06.02.2024
Tuesday:

Printing media ~~for~~ ~~Advance~~ It use

UNSHARPEN IMAGE AND HIGHBOOSTING IMAGE :-

$$\boxed{f_s(x,y) = f_0(x,y) - \bar{F}(x,y)} \rightarrow \text{I}$$

or $F_B(x,y)$ or F'

or Sharpen Image = Original Image − Blur Image

[f_s : output image f_0 or f : Original Image]

complement is a blur image.

$$\Rightarrow \boxed{f_{HB}(x,y) = A\,F(x,y) - \bar{F}(x,y) \quad \text{where } A \geq 1} \rightarrow \text{II}$$

$A == 1 \Rightarrow F(x,y)$ = Original Image

$\Rightarrow f_{HB}$ = sharpened image

From I & II : $\{\bar{F}(x,y)\}$

$$f_s(x,y) = f_0(x,y) + f_{HB}(x,y) - A f_0(x,y)$$

$$\Rightarrow f_s(x,y) = (1-A) f_0(x,y) + f_{HB}(x,y)$$

$$\Rightarrow f_{HB}(x,y) = (A-1) f_0(x,y) + f_s(x,y)$$

$$f_{HB}(x,y) = A f(x,y) - (f(x,y) - f_s(x,y))$$

$$= A f(x,y) - f(x,y) - f_s(x,y)$$

$$\Rightarrow f_{HB}(x,y) = (A-1) f_0(x,y) - f_s(x,y)$$

↓ Laplace

Two masks

0	-1	0
-1	A+4	-1
0	-1	0

-1	-1	-1
-1	A+8	-1
-1	-1	-1

Highboosting: जब print करते Bhaiya कहते हैं की its quality is not good. Then highboost is used.
(Printing capabilities ↑ses)

Any Pack /

1) Apply HB on center bit → No padding is required

Q) $\begin{bmatrix} 1 & 2 & 3 \\ 4 & \boxed{5} & 6 \\ 7 & 8 & 9 \end{bmatrix}$ with $A = 1.8$

Sol: $(1.8 + 8)5 - (\text{sum of remain})$
$= 9 + 40 - 40$
$= 9$

mask = $\begin{bmatrix} -1 & -1 & -1 \\ -1 & A+8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$

↳ o/p $\begin{bmatrix} 1 & 2 & 3 \\ 4 & \boxed{9} & 6 \\ 7 & 8 & 9 \end{bmatrix}$

A : coefficient factor of HB Image.

Q) $\begin{bmatrix} 4 & 3 & 7 & 5 \\ 4 & 3 & 2 & 1 \\ 3 & 5 & 7 & 2 \\ 4 & 6 & 3 & 9 \end{bmatrix}$ Apply HB on this image.

Sol: Padding.

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 4 & 3 & 7 & 5 & 0 \\ 0 & 4 & 3 & 2 & 1 & 0 \\ 0 & 3 & 5 & 7 & 2 & 0 \\ 0 & 4 & 6 & 3 & 9 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} * \begin{bmatrix} 0 & -1 & 0 \\ -1 & (A+4) & -1 \\ 0 & -1 & 0 \end{bmatrix} = \begin{bmatrix} 15 & 2.5 & 28.5 \\ 12 & & \\ & & \end{bmatrix}$$

5.5

$-7 + 22$

$5.5 \times 3 - 14$

$A + 4 = 1.5 + 4 = 5.5$

$$\begin{bmatrix} 15 & 2.5 & 28.5 & 19.5 \\ 12 & 2.5 & -7 & -3.5 \\ 3.5 & 8.5 & 26.5 & -6 \\ 13 & 21 & -5.5 & 44.5 \end{bmatrix} \rightarrow \begin{bmatrix} 15 & 3 & 29 & 20 \\ 12 & 3 & 0 & 0 \\ 4 & 9 & 27 & 0 \\ 13 & 21 & 0 & 45 \end{bmatrix}$$

12.02.2024 Monday.

Rotating any filter does not cause problem. # Binder

→ use: Age detection

FIRST ORDER DERIVATIVE FILTER

① Robert filter or Cross filter $\begin{bmatrix} -1 & 0 \\ 0 & +1 \end{bmatrix} = \begin{bmatrix} 0 & +1 \\ -1 & 0 \end{bmatrix}$

Too many calculation since filter is small. o/p was not accurate.

∴ New filter.

② Sobel operator $\begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix} \Rightarrow \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$

③ Prewitt operator $\begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix} \Rightarrow \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix}$

1 Q) $\begin{bmatrix} 1 & 2 & 3 \\ 4 & \cancel{8}\ 7 & 5 \\ 6 & 7 & 9 \end{bmatrix} * \begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix} \nearrow$ $1-7$ $\begin{bmatrix} 1 & 2 & 3 \\ 4 & \cancel{8}\ 0 & 5 \\ 6 & 7 & 9 \end{bmatrix}$

↳ कोई भी ले लो। दोनों सही है।

↳ outline

Age Filter ← वाला Diagram

Q) Apply Robert's, Sobel & Prewitt operators on the image at the point (2,1) & (3,2). & compare all three filters.

Sol: जब (0,0) या (1,1) specify नहीं हो तब कहीं भी मान लो इन दोनों में

specify कर देगा ऊपर वाला या नीचे वाला।
पहले देखो (0,0) से मिलता है। अगर pts मिलते हैं तो ठीक वरना (1,1) से start

$$\begin{array}{c|ccc} & 0 & 1 & 2 \\ \hline 0 & 1 & 2 & 3 \\ 1 & 4 & 7 & 5 \\ 2 & 6 & 7 & 9 \end{array}$$

(2,1)

start here $-4-7$

$$\begin{array}{c|ccc} & 1 & 2 & 3 \\ \hline 1 & 1 & 2 & 3 \\ 2 & 4 & 7 & 5 \\ 3 & 6 & 7 & 9 \end{array} * \begin{bmatrix} -1 & 0 \\ 0 & +1 \end{bmatrix} = \begin{bmatrix} 1 & 2 & 3 \\ -11\ 0 & 7 & 5 \\ 6 & -16\ 0 & 9 \end{bmatrix}$$

RF

$-7-9$

Sampling, histogram, Linear, Non Linear.

Image stretching & inverse. flip 90° vertically, horizontally.

0 means Border

Constant padding

Sobel opr.

$$\begin{array}{c|ccc} 1 & 1 & 2 & 3 \\ 4 & 4 & 7 & 5 \\ 6 & 6 & 7 & 9 \\ 6 & 6 & 7 & 9 \end{array} \times \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 2 & 3 \\ 20 & 7 & 5 \\ 6 & 6 & 9 \end{bmatrix}$$

Padded

$$\times \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 2 & 3 \\ 15 & 7 & 5 \\ 6 & 6 & 9 \end{bmatrix}$$

Prewitt opr.

Q) Let $I = [1\ 2\ 3\ 6\ 7]$ be an image using the mask as kernel $K = 011$. Perform convolution & correlation.

Sol:

$e^{\pi/2}$ $e^{\pi/4}$ e^{π}

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separation

Zooming

It is the technique ~~the~~ to enhance the pixels.
TO extract the minute ~~pitt~~ information of ~~pixel~~ image

or Replication

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \xrightarrow[\text{Zoom}]{2\times} \begin{matrix} 1 & 0 & 2 & 0 \\ 0 & 0 & 0 & 0 \\ 3 & 0 & 4 & 0 \\ 0 & 0 & 0 & 0 \end{matrix} \xrightarrow[\text{Zoom}]{2\times} \begin{matrix} 1 & 1 & 2 & 2 \\ 1 & 1 & 2 & 2 \\ 3 & 3 & 4 & 4 \\ 3 & 3 & 4 & 4 \end{matrix}$$

1 x

$$\xrightarrow[\text{Zoom}]{3\times} \begin{matrix} 1 & 0 & 0 & 2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 3 & 0 & 0 & 4 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{matrix} \xrightarrow[\text{Zoom}]{3\times} \begin{matrix} 1 & 1 & 1 & 2 & 2 & 2 \\ 1 & 1 & 1 & 2 & 2 & 2 \\ 1 & 1 & 1 & 2 & 2 & 2 \\ 3 & 3 & 3 & 4 & 4 & 4 \\ 3 & 3 & 3 & 4 & 4 & 4 \\ 3 & 3 & 3 & 4 & 4 & 4 \end{matrix}$$

Disadvantages

1. Clarity & visibility does not ↑ses
2. Transmission becomes difficult. Size ↑ses of image.
   No. of calculation ↑ses. ⇒ Efficiency ↓ses.

Interpolation

⇒ works on separation nodes & not on original.

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \longrightarrow \begin{matrix} 1 & 0 & 2 & 0 \\ 0 & 0 & 0 & 0 \\ 3 & 0 & 4 & 0 \\ 0 & 0 & 0 & 0 \end{matrix}$$

$$\boxed{f(x) = P\left(\frac{(x-1)+(x+1)}{2}\right)}$$

previous pixel   next pixel

$$\boxed{f(y) = P\left(\frac{(y-1)+(y+1)}{2}\right)}$$

1 . 1.5 2 1
2 1 3 0.5 → disadvantage

1 & 2 छोटे हैं
इस लिए 1.5 रख दिए
Round off नहीं किया।

⇒ ये Ans was possible for a single pixel.

