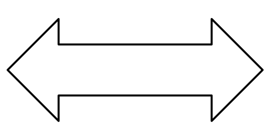
Scheme Of Evaluation

Internal Assessment Test 3 – November 2019

Sub:	Digital Image Processing							**Code:**	15ECE72
Date:	16/11/2019	Duration:	90mins	Max Marks:	50	**Sem:**	VII	**Branch:**	ECE

Note: Answer Any Five Questions

Question #	Description	Marks Distribution	Total Marks
1	Briefly Explain the different Color models and convert the given RGB= (0.683, 0.1608 , 0.1922) model to HSI model.**?** • Explanation of different Color models • Problem	6 M 4 M	10 M
2	What is Pseudo color image processing? Explain intensity slicing as applied to pseudo color image processing.	10M	10 M
3	Explain briefly about Image pyramids and Subband coding • Image pyramids • Subband coding	5 M 5 M	10 M
4	Explain the following morphological algorithms briefly • Dilation • Erosion • iii.Opening • iv.Closing, • v. Convex hull.	2M 2M 2M 2 M 2 M	10M
5	Explain how the chain codes are used to represent a boundary in digital image processing and obtain the shape number for the given image. 		

	1.Explaination of chain code 2. Shape number for the given image.	5M 5M	10 M
6	Explain the Hit or Miss transformation in digital image processing.	10M	10 M

Solution for Evaluation

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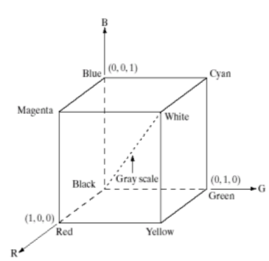
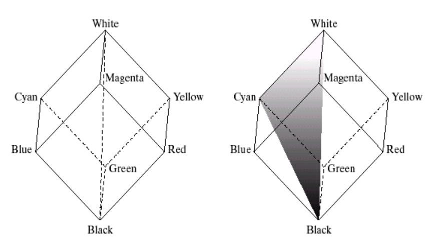
Qn	Description	M
1.	**Briefly Explain the different Color models and convert the given RGB= (0.683, 0.1608 , 0.1922) model to HSI model.?**	10 M

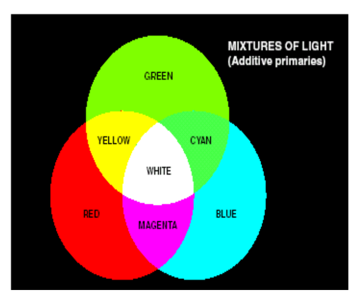
Soln: The color models are

- RGB model- match the human description, useful for displays like monitors
- CYM model
- CYMK model(extension of CMY model)
  - Useful for printers
- HSI model
- The RGB model, CMY Model and CMYK color models are Hardware oriented
- HSI color model is Application Oriented/perception oriented. “I” gives grayscale information , “H & S” gives chromatic information.
-

RGB color model **HSI model** **CMYK**







RGB

- Pixel depth: the number of bits used to represent each pixel in RGB space
- Full-color image: 24-bit RGB color image
  - (R, G, B) = (8 bits, 8 bits, 8 bits)

