COMPUTER VISION : 02/13/2019

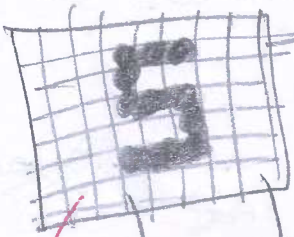
WEDNESDAY

DICOM IMAGE - BIT DEPTH (2^{16})

$$2^{16} = 65536$$

Values range from $[0, 65535]$

Image Representation :



An Image is a 2-D light Intensity function $f(x,y)$

Pixels

SPATIAL DISCRETIZATION BY GRIDS

At every point the value is continuous (Intensity discretization by quantization)

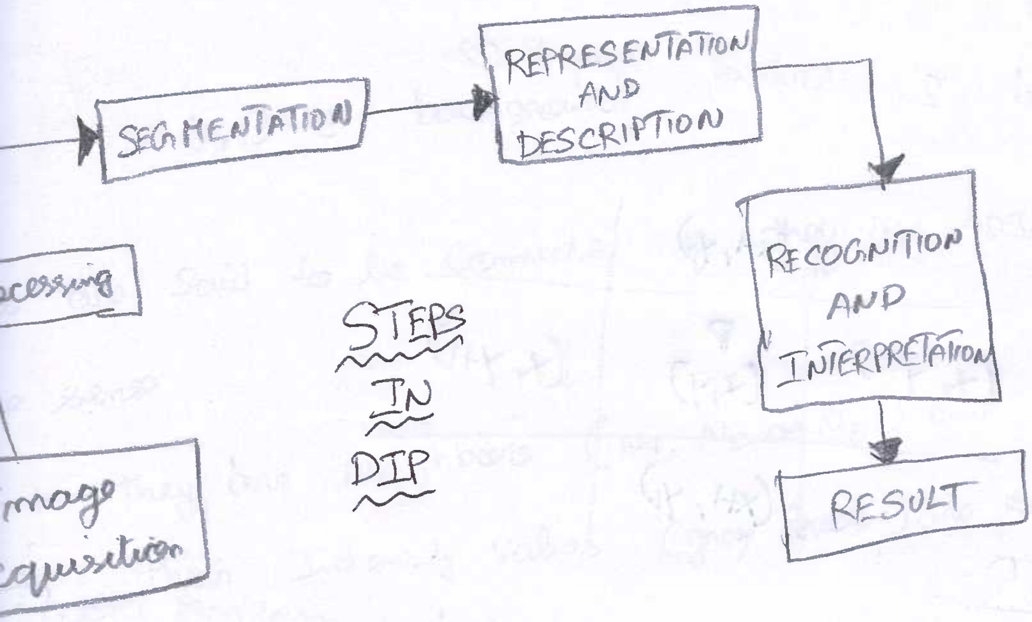
$$I = \begin{bmatrix} f(0,0) & f(0,1) & \cdots & f(0,N-1) \\ f(1,0) & f(1,1) & \cdots & f(1,N-1) \\ f(M-1,0) & \cdots & & f(M-1,N-1) \end{bmatrix}$$

Image Size = 256×256

Quantization = 8 bits

...tion 8 bits (BLACK & WHITE Image)

...tion 24 bits (COLOR IMAGE) $\boxed{R \mid G \mid B}$ 8 8 8 = 24



...G – Image Representation by 2-D finite matrix

...TION – Each Matrix element represented by one of the finite set of discrete value

...ATIONSHIPS

...is pixel neighborhood and different types of neighborhood

...n what is meant by Connectivity

...rm Connected Component Labeling algorithm

Neighborhoods of a Pixels :

A pixel P at location (x, y) has 2 horizontal

and 2 vertical neighbors

	(x-1, y)	
(x, y-1)	P (x, y)	(x, y+1)
	(x+1, y)	

* This set of 4 Pixels is called 4-neighbors of $P = N_4(P)$
* Each of these neighbors is at a unit distance from P
* If P is a boundary pixel then it will have less

Number of Neighbors.

