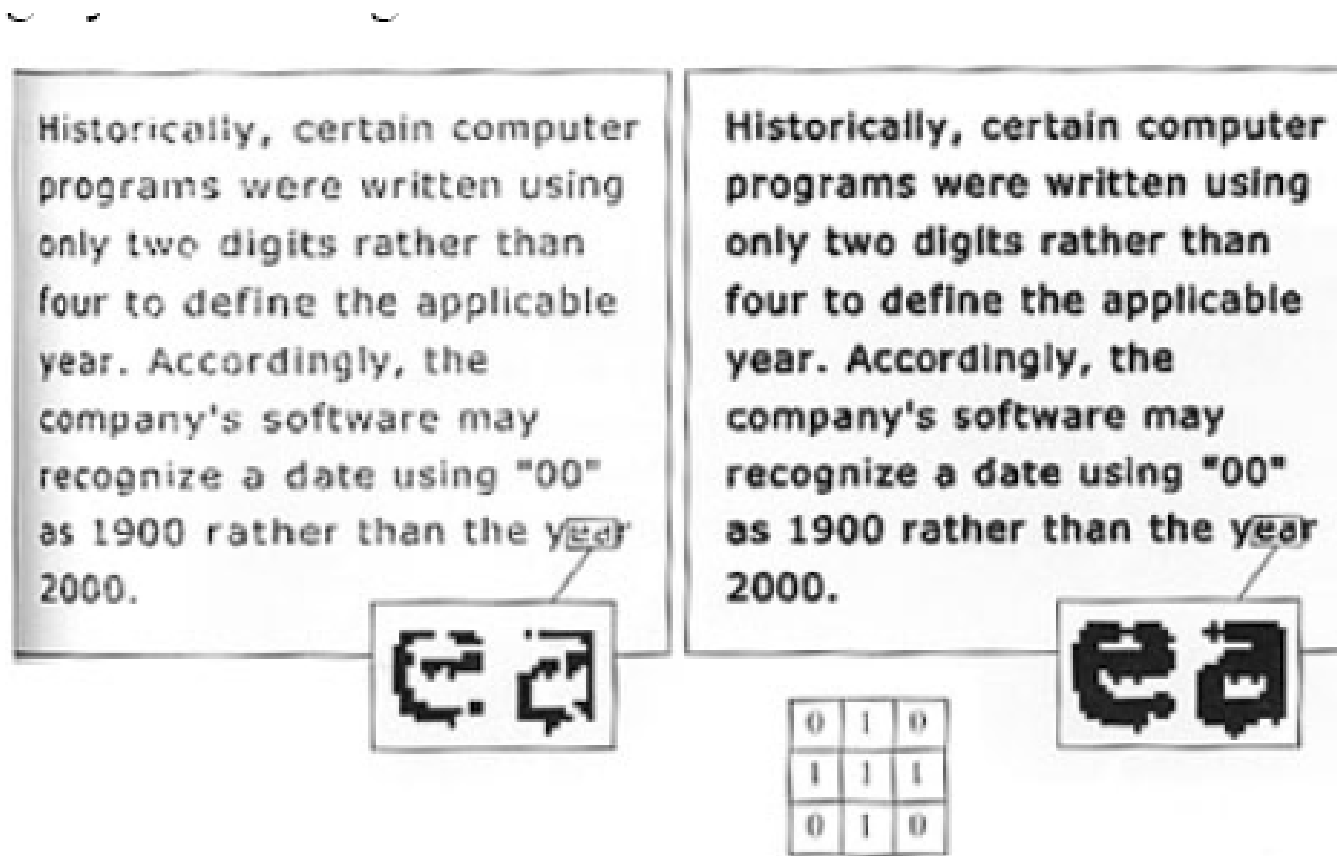
CS 111: Digital Image Processing
