

# Digital Image Processing No 3TA1393

(1)

## Lecture 13

### Morphological Image Processing

Last time

it's like

using Global and Local thresholding  $\rightarrow$  Good for finding objects background.

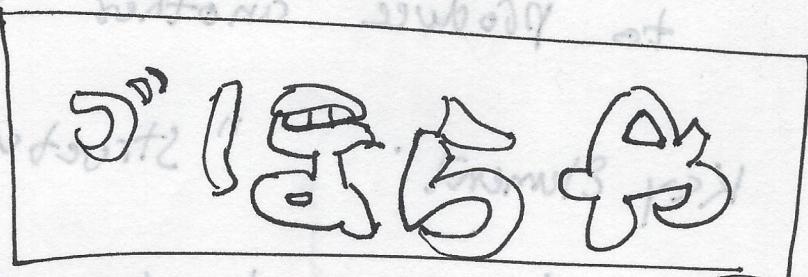
Lighter or Darker than the

We still have

issues after thresholding.

Figure Image

Cropped version



what's

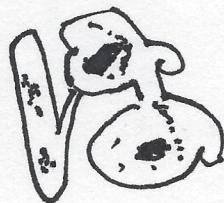
going

last statement from 2 A

want  $\rightarrow$  find 2nd character, 1 Z  
no no not more space not 1 Z

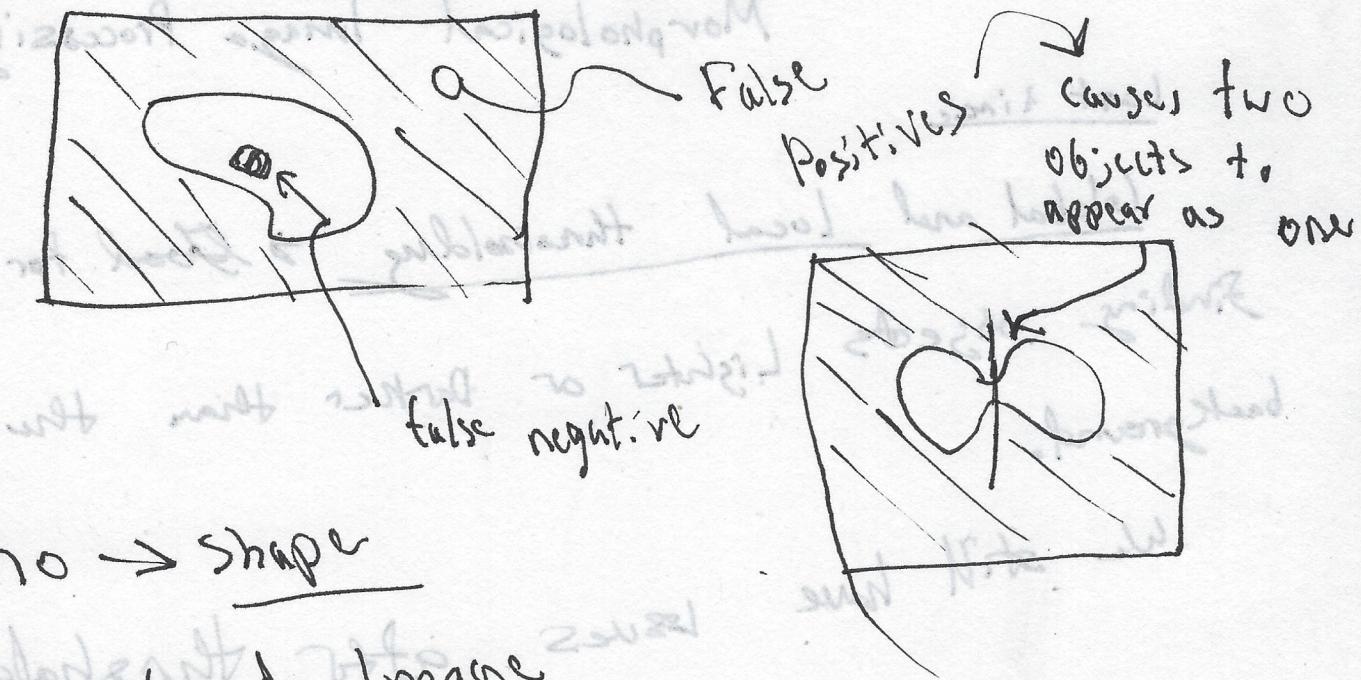
After thresholding we have

pixels inside character



②

## OPERATE ON Binary Images (After thresholding)



### Morpho → Shape

→ Shape based Image Processing → Don't care about colors

Morphological operators TAKE A SET OF pixels to produce another set of pixels

Key Element: "Structuring Element"

A Small template That Helps produce

The new image from the old one.