∴ Mask was developed.

$e^{j\theta} = \cos\theta + j\sin\theta \qquad e^{-j\theta} = \cos\theta - j\sin\theta$

इसमें updated image pixel consider कर लें।

1/4	1/2	1/4
1/2	1	1/2
1/4	1/2	1/4

Mask:

⊙ जहाँ zero है वहीं Apply करते
↳ बाकी रहेंगे zero.

0	1	1.5	2	1
0	*	0	0	0
0	3	0	4	0
	0	0	0	0

$\frac{1}{2} + \frac{1.5}{4} + \frac{3}{2}$
$= 3.75$

Image Enhancement in Frequency Domain

Return to original image. ⟵ ⟶ It is reversible (not like Spatial Domain)

Discrete Fourier Transform (DFT) $e^{-j2\pi kx/N}$

(1768 Fourier sir added this in image)

1D DFT:-

$$\boxed{F(k) = \sum_{x=0}^{N-1} f(x)\, e^{-j2\pi kx/N}}$$

$x = 0, 1, 2, 3, \ldots, N-1$

$I = \{1, 2, 3, 4, 5, 6\}$ $N = 6$ (No. of pixels points)

0 to $6-1 = 5$

Inverse DFT:-

$$\boxed{f(x) = \sum_{k=0}^{N-1} F(k)\, e^{j2\pi kx/N}}$$

$e^{j\pi} = -1$	$e^{-j\pi} = -1$
$e^{j2\pi} = 1$	$e^{-j2\pi} = 1$
$e^{j\pi/2} = j$	$e^{-j\pi/2} = -j$
$e^{j3\pi/2} = -j$	$e^{-j3\pi/2} = +j$
$e^{j9\pi} = -1$	$e^{-j9\pi} = -1$
$e^{j9\pi/2} = j$	$e^{-j9\pi/2} = -j$

Scanned with CamScanner

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Q) $f(x) = \{1, 0, 0, 1\}$ $\therefore N = 4$
$\quad\quad\quad\quad 0\ 1\ 2\ 3$

Sol: $F(k) = \sum_{x=0}^{N-1} f(x) e^{-j2\pi kx/N}$ where $k = 0, 1, 2, 3, \ldots, N-1$

$$F(k) = \sum_{x=0}^{3} f(x) \cdot e^{-j2\pi kx/4}$$

$$= f(0) \cdot e^{0} + f(1)\underbrace{e^{-j2\pi k/4}}_{e^{-j\pi k/2}} + f(2) \cdot e^{-j\pi k}$$

$$+ f(3)\underbrace{e^{-j2\pi 3k/4}}_{e^{-j3\pi/2}}$$

$$= 1 + 0 + 0 + 1 * e^{-j3\pi k/2}$$ [From ques.]

$$\Rightarrow \boxed{F(k) = 1 + e^{-j3\pi k/2}}$$

$k = 0, 1, 2, 3$

$F(0) = 1 + 1 = 2$

$F(1) = 1 + e^{-j3\pi/2} = 1 + j$

$F(2) = 1 + e^{-j3\pi} = 1 - 1 = 0$

$F(3) = 1 + e^{-j9\pi/2} = 1 - j$

$$\boxed{F(k) = \{2, 1+j, 0, 1-j\}}$$

जब 4 point DFT होता है तब Mask apply करते हैं करना।

4 POINT DFT Mask (Kernel)

Apply in 1D $I = \{0, 1, 2, 3\}$

$$\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix}_{4\times4} * \begin{bmatrix} 0 \\ 1 \\ 2 \\ 3 \end{bmatrix}_{4\times1} = \begin{bmatrix} 6 \\ -2+j \\ -2 \\ -2-2j \end{bmatrix}_{4\times1}$$

$$\begin{array}{c|ccc} & 1 & 1 & 1 \\ \hline 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{array}$$

wavelet transform

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Q) $I = \{1, 0, 0, 1\}$

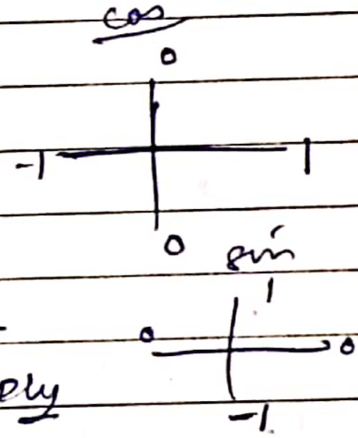
Sol:
$$\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix} * \begin{bmatrix} 1 \\ 0 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 2 \\ 1+j \\ 0 \\ 1-j \end{bmatrix}$$

$$\boxed{\underset{(2D)}{DFT} = \text{kernel} * I * (\text{kernel})^T}$$

Q) $$I = \begin{bmatrix} 2 & 3 & 4 & 5 \\ 0 & 2 & 3 & 0 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 \end{bmatrix}$$

Sol: $$\underset{(2D)}{DFT} = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix} * \begin{bmatrix} 2 & 3 & 4 & 5 \\ 0 & 2 & 3 & 0 \\ 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix}$$

$$= \begin{bmatrix} 3 & 7 & 8 & 7 \\ 1 & 2-j & 3-3j & 4+j \\ & & & \\ & & & \end{bmatrix}$$



Q) 1D image $= \{1, 0, 1, 0, 1, 0, 1, 0\}$ (indices 0 1 2 3 4 5 6 7) — DFT 1D Apply

Sol: $F(k) = \sum_{x=0}^{N-1} f(x)\, e^{-j 2\pi x k / N}$

$= \sum_{x=0}^{7} f(x) \cdot e^{-j 2\pi x k / 8}$

$= \cancel{e^{1}} 1 + e^{-j\pi k/2} + e^{-j\pi k} + e^{-j 3\pi k/2}$

$k = 0, 1, 2, \dots 7$

$F(0) = 1+1+1+1 = 4$

$F(1) = 1 - j$

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Q) $I = \begin{bmatrix} 1 & 3 & 5 & 7 \\ 0 & 2 & 4 & 6 \\ 7 & 5 & 3 & 1 \\ 6 & 4 & 2 & 0 \end{bmatrix}$ 2D Image.

Calculate DFT.

$DFT = K \cdot I \cdot K^T$

Sol: $DFT = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix} * \begin{bmatrix} 1 & 3 & 5 & 7 \\ 0 & 2 & 4 & 6 \\ 7 & 5 & 3 & 1 \\ 6 & 4 & 2 & 0 \end{bmatrix} * \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix}$

$= \begin{bmatrix} 14 & 14 & 14 & 14 \\ -6+6j & -2+2j & 2-2j & 6-6j \\ 2 & 2 & 2 & 2 \\ -6-6j & -2-2j & 2+2j & 6+6j \end{bmatrix} \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix}$

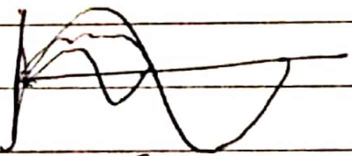
$= \begin{bmatrix} 56 & 0 & 0 & 0 \\ 0 & -4+8j & & \\ & & & \\ & & & \end{bmatrix}$

$-8+8j$

$\cancel{+2j+2}$

$+\cancel{2j}+2-\cancel{2j}+2$

COSINE DFT :-



$\begin{bmatrix} 0.5 & 0.5 & 0.5 & 0.5 \\ 0.6532 & 0.2706 & -0.2706 & -0.6532 \\ 0.5 & -0.5 & -0.5 & 0.5 \\ 0.2706 & -0.6532 & 0.6532 & 0.2706 \end{bmatrix}$

HAAR TRANSFORM :-

Image compression "Age detection"

$H_2 = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$ 2x2 image Fine Image

$H_4 = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & -1 & -1 \\ \sqrt{2} & \sqrt{2} & 0 & 0 \\ 0 & 0 & +\sqrt{2} & -\sqrt{2} \end{bmatrix}$ Super fine Image

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2×2 Image

Q) $\begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 6 \\ 5 & 4 & 3 & 2 \\ 1 & 2 & 3 & 4 \end{bmatrix}$

Q) Write a program : Apply HAAR Tranformation to find the signal of image. $I = \begin{bmatrix} 4 & -1 \\ 2 & 3 \end{bmatrix}$

$I = \{4 \quad -1 \quad 2 \quad 3\}$ ← 1D format

For 1D :

