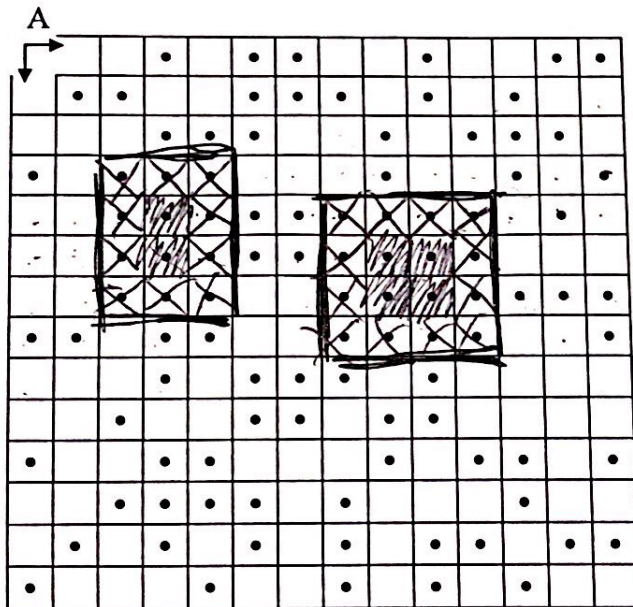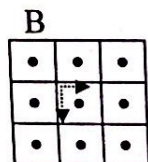# Assignment 4
Due on November 7 (by 11:59pm)

Part A: Questions: (50%)

(1) (12%) Use the definition of Dilation to prove "A $\oplus$ B = B $\oplus$ A"

(2) (12%) Binary image A and structuring element B are defined below. Show the result of opening operation (A ° B). *erosion ten dilation*
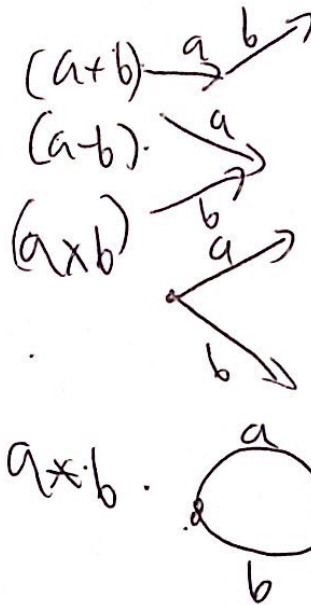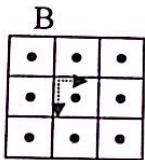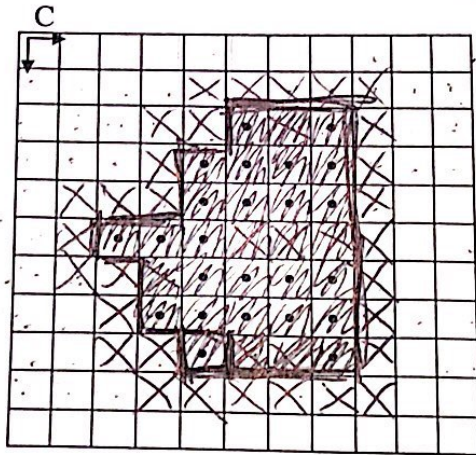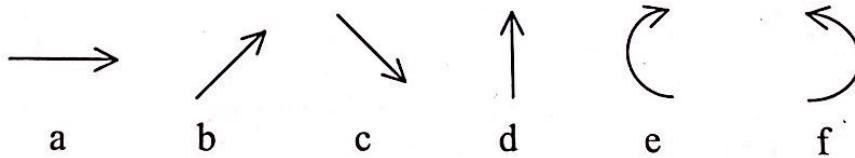
if fully inside take middle pix

(2) (12%) Binary image C and structuring element B are defined below. Show the result of closing operation (C • B).   *diation ten erosion*
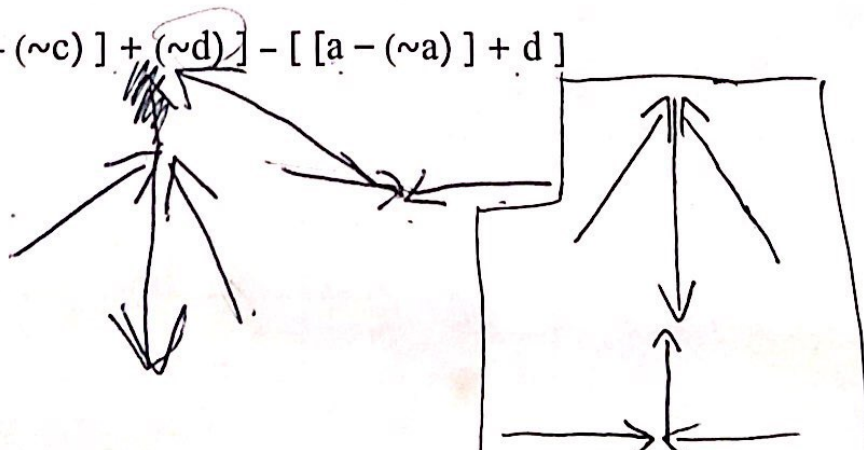
C

