SIMG-782 Introduction to Digital Image Processing
Homework 3 – Due September 29, 2005

1. A binary array that represents a portion of a black and white image is given below. Perform the operations listed below on this piece of image. Assume that all of the pixels that surround this segment contain black background.

0	0	0	0	0	0	0
0	0	1	1	0	0	0
0	0	0	1	0	0	0
0	0	0	1	1	0	0
0	0	1	1	1	1	0
0	0	1	1	1	0	0
0	1	0	1	0	1	0
0	0	0	0	0	0	0

(a) Dilation with the structuring element $\boxed{① \, 1 \, 1}$ The origin is shown with a circled element.

(b) Erosion with the structuring element $\boxed{① \, 1 \, 1}$

(c) Dilation with the structuring element $\begin{array}{|c|c|} \hline 1 & ① \\ \hline 0 & 1 \\ \hline \end{array}$

(d) Erosion with the structuring element $\begin{array}{|c|c|} \hline 1 & ① \\ \hline 0 & 1 \\ \hline \end{array}$

(e) Opening with each of the above structuring elements.

(f) Closing with each of the above structuring elements.

2. Shown below is a binary image with some disks and squares, some of which overlap. This is the image BW3.png in the images directory. For each question provide an algorithm that uses morphological and logical operations to answer the questions. The answers may be in the form of pseudocode with a block diagram. For extra credit, you may submit an IDL program that implements the algorithms. Assume all disks are the same size and all squares are the same size.
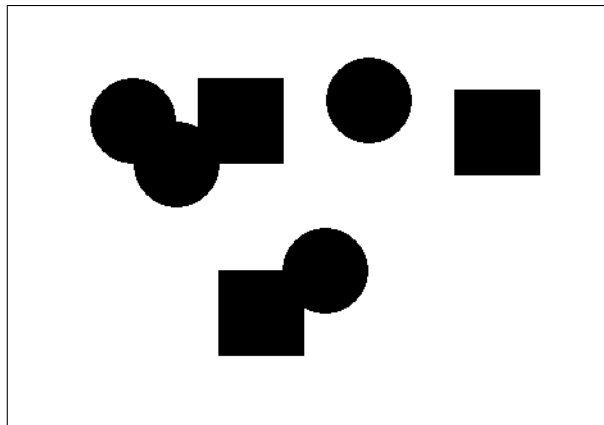

Binary image BW3.png with touching objects

(a) Develop a technique based on morphology and connected components to count the number of disks in the above image.

(b) Develop a technique based on morphology and logic to count the boundary pixels in the above image.

(c) Develop a technique based on morphology and logic to count the pixels that are common to two or more objects.

3. Shown below is an image with a number of touching black disks against a white background. Construct a program that will count the number of disks. [Hint: The program `disc.pro` in the programs directory can be used to help in constructing disk-shaped structuring elements of different sizes.]
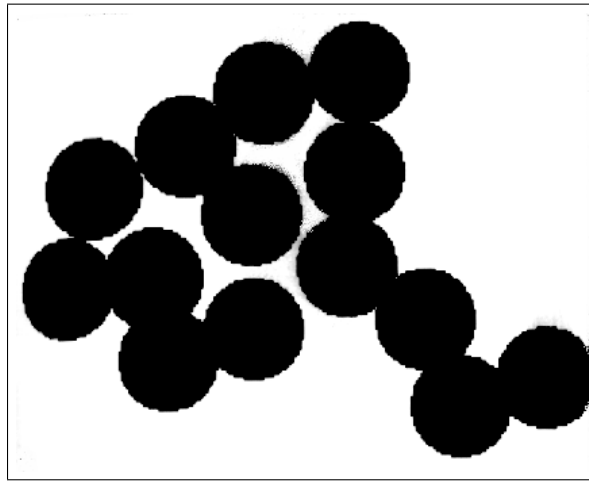
Binary image BWFatCircles.png showing a number of touching disks.

4. Shown below is an image with circles and squares of various sizes. Some of the objects have one or two holes in them. You are to provide an algorithm that uses morphological and logical operations to answer the questions below. The answers may be in the form of pseudocode with a block diagram. For extra credit, you may submit an IDL program that implements the algorithms. The image is in the images folder with the name 'blocks1.png'
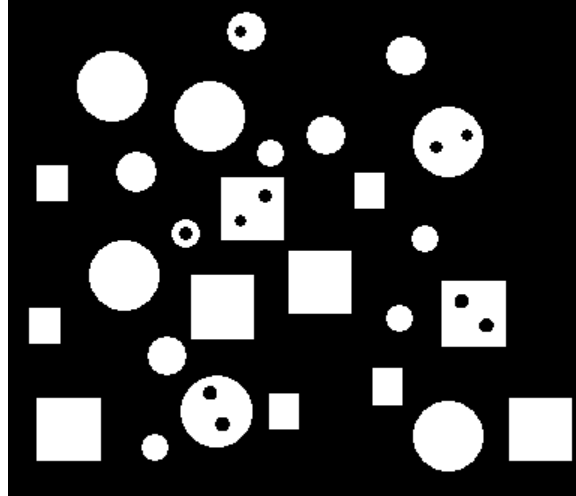
Binary image blocks1.png showing a variety of circles and squares, some of which have one or two holes.

(a) What fraction of the image pixels are white?

(b) How many objects are in the image?

(c) How many holes are in the image?

(d) How many objects have one or more holes?

(e) How many square objects are in the image?

(f) Identify the square objects that have holes.

(g) Identify the circular objects that have no holes.

5. Construct a program that will determine the amount of money in the picture coins1.png that is shown below. This is a color image. You need to construct ways to tell the difference in the coins. You can use color and size.

Color image coins1.png showing a variety of coins of various values.