2 Sep 2024
MONDAY

lec-7 :-

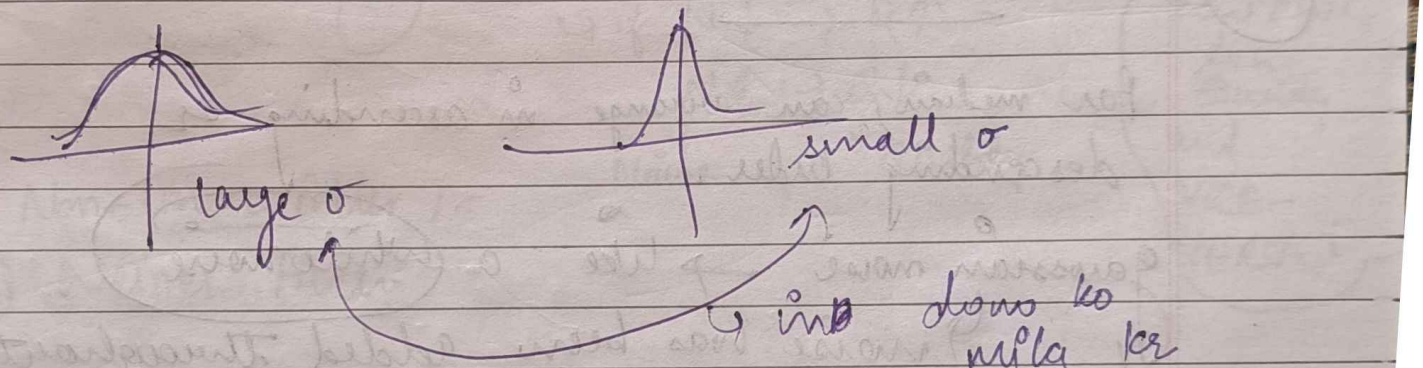
Non linear filter :-

similar kind of values will be passed.

(1) Gaussian filter :-

↳ are class of low-pass filters, all based on gaussian probability distribution function with σ as standard deviation.

$$f(x) = e^{\frac{-x^2}{2\sigma^2}}$$



→ background ko smoothen krne ke liye large σ.
→ image mein jo jyada highlight krna like your face, then use small σ as

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edges urgent hongi, so we need smaller area.

↓

→ will take smaller area.

$$f(x,y) = e^{-\left(\frac{x^2+y^2}{2\sigma^2}\right)}$$

Camera man
Lena
Tiger
→ by default Benchmark Datasets.

σ small → more clear picture
σ large → smoothening large area of pixels
↳ saara ka saara ek jaisa hi dikh raha hoga!

(2) Rank Order Filter:-

for median, can arrange in ascending or descending order.

gaussian noise → like a white noise
↳ noise has been added throughout image,
↳ diff. from salt & pepper
↳ as it will be at many places but will not cover the whole image.

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✗ agar matrix mein sirf ek-2 values bhut ↑ yaa ↓ dusri values se, then use averaging filter to set them in particular range.
or median filter
↳ Preferable! → as provide better quality image after denoising.
↳ How to decide which is better?
↳ which is looking good to us eyes,
can compare them using some mathematical model
↳ (1) Peak signal to noise ratio (PSNR)
(2) MSE
(3) SNR.
↳ if N↓ → Q↑
N↑ → Q↓
↑ Noise ↓ quality.
high N, low PSNR, low quality and VICE-VERSA.

Non-Linear filter :-
(1) Weiner filter

$$\mathcal{E}\,(x_{i,j} - \hat{x}_{i,j})^2$$

↳ '0' means exactly same picture

(2) centering / weighting
↳ get mean, subtract mean from each data set.

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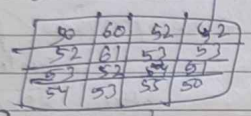
Lec-8 :-

no clear cut boundary



↳ not much difference

↳ like Background

there is step:

50 to 150

↳ like something important in image

$$\begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$$ → to get all lines at 45°.

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$ → to get all lines at 135°

In this way, kisi bhi direction ki saari edges nikaali jaa sakti hain.

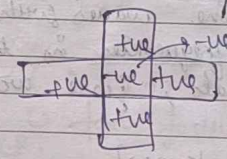
Sobel filter:-

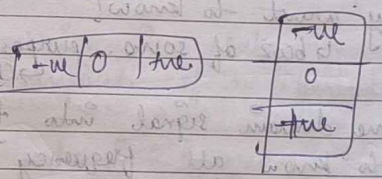
$$\begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$$ → horizontal line milegi

$$\begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$$ → vertical line milegi

sobel better → as jyada accha se lines aati hain!, in Robert, some lines missing hoti hain!!