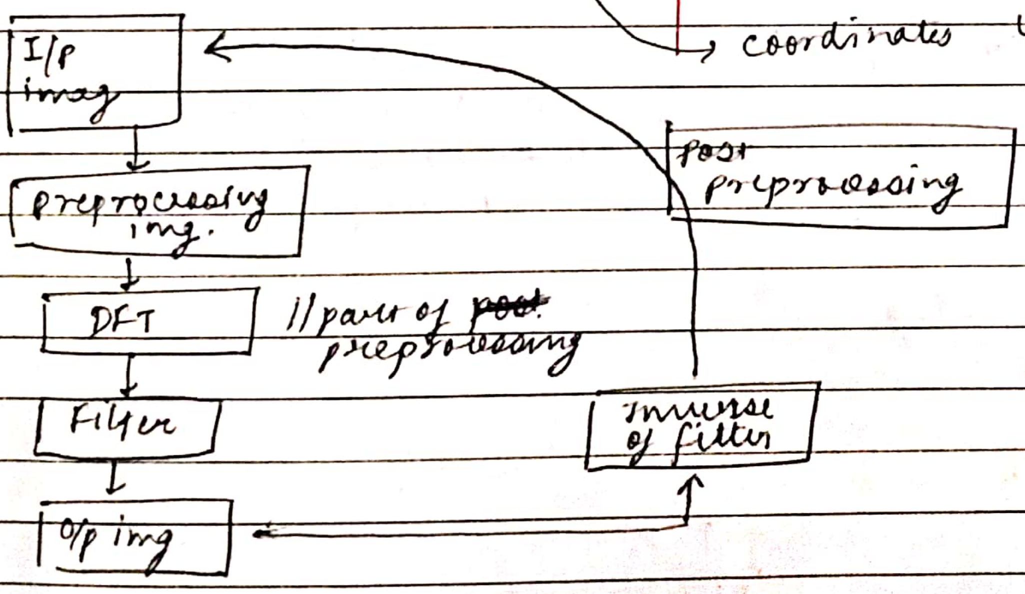
$$\text{HAAR Transform} = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix} * \begin{bmatrix} 4 & -1 \\ 2 & 3 \end{bmatrix} = \begin{bmatrix} \frac{3}{\sqrt{2}} & \frac{5}{\sqrt{2}} \\ & \end{bmatrix}$$

Frequency Domain vs Spatial Domain

$F(u,v) — H(u,v) \rightarrow G(u,v)$ | $f(x,y) \longrightarrow (h(x,y)) \longrightarrow g(x,y)$

i/p filter. o/p | i/p filter. o/p

→ coordinates u,v , x,y of pixel.



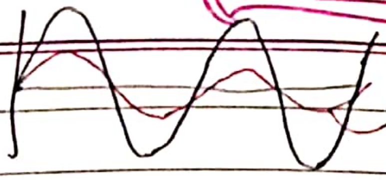
H : Filter
G : Output

Δ Frequency Domain

① // pixel to pixel multiplication
② Image can be reversed back.

> कुछ नहीं दिया तो Spatial or Frequency domain से कर लो।

Types of Frequency Domain



LPF रहने देता इसे।

I ① Low Pass Filter (LPF) Low Frequency filter

(Smoothing, Blur effect) → to remove noisy effect from image

② High Pass Filter · High frequency filter

(Sharpness effect) ⇒ background removal

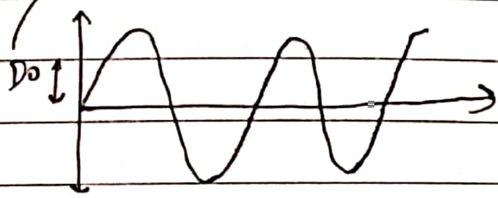
Types of LPF (Smoothing Filter)

① ILPF (Ideal)

② BLPF (Butterworth)

③ DLPF (Guassian)

low frequency रहने देता है।



① Ideal

$$\boxed{H(u,v) = \begin{cases} 1 & D(u,v) <= D_0 \\ 0 & D(u,v) > D_0 \end{cases}}$$

② Butterworth

$$\boxed{H(u,v) = \frac{1}{1 + \left[D(u,v)/D_0\right]^{2n}}}$$

n, D_0 in question

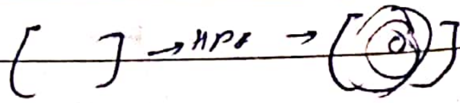
n : Butterworth constant

↳ n की value से Ring को remove हटाने में काम आता है।

③ Guassian

$$\boxed{H(u,v) = e^{-D^2(u,v)/2D_0^2}}$$

Ring



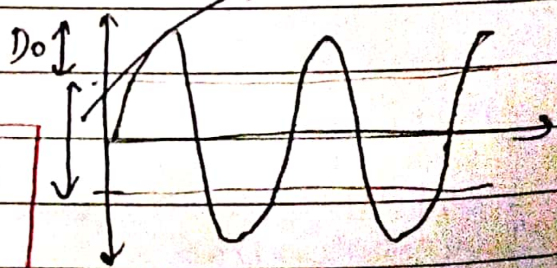
Types of HPF (Sharp)

① IHPF (Ideal)

② BHPF (Butterworth)

③ ~~GB~~HPF (Guassian)

Area of denial



① Ideal

$$\boxed{H(u,v) = \begin{cases} 0 & D(u,v) <= D_0 \\ 1 & D(u,v) > D_0 \end{cases}}$$

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② Butterworth

$$H(u,v) = \frac{1}{1 + [D_0/D(u,v)]^{2n}}$$

Interesting

③ Guassian

$$G(u,v) = 1 - e^{-D^2(u,v)/2D_0^2}$$

Step 1

$$\begin{bmatrix} 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 \end{bmatrix}_{4\times4} * \begin{bmatrix} 1 & -1 & 1 & -1 \\ -1 & 1 & -1 & 1 \\ 1 & -1 & 1 & -1 \\ -1 & 1 & -1 & 1 \end{bmatrix} \overset{\text{point Multiplication}}{=} \begin{bmatrix} 1 & 0 & 1 & 0 \\ -1 & 0 & -1 & 0 \\ 1 & 0 & 1 & 0 \\ -1 & 0 & -1 & 0 \end{bmatrix}$$

input img. — universal preprocessing filter $(-1)^{x+y}$. — o/p of preprocessing (I)

Step 2

Apply DFT on (I)

DFT(2D) = kernel * I * kernel^T

$$DFT(2D) = \left[\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix} * \begin{bmatrix} 1 & 0 & 1 & 0 \\ -1 & 0 & -1 & 0 \\ 1 & 0 & 1 & 0 \\ -1 & 0 & -1 & 0 \end{bmatrix}\right] * \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 4 & 0 & 4 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} * \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix}$$

$$DFT(2D) = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 8 & 0 & 8 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

DFT(2D) image (I) — Δ Preprocessing (DFT(2D))

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Q3)
$$\begin{bmatrix}1&1&1&0\\1&0&1&0\\0&1&0&1\\1&1&1&0\end{bmatrix} \xrightarrow{\text{Preprocessing}} * \begin{bmatrix}1&-1&1&-1\\-1&1&-1&1\\1&-1&1&-1\\-1&1&-1&1\end{bmatrix} = \begin{bmatrix}1&-1&1&\\-1&0&-1&0\\0&-1&0&\\-1&1&-1&\end{bmatrix}$$

$$\cancel{\begin{bmatrix}1&-1&1&-1\\2&-2&2&-2\\-2&2&-2&2\\1&-1&1&-1\end{bmatrix}}$$
I

$$K = \begin{bmatrix}1&1&1&1\\1&-j&-1&j\\1&-1&1&-1\\1&j&-1&-j\end{bmatrix}$$
for DFT

$$K * I * K^T = \begin{bmatrix}1&1&1&1\\1&-j&-1&j\\1&-1&1&-1\\1&j&-1&-j\end{bmatrix} * \begin{bmatrix}1&-1&1&0\\-1&0&-1&0\\0&-1&0&-1\\-1&1&-1&0\end{bmatrix} * \begin{bmatrix}1&1&1&1\\1&-j&-1&+j\\1&-1&1&-1\\1&j&-1&-j\end{bmatrix}$$

$$= \begin{bmatrix}-1&-1&-1&-1\\1&j&1&1\\3&-3&3&-1\\1&-j&1&1\end{bmatrix} * \begin{bmatrix}1&1&1&1\\1&-j&-1&j\\1&-1&1&-1\\1&j&-1&-j\end{bmatrix}$$

$j^2 = -1$
$-j^2 = 1$
$1+1$
-1

$$= \begin{bmatrix}-4&0&0&0\\j+3&j+1&1-j&-1-j\\2&2j&10&-2j\\3-j&j-1&1+j&1-j\end{bmatrix}$$
$\Rightarrow H(u,v)$

$$\xrightarrow[D_0 = 0.5]{\text{Filter}} \begin{bmatrix}\sqrt{8},&\sqrt{5},&2,&\sqrt{5}\\\sqrt{5}&\sqrt{2}&1&\sqrt{2}\\2&1&0&1\\\sqrt{5}&\sqrt{2}&1&\sqrt{2}\end{bmatrix}$$

$$\underset{D(u,v)}{\begin{bmatrix}1&1&1&1\\1&1&1&1\\1&1&0&1\\1&1&1&1\end{bmatrix}} * \underset{H(u,v)}{\begin{bmatrix}-4&0&0&0\\j+3&j+1&1-j&-1-j\\2&2j&10&-2j\\3-j&j-1&1+j&1-j\end{bmatrix}} = \underset{G(u,v)}{\begin{bmatrix}-4&0&0&0\\j+3&j+1&1-j&-1-j\\2&2j&0&-2j\\3-j&j-1&j+1&1-j\end{bmatrix}}$$

