<u>ASSIGNMENT-07(A)</u>

9.3 Sketch the structuring elements required for the hit-or-miss transform to locate (i) isolated points in an image, (ii) end points in a binary skeleton and (iii) junction points in a binary skeleton. Several structuring elements may be needed in some cases to locate all possible orientations.

Ans.

9.3
Step
(i) The isolated points in an image a point which x is called an isolated point of subnet.

(i) isolated points in images

In SD

fills isolated interior points

1	1	1
1	0	1
1	1	1

Remove isolated points

0	0	0
0	1	0
0	0	0

step (ii) Endpoints in a binary skeleton

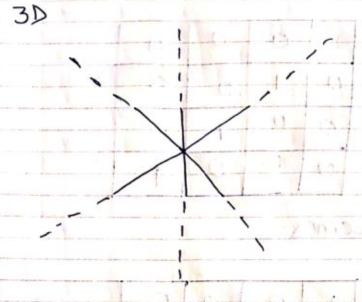
1	0	0	0
0	1	0	0
0	0	1	0
0	0	0	1

becomes

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

Step (iii) Junction point in binary skeletons

In 3D



9.4 How can the hit-or-miss transform be used to perform erosion? How can the hit and-miss transform, together with the NOT (or inverse) operation, be used to perform dilation?

Ans.

9.4 <u>Morphological Operation:</u>

- In Morphology we find the shape & size or the structure of the object
- We use the concept of structuring element.
- Structuring element is the mask or window which we place on original image to find the desired output.
- There are two main characterstics of structuring element.

<u>Shape</u>: Triangles, rectangle, square, circular.

<u>Size</u>: Varies from 3X3 to 21X21

<u>Hit and miss transform with examples:-</u>

Donated by $A \circledast B$

Given by, $A \circledast B = (A \ominus B_1) \cap (A^c \ominus B_2)$

$\ominus$ Denotes erosion.

A is the image.

B_1 & B_2 are the two structuring elements, having center elements as the seed point.

$$A = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

Seed Point

$$B_1 = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \qquad B_2 = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

To find the erosion, we have to take the seed point of the structuring element and place it at every pixel of the image and whenever there is a match or 1's at that time the seed point and the output will be '1' else it is '0'

$$A \ominus B_1 = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$A^c = \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

When we match A^c and B_2, we only want a '1' above the seed point, to match

$$A^c - B_2 = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

To find the intersection, we have to check that whenever there is '1' at both $(A \ominus B_1)$ & $(A^c - B_2)$ then at intersection also it will be '1'

$(A \ominus B_1) \cap (A^c \ominus B_2)$

$(A \ominus B_1) \cap (A^c \ominus B_2)$

$$= \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

Dilations:-

→ With the help of dilation, we can expand the image

→ It is given by,

$$X \oplus B = \{ P \in Z^2 \mid P = x + b,\ x \in X;\ b \in B \}$$

Positional Image   Structuring Element   Binary Image

Example -

Origin

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \qquad B = \begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix}$$

We have check the origin with each elements at A, and if it matches we will replace it with the structural elements.

$$A \oplus B = \begin{bmatrix} 0 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

Characteristics of dilation :-

→ dilation add Pixel to the binary of an object in an image.

→ Number of Pixel added depend on shape and size of structuring elements.

→ Connects area that are seperated.

Erosions :-

This is opposite process of dilation where we decompose the image shrinking is obtained.

Represented as $A \ominus B$

Example -

Here we have to match the whole structuring element, with the given matrix (image).

$$A = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 \end{bmatrix} \qquad B = \begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}$$

$$A - B = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

9.7 How can the medial axis transform be used to reconstruct the original shape of the region it was derived from?

Ans. By generating a circle of radius equal to the pixel value around each pixel, the medial axis transform may be used to recreate the original shape perfectly, making it ideal for lossless picture compression.

9.9 The features in the image shown in Figure E9.2(i) are flawed by small gaps, which have been removed in the image shown in Figure E9.2(ii). What processing operation would achieve this result? What size and shape of structuring element is required?

(i) (ii)

Figure E9.2

Ans.

9.10 What is (i) the skeleton and (ii) the medial transform of Figure E9.3?

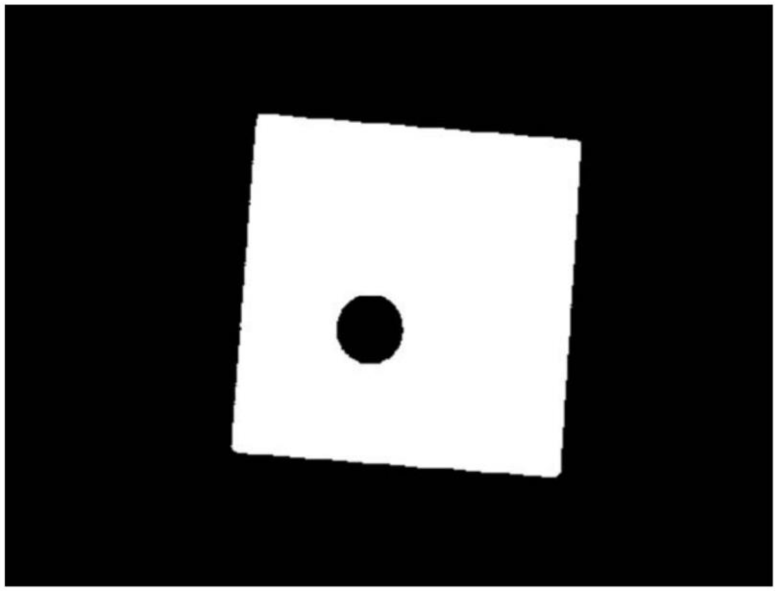


Figure E9.3

Ans.

(i) Skeleton Image is nothing more than a binary image of a skeleton. The intensity of each point on the skeleton shows its distance from a boundary in the original item.

(ii) Medial Transform

A grayscale image is the Medial Axis Transform. The only colors in a gray level image are shades of gray. Each pixel in a grayscale image requires less information. Gray is defined as a color in which the intensity of all green, red, and blue in RGB space is equal.

9.11 Which distance metric is used to obtain the distance transform in Figure 9.22?

Ans. This is a city block distance transform.

It is defined as

$|x_1 - x_2| + |y_1 - y_2|$.