(x-1, y-1)		(x-1, y+1)
	P (x, y)	
(x+1, y-1)		(x+1, y+1)

* A Pixel P has 4 diagonal neighbors $= N_D(P)$
* the Points of $N_4(P)$ and $N_D(P)$ together are called

CONNECTIVITY

If Intensity $F(x,y)$ > Some threshold

$\Rightarrow (x,y) \in$ object

Else

$(x,y) \in$ background

Two pixels are said to be Connected if they are A

in Some sense

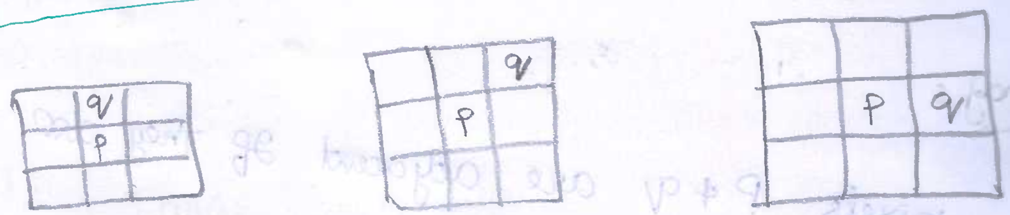
→ they are Neighbors (N_4, N_D or N_8) and

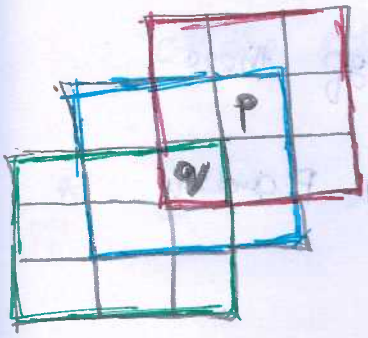
→ their Intensity values (gray levels) are

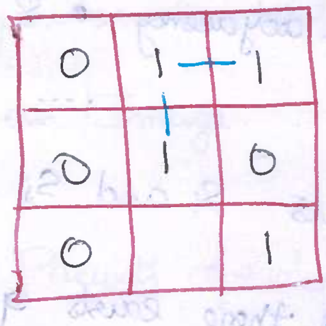
Ex: For a Binary Image B, two points P and q

be Connected if $q \in N(P)$ or $P \in N($

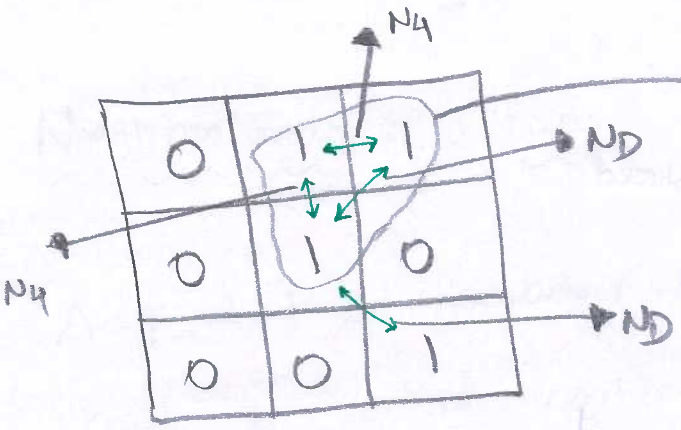
$\boxed{B(P) = B(q)}$ → Intensity value







4- Connected

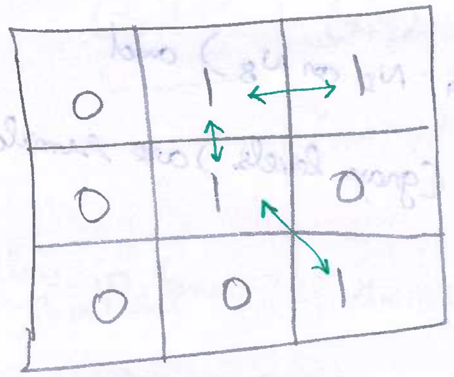


8-Connected

Do you see the Problem here?

