Morphological Operation

Sung Soo Hwang

Introduction

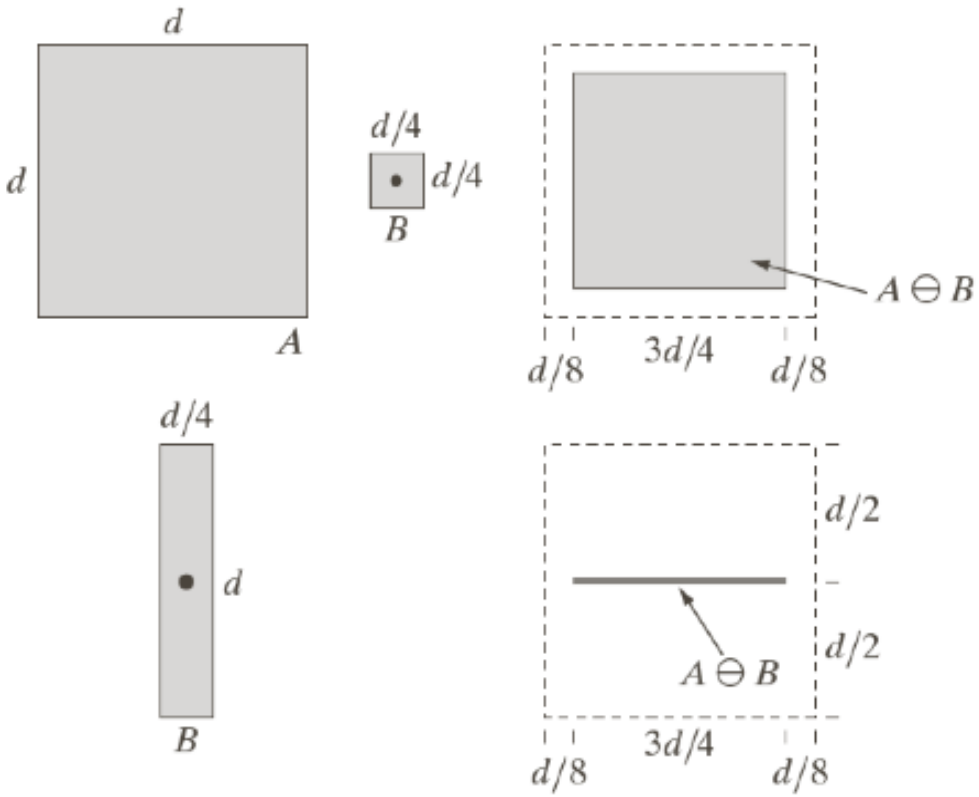
Background subtraction

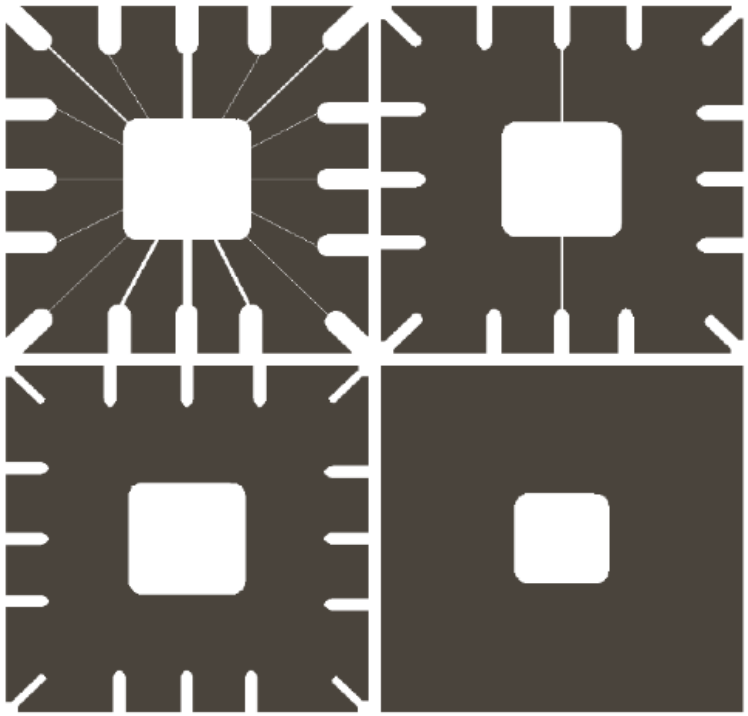
Morphological operation

Lee JH, Choi JS, Jeon ES, Kim YG, Le TT, Shin KY, Lee HC, Park KR, "Robust pedestrian detection by combining visible and thermal infrared cameras," Sensors (Basel) (2015)