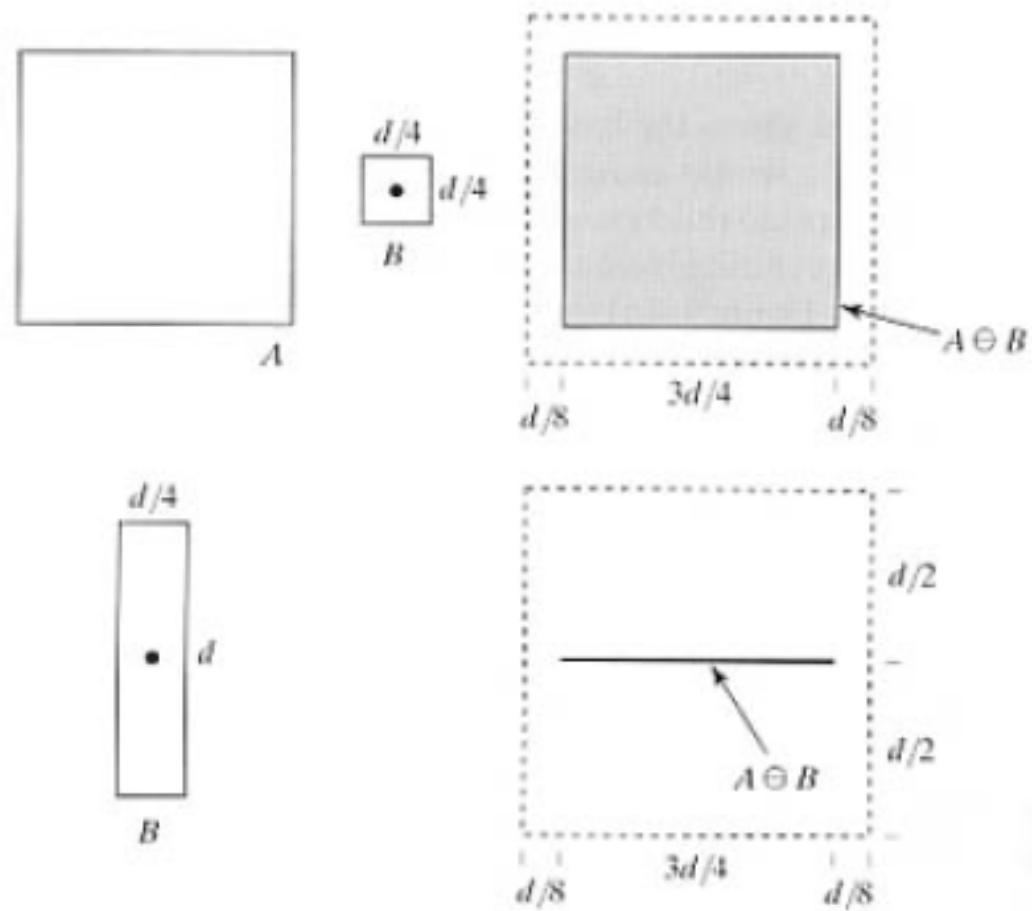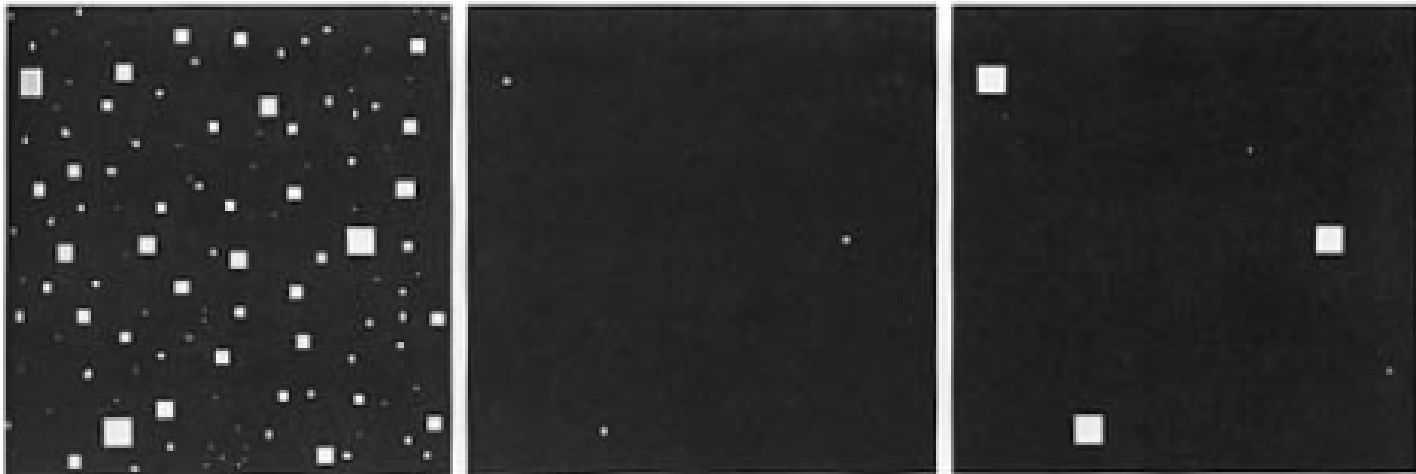
Dilation