Multiple Path of Connectivity exists

"M- Connectivity" is Introduced to avoid the above issue



m - Connected
(Mixed Connectivity)

Adjacency:

Two pixels P & q are adjacent if they are Connected

- 4- adjacency
- 8 -adjacency
- m-adjacency

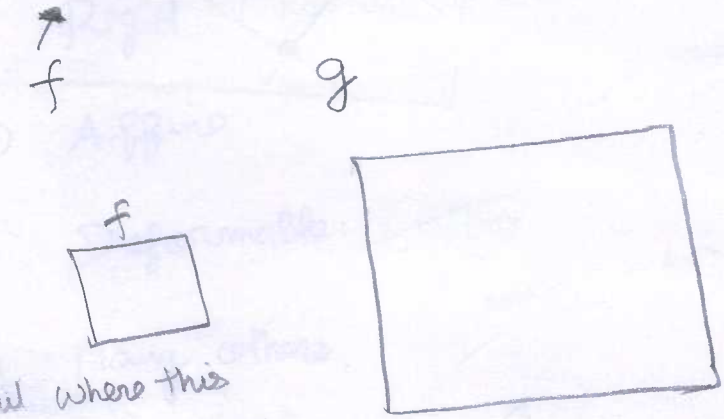
Two Image Subsets S_i and S_j are adjacent if there exists $P \in S_i$ and there exists $q \in S_j$ such that P and q are adjacent

02/15/2019
Friday

Image Registration

Registration is a process which makes the pixels
images precisely coincide to the same point i
once registered, the image can be c
or fused in a way that improves informatio

Template



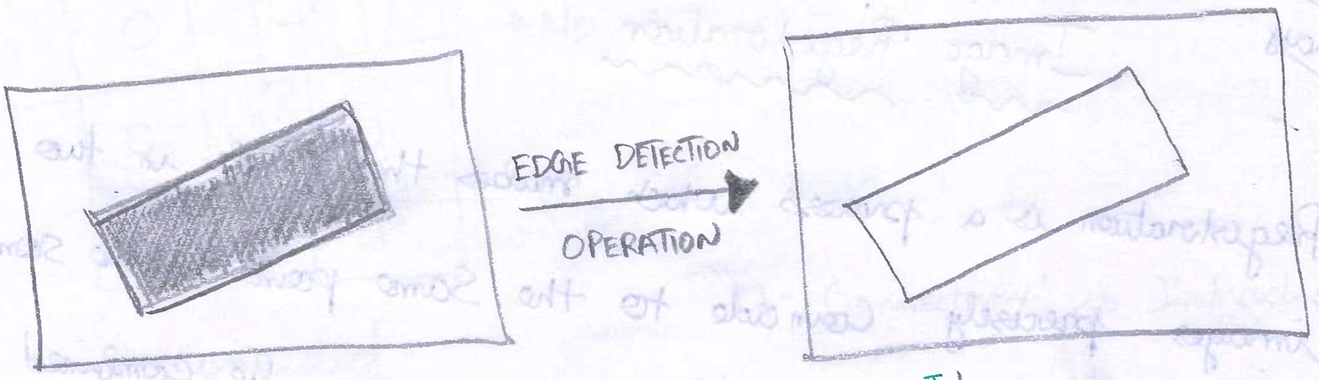
Find out where this template matches best in g?