Matrix 3×3 4×4 8×8

$\begin{bmatrix} - & - & - \\ - & \bigcirc & - \\ - & - & - \end{bmatrix}$ center value

$$\boxed{H(u,v) = \sqrt{\left(u-\frac{M}{2}\right)^2 + \left(v-\frac{N}{2}\right)^2}}$$

$$H(u,v) \begin{cases} 1 & H(u,v) > 0.5 \\ 0 & H(u,v) < 0.5 \end{cases}$$

Euclidean distance

Step 3

For $H(u,v)$

$$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 8 & 0 & 8 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \rightarrow \begin{array}{cccc} 0,0 & 0,1 & 0,2 & 0,3 \\ 1,0 & 1,1 & 1,2 & 1,3 \\ 2,0 & 2,1 & 2,2 & 2,3 \\ 3,0 & 3,1 & 3,2 & 3,3 \end{array}$$

$H(u,v) = \sqrt{(u-2)^2+(v-2)^2}$

Center value

. 4 5×5 के लिए ।

$m = 4 \quad n = 4$

(4 rows & 4 columns)

val > 0.5 ⇒ 1

else 0

$H(u,v)$

$$\begin{bmatrix} \sqrt{8} & \sqrt{5} & 2 & \sqrt{5} \\ \sqrt{5} & \sqrt{2} & 1 & \sqrt{2} \\ 2 & 1 & 0 & 1 \\ \sqrt{5} & \sqrt{2} & 1 & \sqrt{2} \end{bmatrix}$$

$$\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix} * \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 8 & 0 & 8 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 8 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$D(u,v) \quad * \quad H(u,v) \quad = \quad G(u,v)$$

Step 4 Inverse

$\frac{1}{m} K * I * \frac{1}{m} K^T \rightarrow G(u,v)$

$m \rightarrow 4 \qquad m \rightarrow 4$

$$\frac{1}{4}\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix} * \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 8 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} * \frac{1}{4}\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix} = \frac{1}{4}\begin{bmatrix} 8 & 0 & 0 & 0 \\ -8 & 0 & 0 & 0 \\ 8 & 0 & 0 & 0 \\ -8 & 0 & 0 & 0 \end{bmatrix} * \frac{1}{4}\begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix}$$

or

$$\frac{8}{2}\begin{bmatrix} 1 & 1 & 1 & 1 \\ -1 & -1 & -1 & -1 \\ 1 & 1 & 1 & 1 \\ -1 & -1 & -1 & -1 \end{bmatrix} = \frac{1}{16}\begin{bmatrix} 8 & 8 & 8 & 8 \\ -8 & -8 & -8 & -8 \\ 8 & 8 & 8 & 8 \\ -8 & -8 & -8 & -8 \end{bmatrix} = \begin{bmatrix} 0.5 & 0.5 & 0.5 & 0.5 \\ -0.5 & -0.5 & -0.5 & -0.5 \\ 0.5 & 0.5 & 0.5 & 0.5 \\ -0.5 & 0.5 & -0.5 & -0.5 \end{bmatrix}$$

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step 5 Post preprocessing

Q)
$$\frac{1}{2}\begin{bmatrix}1&1&1&1\\-1&-1&-1&-1\\1&1&1&1\\-1&-1&-1&-1\end{bmatrix} * \begin{bmatrix}1&-1&1&-1\\-1&1&-1&1\\1&-1&1&-1\\-1&1&-1&1\end{bmatrix} = \frac{1}{2}\begin{bmatrix}0&0&0&0\\0&0&0&0\\0&0&0&0\\0&0&0&0\end{bmatrix}$$

universal preprocessing filter

↓ ~~pair~~ pixel to pixel multiplication

$\boxed{\text{i/p image} == \text{o/p image}}$

$$\frac{1}{2}\begin{bmatrix}1&-1&1&-1\\+1&-1&1&-1\\1&-1&1&-1\\1&-1&1&-1\end{bmatrix} \xrightarrow[:0]{-ve} \frac{1}{2}\begin{bmatrix}1&0&1&0\\1&0&1&0\\1&0&1&0\\1&0&1&0\end{bmatrix}$$

enhancement of the image.

enhanced image

Q)
$$\begin{bmatrix}0&0&0&0\\0&0&0&0\\8&0&8&6\\0&0&0&0\end{bmatrix}$$

Butterworth

$$H(u,v) = \frac{1}{1+(D_0/D(u,v))^{2n}}$$

~~$D_0 = 0.5$~~

$n = 0.5$

$$H(u,v) = \frac{1}{1+(0.5/D(u,v))^{1}}$$

~~$D(u,v)$~~

$-j^2 = 1 \qquad j^2 = -1$

Inverse $\frac{1}{m}K * I * \frac{1}{m}K^T$

$$\frac{1}{4}\begin{bmatrix}1&1&1&1\\1&-j&-1&j\\1&-1&1&-1\\1&j&-1&-j\end{bmatrix} * \begin{bmatrix}-4&0&0&0\\j+3&j+1&1-j&-1-j\\2&2j&0&-2j\\3-j&j-1&j+1&1-j\end{bmatrix} * \frac{1}{4}K^T = \frac{1}{16}\begin{bmatrix}4&+4j&+2&-2j\\-4&-4j&-2&4j\\-8&0&-2&0\\-8&0&2&0\end{bmatrix} * K^T$$

$1-j-2j-1-j \quad -\cancel{j}-1-1+\cancel{j} \quad -j-1 \quad -1+\cancel{j}-\cancel{j}-1$

$j+\cancel{1}+2j+j-\cancel{1}$

$1+\cancel{j}-2\cancel{j}$

$1-j-2j-1-j$

$j-\cancel{1}$

$-2 \quad -4+\cancel{1}-3\cancel{j}-\cancel{2}+3\cancel{j}+\cancel{1}$

$-j-1-1+j$

$-\cancel{1}-\cancel{j}-3+\cancel{2}-3+\cancel{j}$

$\cancel{j}+1+1-\cancel{j}+j-1+2j+j+1$

~~$-j+1$~~ $-\cancel{j}-\cancel{1}+2j-\cancel{j}+1$

$-4-1+3j-2-3j-1$

$-1+\cancel{j}-2j+1+\cancel{j}$

$-j+1+2j-j-1$

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$$\frac{1}{8} \times \begin{bmatrix} 2 & 2j & +1 & -j \\ -2 & -2j & -1 & 2j \\ -4 & 0 & -1 & 0 \\ -4 & 0 & +1 & 0 \end{bmatrix} * \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix}$$

$$= \frac{1}{8} \begin{bmatrix} j+3 \end{bmatrix}$$

Q) $$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 \end{bmatrix} * \begin{bmatrix} 1 & -1 & 1 & -1 \\ -1 & 1 & -1 & 1 \\ 1 & -1 & 1 & -1 \\ -1 & 1 & -1 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ -1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ -1 & 0 & 0 & 1 \end{bmatrix}$$

universal preprocessing filter

DFT : $K * I * K^T$

$$= \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix} * \begin{bmatrix} 1 & 0 & 0 & 0 \\ -1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ -1 & 0 & 0 & 1 \end{bmatrix} * K^T$$

$$= \begin{bmatrix} 0 & 0 & 0 & 2 \\ 0 & 0 & 0 & 0 \\ 4 & 0 & 0 & -2 \\ 0 & 0 & 0 & 0 \end{bmatrix} * \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 2j & -2 & -2j \\ 0 & 0 & 0 & 0 \\ 2 & 4-2j & 6 & 4+2j \\ 0 & 0 & 0 & 0 \end{bmatrix} = 2 \begin{bmatrix} 1 & j & -1 & -1 \\ 0 & 0 & 0 & 0 \\ 1 & 2-j & 3 & 2+j \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