Dilation: Join Broken Segments

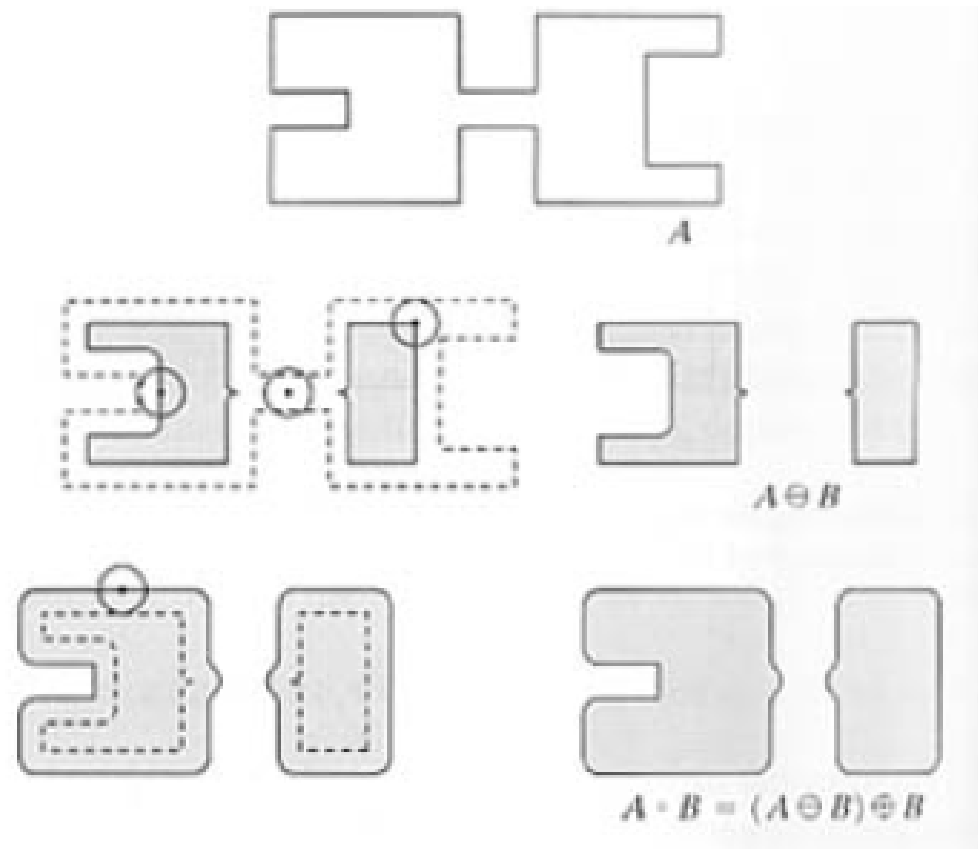