Methods which closing

Set of Pixels is a list of  $(x, y)$

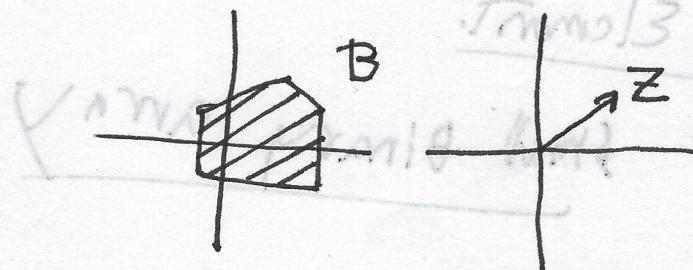
coordinates (integers)  $\rightarrow$  That are valued at 2  
Not 0

Simple operations on a set  $B$ :

$B_Z$ : Translation of  $B$  By a vector  $Z$

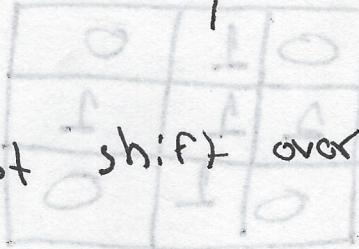
$$\{c \mid c = b + Z, b \in B\}$$

$$= \{(x+Z_1, y+Z_2) \mid (x, y) \in B\}$$

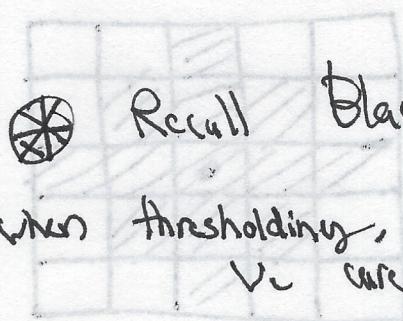


Set  $B$

vector  $Z$

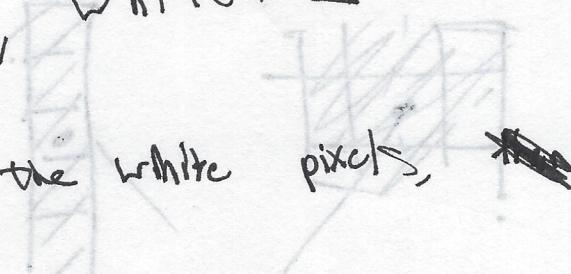


Some how we just shift over the pixels.



Recall Black: 0, white: 1

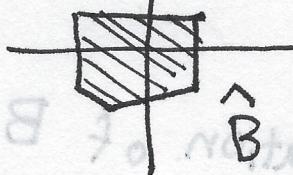
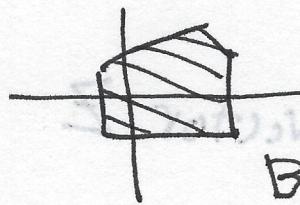
When thresholding, we care about the white pixels,



Another  
example

④  $\hat{B}$ : reflection of  $B$  ~~tilt~~  $\Rightarrow$  close to  $B$

$$\left\{ c \mid c = -b, b \in B \right\} \\ = \sum (-x, -y) \mid (x, y) \in B$$



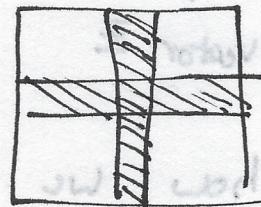
$\hat{B}$  is obtained by  
flip across both axis  
or the diagonal.

