DHARMSINH DESAI UNIVERSITY, NADIAD
FACULTY OF TECHNOLOGY
ONLINE SESSIONAL EXAMINATION

B. Tech (CE) Sem : 7
Subject : Image Processing

Roll. No. : CE 129
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Date : 05/10/2020
Time : 10:00 AM to 11:15 AM

Total Pages : 18

Question :- 2 (b)

↳ Objectives of canny's edge detector

1. Low error rate. All edges should be found and there should be no spurious responses. detected edges must be as close as possible to the true edges.

2. Edge points should be well localized. The edges must be as close as possible to the true edges.

3. Single point edge response : The detector should return only one point for each true edge point. The number of local maxima around the the true edge should be minimum.

⇒ Algorithm.

1. Smooth the input image with a Gaussian filter.

2. Compute the Gradient magnitude and angle images.

3. Apply nonmaxima supression to the gradient magnitude image.

4. Use double thresholding and connectivity analysis to detect and link edges.

Step :- 1

First derivative of the Gaussian approximates the operator that optimizes the product of signal-to-noise ratio localization.

$$\frac{d}{dx} e^{\frac{-x^2}{2\sigma^2}} = \frac{-x}{\sigma^2} e^{\frac{-x^2}{2\sigma^2}}$$

image = $f(x,y)$
Gaussion fn. $G(x,y)$.

↳ smoothed image by convolving.

$$f_s(x,y) = G(x,y) * f(x,y)$$

Step :- 2

Gradient Magnitude.

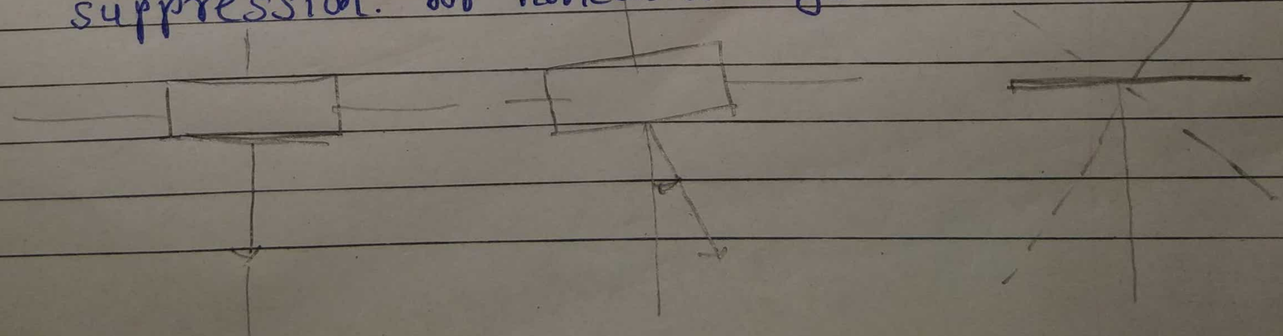
$$M(x,y) = \sqrt{g_x^2 + g_y^2}$$

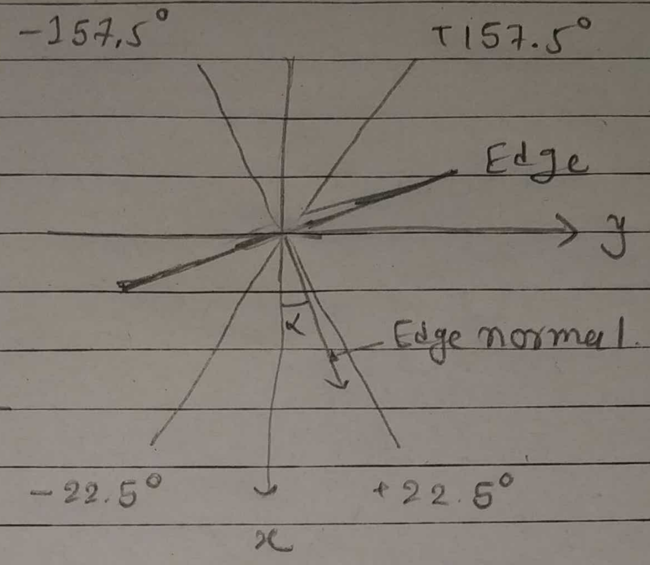
and

$$\alpha(x,y) = \tan^{-1}\left[\frac{g_y}{g_x}\right]$$

Step :- 3 Non maxima suppression :-

Gradient typically contains wide ridges around local maxima - non maxima suppression. for horizontal edge





its define horizontal edge. Same way for other edges.

