ECE 415 – Computer Vision I
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Homework – 6

Problem 1)

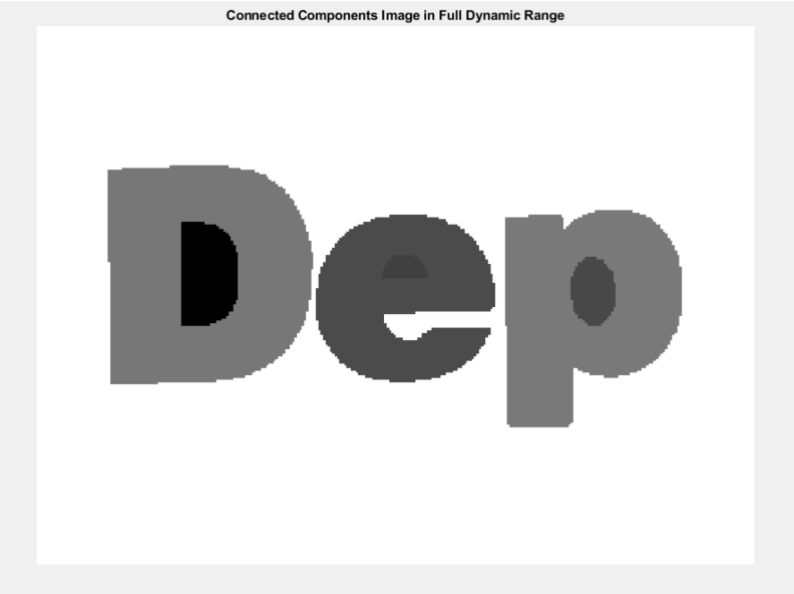
1). The input image is:

2). Thresholding is performed using **Global thresholding.** A value below the threshold is assigned 1 and a value above the threshold is assigned 0.

The binary image after thresholding is:

3). Applying the 4 connectivity 2-pass algorithm to find the connected components we see in the resulting image that there is a total of 7 connected components in it.

4). By applying full dynamic range for the connected components image, we get:

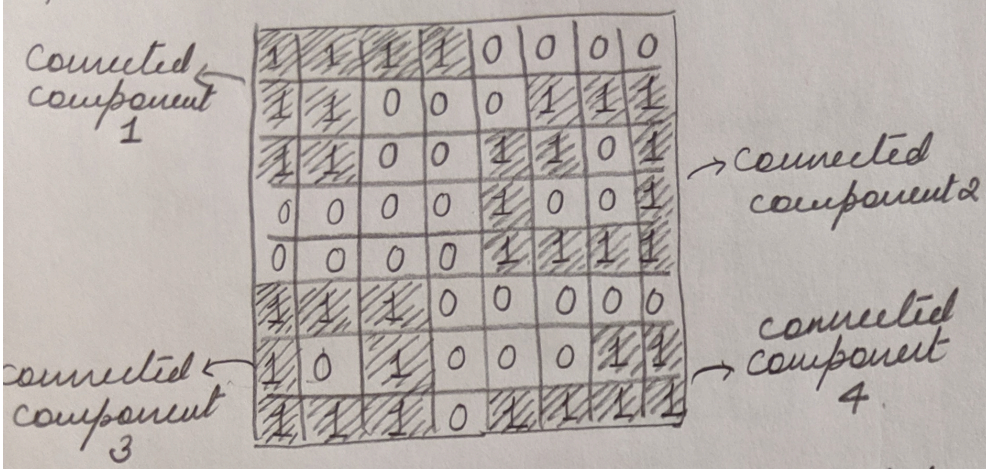


From the image, we see that there is a total of 7 connected components having different gray levels.

Problem-2

Given, 8×8 image:

1).



∴ There are 4 connected components in the binary image.

2). • Area of connected component 1 is: 8
• Area of connected component 2 is: 12
• Area of connected component 3 is: 8
• Area of connected component 4 is: 6.

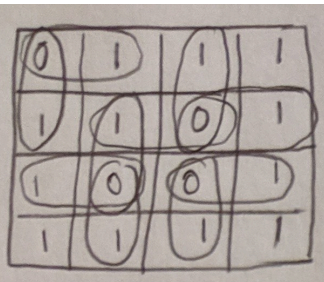
3). The smaller image is:

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

4). W.r.t dilation is given by: $\hat{S}(x,y) = \begin{cases} 1 & , C(x,y) \geq 1 \\ 0 & , \text{otherwise.} \end{cases}$

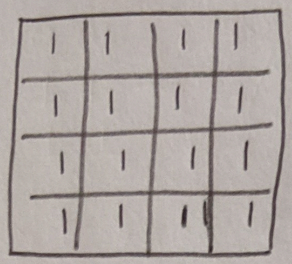
The 3×3 box filter is: (Centre pixel element is padded with 1's)

1	1	1
1	1	1
1	1	1



∴ After 1st pass we get,

the filtered image.



∴ only 1 pass of the dilation operator is required to remove the black hole within the white object.