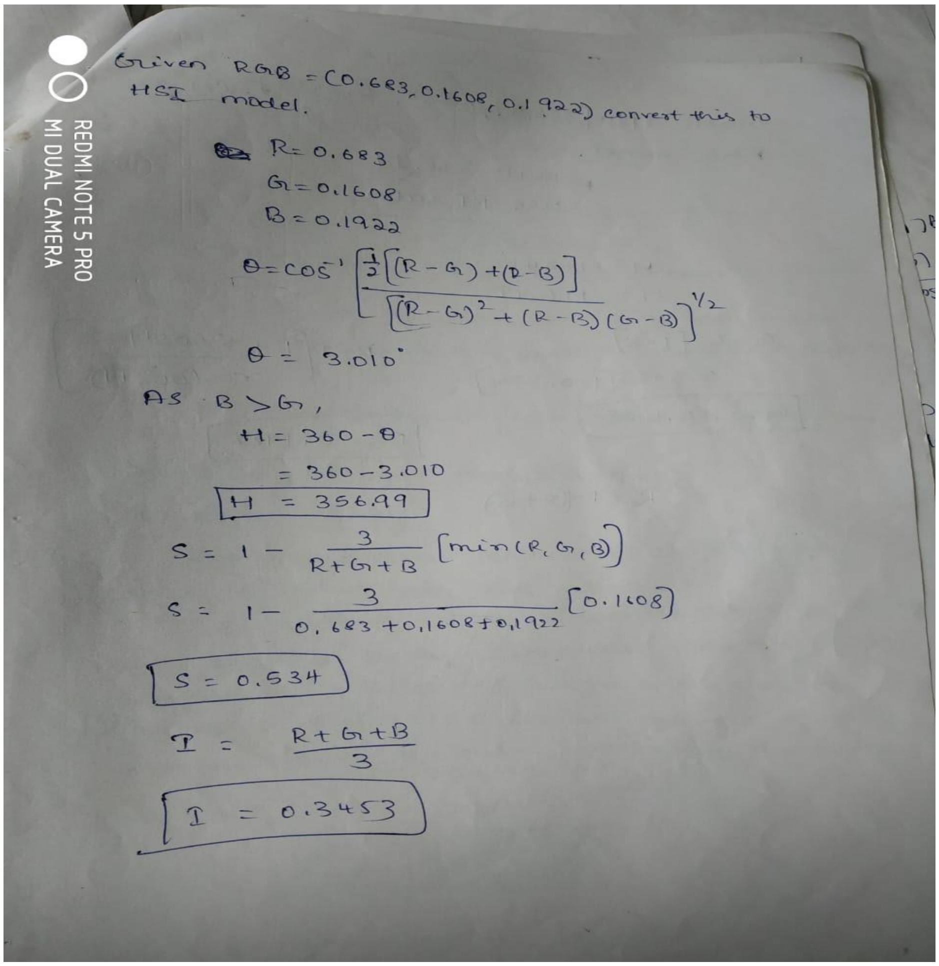
CMYK

- secondary colors of light, or primary colors of pigments(defined as one that subtracts /absorbs a primary color of light and reflects the other two.)
- Used to generate hardcopy output

HSI

- The HSI color model decouples the intensity component from color carrying information(hue and saturation) in a color image.
- RGB model is ideal for image color generation.
  HSI model is ideal for image color description

Problem:



2

What is Pseudo color image processing? Explain intensity slicing as applied to pseudo color image processing.

Soln: **Pseudo-color(False color) image processing**

- Assign colors to gray values based on a specified criterion
- For human visualization and interpretation of gray-scale events

Intensity slicing

- The technique of intensity slicing or density slicing or color coding is one of the simplest example of Pseudo-color image processing.