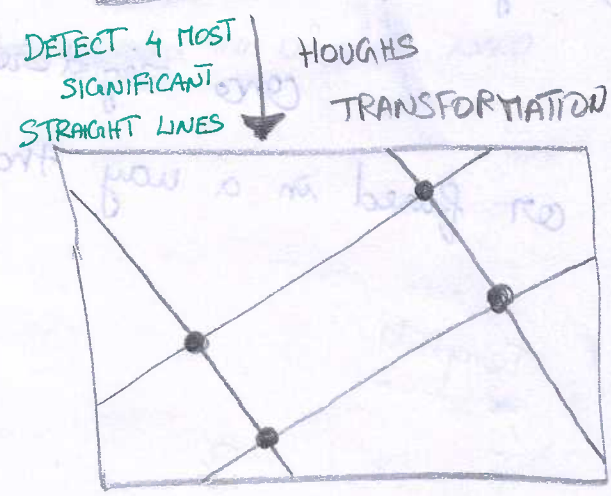
02/16/2019
SATURDAY

IMAGE SEGMENTATION

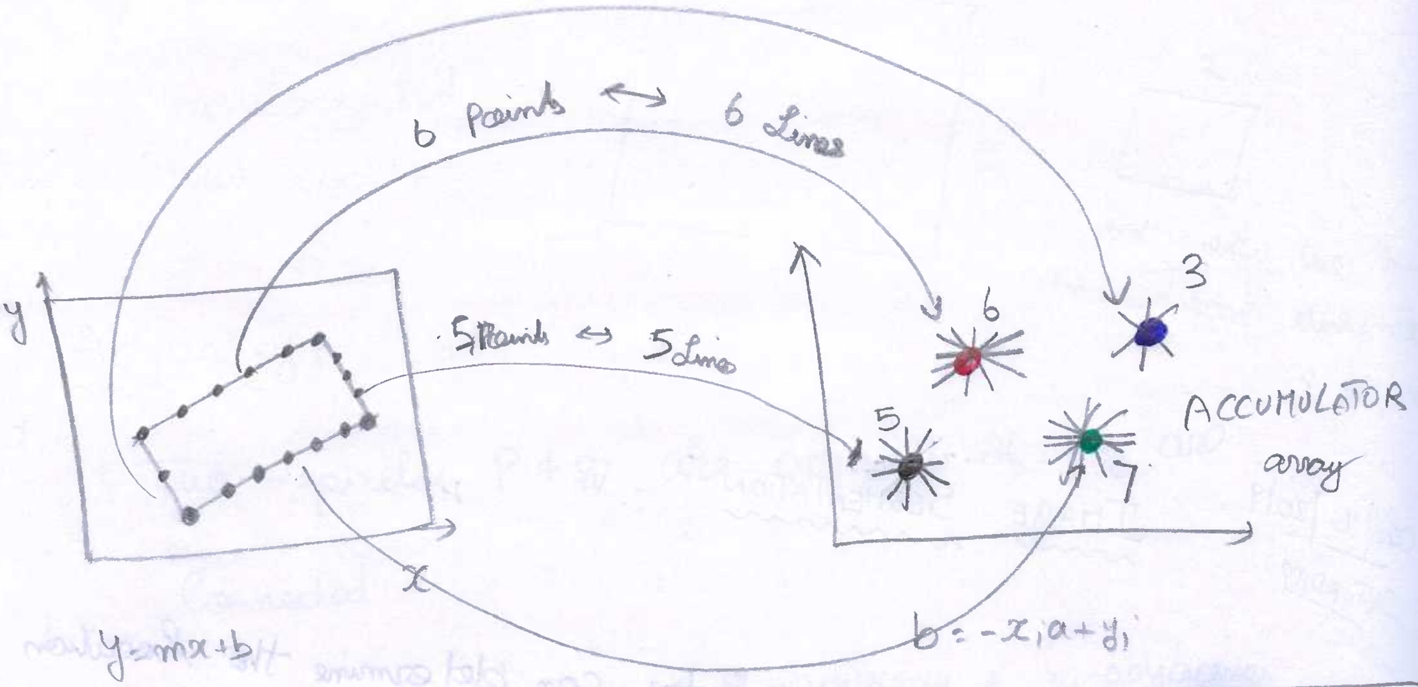
* Laplacian of Gaussian operator can determine the of the edge present in an Image.