Non maxima supression

let d_1, d_2, d_3 and d_4 denote four basic edge horizontal, $-45°$, vertical, $+45°$ respectively.

non maxima supression for 3×3 region centered at every point (x,y) in $\alpha(x,y)$:

1. Find the direction d_k that is closest to $\alpha(x,y)$

2. If the value of $M(x,y)$ is less than at least on of its two neighbors along d_k, let $g_N(x,y) = 0$ (supression) otherwise, let $g_N(x,y) = M(x,y)$

Step:- 4

Thresholding for canny edge detection

Two additional images are created.

$$g_{NH}(x,y) = g_N(x,y) \geq T_H$$

$$g_{NL}(x,y) = g_N(x,y) \geq T_L$$

$g_{NH}(x,y)$ will have fewer nonzero pixels than $g_{NL}(x,y)$ in general. but all pixels in $g_{NH}(x,y)$ will be contained.

so that,

$$g_{NL}(x,y) = g_{NL}(x,y) - g_{NH}(x,y)$$

$g_{NH}(x,y)$ Strong edge pixel

$g_{NL}(x,y)$ weak edge pixel.

In above there is some gaps. Longer edges are formed using the following procedure.

a) Locate the next unvisited edge pixel p. in $g_{NH}(x,y)$

b) Mark as valid edge pixels all the weak pixels in $g_{NL}(x,y)$ that are connected to p using say 8-connectivit

c) If all nonzero pixels in $g_{NH}(x,y)$ ~~the~~ have been visited go to step d. Else step a.

d) Set ~~to~~ zero all pixels in $g_{NL}(x,y)$ that were not marked as ~~valid~~ valid edge pixels.

Question 2 : C

10	10	10	10	10	10	10
10	10	10	$\boxed{60}$	70	10	10
59	10	$\boxed{60}$	$\boxed{64}$	$\boxed{59}$	56	$\boxed{60}$
10	59	10	$\boxed{60}$	$\boxed{70}$	10	$\boxed{62}$
10	60	59	$\boxed{65}$	$\boxed{67}$	10	$\boxed{65}$
10	10	50	10	10	10	10
10	10	10	10	10	10	10

Here $|seed - f(x,y)| \le 5$

segmentation for horizontal & vertical means 4 connected

Applying ~~for~~ 4 connected in above

10	10	10	10	10	10	10
10	10	10	60	70	10	10
59	~~59~~ 10	60	64	59	56	60
10	~~60~~ 59	10	60	70	10	62
10	~~10~~ 60	59	65	67	10	65
10	10	10	10	10	10	10
10	10	10	10	10	10	10

Now applying region for horizontal, vertical & diagonal means 8 connected

10	10	10	10	10	10	10
10	10	10	60	70	10	10
59	10	60	64	59	56	60
10	59	10	60	70	10	62
10	60	59	65	67	10	65
10	10	10	10	10	10	10
10	10	10	10	10	10	10

			60			
59		60	64	59	56	60
	59		68	70		62
	60	59	65	67		65

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Question :- 1

(a) Translation property of 2-D Discrete fouriour transform.

$$f(x,y)\, e^{j2\pi(u_0 x/M + v_0 y/N)} \Leftrightarrow F(u-u_0, v-v_0)$$

$$f(x-x_0, y-y_0) \Leftrightarrow f(u,v)\, e^{-j2\pi(x_0 u/M + y_0 v/N)}$$

Proof :-

$$f(u,v) = \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} f(x,y)\, e^{-j2\pi\left(\frac{ux}{M} + \frac{vy}{N}\right)}$$

$$FT = \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} f(x,y)\, e^{j2\pi\left(\frac{xu_0}{M} + \frac{yv_0}{N}\right)}\, e^{-j2\pi\left(\frac{ux}{M} - \frac{vy}{N}\right)}$$

$$FT = \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} f(x,y)\, e^{-j2\pi\left(\frac{x(u-v_0)}{M} + \frac{y(v-v_0)}{N}\right)}$$

$$= F(u-v_0, v-v_0)$$

(b) False, Butterworth achieves more blurring Gaussian.