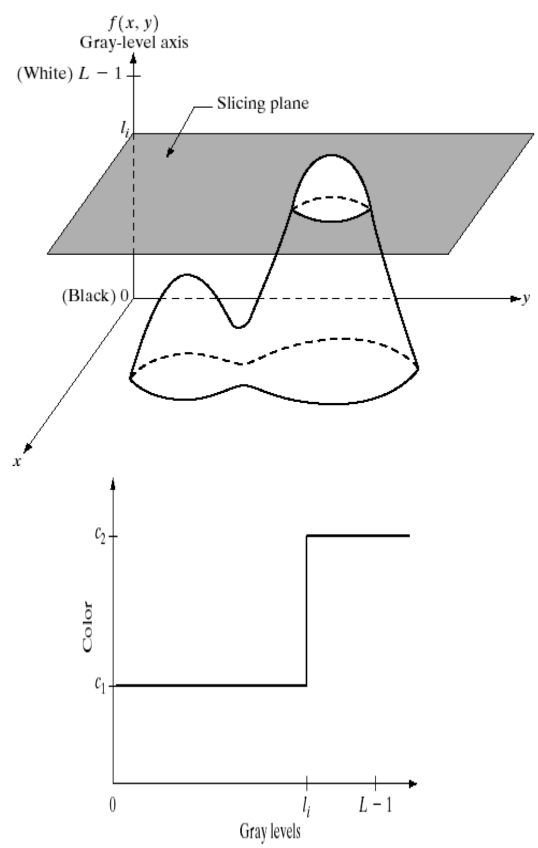


FIGURE 6.19 An alternative representation of the intensity-slicing technique.

Fig:3-D view of intensity image

10 M

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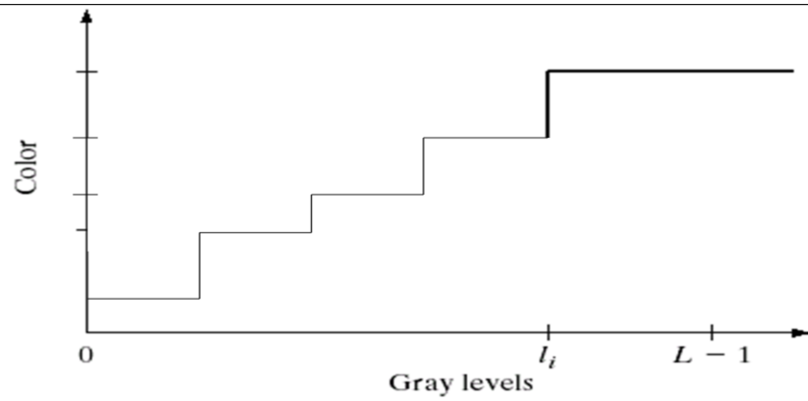

- The Gray Scale [0,L-1] is divided into L levels; where l_0 represents Black (f(x,y)=0) and l_{L-1} represents white (f(x,y)=L-1)
- Suppose that P planes perpendicular to the intensity axis are defined at levels $l_1,l_2\ldots,l_p$
- Then assuming that 0<P<L-1 the P planes partition the gray scale into P+1 intervals, $V_1,V_2\ldots\ldots V_{p+1}$
- Gray level to color assignments are made according to the relation:
- f(x,y)= ck if f(x,y)€vk
- Where ck is the color associated with the kth intensity interval vk defined by the partition planes at l=k-1 and l=k
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Explain briefly about Image pyramids and Subband coding.

Soln: Image pyramids

- Image pyramid is the simple structure for representing images at more than one resolution.
- An image pyramid is a collection of decreasing resolution images arranged in the shape of a pyramid.
- It is devised for machine vision and image compression algorithms.
- The base of pyramid contains a high resolution representation of the image being processed.
- The apex contains low resolution approximation.
- As we move up the pyramid, both size and resolution decreases.
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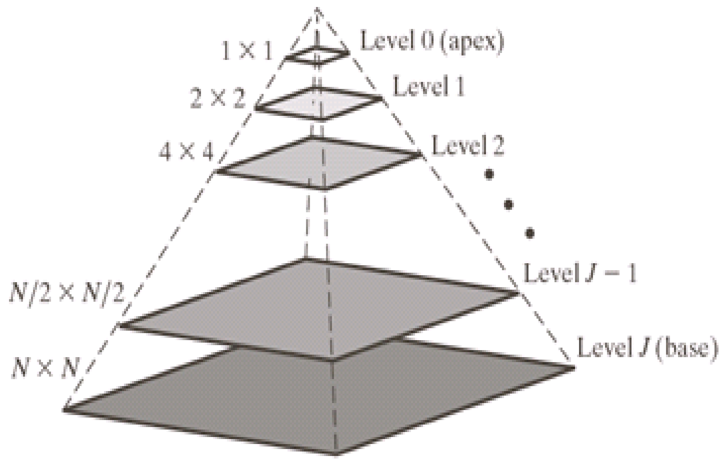