Imp: Zero crossing using Laplacian.





* Unsharp Masking and Highboost filtering:-

→ to get high quality image than original, mask jab add kr rahe ho... → ratio ↑ kro, agar simply add krege toh toh original image hi mil jaayegi!!!

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lec-9 :-

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amplitude
time
⇒ as in real time domain, we are recording the amplitude.

(*) If two sound signals are synchronized (like 2 speaker ikatthe chala diye), then superposition will happen.

(*) fourier transform → decompose f^n in even (~~sin~~ cos) and odd (sin) components
↳ any signal can be decomposed in form of sine and cosine waves with certain weights.
⇒ so want all hidden frequencies in the signal of different signals, jisse wo signal bna.
↳ why want to know?
↳ bcoz of sound purpose (CH/ω).

⇒ So converting time domain signal into frequency domain signal to know all frequency components jisse wo signal bna hoga,

sine and cosine have phase difference of 90°.

→ do these point wise add^n and will get resultant signal.

any f^n can be written as sum of even and odd f^n.

WORK IS WORSHIP.

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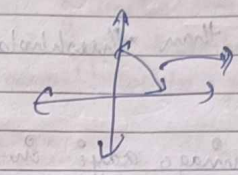
* As we have complex conjugate :-



ek quad ko analyse kro, diagram ki kya ki no zaroorat.

* also complex numbers can write in form of sine and cosine.

$x = a + ib$
$\bar{x} = a - ib$
$x \cdot \bar{x} = a^2 + b^2$.

* fft( ), fft2( )
↳ fast fourier transform.
(for signal in 2D (like image signal).)
→ one of the methods to do fourier transform in fast way

Imp. **.
→ If getting 3 peaks in signals, then it is composed of 3 different signals.

→ If 3 peaks in Image :-
possibilities :-
① 3 images combined.
② noise signals of 3 types
is can decompose it in 3 images.
③ 3 different objects in image.

that's why learning fourier transform is important.

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(*) Resultant signal will be a complex function.

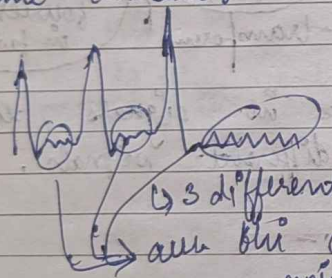
(*) If frequency < than threshhold, remove it!

Preprocessing:- as image aayi in unsigned int (0-255)
↳ can make them double

Postprocessing:-
↳ can again make them b/w 0-255.

imp: CONVOLUTION:-

Multiplication in frequency domain = convolution in time domain.

→ 

↳ 3 different peaks ke alawa, aur bhi choti-2 peaks → thus noise

can apply filter, like if freq < 0.1 → ~~remove~~ remove/ignore it.

* FFT using taylor approximation

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(*) Binary Image Processing :-

1) Binary image generation → → gray scale
① apply thresholding on image.
② Black-white printer se jo image nikli.

imp:
Display convention for Binary Images
↳ Black = 1 } → for printed page
White = 0
Black = 0 } → for computer monitor
White = 1

For 'Histogram Plot' can decide which threshhold value to consider.
Bimodal → means 2 modes/'2 peaks'.

NOT (x) → flip bits OR subtract from 1.

AND → means 'chota' ko diya.
OR → means 'bdha' ko diya.

X-NOR → equivalence gate.

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Lec-10 :-

Blob Coloring :→

→ Majority voting → when have to make decisions.

→ logical operations
↳ to make system easy

⇒ to eliminate noise part and to get existing part → Blob coloring can be used.

→ connected 1's jyada → toh iwo region ka bda.
for that can use 4 or 8 - connectivity.

⇒ jis shape ka filter leinge → usi type ki shape ko bss hm extract kri skte hain!