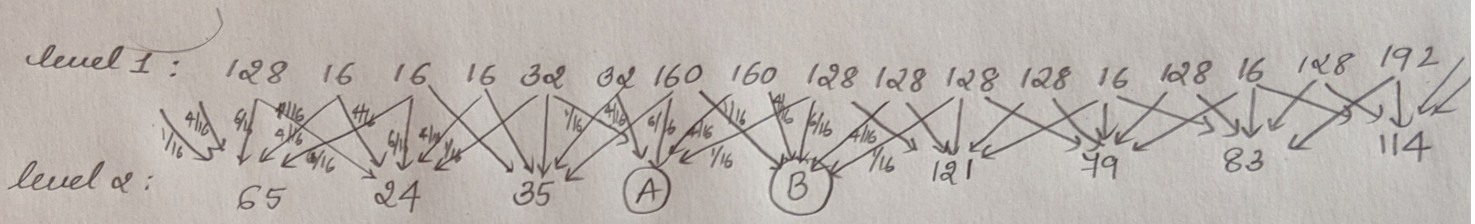
Problem 3)

Given, Binomial kernel = $\frac{1}{16}$ [1 | 4 | 6 | 4 | 1]

decimation factor = 2.

We know that, a Gaussian pyramid is created by smoothing using a Binomial kernel and down sampling by half.

∴ following the same process we can calculate the values of A, B, C and D.



∴ A can be calculated as:

$$A = \frac{1}{16}[1\ 4\ 6\ 4\ 1] * [32\ 32\ 160\ 160\ 128] = \frac{1}{16}[1\times32 + 4\times32 + 6\times160 + 4\times160 + 1\times128]$$

$$= \frac{1}{16}[32 + 128 + 960 + 640 + 128]$$

$$\therefore A = \frac{1}{16}[1888] = 118 \qquad \boxed{A = 118}$$

∴ B can be calculated as:

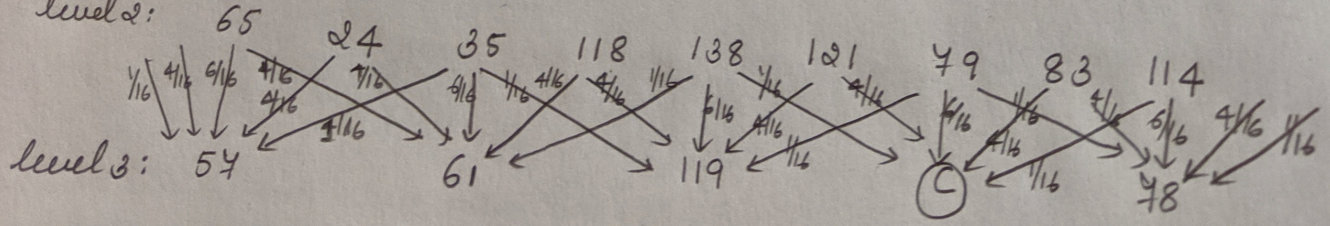
$$B = \frac{1}{16}[1\ 4\ 6\ 4\ 1] * [160\ 160\ 128\ 128\ 128] = \frac{1}{16}[1\times160 + 4\times160 + 6\times128 + 4\times128 + 1\times128]$$

$$= \frac{1}{16}[160 + 640 + 768 + 512 + 128]$$

$$= \frac{1}{16}[2208]$$

$$= 138.$$

$$\therefore \boxed{B = 138}$$



• C can be calculated as:

$$C = \frac{1}{16}\boxed{1\,|\,4\,|\,6\,|\,4\,|\,1} * \boxed{138\,|\,121\,|\,79\,|\,83\,|\,114}$$

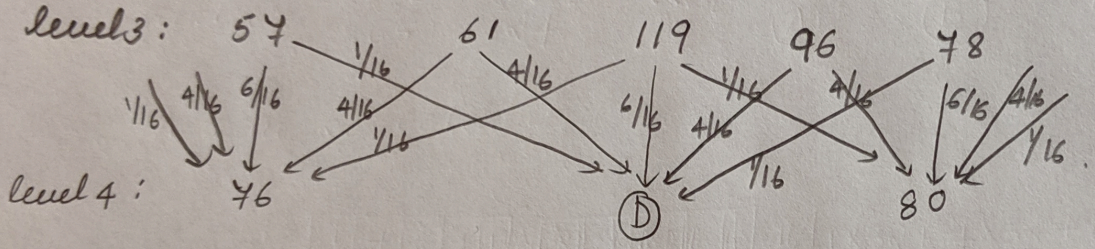
$$= 1/16\,[1\times138 + 4\times121 + 6\times79 + 4\times83 + 1\times114]$$

$$= 1/16\,[138 + 484 + 474 + 332 + 114]$$

$$= 1/16\,[1542]$$

$$= 96.375.$$

$$\therefore \boxed{C = 96}$$



• D can be calculated as:

$$D = \frac{1}{16}\boxed{1\,|\,4\,|\,6\,|\,4\,|\,1} * \boxed{57\,|\,61\,|\,119\,|\,96\,|\,78}$$

$$= 1/16\,[1\times57 + 4\times61 + 6\times119 + 4\times96 + 1\times78]$$

$$= 1/16\,[57 + 244 + 714 + 384 + 78]$$

$$= 1/16\,[1477]$$

$$D = 92.3125.$$

$$\therefore \boxed{D = 92}$$