- The image pyramid shown is composed of J+1 resolution levels from $2^J \times 2^J$ to $2^0 \times 2^0$.
- Most image pyramids are truncated to P+1 levels, where $1 \le P \le J$ and $j = J - P, \ldots, J - 2, J - 1, J$.
- The total number of pixels in a P+1 level pyramid for $P > 0$ is

$$N^2\left(1 + \frac{1}{(4)^1} + \frac{1}{(4)^2} + \cdots + \frac{1}{(4)^P}\right) \le \frac{4}{3}N^2$$

- **Subband coding .**

- An image is decomposed into a set of bandlimited components called subbands.
- The decomposition is performed so that the subbands can be reassembled to reconstruct the original image without error.
- The decomposition and reconstruction are performed by means of digital filters.

a
b

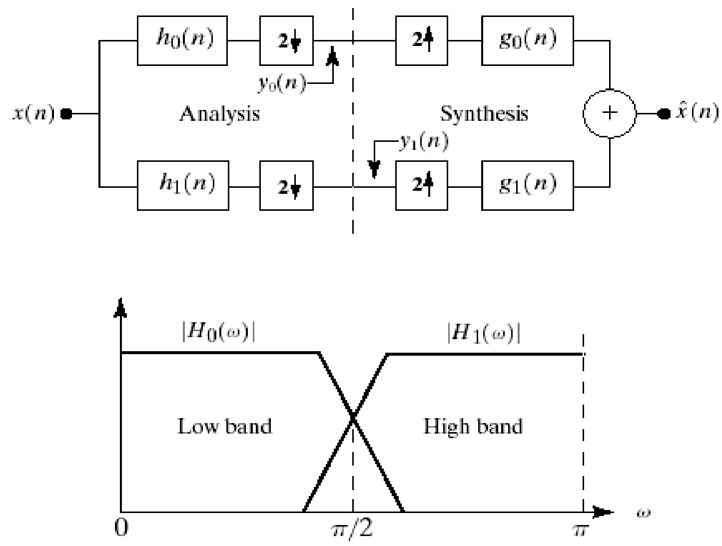


FIGURE 7.4 (a) A two-band filter bank for one-dimensional subband coding and decoding, and (b) its spectrum splitting properties.

The system is composed of two filter banks → Analysis filter Bank and Synthesis Filter Bank.

- Each Filter bank consists of two FIR Filters.
- The goal in subband coding is to select $h_0(n), h_1(n), g_0(n)$ and $g_1(n)$ so that $\hat{f}(n) = f(n)$. That is, if the input and output of the subband coding and decoding system are identical then the resulting system is called perfect reconstruction filter.
- The resulting system is perfect reconstruction filter if the synthesis filters are modulated versions of the analysis filters- with one synthesis filter being sign reversed as well. i.e,. The impulse responses of the synthesis and analysis filters must be related in one of the following two ways:

$$g_0(n) = (-1)^n \quad h_1(n)$$
$$g_1(n) = (-1)^{n+1} h_0(n)$$

or

$$g_0(n) = (-1)^{n+1} h_1(n)$$
$$g_1(n) = (-1)^n \quad h_0(n)$$

- Filters $h_0(n), h_1(n), g_0(n)$ and $g_1(n)$ are said to be cross modulated because diagonally opposed filters in the block diagram.