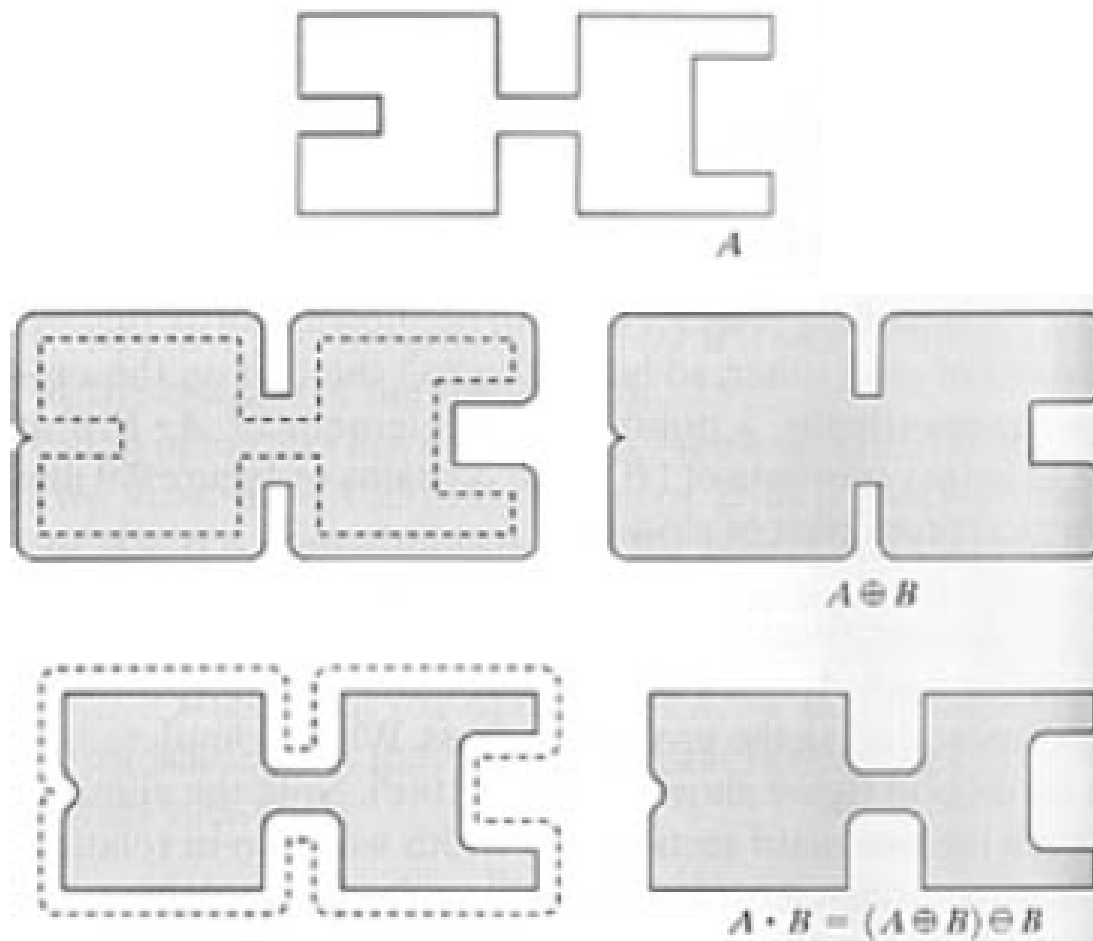# Erosion