4.03.2024
Monday

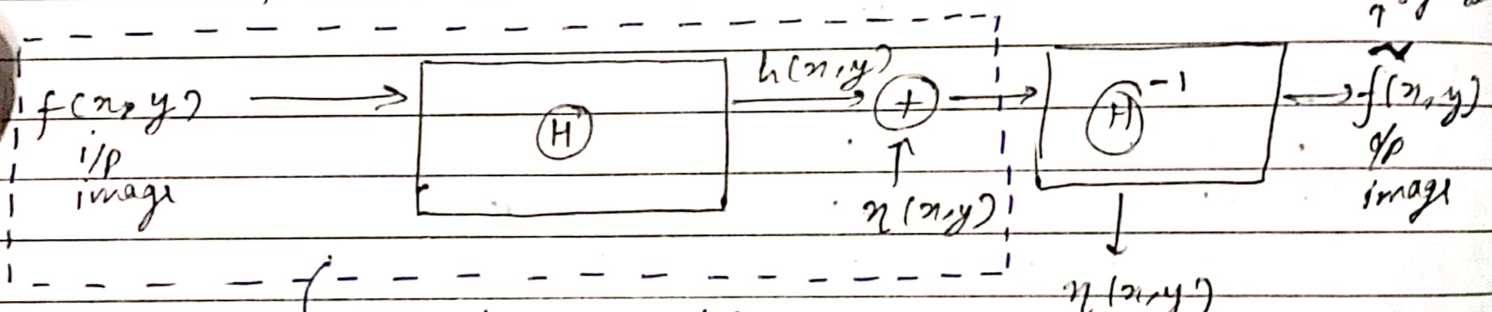
\# (0,0) (0,1) (0,2) (0,3) $\sqrt{8}$ $\sqrt{5}$ 2 $\sqrt{5}$
(1,0) (1,1) (1,2) (1,3) → $\sqrt{5}$ $\sqrt{2}$
(2,0) (2,1) (2,2) (2,3)
(3,0) (3,1) (3,2) (3,3)

DEGRADATION MODEL

$$\boxed{g(x,y) = f(x,y) * h(x,y) + \eta(x,y)}$$

- $g(x,y)$ → degraded image
- $f(x,y)$ → i/p image
- $*$ → convolution (filter type multiply)
- $h(x,y)$ → Degradation image
- $\eta(x,y)$ → Noise

Shutter speed is also responsible for degradation



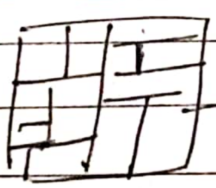
Degradation model

Frequency Domain

$$\boxed{\text{Result operation} = H(u,v) \cdot G(u,v)}$$

image degrade (Dust particles, Noise) इन सब के कारण हो सकती है।

IMAGE SEGMENTATION → { Continuous Model, Discontinuous Model }



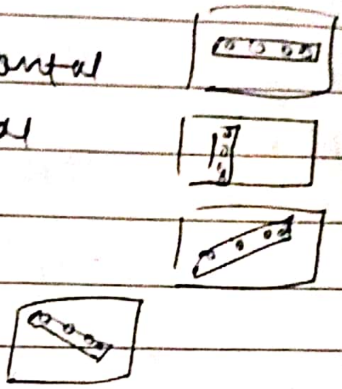
→ segmentation of image { To reduce operation on whole image. [cost & time ↓]

05.03.2024
Tuesday

Types of continuous Model

(i) Point detection model → $\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$ Point detection kernel.

(ii) Line detection → Horizontal, Vertical, 45°, -45°



(iii) Edge detection (N)

4	3	7	5	2	3	5	7
1	1	1	2	4	5	7	7
1	1	1	3	4	6	6	7	7
1	1	1	4	4	4	4	4
1	1	1	4	6	7	0	6
1	1	1	4	5	6	7	6

→ point detect (sudden change of pixels value)

$\begin{bmatrix} 2 & -2 & 0 \\ -2 & 0 & -2 \\ 0 & -2 & 2 \end{bmatrix}$ 45°

0	0	0	6
0	3	4	5
2	2	1	0
0	0	0	0

Image split (segment) → Image dataset segment

Merge at last.
('0' वाला portion हटा दो)

Edge detection { Split, Merge, Split & merge

→ TH <= 4 (Threshold <= 4)

IMAGE SPLITTING SEGMENTS (Region based splitting)

For whole image MAX = 7, MIN = 0 { Diff = 7-0 = 7 > 4

∴ Split (from middle)

R1 R2 R3 R4

R1
MAX = 7
MIN = 0
Diff = 7-0 = 7 > 4

- R1A [R1A1, R1A2, R1A3, R1A4
- R1B [R1B1, R1B2, R1B3, R1B4
- R1C
- R1D [R1D1, R1D2

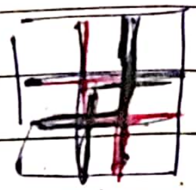
R1				R2			
7	6	5	3	5	1	1	2
2	4	7	1	5	1	1	3
3	7	0	5	6	1	1	4
4	3	2	5	6	7	5	5
R3				**R4**			
7	7	7	3	1	1	7	1
6	6	5	3	1	1	5	2
6	5	4	4	0	1	6	3
4	4	6	5	1	1	5	4

For each calculate MAX-MIN → Diff
If Diff <= TH then OK
else split further.

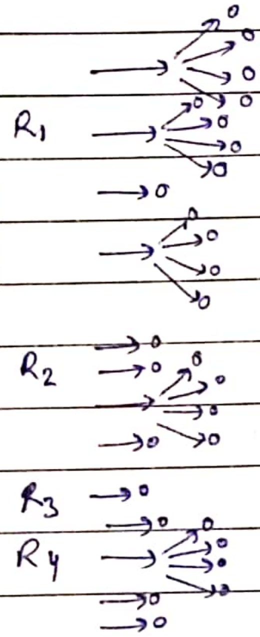
R1 R2 R3 R4

- R1
  - R1A
    - R1A1
    - R1A2
    - R1A3
    - R1A4
  - R1B
    - R1B1
    - R1B2
    - R1B3
    - R1B4
  - R1C
  - R1D
    - R1D1
    - R1D2
    - R1D3
    - R1D4
- R2
  - R2A
  - R2B
    - ~~R2B1~~
    - ~~R2B2~~
    - ~~R2B3~~
    - ~~R2B4~~
  - R2C
    - R2C1
    - R2C2
    - R2C3
    - R2C4
  - R2D
- R3
- R4
  - R4A
  - R4B
    - R4B1
    - R4B2
    - R4B3
    - R4B4
  - R4C
  - R4D

3×3



overlapping subimages



Region of using min

1 ←	1	6	6	1
1 ←	2	3	7	6
1 ←	1	4	5	3
2	2 ←	1 →	1	7
1	7	6	2	6
2	6	5	2	7

CV (center value)

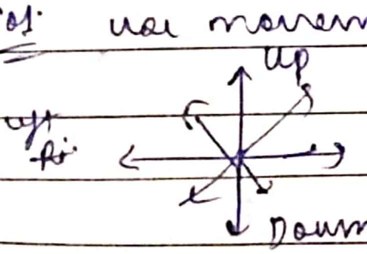
IMAGE GROWING

Q) Apply image growing method with Threshold value 4 (TH <= 4)

If initial point not given then take centre $= \left(\frac{n+1}{2}\right) = \frac{5+1}{2} = 3$

If (CV <= TH) {
go ahead;
} else {
Take from neighbour any value as centre ~~such as TH <= 4~~;
}

Sol: use movements first of the X



go on the pixel such that ~~TH~~ <= value <= TH

05.03.2024 Wednesday

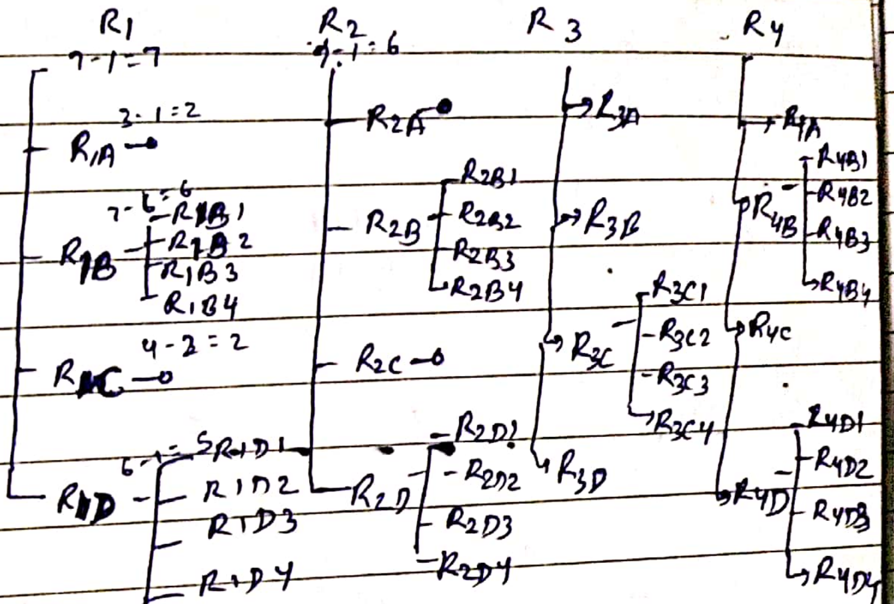
Initial Pixel = (4,4)