* Shobel edge operator, Prewitt operator

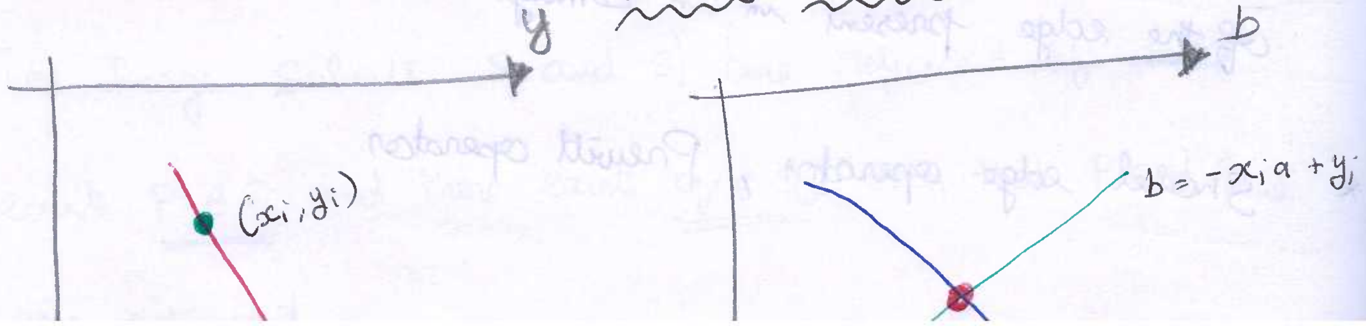




Is Hough Transform limited to detection of line segments only ?



HOUGH TRANSFORM



is Registration ?

e Process of aligning a target image to a Source Image

re generally, determining the transform that maps

ints in the target image to points in the Source

age.

sfor Types:

Rigid (Rotate, translate)

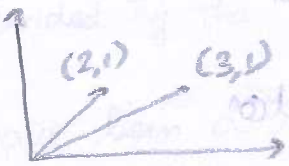
Affine (rigid + Scalar & Shear)

Deformable (affine + Vector field)

Many others

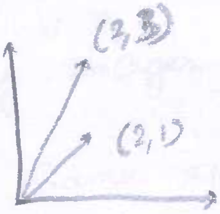
g in x-direction "Pushes things sideways"

$$\ldots)\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} x+y \\ y \end{pmatrix}$$



wards, ie Shear in y-direction

$$\ldots)\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} x \\ x+y \end{pmatrix}$$



UNIT VECTOR:

A Vector $\vec{v}$ is a "UNIT VECTOR" iff $||\vec{v}|| = 1$

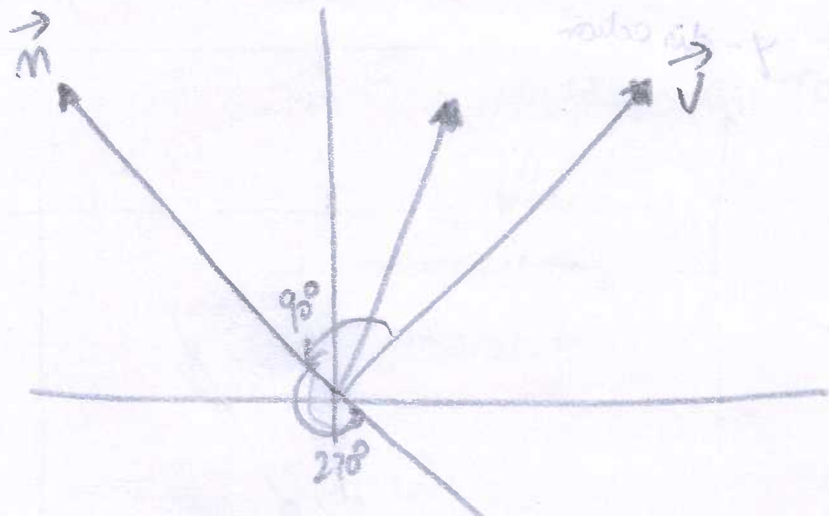
Normalization → given an arbitrary vector $\vec{v}$, we can find a unit vector parallel to $\vec{v}$ by

$$\vec{v}_{unit} = \frac{\vec{v}}{||\vec{v}||}$$

1) Parallel Vectors are also called Linearly dependent

2) Vectors that are not parallel are called Linearly Independent

3) A vector that is perpendicular to another one is called "normal vector" (or Just normal) to that vector