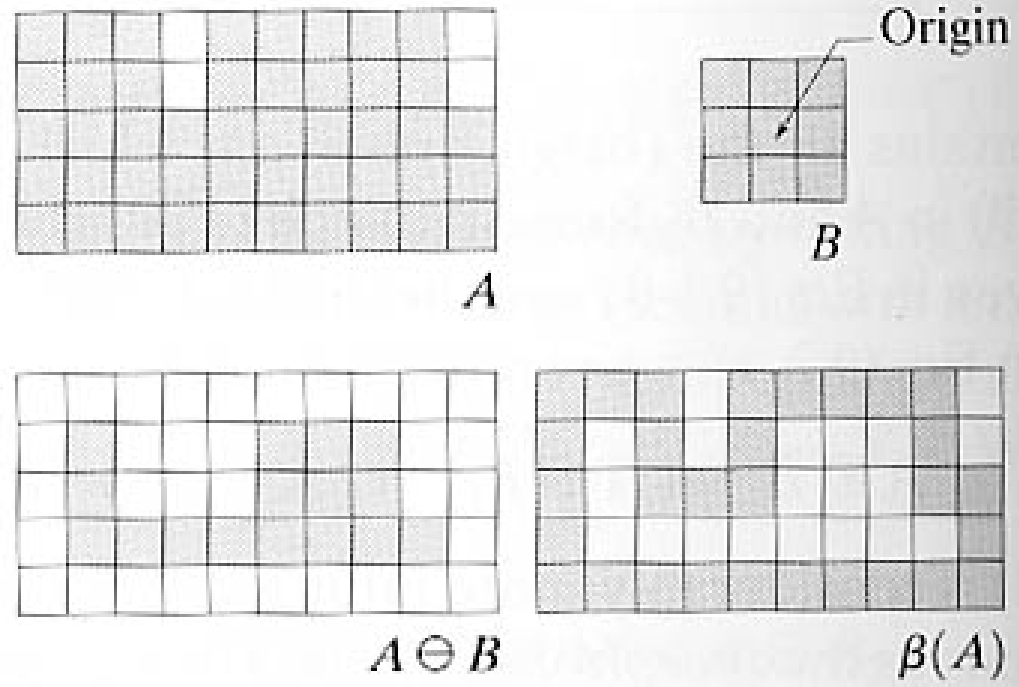# Erosion and Dilation: Eliminating Irrelevant Details
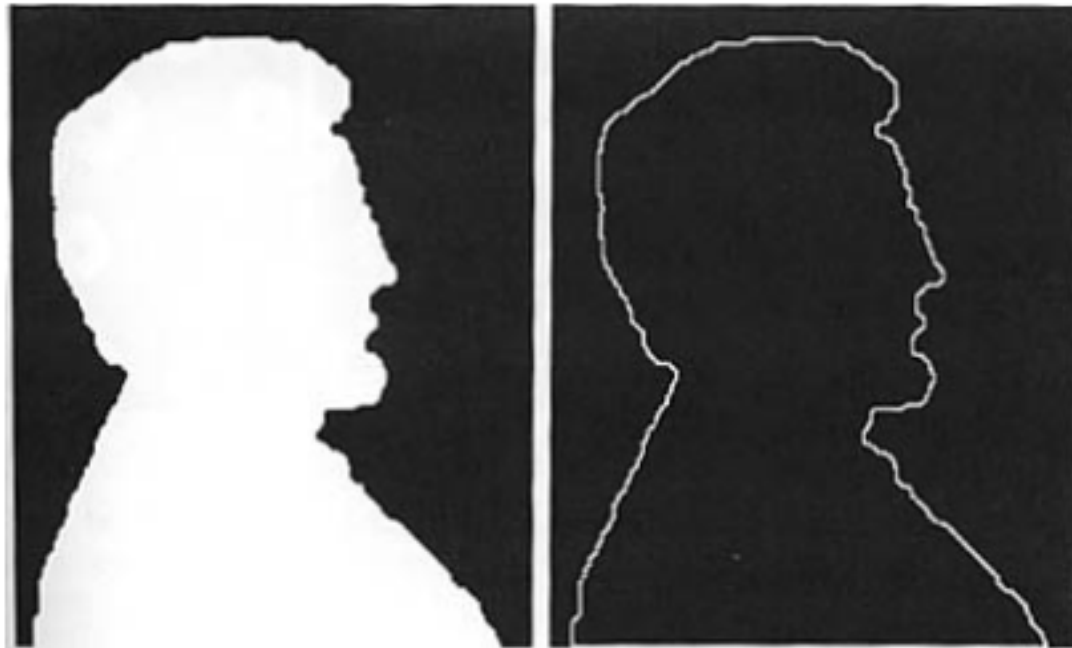
Opening

