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No Computer Vision
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Sheet 1

1) a) Dynamic Range:- the unique values
Contrast:- the difference between highest and lowest

- Contrast = 48 - 0 = 48

→ Dynamic Range: 0, 1, 2, 3, 4, 5, 6, 7, 8
9, 10, 11, 12, 13, 14, 15

Dynamic Range: 16

b) Over exposure

c)

i	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
h(i)	0	0	0	5	15	20	18	16	15	5	8	25	25	30	20	48
$i' = 13\,i$	0	1	2	3	4	6	7	8	9	10	11	12	13	14	15	
$h'(i)$	0	0	0	5	15	18	16	15	5	8	25	25	30	20	48	

Contrast = 48 - 0 = 48

Dynamic Range: 0, 1, 2, 3, 4, 6, 7, 8, 9, 10, 11
12, 13, 14, 15

Dynamic Range = 15 ← changed

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d) $f_{eq}\left[H(a)\frac{K-1}{MN}\right]$ $\quad K-1=15$

MN = Total Pixels = 250

i	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
H(a)	0	0	0	5	20	40	58	74	89	94	102	127	152	182	202	250
feq	0	0	0	0	1	2	3	4	5	5	6	7	9	10	12	15
heq	0	0	0	0	15	20	18	16	15	5	8	25	25	30	20	48

② a) edge detection of a 45 degree

b) Maximum $\begin{bmatrix} 0 & -3 & -1 \\ 3 & 0 & -3 \\ 1 & 3 & 0 \end{bmatrix} \begin{bmatrix} 0 & 0 & 0 \\ 255 & 0 & 0 \\ 255 & 255 & 0 \end{bmatrix} \Rightarrow 255$

Minimum $\begin{bmatrix} & & \\ & & \\ & & \end{bmatrix} \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \Rightarrow 0$

c) impulse $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 0 & -3 & -1 \\ 3 & 0 & -3 \\ 1 & 3 & 0 \end{bmatrix} = 3+1+3-3-1-3 = 0$

d) Yes, because, it's an asymmetric filter

③ $\begin{bmatrix} 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ • Shift image on pixel left and shift it on pixel up

↑ shift

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④ Compute the gradient vector, gradient magnitude and orientation at (3,3).

Use the filter $S_x = [-1, 0, 1]$ $S_y = \begin{bmatrix} -1 \\ 0 \\ 1 \end{bmatrix}$ to compute gradients

$$\nabla f = \left[\frac{\partial f}{\partial x}, \frac{\partial f}{\partial y}\right] \quad \text{gradient}$$

$$\theta = \tan^{-1}\left(\frac{\partial f}{\partial y} / \frac{\partial f}{\partial x}\right) \quad \text{direction}$$

$$\|\nabla f\| = \sqrt{\left(\frac{\partial f}{\partial x}\right)^2 + \left(\frac{\partial f}{\partial y}\right)^2}$$

	1	2	3	4	5
1	100	111	97	100	105
2	107	111	107	105	115
3	117	100	117	120	128
4	111	105	111	120	122
5	100	110	100	110	100

$= f$

$\frac{\partial f}{\partial x}$ =

	1	2	3
1	-3	-11	8
2	0	-6	8
3	0	16	11
4	0	15	11
5	0	0	0

$\frac{\partial f}{\partial y}$ =

1	2	3	4	5
17	-11	20	10	23
4	-6	4	15	7
-17	10	-17	0	-28

$$\nabla f_{(3,3)} = [11, -17], \quad \theta = \tan^{-1}\left(\frac{-17}{11}\right) = -57.1^\circ$$

$$\|\nabla f\| = \sqrt{410} = 20.25$$

orientation ⇒ ~~edge~~ Ledge

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