Dilate (I, B)
↓↓
Dilate image I using structuring element B

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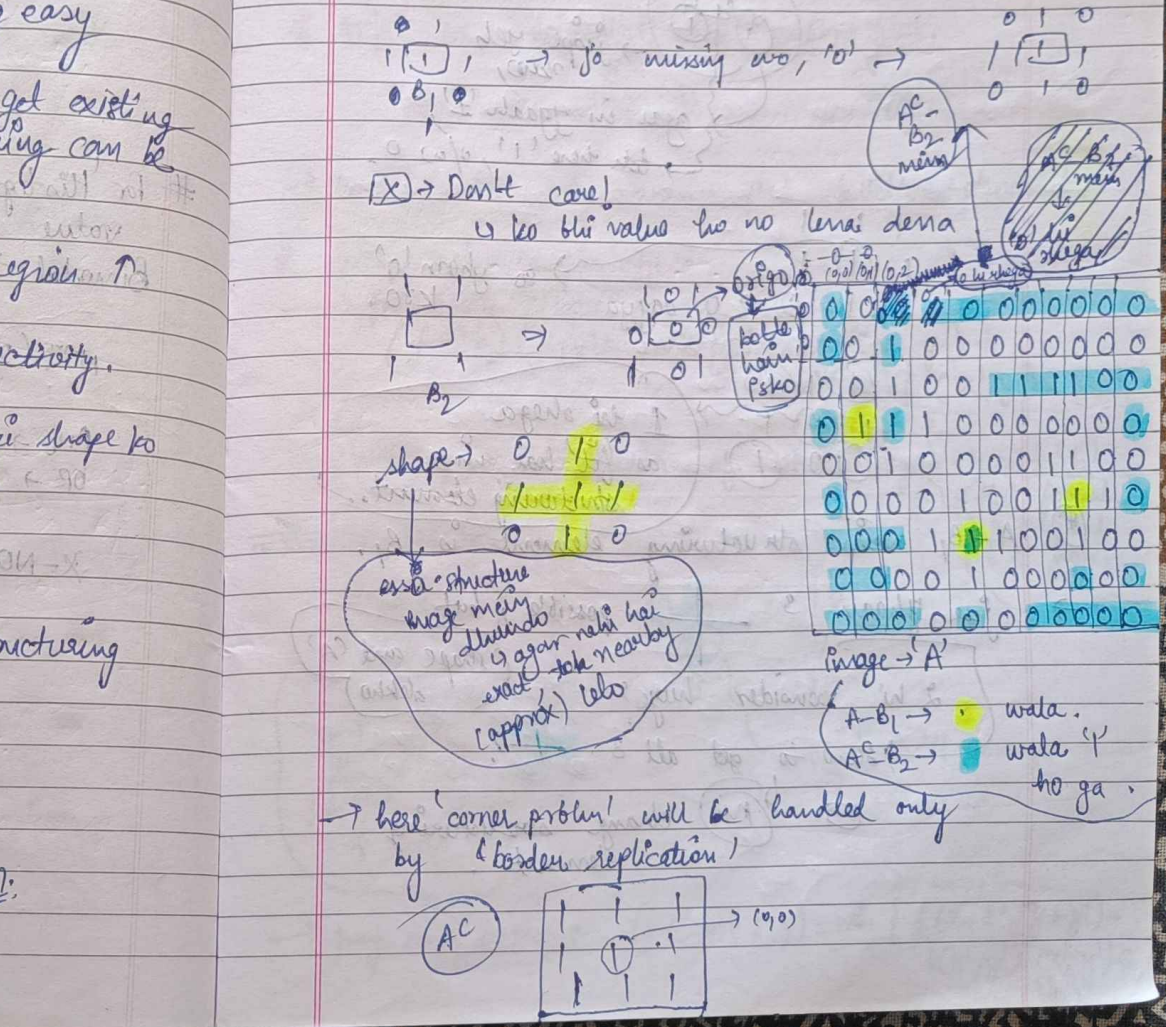
The Hit-or-Miss Transformation :-

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

$B_1 \rightarrow$ set of elements of B associated with an object.
$B_2 \rightarrow$ set of " " " " background.
$\ominus \rightarrow$ erosion.

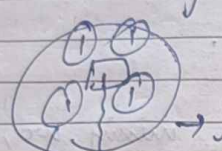


WORK 5th Day.

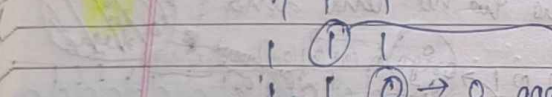
$A \circledast B \Rightarrow$

(3,2), (6,4) → only yeh '1' honge.

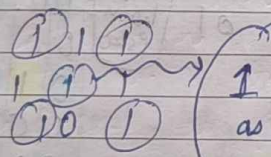
* $A_c - B_2$ mein structuring element is :- (B_2)



→ jispe yeh rakho, agar in jgaah '1', toh here '1', o/w 0.



so yhaan '0' rakho



1 wi shega as fit hai in structuring element.