Q) TH <= 4

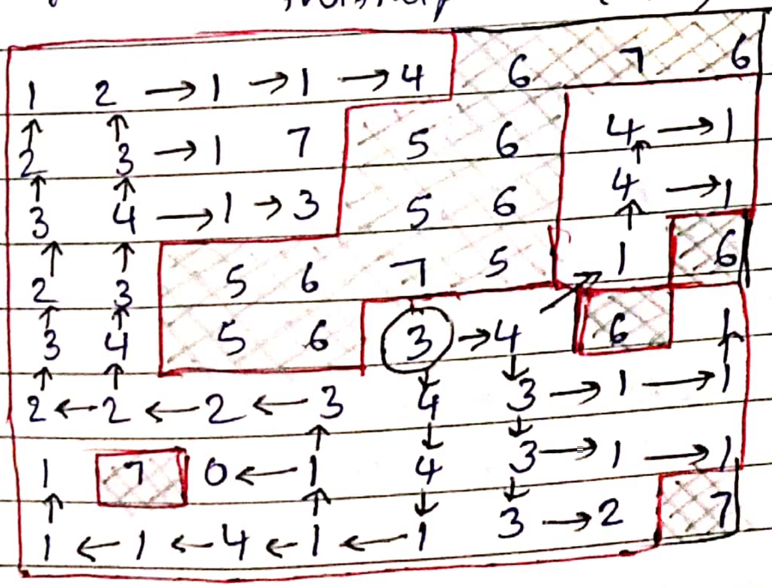
(i) Image Splitting

1	2	1	1	4	6	7	6
2	3	1	7	5	6	4	1
3	4	1	3	5	6	4	1
2	3	5	6	7	5	1	6
3	4	5	6	3	4	6	1
2	2	2	3	4	3	1	1
1	7	0	1	4	3	1	1
1	1	4	1	1	3	2	7

Image splitting:
7 − 0 = 7 > TH.
Split



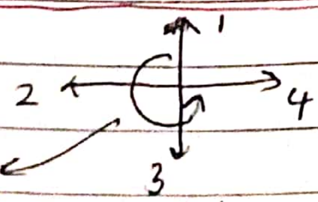
(ii) Image Growing from initial pixel = (4,4)



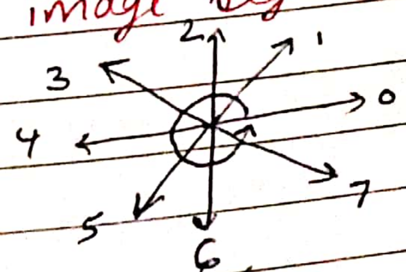
Shade the unwanted or wanted region

Here unwanted i.e. TH > 4

CHAIN CODING in image segmentation:-

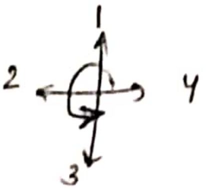


Not compulsory 4 Point

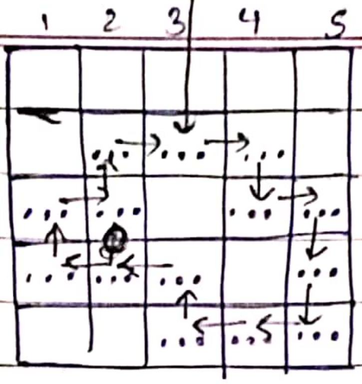


8 Point
[Fine boundaries]

① → Right
② ↓ Down
③ Any
→ 4 point



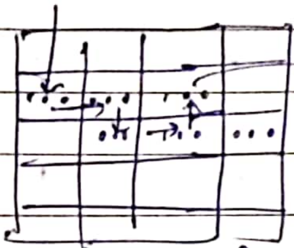
(3,2)

Q) 

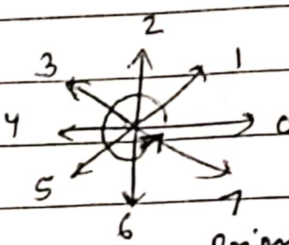
Initial point (3,2)
Write boundary & chain code for 4 point

~~4~~ ~~3~~ 4
4 3 4 3 ~~3~~ 2 2 1 2 2 1 4 1 4
↳ chain code

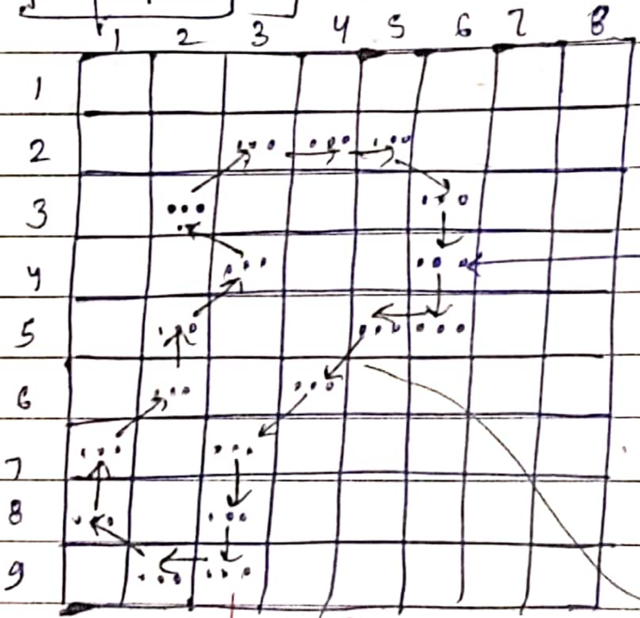
5×5



→ Failed
4 point



Priority
→ 0 (1)
7 (2)
6 (3)
Any (4)

Q) 

initial point (6,4)

Start point

chain code

6 ~~8~~ 4 5 5 6 6 4 3 2 1 2 1 3 1 0 0 7 6

, Failure of 4 Point Code

↳ तीन Dots की जगह Shade हो सकता है।

THRESHOLD IN SEGMENTATION

TH <= 4 { ≤4 Background {1, 2, 3, 4}
>4 Foreground {5, 6, 7, ...}

11.03.2024
Monday

7	1	2	4	3
6	5	1	2	7
4	2	3	7	1
3	1	2	4	7
3	2	1	4	5

1	5	5	6
2	5	4	6
3	5	4	7
4	4	4	7
5	1	1	7
5	2	2	6

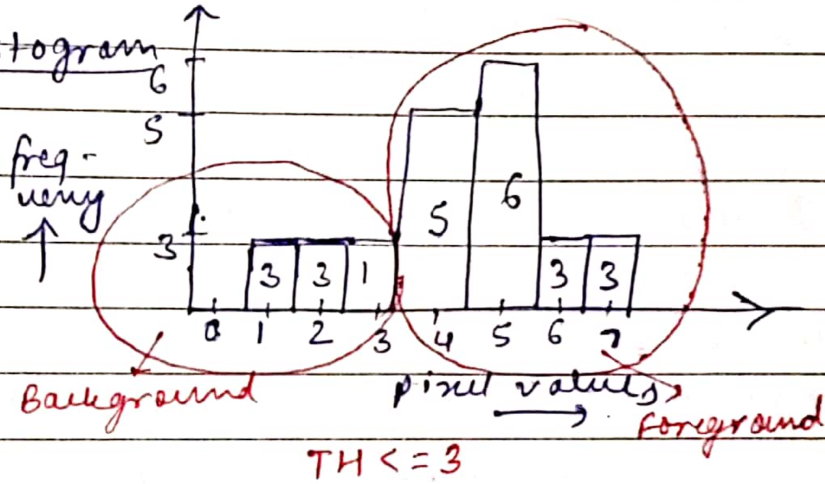
Complex photos में multiple threshold हो सकते है।

$T_1 <= 2$ $T_2 >= 5$

Ex. Medical X-Ray
अलग Parts पर multiple threshold रखते है।

{Image mining}

Histogram



TH <= 3

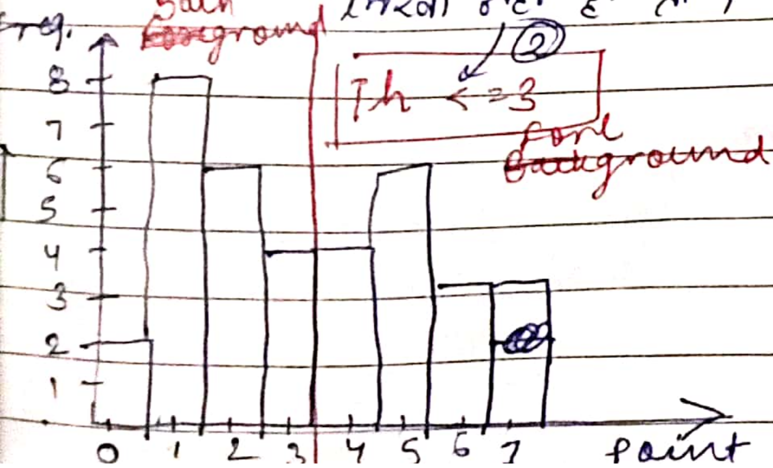
Ostu Thresholding Method

Point	0	1	2	3	4	5	6	7
freq.	2	8	6	4	4	6	3	2

① ←

0	1	3	5	5	7
1	2	4	6	6	7
4	5	0	2	1	2
5	4	3	1	2	3
7	5	2	1	2	4
5	6	1	1	1	3

~~Histogram → Bar आग line छूती हो तो~~ (छूती नहीं है तो)