4	**Explain the following morphological algorithms briefly** **Soln:** **Dilation** ▪ Dilation is the set of all points in the image, where the structuring element "touches" the foreground. ▪ It adds pixels to the boundaries of objects in an image. It increases the size of object & fills gap. ▪ Dilation "grows" or "thickens" objects in an binary image. ▪ The extent of thickening is controlled by the shape of the structuring element used. ▪ Dilation is used for expanding an element A by using structuring element B. Dilation of A and B is defined by the following equation. $A \oplus B = \{z \mid (\hat{B})_z \cap A \neq \emptyset\}$ Where A is Given image and B is structuring element. **Erosion** ▪ Erosion is used for shrinking of element A by using element B. ▪ Erosion is the set of all points in the image, where the structuring element "fits into". ▪ Good for, e.g., ▪ Noise removal in background ▪ Removal of holes in foreground / background ▪ One of the simplest uses of erosion is for eliminating irrelevant details (in terms of size) from a binary image. With A and B as sets in Z2 , the erosion of A by B, denoted A, is defined as $A \ominus B = \{z \mid [(B)z \subseteq A\}$ ▪ This equation indicates that the erosion of A by B is the set of all points z such that B, translated by z, is contained in A where B is the structuring element. • **iii.Opening and iv.Closing** ▪ Opening – smoothes contours , eliminates protrusions ▪ Closing – smoothes sections of contours, fuses narrow breaks and long thin gulfs, eliminates small holes and fills gaps in contours as opposite to opening. ▪ These operations can be applied few times, but has effect only once.	10 M

- The Opening of set A by structuring element B, denoted $A \circ B = (A \ominus B) \oplus B$
  - First – erode A by B, and then dilate the result by B
  - In other words, opening is the unification of all B objects Entirely Contained in A
- The Closing of set A by structuring element B, denoted $A \cdot B = (A \oplus B) \ominus B$
  - First – dilate A by B, and then erode the result by B
  - In other words, closing is the group of points, which the intersection of object B around them with object A – is not empty

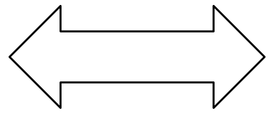
v. Convex hull.

- A set *A* is convex if the straight line segment joining any two points in *A* lies entirely within *A*.
- The convex hull *H* of an arbitrary set *S is* the smallest convex set containing *S*.
- The difference *H-S* is called convex deficiency.
- The convex hull and the convex deficiency are useful quantities to characterize shapes.
- We present here a morphological algorithm to obtain the convex hull *C*(*A*)of a shape *A*.
- The Convex Hull of a set A is denoted as C(A).
- The method consists of iteratively applying the hit-or miss transform to A with B^i(set of structuring elements).
- $B^i, i = 1,2,3,4$ →4 structuring elements.
- $X_k^i = \left(X_{k-1}^i \circledast B^i\right) \cup A\ , i = 1,2,3,4\ and\ k = 1,2,3, \ldots\ldots with\ X_0^i = A$
- The iteration stops when $X_k^i = X_{k-1}^i$(In two subsequent iterations the output does not change).

5

Explain how the chain codes are used to represent a boundary in digital image processing and obtain the shape number for the given image.

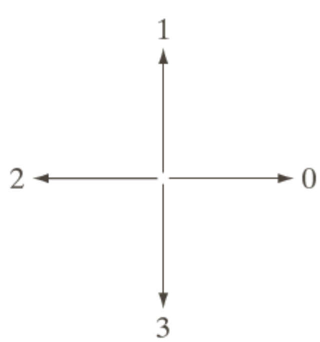
10 M



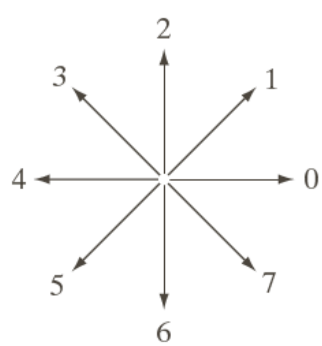
Soln:

Chain codes

- A chain code is a lossless compression algorithm for monochrome images. The basic principle of chain codes is to separately encode each connected component in the image.
- It is a Boundary based representation and from this we find boundary descriptors possible from this.
- Chain code – describe the sequence of steps generated when walking around the boundary
- Chain code are used to represent a boundary by a connected sequence of straight line segments of specified length and direction.
- Typically, this representation is based on 4- or 8-connectivity of the segments. The direction of each segment is coded by using a numbering scheme, as in Fig.



