Unit - 1

Introduction to Digital Image Processing.

→ What is Digital Image Processing.

→ Application Fields of IP.

→ Levels of IP.

→ Calculation of total No. of pixels

→ Key stages of Digital Image Processing

→ Components of Image Processing

→ Types of Image Representation
- Binary Image
- Gray Image
- Color Image
- Multispectral Image.

→ Image File Formats
- Raster Image
- Vector Image

→ Sampling Vs Quantization

→ BPP, Calculation of No. of colos / shades. (Sums)

$$L = 2^{bpp}.$$

→ RGB to Hex and Hex to RGB.

→ Neighbors (Sum + Theory)
- $N_4(P)$ +
- $N_D(P)$ ×
- $N_8(P)$ *

→ Distance measures. [equation + sum]

- Euclidean (D_e): $\sqrt{(x-s)^2+(y-t)^2}$
- city block (D_4): $= |x-s|+|y-t|$
- chess board (D_8): $= \max(|x-s|, |y-t|)$
- Dm Distance → required V.

→ Zooming → What?

Methods → Pixel Replication
→ zero order hold method
→ K-times zooming.

- What
- Working
- Sum
- Advantage
- Disadvantage

Unit-2
Matlab.

Working and syntax of,

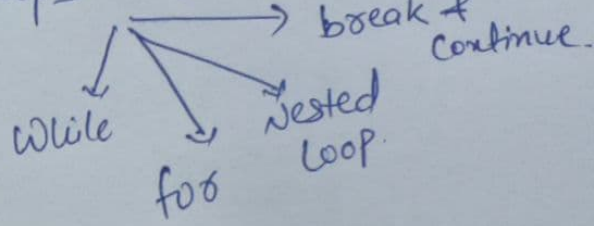
- save
- load
- who
- whos
- clear
- clc
- disp
- fprintf
- imadd()
- imsubtract()
- imdivide()
- immultiply()
- zeros()
- ones()
- eye()
- rand()
- imread()
- imshow()
- imwrite()
- size()
- iminfo()
- subplot()
- impixel()
- imagesc()
- imresize()
- imcrop()
- im2bw()
- rgb2gray()
- grayslice()
- imcomplement()
- uigetfile()