Erosion and dilation

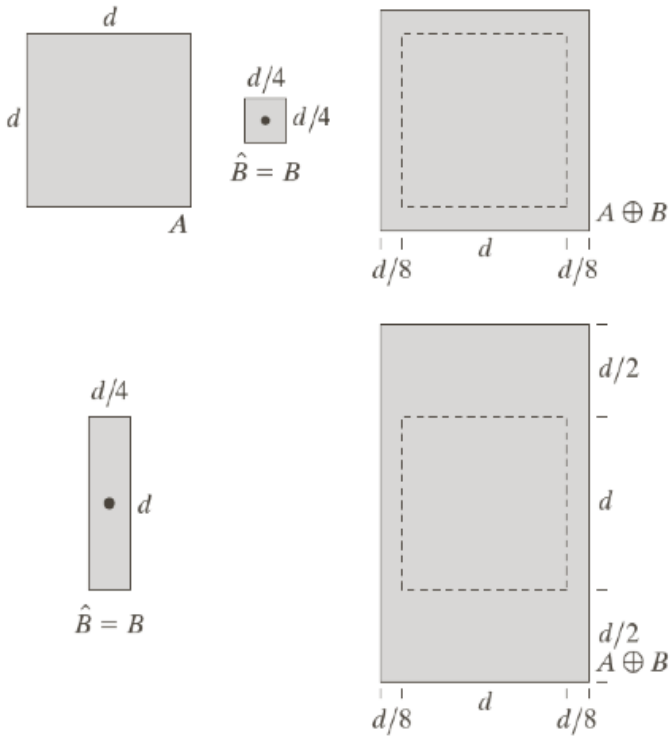
- Erosion
  - Erosion of A by B: the set of all points z such that B, translated by z is contained in A
  - Erosion shrinks or thins objects in a binary image

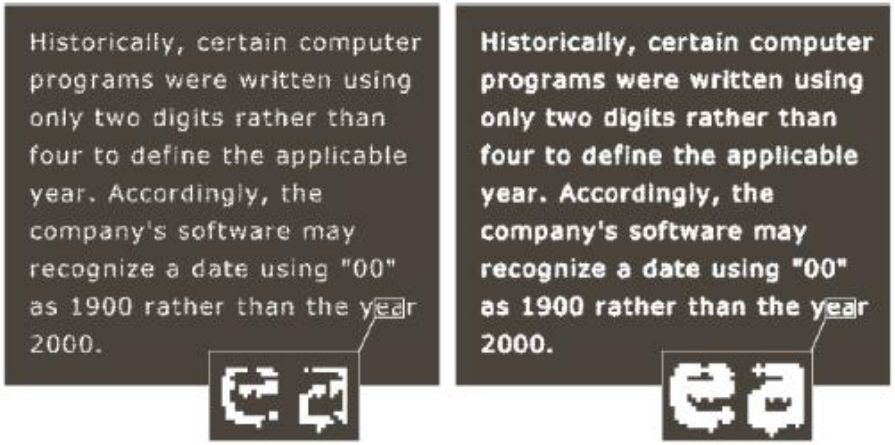




Erosion and dilation

- Dilation
  - Dilation of A by B: the set of all displacements, z, such that $\hat{B}$ and A overlap at least one element
  - Dilation grows or thickens objects in a binary image