4-Directional Chain code



8- Directional Chain code

b. Shape number for the given image.

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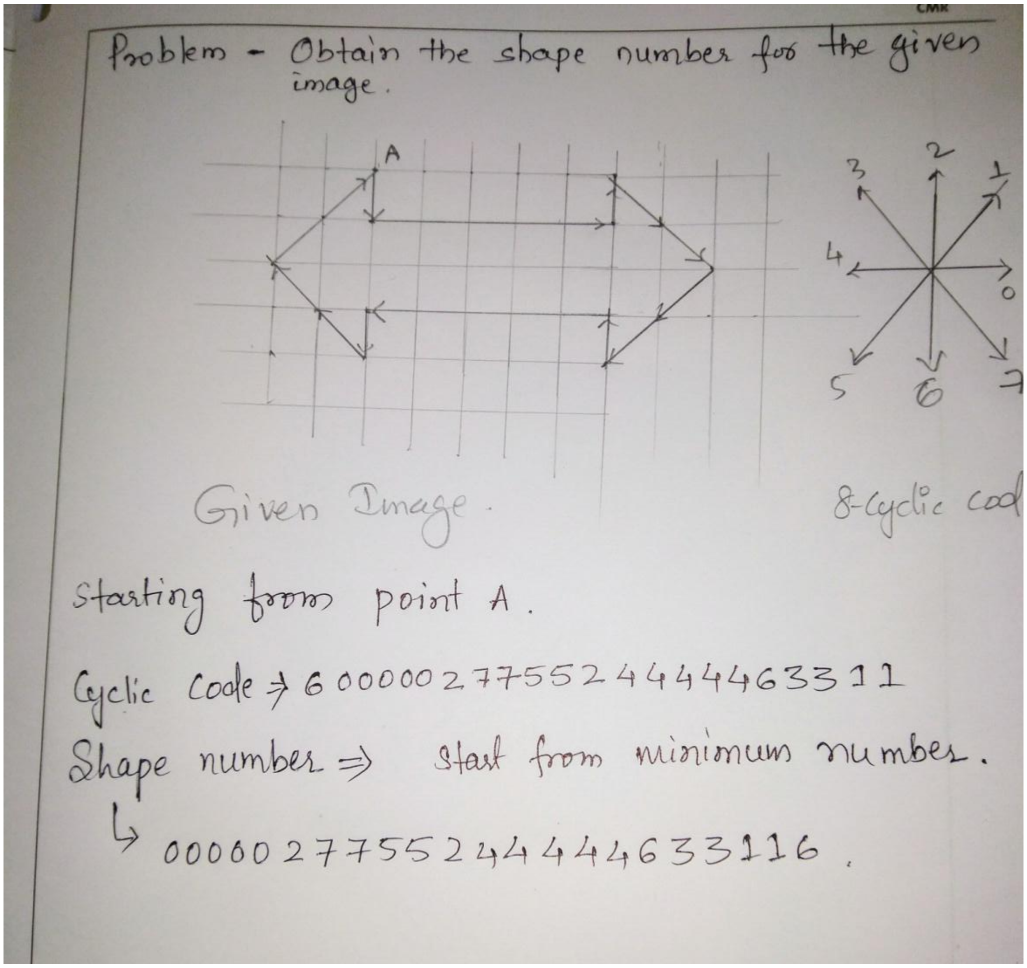
<tr><td></td><td>
</td><td></td></tr>
<tr><td>6</td><td>Explain the Hit or Miss transformation in digital image processing.