A

$A \ominus B$

$A \cdot B = (A \ominus B) \oplus B$

Closing

A

$A \oplus B$

$A \cdot B = (A \oplus B) \ominus B$

Opening and Closing: Noise Filter

Boundary Extraction

Region Filling

Region Filling

A	A^c	B
X_0	X_1	X_2
X_6	X_7	$X_7 \cup A$
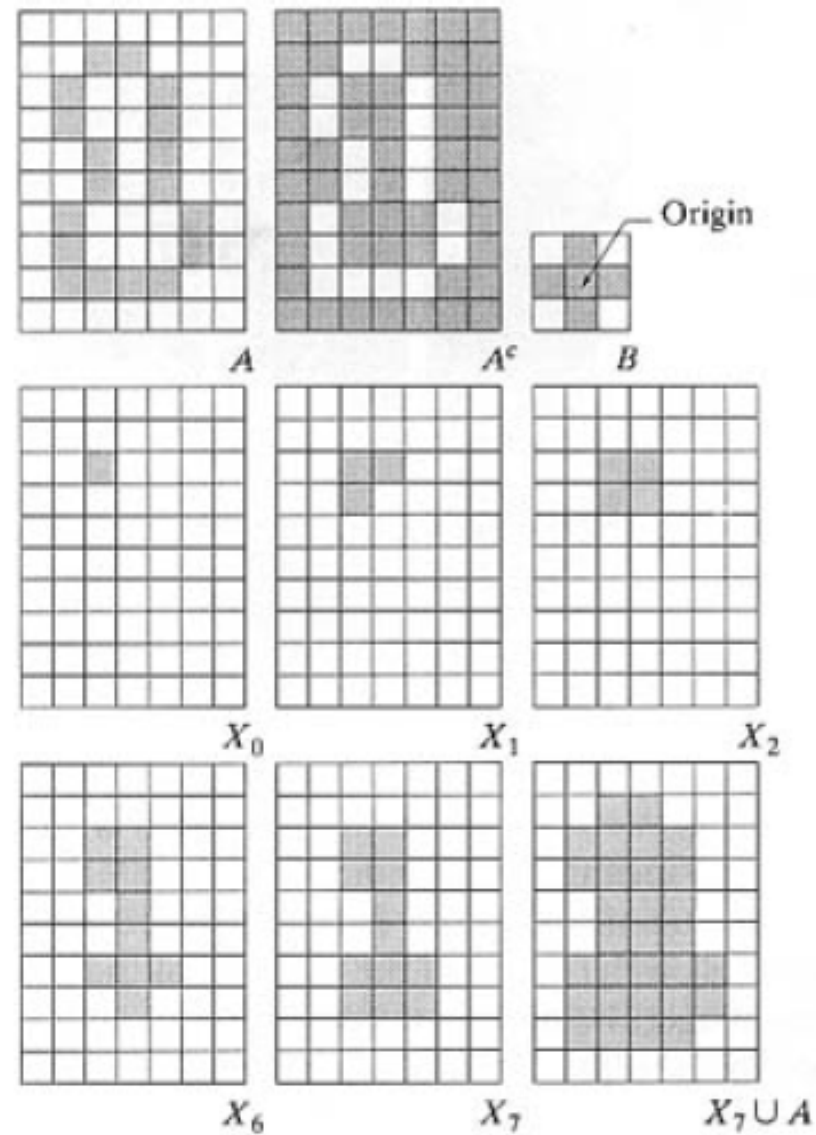
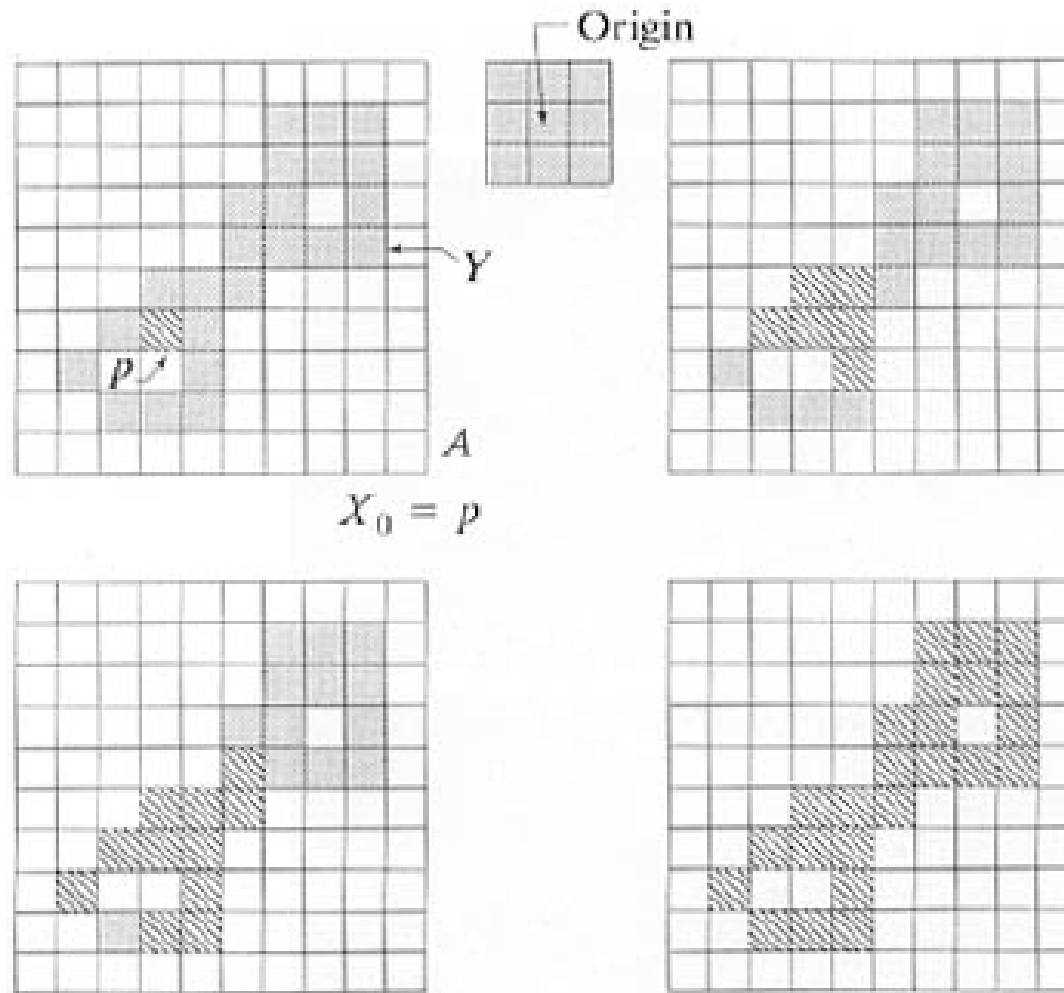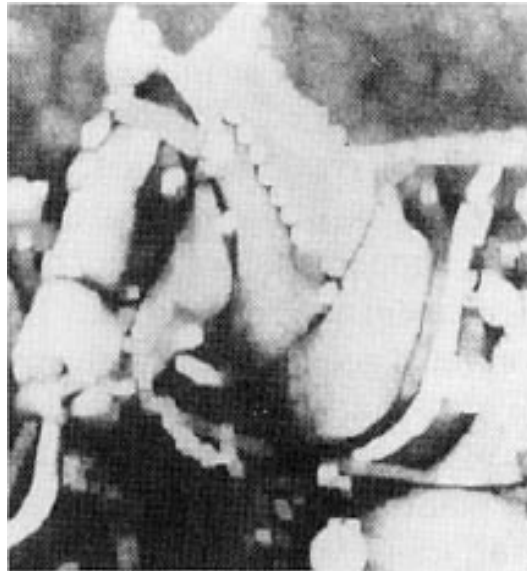Origin