→ .m file

→ .mat file

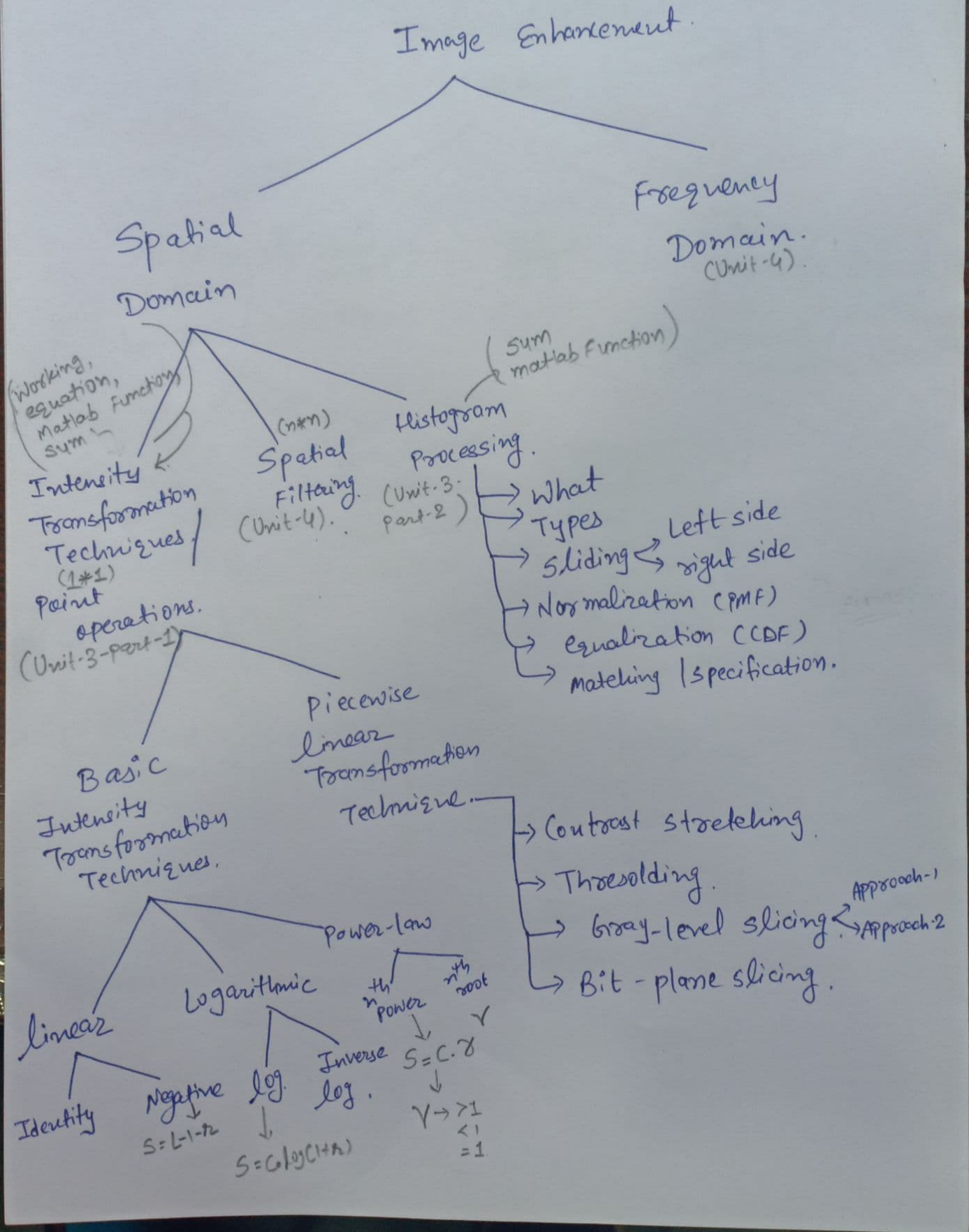
→ Special variables in matlab

→ Decision making & loops in matlab.



(Syntax & working).

Ch-3
Image Enhancement.



Unit-4.

Image Filtering Techniques.

→ (Convolution vs Co-relation.)

Spatial Filtering → [Sum, matrix, Advantage, disadvantage.]

(Unit-4. part-1)

Smoothing Filters / Low pass Filter / Blurring. → Sum of matrix element = 1

(Unit-4. part-2)

Sharpening Filters / High pass Filters. / Edge Detection / Derivative Filters. → Sum of matrix elements = 0.

Linear Filters / Mean Filters

- Averaging Filter. $\frac{1}{9}\begin{bmatrix}1&1&1\\1&1&1\\1&1&1\end{bmatrix}$
- Weighted Averaging Filter $\frac{1}{16}\begin{bmatrix}1&2&1\\2&4&2\\1&2&1\end{bmatrix}$
- Geometric mean
- Harmonic mean
- Contra-harmonic mean.

Non-linear Filters. / Order-statistics Filters

- Max Filter
- min Filter
- Median Filter
- Mid-point Filter
- Alpha-Trimmed mean Filter.

Gradient based Edge Detection / 1st order derivative (Thicken edge) (Horizontal / Vertical / Diagonal edge)