Soln:The Hit or Miss transform is used for detecting shapes. It uses two structuring elements.
■ The 1st SE is the foreground shape of the object to be detected.
■ The 2nd SE contains the background shape around the object which is to be detected.
■ If the foreground matches with the 1st structuring element and
■ If the complement(i.e. background)matches with the second structuring element , then we say that the object shape exists at that point.</td><td>10 M</td></tr>
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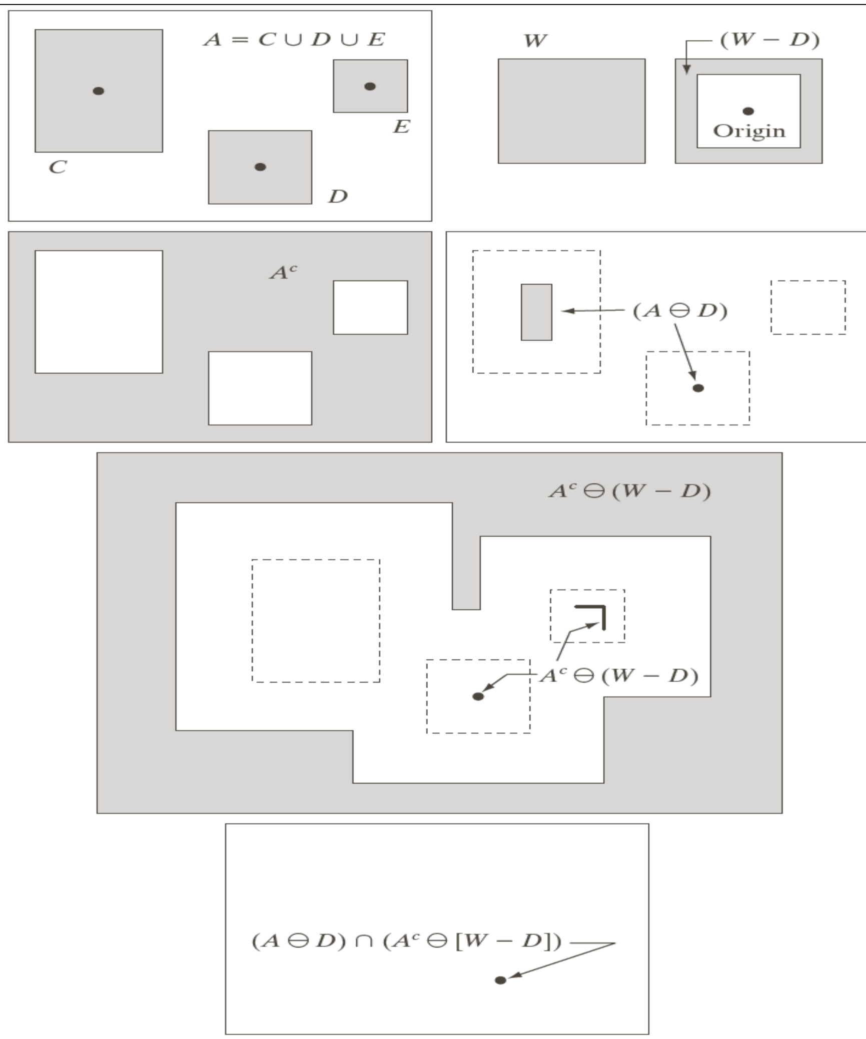

- Let the origin of each shape be located at its center of gravity.
- If we want to find the location of a shape , say – D , at (larger) image, say – A :
- Let D be enclosed by a small window, say – W.
- The local background of D with respect to W is defined as the set difference (W - D).
- Apply erosion operator of A by D, will get us the set of locations of the origin of D, such that D is completely contained in A.

It may be also view geometrically as the set of all locations of the origin of D at which D found a match (Hit) in A

- Apply erosion operator on the complement of A by the local background set (W – D).
- Notice, that the set of locations for which D exactly fits inside A is the intersection of these two last operators above.
- This intersection is precisely the location sought.
- If B denotes the set composed of D and it's background, the match of B in A, denoted $A \circledast B = (A \ominus D) \cap [A^c \ominus (W - D)]$
- Generalizing the equation B = (B1,B2) ; B1 = D , B2 = (W-D).
- The match (or set of matches) of B in A, denoted

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