$p <= Th \Rightarrow$ ~~Fore image~~ Back ground
$p > Th \Rightarrow$ ~~Background~~ Fore

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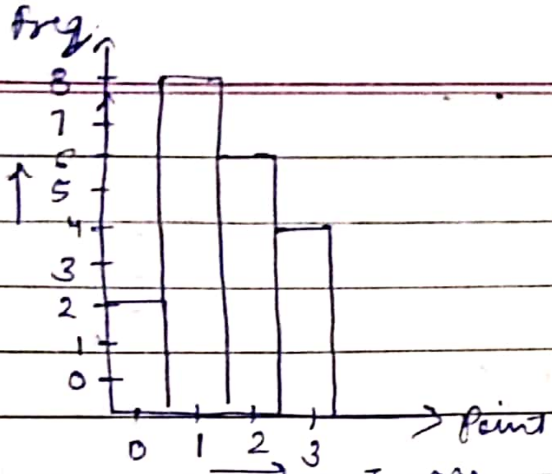
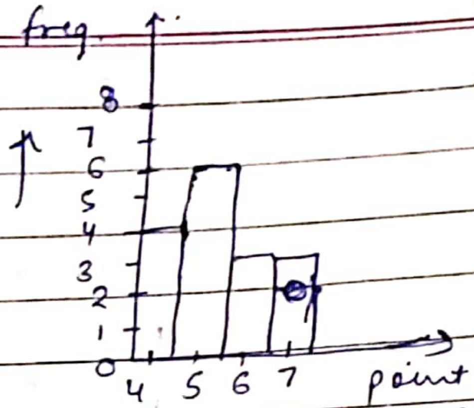


Δ Background of ~~the Image~~ Image (Histogram)



Δ Foreground of Image Histogram

Weight of background $W_b = \frac{2+8+6+4}{36} = \frac{\sum_{i=0}^{N_b} f_i}{N}$

$= \frac{20}{36} = 0.55$

Weight of foreground $W_f = 1 - W_b$
$= 0.45$

Mean of background (μ) $M_b = \frac{\sum^{N_b} f_i P_i}{\sum_{i=0}^{N_b} f_i}$

$= \frac{0\times2 + 1\times8 + 2\times6 + 3\times4}{0+8+12+12}$

$\Rightarrow M_b = \frac{32}{20} = 1.6$

Mean of foreground (μ_f) $M_f = \frac{4\times4 + 5\times6 + 6\times3 + 3\times7}{16}$

$= \frac{16+30+18+21}{16}$

$\Rightarrow M_f = \frac{85}{16} = 5.312$

Variance of background (σ_b^2) $V_b = \frac{\sum_{i=0}^{N_b} (P_i - \mu_b)^2 * f_i}{\sum_{i=0}^{N_b} f_i}$

$= \frac{(0-1.6)^2\times2 + (1-1.6)^2\times8 + (2-1.6)^2\times6 + (3-1.6)^2\times4}{20}$

$= \frac{16.8}{20} = 0.84$

Variance of foreground (σ_f^2) $V_f = \frac{(4-5.3)^2\times4 + (5-5.3)^2\times6 + (6-5.3)^2\times3 + (7-5.3)^2\times7}{\cancel{20}\ 16}$

$= \frac{17.44}{\cancel{20}\ 16}$ ~~14.55~~

$\Rightarrow V_f = \cancel{0.727}\ 1.09$

$\boxed{\text{Overall variance of class of Histogram at } Th <= 3 = (W_b \times \sigma_b^2) + (W_f \times \sigma_f^2)}$

$= (0.55 \times 0.84) + (0.45 \times 1.08)$
$= 0.95$

Question ends

Extension & Understanding

12.03.2024
Tuesday

$\boxed{\text{Completely blank} = 0}$

DATE ______
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Find overall variance of class of histogram at

Th <= y	value.
0	$\rightarrow v_1$
1	$\rightarrow v_2$
2	$\rightarrow v_3$
3	$\rightarrow v_4$
4	$\rightarrow v_5$
5	$\rightarrow v_6$
6	$\rightarrow v_7$
7	$\rightarrow v_8$

$y = \arg\text{-}\cancel{\max}\ \min \{v_1, v_2, v_3 \dots v_8\}$

↳ Best suited Threshold for breaking image in foreground & ~~for~~ background.

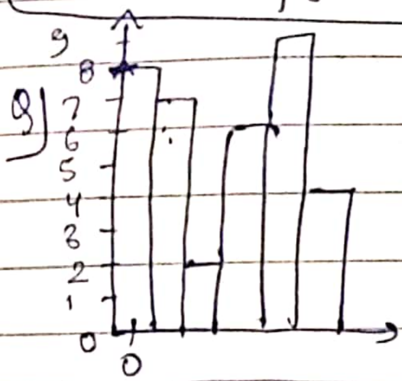
min. v_i के corresponding के वाला Threshold लेना → Otsu Method.

Python code

Question → def function() { }.

Take tuple of y
for i in range(8):
f(i)

min.



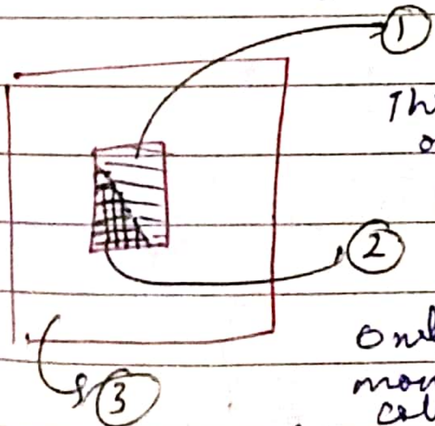
Th < 3

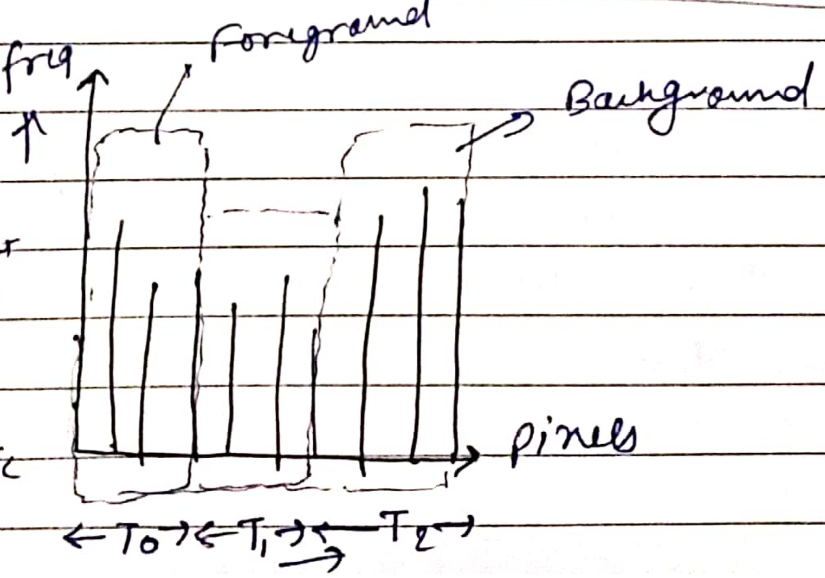
p_i	0	1	2	3	4	5
f_i	8	7	2	6	9	4

$\underbrace{8+7+2}_{17}$ $\underbrace{6+9+4}_{19}$, total 36

Thresholding.

बड़ी value Background





Ostu Method > Current method
(Best Method)

DATE ____
PAGE ____

Q)

1	2	3	4	5	7
3	2	1	7	7	7
4	4	3	3	3	7
3	3	3	2	1	6
5	6	5	7	5	6
4	4	4	3	4	6

Sol:

P_i	0	1	2	3	4	5	6	7
⇒ f_i	1	2	3	9	7	4	4	6
$P_i f_i$	1	2	6	27	28	20	24	42

$\Sigma P_i f_i = 150$ $\quad \Sigma N = \Sigma f_i = 36$

Threshold, $T_1 = \dfrac{\Sigma P_i f_i}{\Sigma N} = \dfrac{150}{36} = 4.16 \approx 4$

$Th \begin{cases} <= 4 \\ > 4 \end{cases}$

P_i	0	1	2	3	4	5	6	7
f_i	1	2	3	9	7	4	4	6
$P_i f_i$	0	2	6	27	28	20	24	42

5 $\qquad$ 3

$\Sigma f_i = 22$ $\quad \cancel{\frac{63}{22} = 12.6}$

$\mu_1 = \dfrac{\Sigma f_i P_i}{\Sigma f_i} = \dfrac{63}{22} = 2.86 \approx 3$

~~28~~

$\dfrac{86}{14} = 6.14 \approx 6$

$T_2 = \frac{1}{2}(\mu_1 + \mu_2)$

$= \frac{1}{2}(3+6)$

$= \frac{9}{2} = 4.5 \approx 4$

$T_1 == T_2$

yes → $\boxed{\text{Stop}}$

No → T_2

↓

Again calculate T_3

↓

$T_2 == T_3$

yes → $\boxed{\text{Stop}}$

No → T_3

↓

Repeat....