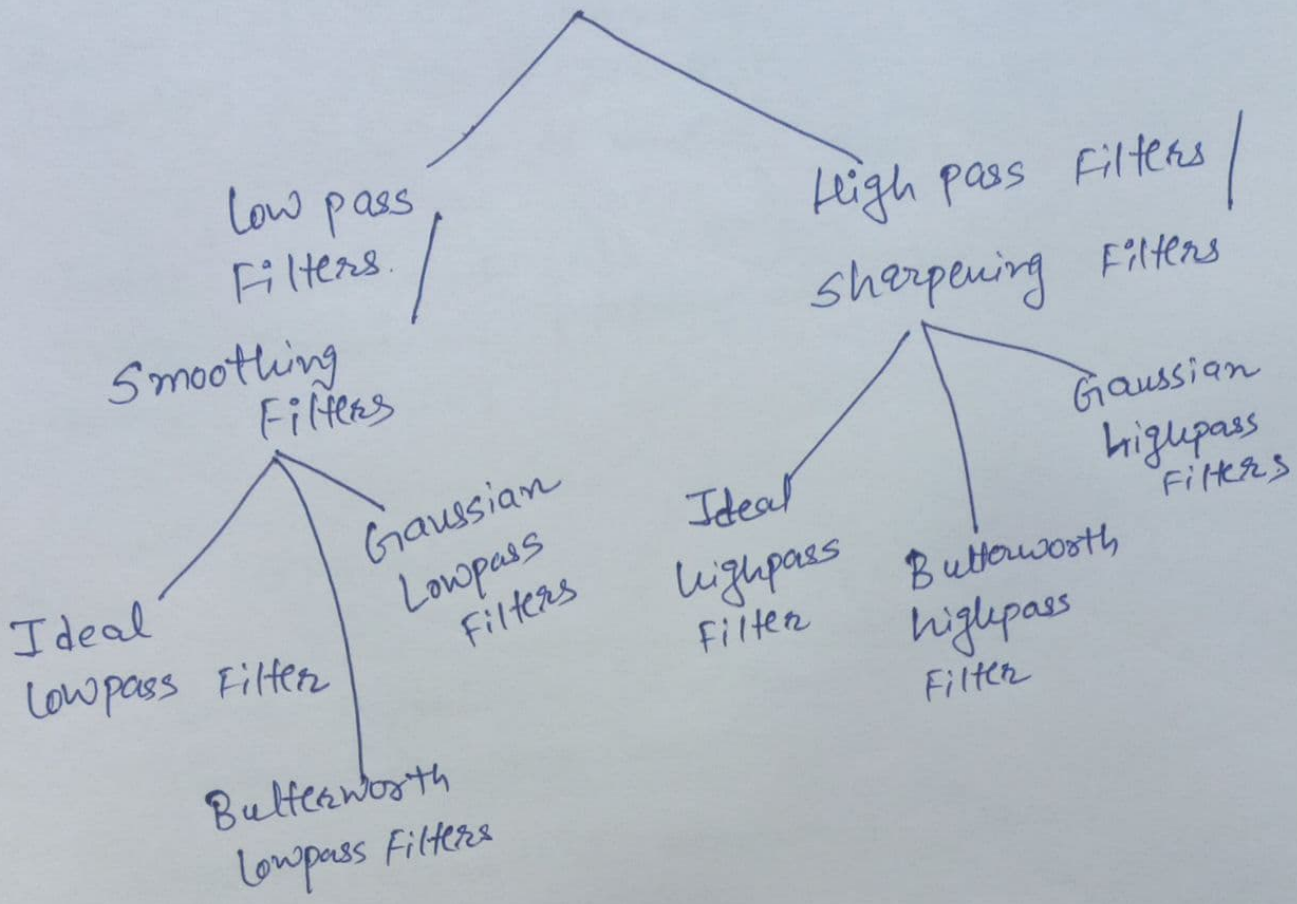
- Robert operator → $\begin{bmatrix}1&0\\0&-1\end{bmatrix}$ → $\begin{bmatrix}0&1\\-1&0\end{bmatrix}$
- Prewitt operator → $\begin{bmatrix}-1&0&1\\-1&0&1\\-1&0&1\end{bmatrix}$ → $\begin{bmatrix}-1&-1&-1\\0&0&0\\1&1&1\end{bmatrix}$
- Sobel operator → $\begin{bmatrix}-1&0&1\\-2&0&2\\-1&0&1\end{bmatrix}$ → $\begin{bmatrix}-1&-2&-1\\0&0&0\\1&2&1\end{bmatrix}$
- Robinson compass operator
- Krisch compass operator → 8 direction matrix with rotation.

Laplacian based 2nd order derivative. (Thin edge) (Inward / outward edge).

- Laplacian operator → +ve, -ve. $\begin{bmatrix}0&1&0\\1&-4&1\\0&1&0\end{bmatrix}$ $\begin{bmatrix}0&-1&0\\-1&4&-1\\0&-1&0\end{bmatrix}$
- Laplacian of Gaussian operator

(Unit-4-Part-3).

Frequency Domain (only equations)



Ch-5
Image Degradation & Restoration.

→ Noise (matlab function)
- What
- Types of Noise (Graph of each)
  - Gaussian
  - Speckle
  - Salt & pepper
  - Poisson
  - Rayleigh
  - Gamma.
  - Uniform
  - Exponential.
- Sources of Noise

→ Image Enhancement
Image Degradation
Image Restoration
] meaning and Difference.

→ Spatial Domain & Frequency Domain.

Image Degradation in
Image Restoration in

[Diagram, Mathematical Formula.).