$$\sum B \rightarrow (x, y) \mid (x, y) \in B$$

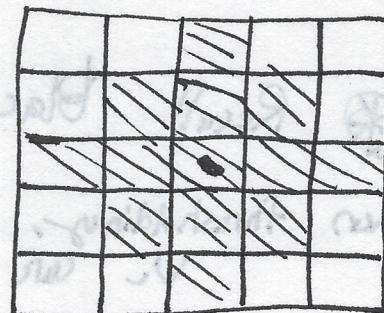
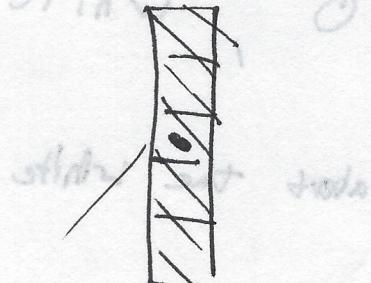
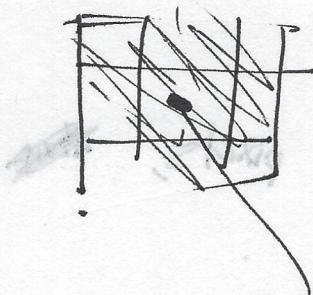
STRUCTuring Element

Small Binary array

0	1	0
1	1	1
0	1	0



could also have



center  
Element

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Structure Element will assist in helping us get rid of stuff outside of our foreground that are unwanted and fill in holes in our objects