* $A \circledast B_1$ mein structuring element is B_1.

→ jese yhaan 3 + possible, but (shape and (4) dekho)

2 wi consider huye?

→ How to get all 3 + ?

eg (M+1) change structuring element.

WORK 5th Day.

Thinning symbol

$A \otimes B = A - (A \circledast B)$

$= A \cap (A \circledast B)^c$

B is sequence of structuring element ⇒

$\{B\} = \{B^1, B^2, \ldots, B^n\}$

* origo can be flat or non-flat.
  - flat → all values same
  - non-flat → some values different.

→ we'll work only with flat structure element.

* Gray-scale Morphology :-

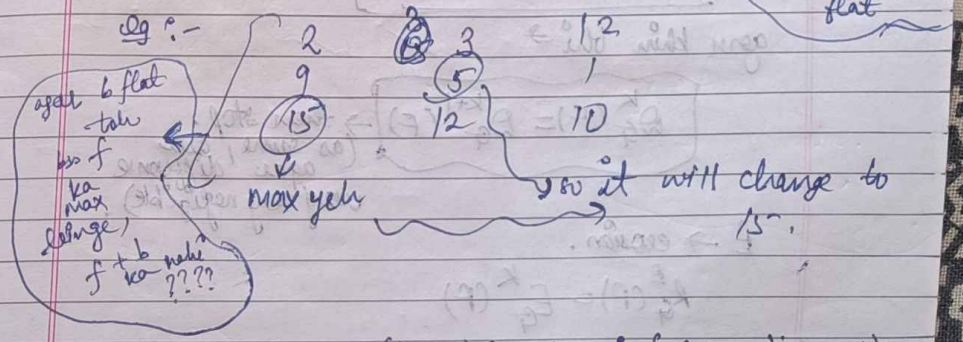
→ gray-scale Dilation :-

$$(f \oplus b)(x,y) = \max\{f(x-x', y-y') + b(x', y') \mid (x', y') \in D_b\}$$

where, D_b is domain of structuring element 'b'. (this formula is only if b is non-flat)

~~* Gray-scale.~~

eg :-



→ gray-scale Erosion :- $(f \ominus b)(x,y) = \min\{f(x+x', y+y') - b(x', y') \mid (x', y') \in D_b\}$

→ gray-scale opening (∘) and closing (•) ⇒

$$f \circ b = (f \ominus b) \oplus b$$
$$f \bullet b = (f \oplus b) \ominus b$$

* Morphological gradient :-

$$g = (f \oplus b) - (f \ominus b)$$

K-map → mein also don't care values pdhi thi 'X'

→ morphological reconstruction by dilation and erosion :-

F → image
G → mask
R → reconstruction
D → dilation
k → k no. of times krenge

same process, to get final result.

$$R_G^D(F) = D_G^{(k)}(F)$$

agar kbh bhi →

$$D_G^k(F) = D_G^{k+1}(F)$$ → then stop. (as same, agar difference very negligible).

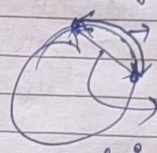
E → erosion.

$$R_G^E(F) = E_G^k(F)$$

ruko when →

$$E_G^k(F) = E_G^{k+1}(F)$$

(*) Geodesic Erosion? Geodesic dilation?
⇒ Geodesic distance?
"Earth" se aaya word, and earth 'gol' hai !!



yeh distance is 'geodesic' distance, as esse toh nahi jaa skte, so euclidean distance nahi lenge hm !

(*) dilation → brighter filtered image dega.

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Monday

Lec-13

Hough Transform :-

Canny → is also detection method.

problem → for vertical → slope = ∞
↳ can't compute in cartesian coordinates, so move to polar coordinates.

WOMK ☺ =3v♡M.   WOMK ☺ 3v =MM.

6/11 Wednesday

lec-14 :-

* If u see red object with yellow light, toh object yellow dikhega. as wo hi reflect ho kr eyes mein jaayegi!!

3 Bytes / cell ≡ 3 planes of (1 byte / cell) → gray scale
≡ R G B.
so for 1 cell → 3 bytes
= 24 bits

Magenta
cyan
yellow
black
→ colours in colour printer

→ to get this, subtract green from combination of green, red, blue
⇒ subtractive colour model

as inse jo black milta hai, wo black exact nhi hota, misty sa hota, so black alag se lete hain