B

$(a+b)$ → $\overset{a}{\underset{b}{\nearrow}}$

$(a-b)$ · $\overset{a}{\underset{b}{\searrow}}$

$(a \times b)$ $\overset{b}{\underset{a}{>}}$

$a * b$ ·

(3) (14%) Use the following primitives:

| a | b | c | d | e | f |

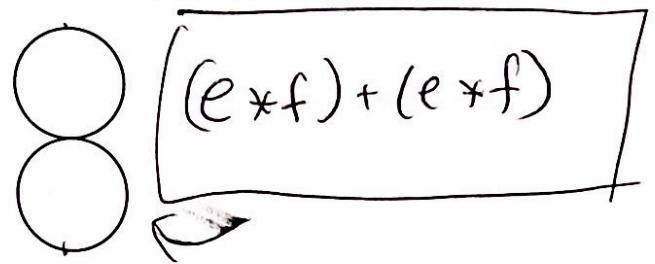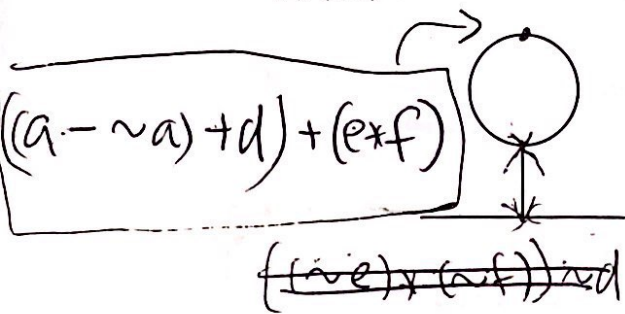and use the structure relations given in class (+, −, ×, *, ~)

(a) (7%) Sketch the structure whose PDL (program description language) structural description is:

$$[\,[\,b - (\sim c)\,] + (\sim d)\,] - [\,[\,a - (\sim a)\,] + d\,]$$

(b) (7%) Give PDL structural description of the following two structures:

$$((a. - \sim a) + d) + (e*f)$$

$$(e*f) + (e*f)$$

~~(~e) + (~f)))~d~~

Part B: (50%) Programming: Morphological image processing

- **Description:** Dilation and Erosion are two basic morphological operations. Dilation is to enlarge the image, and fill the small holes within objects. Erosion is to shrink the object, and separate the objects for segmentation. In this assignment you are required to employ morphological operations to separate the multiple objects from each other and count the number of objects (e.g., pigs) in the following image (I).
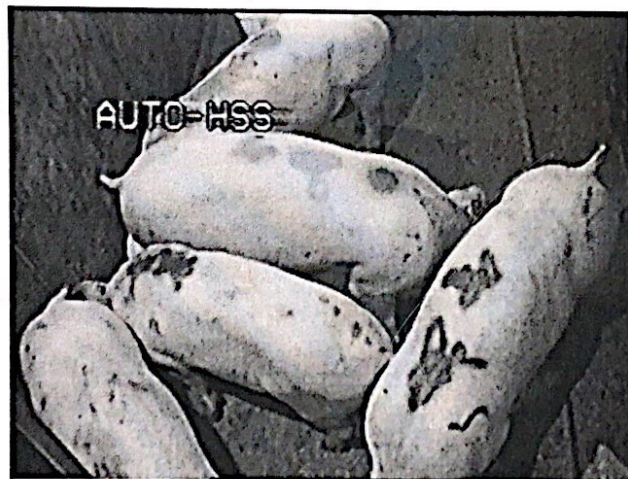
- **Your implementation:**
  (1) (5%) Obtain image I, and convert it into binary image F for display.
  (2) (25%) Design your algorithm to separate the objects in the given image (hint: using morphological operation)
  (3) (10%) Apply the morphological operations on the original grey scale image directly, you need to report your result and explain your algorithm.
  (4) Write-up (10%): Print out the binary image F and the image after the morphological operation. Show your structuring elements and explain your algorithms (approaches) in the report.