Connected Components

Gray Scale: Dilation and Erosion

Original

Dilation: Brighter where small dark details are reduced

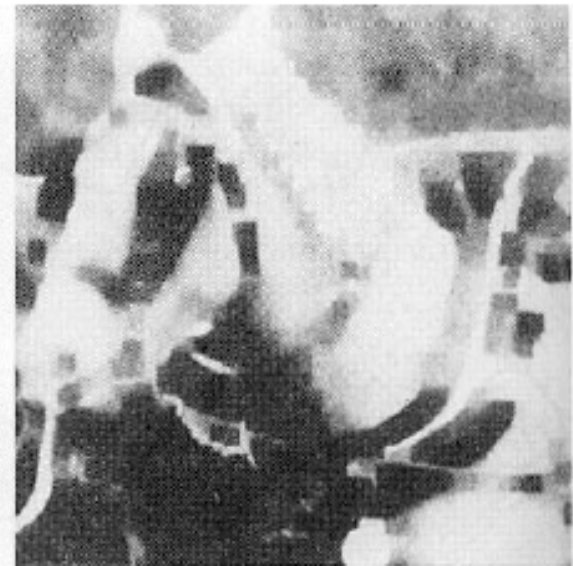Erosion: Darker where small bright details are reduced
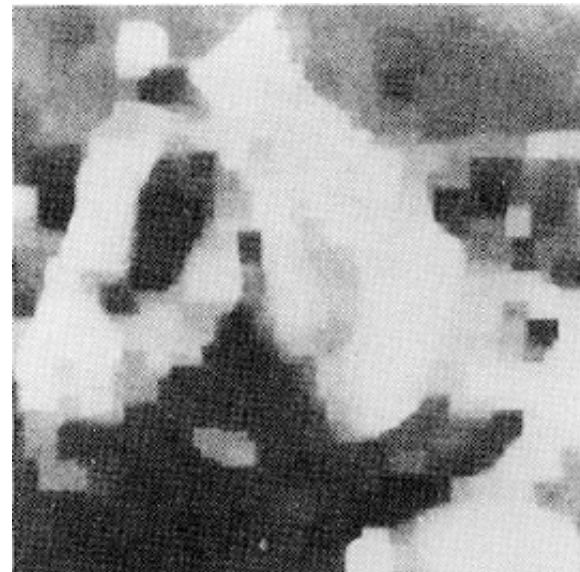
Gray Scale: Opening and Closing

Original

Opening: Reduces
small bright details with
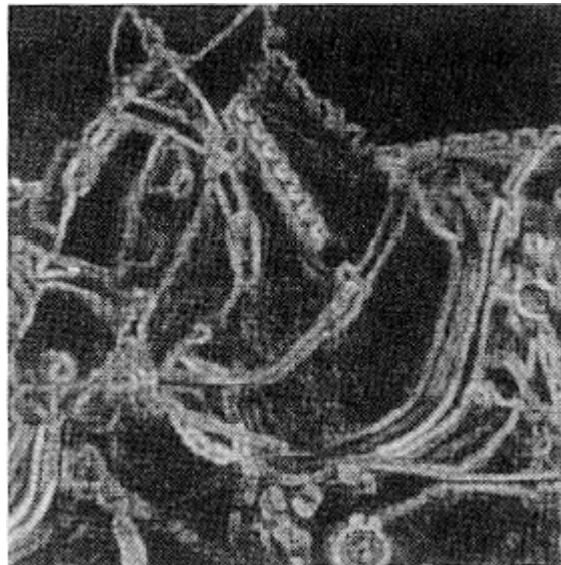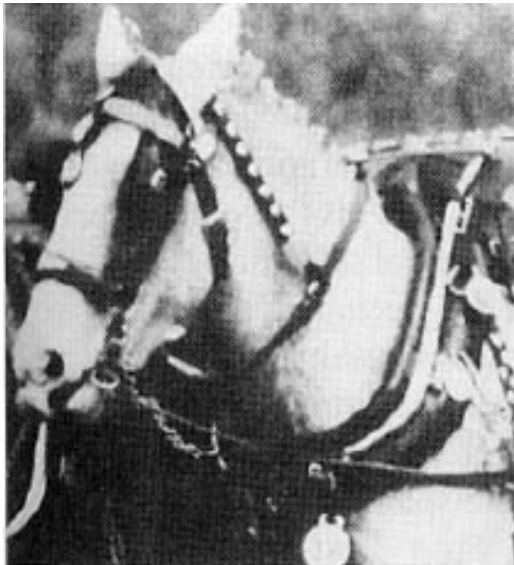little effect on dark
areas.

Closing: Reduces small
dark details with little
effect on bright areas

Smoothing: Opening and then Closing

Gradient: Dilation - Erosion

- Morphological Edge Detector
- Direction Independent