## Basic OPERATIONS : EROSION

$$A \ominus B = \{ z \mid B_z \subseteq A \}$$

↓              ↓  
 original set    structure element

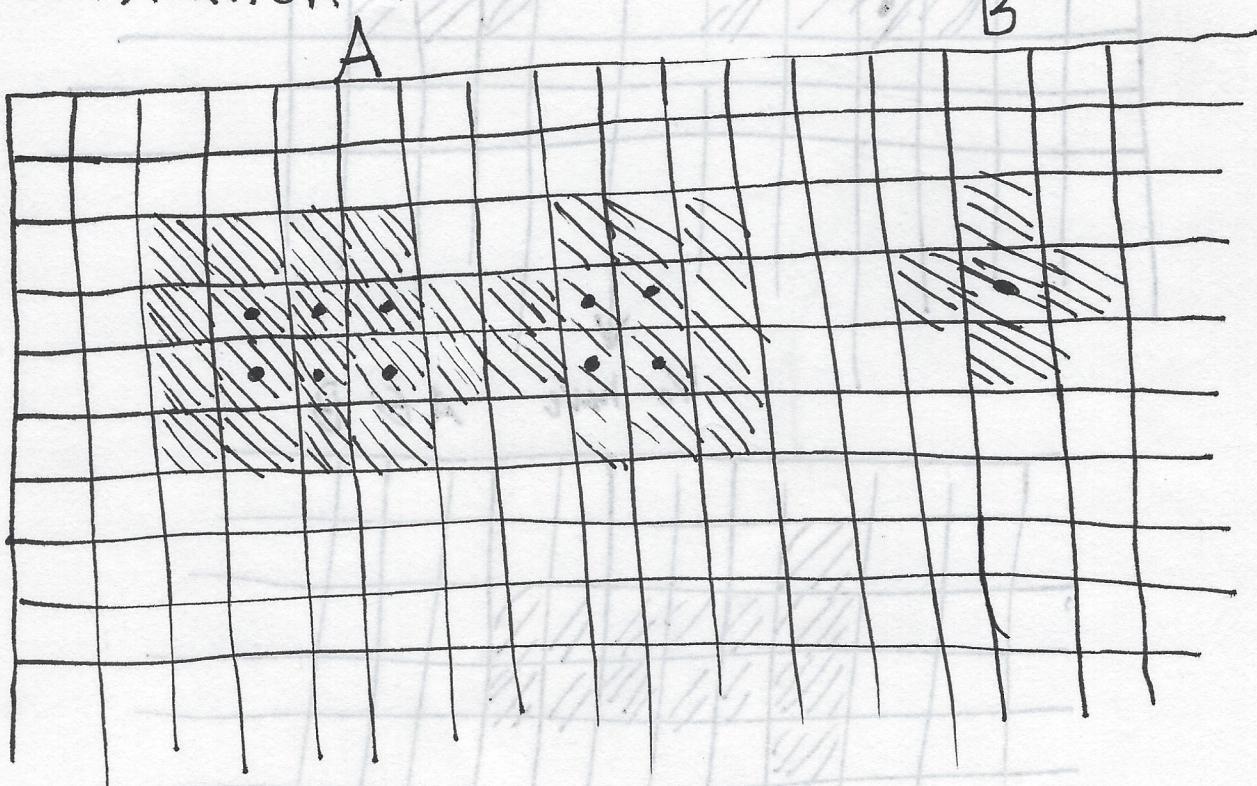


= B

A

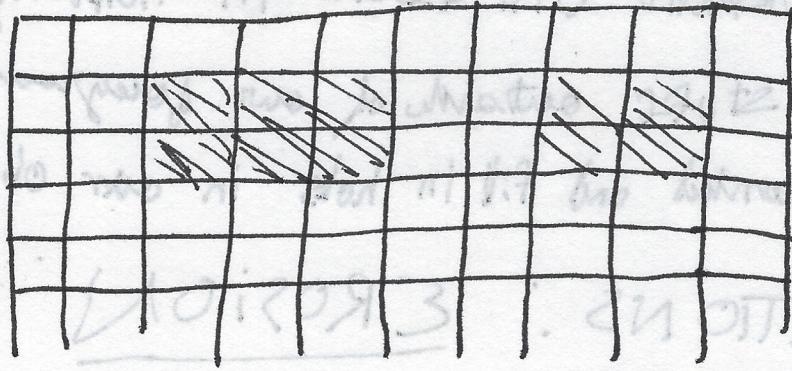
SET of points  $z$  such that STREL Translated by  $z$  fits fully inside A.