For butterworth

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

where D_0 = cut-off frequency

For Gaussian

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

(c) Moire patterns are generated from sampling scenes with periodic or nearly periodic components whose spacing is comparable to spacing b/w samples.

Anti aliasing filter is used to reduce moire patterns.

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(d) Basic conditions that must be fullfilled during image segmentation are:

→ segmentation must be complete.

→ pixels in a region must be connected

→ Regions must be disjoint.

→ pixels in a region must be share same property

(e) Gradient angle image is computed by

$$\nabla f = grad(f) = \begin{bmatrix} g_x \\ g_y \end{bmatrix} = \begin{bmatrix} df/dx \\ df/dy \end{bmatrix}$$

$$M(x,y) = \sqrt{g_x^2 + g_y^2}$$

$$\alpha(x,y) = \tan^{-1}\left[\frac{g_x}{g_y}\right]$$

⇒ Constant intensity indicate that there is slow ~~varia~~ variation of intensities.

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(f) Variable thresolding is a process in which the threshold value varies over the image as a function of local image characteristic.

⇒ standard deviation and mean of local neighbourhood on every point is used

Eg:

non negative constants

$$T_{xy} = a\,\sigma_{xy} + b\,m_{xy}$$

standard deviation

mean

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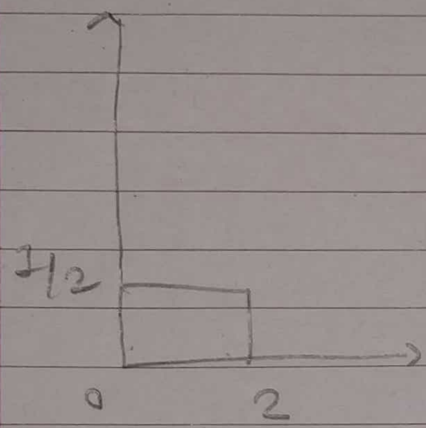
Question :- 3

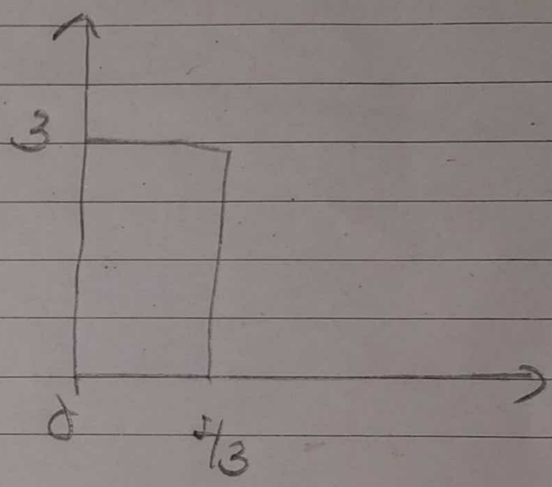
(a) $f(x) = \begin{cases} 1/2 & , 0 < x < 2 \\ 0 & \text{else} \end{cases}$

$h(y) = \begin{cases} 1/3 & 0 < y < 3 \\ 0 & \text{else} \end{cases}$

$T = 4$



f(x)



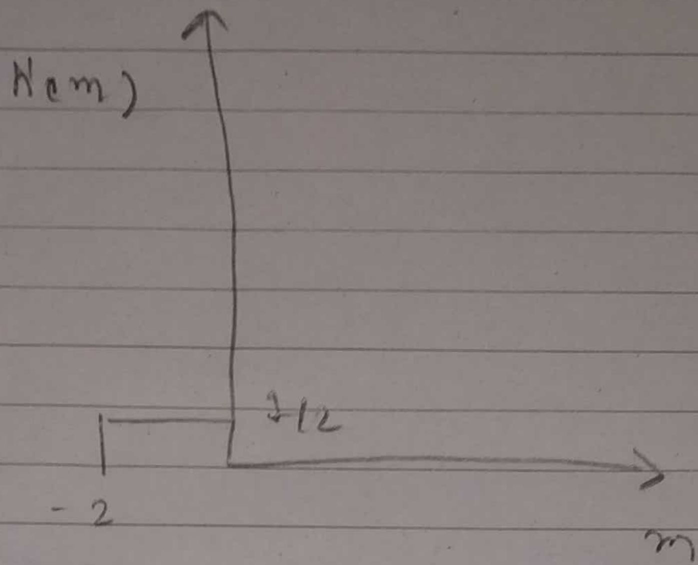
h(y)