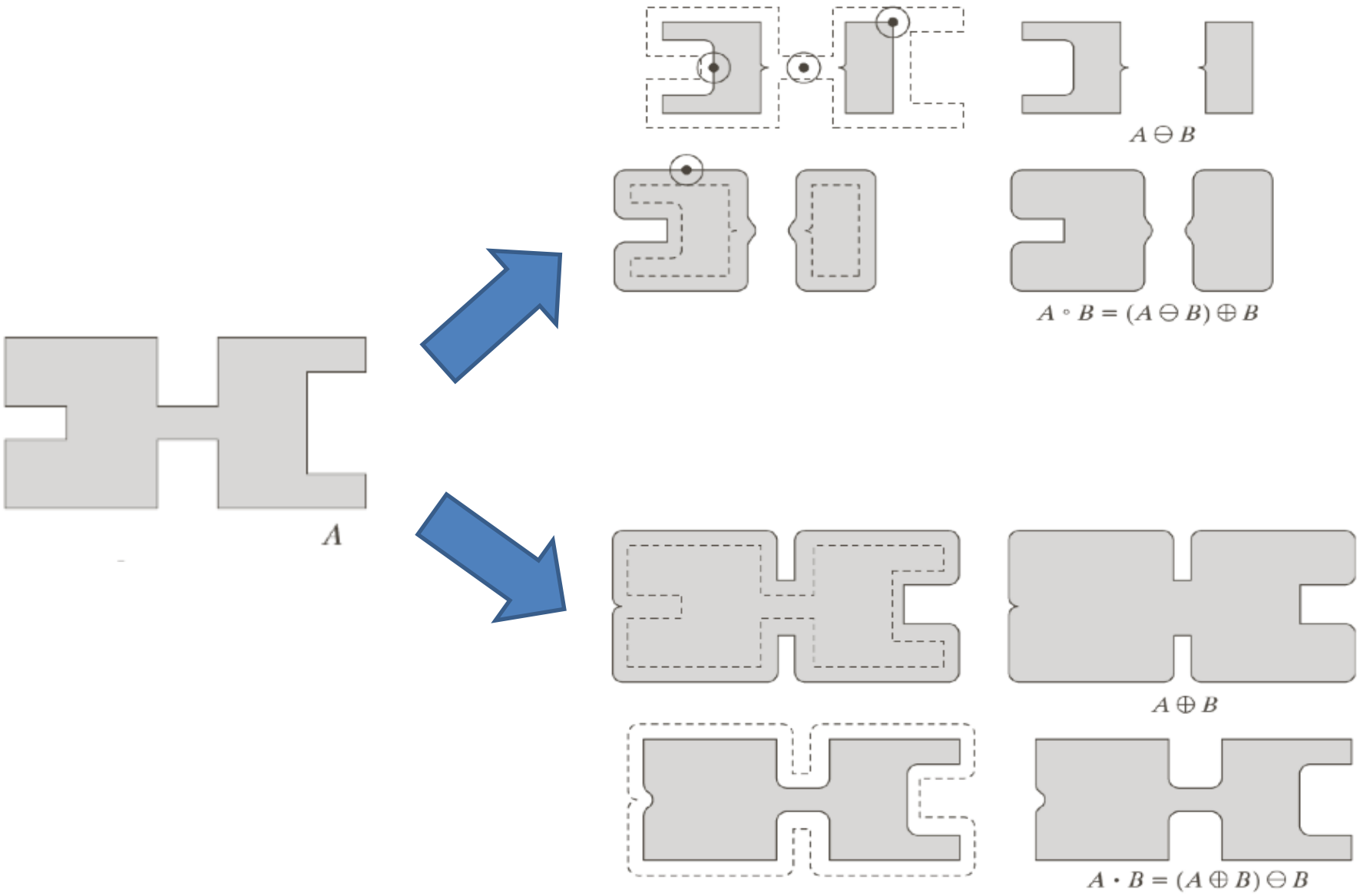


0	1	0
1	1	1
0	1	0

Opening and closing

- Opening
  - The erosion of A by B, followed by a dilation of the result by B
  - Smoothens contours, breaks narrow isthmuses, and eliminates small island and sharp peaks
- Closing
  - The dilation of A by B, followed by a erosion of the result by B
  - Smoothens contours, but fuses narrow breaks and long thin gulfs, and eliminates small holes

Opening and closing



Erosion and dilation

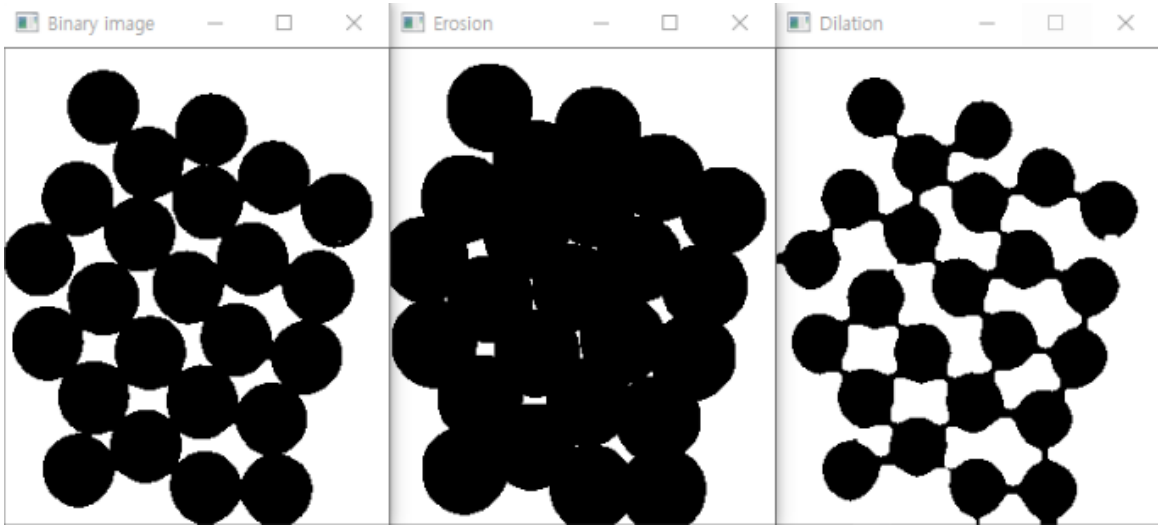
- Example code

```
Mat image, erosion, dilation;
Mat element = getStructuringElement(MORPH_ELLIPSE, Size(10, 10));
//Other options:MORPH_RECT, MORPH_CROSS

image = imread("water_coins.jpg", 0);
threshold(image, image, 128, 255, THRESH_BINARY);

erode(image, erosion, element);
dilate(image, dilation, element);

imshow("Binary image", image);
imshow("Erosion", erosion);
imshow("Dilation", dilation);
```



Opening and closing

- Example code

```
Mat image, opening, closing, element;
image = imread("assets/water_coins.jpg", 0);

threshold(image, image, 128, 255, THRESH_BINARY);
element = getStructuringElement(MORPH_ELLIPSE, Size(7, 7));

morphologyEx(image, closing, MORPH_CLOSE, element);
morphologyEx(image, opening, MORPH_OPEN, element);

imshow("Binary image", image);
imshow("opening", opening);
imshow("closing", closing);
```