→ Types of Restoration Filters. [Working, Assumptions. [Diagram, Mathematical Formula]

- Inverse Filter (No Noise)
- Wienear Filter / Minimum mean Square error Filter. (only Gaussian Noise).

Ch-6
Color Image Fundamentals.

→ Category of Color Image Processing
- → Full Color processing
- → Pseudo-Color Processing.

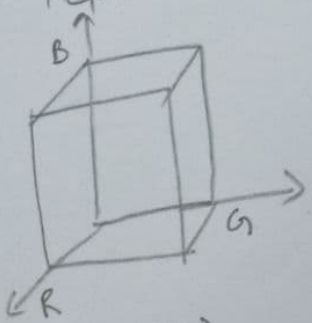
→ Primary Colors - RGB
Secondary Colors - CMY

Primary Colors of Pigment - CMY
Secondary Colors of Pigment - RGB.

→ Additive Color (RGB) Vs. Subtractive color (CMY).

→ Color models
- [Comparison between All 3 models]
- [Advantage, Disadvantage]

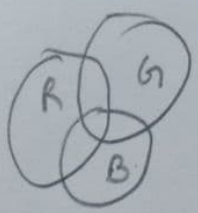
RGB
- What
- Representation.



(PPT Pg-23).

→ Equation
→ RGB to CMY Conversion sum

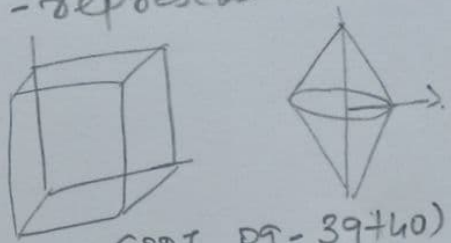
CMY | CMYK
- What
- Representation



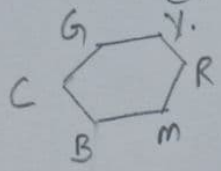
(PPT Pg-27)

→ Equation
→ CMY to RGB Conversion sum

HSI
- What
- representation



(PPT Pg-39 to 40)



→ Equation
→ RGB to HSI Conversion sum.

→ Pseudo color processing.

- intensity slicing [Color Approximation].
- Gray level to Color transformations [Color Quantization]

→ Color Image Smoothing &
Color Image sharpening.

Ch. 7.
Image Morphology.

→ What is Image Morphology

→ Basic Concepts → Structuring Element
- Fit
- Hit
- Miss

→ Types of Morphological Operations
- Dilation
- Erosion
- Opening
  - dilation → Erosion
- closing → Erosion → Dilation

→ What, How to represent in mathematical expression.
→ Use | Application
→ Advantage
→ Disadvantage
→ Example.

→ Morphological Algorithms.
- what
- Application.
- Example

- Extraction of connected component
- Convex hull
- Thinning
- Thickening
- Boundary extraction
- Hole Filling / Region Filling
- Skeletonization

Ch-8
Image Segmentation.

→ What is Image Segmentation

→ Application

→ Goal

→ Approaches of segmentation

- Discontinuity Approach. (What, Matrix) ← difference between → Similarity Approach. (What, working, Advantage, Disadvantage)
  - Point Detection
    $$\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$$
  - Lines Detection
    - Horizontal (0°)
      $$\begin{bmatrix} -1 & -1 & -1 \\ 2 & 2 & 2 \\ -1 & -1 & -1 \end{bmatrix}$$
    - Vertical (90°)
      $$\begin{bmatrix} -1 & 2 & -1 \\ -1 & 2 & -1 \\ -1 & 2 & -1 \end{bmatrix}$$
    - +45°
      $$\begin{bmatrix} -1 & -1 & 2 \\ -1 & 2 & -1 \\ 2 & -1 & -1 \end{bmatrix}$$
    - -45°
      $$\begin{bmatrix} 2 & -1 & -1 \\ -1 & 2 & -1 \\ -1 & -1 & 2 \end{bmatrix}$$
  - Edge Detection → [Unit-4 Part-2]
- Similarity Approach.
  - Threshold based segmentation [difference between]
    - Global Thresholding → Single Threshold
    - Local Thresholding. → multiple Threshold.
  - Clustering based segmentation
  - Region based segmentation [difference between]
    - Region Growing method
    - Region Splitting & merging method.