Demonstration at 15:01



Dots in A is where the strel would fit inside Entirely

6 As a Result, we have  $A \ominus B$

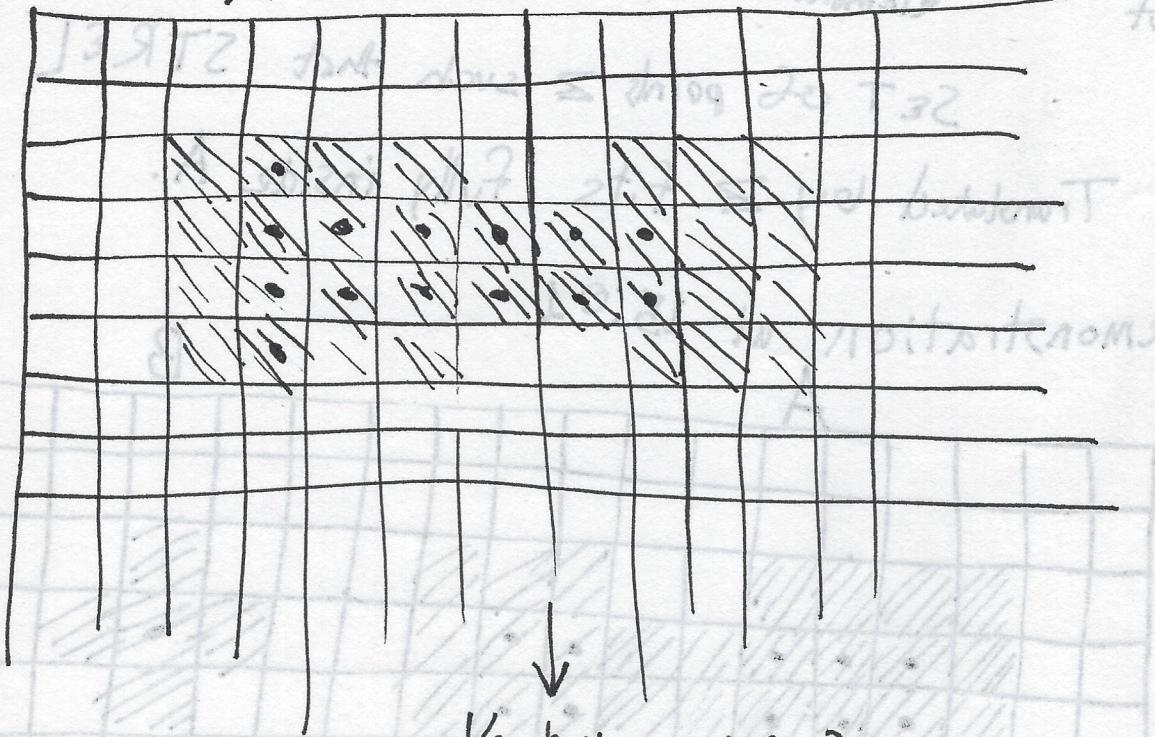


Dependent on the struc what of  $B = B \ominus A$

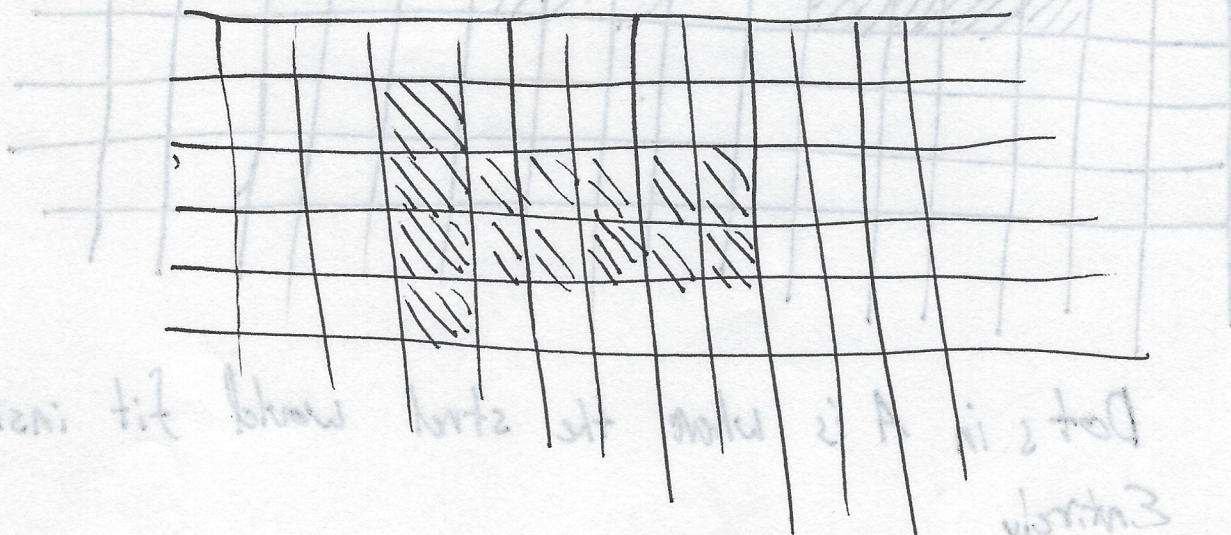
$$B =$$



A



We have  $A \ominus B$



Preserving horizontal connections

But sever Vertical connections

7

Choose A

Use Appropriate Str for appropriate mean

BW circuit.tif - 20.07

$S = \text{strel}(\text{'disk'}, 1)$ ; % disk of radius 1.

## Neighborhood

stoll notation

~~String~~ S is class Stack

`ot = imerode(im, s);`      Struct variable

of you a soft ~~skin~~  
Small lines are gone

Big thick lines are skinnier

Small lines Big thick lines are skinnier

at ~~the~~ the top A 290 A

A 290 A

→ To get rid of this

a bigger styl

(8)

$s = \text{strel}('disk', 4)$

Neighborhood:

0	0	1	2	1	0	0
0	1	1	1	1	0	0
1	1	1	1	1	1	1
1	1	1	1	1	1	1
2	1	1	1	1	1	1
0	2	1	1	1	1	0
0	0	2	1	0	0	0

$\text{out} = \text{imode}(im, s)$ ,  
 $\text{imshow}(\text{out})$

$\rightarrow$  all lines gone, but thick lines gone  
thick lines are gone

Erosion Removes Thin Lines, Isolated Dots

Large  $\rightarrow$  Cross Details

"Piling AWAY" Layers

Object Size changed, is there a way to  
 return it?