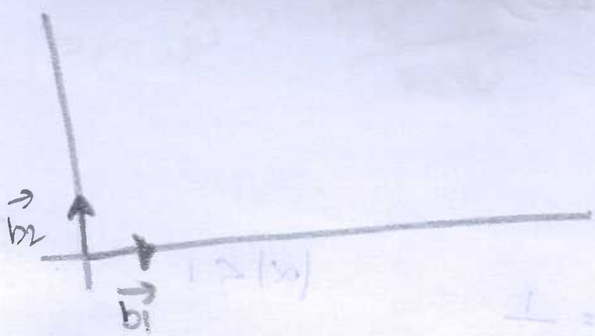
Orthonormal Basis :-

In general, we say that two vectors form

orthonormal basis if

1) they are "orthogonal" to each other

2) they are unit vectors



Tissue Probability maps :

we have approximate knowledge of the spatial distribution of tissue (WM, GM, CSF) clusters in the of PROBABILITY IMAGES (Provided by the Montereal Neurological Institute) which have been derived from Images of a large number of Subjects. The original were Segmented into binary images of GM, WM and all normalized into the Same space using a - parameter affine transformation (3-translatio rotation, 3 orthogonal Zooms). The Probabi

These Images represent a Priori Probability of Voxel being GM, WM or CSF after an image has been normalized to the same space using a nine-parameter affine transform.

03/08/2019
FRIDAY

PROBABILITY THEORY - MIT
(JOHN TSITSIKLIS)

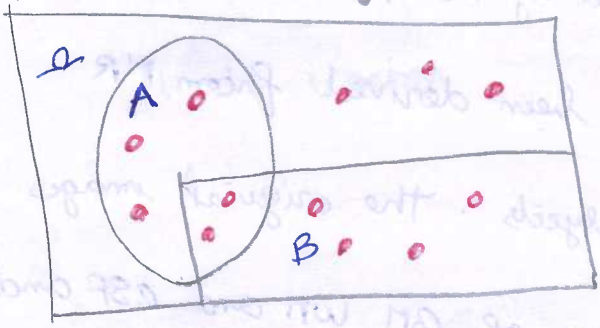
Geometric series

$|\alpha| < 1$

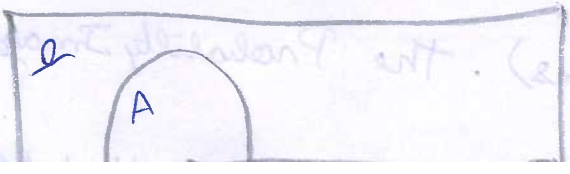
$$S = \sum_{i=0}^{\infty} \alpha^i = 1 + \alpha + \alpha^2 + \dots = \frac{1}{1-\alpha}$$

CONDITIONAL PROBABILITY

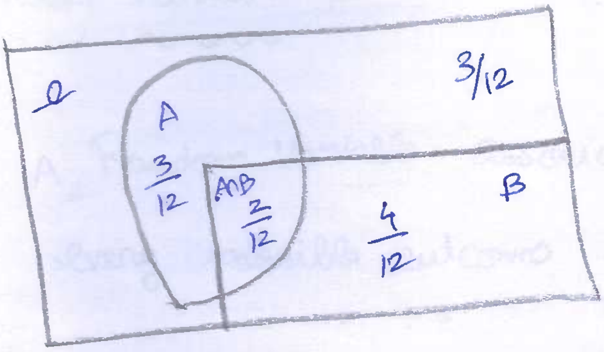
Assume 12 equally likely outcome



If told B occurred



$P(A|B) = \frac{2}{6} = \frac{1}{3}$



$P(A|B)$ = " Probability of A given that B occurred "

$$P(A|B) = \frac{P(A\cap B)}{P(B)} = \frac{\frac{2}{12}}{\frac{6}{12}} = \frac{1}{3}$$

Multiplication Rule :