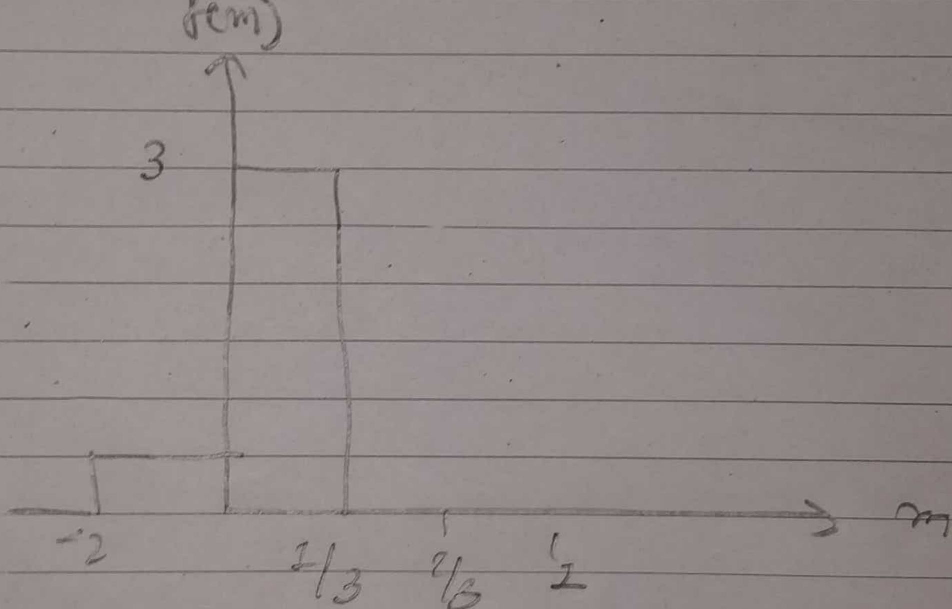
$g(x) = \begin{matrix} 3 & 0 < x < 1/3 \\ 0 & \text{elsewhere} \end{matrix}$