Iterative method

"Chemistry वाला"

Scanned with CamScanner

T_2

DATE ____
PAGE ____

Phase (12.03.2024)

Q)

	T_1									
P_i	0	35	75	100	128	175 ~~200~~	200 ~~225~~	225	255
f_i	10	10	23	8	13	5	16	5	10
$P_i f_i$	0	350	1725	800	1664	875	3200	1125	2550

Σ

It 1 $\Sigma P_i f_i$ $T_1 = \frac{\Sigma P_i f_i}{\Sigma N} = \frac{12289}{100} = 122.89 \approx 123$

$Th \begin{cases} <= 100 \\ > 100 \end{cases}$

It 2

$\mu_1 = \frac{2875}{51} = 56.37 \simeq 56$ $\mu_2 = \frac{9414}{49} = 192.12 \simeq 192$

$T_2 = \frac{1}{2}(\overset{56}{\mu_1} + \overset{192}{\mu_2}) = 124.24 \approx 123$

$T_2 <= 100$

$\boxed{T_1 == T_2}$

$\underline{Th = 100}$

Ostu's method $Th <= 128$

$w_b = \sum_{0}^{N_b} f_i \Big/ N = \frac{64}{100} = 0.64$

$w_f = 0.36$

$\mu_b = \frac{\sum_{0}^{N_b} P_i f_i}{\sum_{0}^{N_b} f_i} = \frac{4539}{64} = 70.92$

$\mu_f = \frac{7750}{36} = 215.27$

$\sigma_b^2 = \frac{\Sigma (P_i - \mu_b)^2 \times f_i}{\Sigma f_i} = \frac{112702.609}{64} = 1760.97$

$\sigma_f^2 = \frac{28097.22}{36} = 780.47$

overall $\sigma^2 = w_b \sigma_b^2 + w_f \sigma_f^2$

$\boxed{\text{overall } \sigma^2 = 1407.99}$ for $Th = \cancel{100}\ 128$

13.03.2024
Wednesday

~~$w_b = 0.69$~~ ~~$w_f = 0.31$~~

$\mu_b = \frac{5414}{69} = \cancel{84.66}$ 78.46

$\mu_f = \cancel{190.}\ \cancel{191}\ \frac{6875}{31} = 221.77$

~~$V_b = \frac{165537.24}{64} = 2586.5$~~ or σ_b^2

~~$V_f = \frac{601996.96}{36}$~~ or σ_f^2

$\sigma_f^2 = \frac{18679}{31} = 602.25$

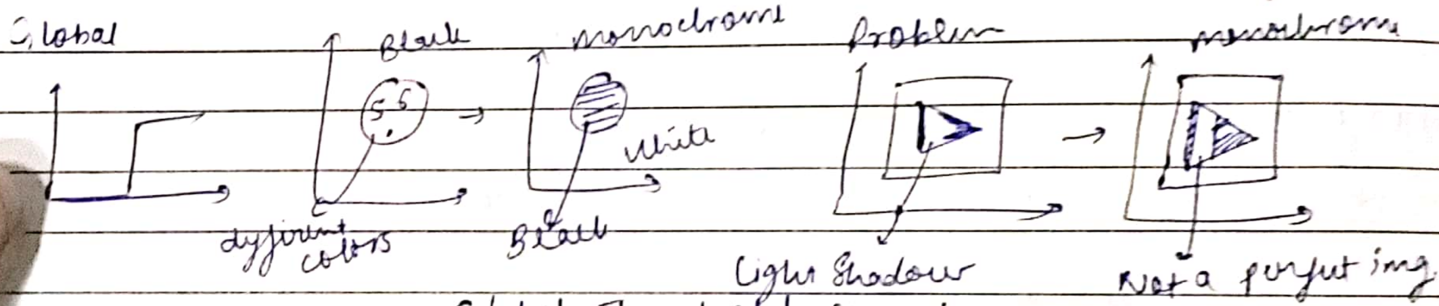
$\sigma_b^2 = \frac{162939.25}{69} = 2361.43$

Overall $\sigma^2 = w_b \sigma_b^2 + w_f \sigma_f^2$

$\Rightarrow \boxed{\text{Overall } \sigma^2 = 1816.08 \text{ for } Th = 175}$

Thresholding
→ Global (पहले वाला)
→ Adaptive (अभी वाला)
→ Comb^n of Thresholding & segmentation

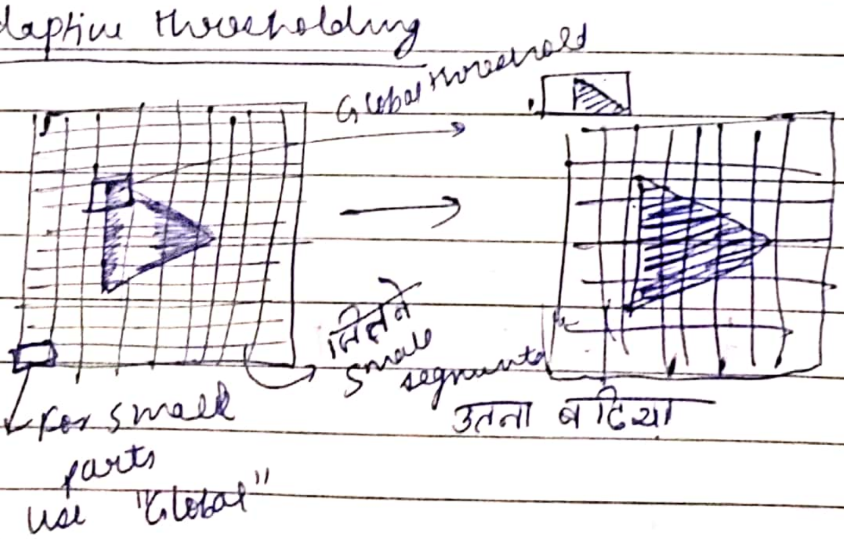
Global



→ Global Thresholding fails.

Adaptive thresholding

left side → 0 (Black)



Adaptive threshold ~~img~~

ए

मत बनाओ वाले ।

Divide in two parts for adaptive thresholding

Adaptive Threshold

Q)

I			II		
4	3	7	1	2	5
2	3	4	1	2	4
5	6	5	6	3	2
1	7	2	2	1	4
6	4	1	2	3	4
2	3	5	2	5	7
III			IV		

I)

p_i	0	1	2	3	4	5	6	7
f_i	0	0	1	2	2	2	1	1
p_if_i	0	0	2	6	8	10	6	7

$$T_1 = \frac{\Sigma p_if_i}{\Sigma f_i} = \frac{39}{9} = 4.33 = 4$$

$$\mu_1 = \frac{16}{5} = 3 \qquad \mu_2 = \frac{23}{4} = 5.75 \approx 5$$

$$T_2 = \frac{1}{2}(\mu_1+\mu_2) = 4$$

$$T_1 == T_2$$

No need for small images of μ_1 & μ_2 Direct T_1

II : $T_2 = \frac{\Sigma p_if_i}{\Sigma f_i} = \frac{2+6+4+3+5+6}{9}$

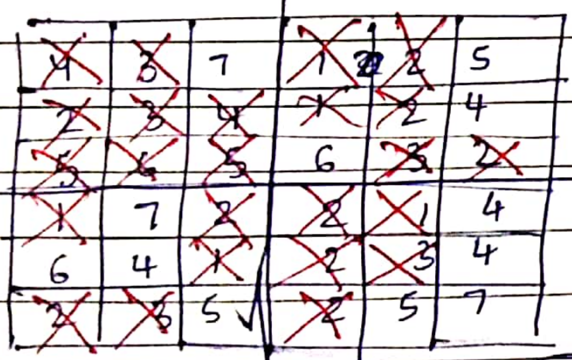
$$T_2 = \frac{26}{9} = 2.8 = 3$$

III : $T_3 = \frac{2+4+4+3+5+7}{9}$

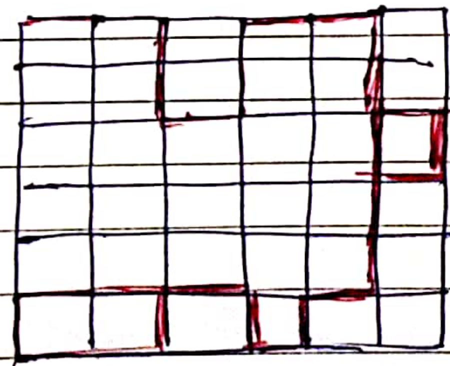
$$= \frac{25}{9} = 2.5 \text{ से ज्यादा} = 3$$

IV : $T_4 = \frac{1\times1+2\times3+3+4\times2+5+7}{9}$

$$= \frac{1+6+3+8+5+7}{9} = \frac{30}{9} = 3.4 \approx 3$$



$\Longrightarrow$



Otsu Method

$Th <= B$

$4 > W$

0.5 → 0 4.5 → 4

क्या किया ceil लेना ।

HW Apply 5×5 Adaptive thresholding on whatsapp image 12.03.2024 (Wednesday)