$$A \ominus B \subseteq A$$

when you create the image  
 you are going to be fully

erosion is always a subset of inside the image

of A

but rapid a

Dilation: opposite of Erosion; Fattens up

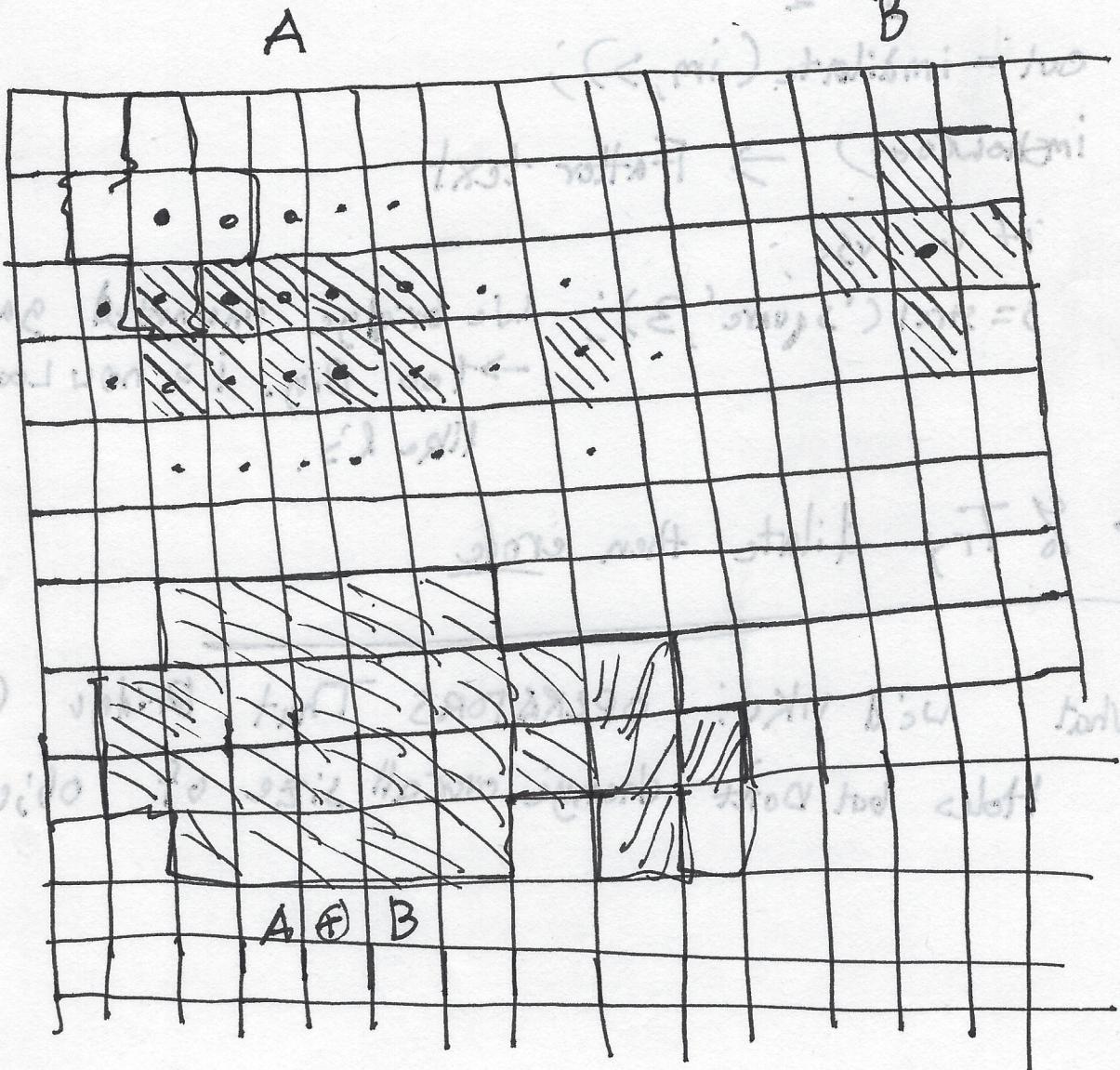
(9)

$$A \oplus B = \{z \mid \hat{B}_z \cap A \subseteq A\}$$

Find pixels such that the shifted set has any overlap with original set.

→ Most STREL are symmetric so they don't account for the flip part

29:45



Bridge the gaps,

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## ON OPTIMAL Character Recognition Algorithm to text

32:21

$im = imread('context.tif');$  → Not a good  
thresholded image  
or fixed

$S = strel('square', 2);$

Gaps in letter S

1 pixel wide, use  
a strel

Neighborhood

$$\begin{matrix} 1 & 1 \\ 1 & 1 \end{matrix}$$

$out = imdilate(im, S);$

A

$imshow(out)$  → Fatter text

if we use:

$S = strel('square', 3);$  We bridge unwanted gaps  
→ too big. it now looks  
like l's.

⇒ Try dilate then erode

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What we'd like: OPERATORS That Bridge Gaps/fill  
holes but don't change overall size of object

B C A

taped off 20078