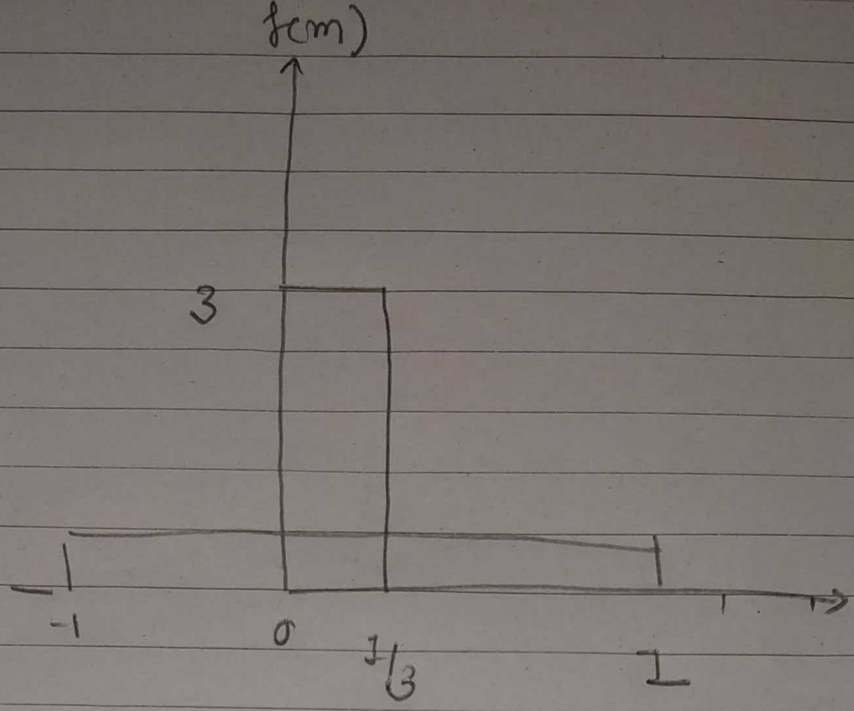
Representation of h(y) in another form

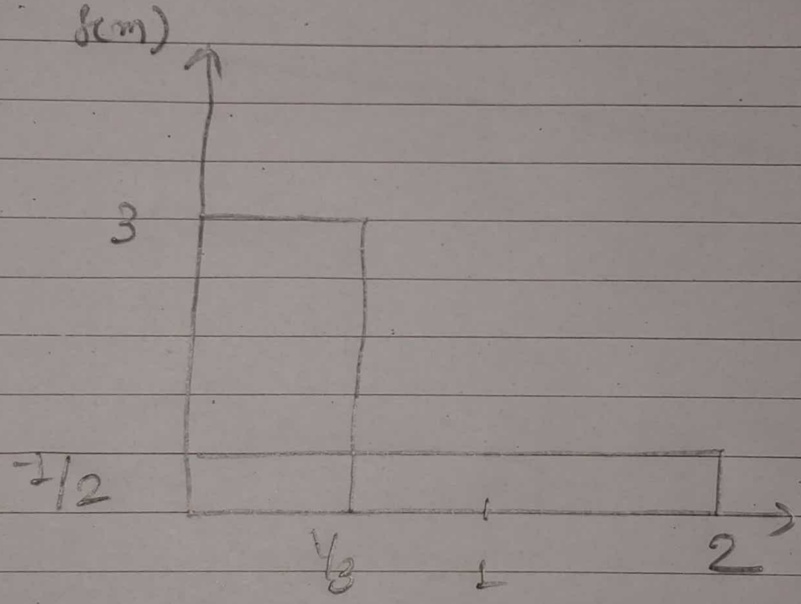
(I)

$$f(x) * h(x) = \sum_{m=0}^{3} f(m)\, h'(x-m)$$

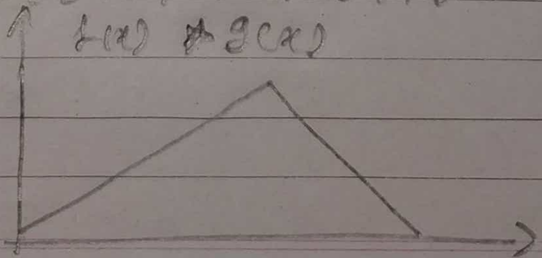








Convolution Result



Q.13
(b)

1. Let P be the sequecnce of ordered, distinct point of binary image
Select two stationary points (A, B)

2. Given a threshold T.
Create two empty stacks. namel OPEN, CLOSE

3. If points in P corresponds to a closed curve put A in OPEN, put B in Both.
else
A in OPEN
B in CLOSEd

5. Calculate distance of the line formed in step 4 from all point in P.

Select a point with max distance.

Let max. dist. d max
Max. dist. point Vmax.

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4. Compute the parameters of the line passing from the last vertex in closed to cast vertex in OPEN

5. calculate distance of the line formed in step 4 from all point in p
select a point with max distance.

Let maximum dist. d max
Max. dist point v max

6) if d max > t
put v max at the end of the open stack as new vertex
GTO to step 4.

Step 5, 6 Dmax does not exceed "T

7. Else remove the last vertex from OPEN and insert it as the last vertex CLOSED.

8. If OPEN is not empty go to step 4.

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9. Else, exit. The vertices in CLOSED are the vertices of the polygonal fit to the points in I.

CLOSED	OPEN	Curve segment processes	vertex generated
B	B, A	-	A, B
B	B, A	(BA)	C
B	B, A, C	(BC)	-
B, C	B, A	(CA)	-
B, C, A	B	(AB)	D
B, C, A	B, D	(AD)	-
B, C, A, D	B	(DB)	-
B, C, A, D, B	Empty	—	-