Final

23/1/25

Image Compression
chap-08

Compression দুই প্রকার

1) Lossy compression ; definition সহ
2) Lossless compression exam.

Relative data redundancy -

$$R = 1 - \frac{1}{C}$$

where compression ratio,

$$C = \frac{b}{b'}$$

দুটো জিনিসের মধ্যে compare করলে একটা b হলে অপরটা b',

coding redundancy -

$$P_r(r_k) = \frac{n_k}{m_N} \quad k = 0, 1, 2, \ldots L-1.$$

$$L_{avg} = \sum_{k=0}^{L-1} l(r_k) P_r(r_k)$$

Table 8.1 ~~bol~~ থেকে এর math ~~out~~ দেখা আছে.

slide - $L_{avg} = 2(0.25) + 1(0.47) + 3(0.25) + 3(0.03)$

$= 1.81$ bits.

10	10	15	15
10	10	15	15
20	20	15	15
25	25	25	25
25	10	15	30

$P_r(r_{10}) = \frac{5}{20} = \frac{1}{4}$

$P_r(r_{15}) = \frac{8}{20} = \frac{2}{5}$

$P_r(r_{20}) = \frac{2}{20} = \frac{1}{10}$

$P_r(r_{25}) = \frac{5}{20} = \frac{1}{4}$

$P_r(r_{30}) = \frac{1}{20}$

r_k	$P_r(r_k)$	code 1	$l_1(r_k)$	code 2	$l_2(r_k)$
10	0.25	00001010	8	01	1
15	0.35	00001111	8	11	2
20	0.1	00010100	8	010	3
25	0.25	00011001	8	110	3
30	0.05	00011110	8	11	2

$L_{avg} = 1(0.25) + 2(0.35) + 3(0.1) + 3(0.25) + 2(0.05)$

$= 2.1$

$MNL_{avg} = 5 \times 4 \times 2.1 = 42$

Compression ratio

$$C = \frac{5 \times 4 \times 8}{5 \times 4 \times 2.1} = 3.80$$

$$R = 1 - \frac{1}{3.80} = 0.736$$

$$= 73.6\%.$$

6/10/25

spatial & temporal redundancy -

run length pair/run length encoding → definition, example.

কোন intensity কতবার আছে.

→ image থেকে run length pair বের করা

" " " " " "

বের করা

Measuring Image Information-

$$I(E) = \log \frac{1}{P(E)} = -\log P(E) \quad ; E = \text{a random ever}$$

$$\text{entropy, } H = -\sum_{j=1}^{J} P(a_j) \log P(a_j)$$

$$\tilde{H} = -\sum_{k=0}^{L-1} P_r(r_k) \log_2 P_r(r_k)$$

Intensity source's entropy

Exam
***

Huffman Coding-

slide - 557

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8
0.2	0.35	0.04	0.01	0.3	0.03	0.02	0.05

Symbol	Probability	1	2	3	4	5	6	7
a_2	0.35	0.35	0.35	0.35	0.35	0.35	0.65	1
a_5	0.3	0.3	0.3	0.3	0.3	0.35	0.35	
a_1	0.2	0.2	0.2	0.2	0.2	0.3		
a_8	0.05	0.05	0.06	0.09	0.15			
a_3	0.04	0.04	0.05	0.06				
a_6	0.03	0.03	0.04					
a_7	0.02	0.03						
a_4	0.01							

7/10/25

exam ***

LZW coding - disadvantage

10	15	10
10	10	15

Currently recognized sequence	Pixel being processed	encoded output	Dictionary location	Dictionary entry
	10			
10	15	10	256	10-15
15	10	15	257	15-10
10	10	10	258	10-10
10	10			
10-10	15	258	259	10-10-15
15		15		

repeated value না থাকলে huffman coding use করা better.

1) Dictionary can grow too large.
2) Not efficient for small/random data.
3) Needs to handle dictionary reset.
4) encoding & decoding adjustment.

13/10/25

encode

1)

A	B	C	D	E	F	
5	9	12	13	16	45	→ frequency

sum = 100

$A = \frac{5}{100} = 0.05$

$B = \frac{9}{100} = 0.09$

$C = \frac{12}{100} = 0.12$

$D = \frac{13}{100} = 0.13$

$E = \frac{16}{100} = 0.16$

$F = \frac{45}{100} = 0.45$

Symbol ~~E_k~~	~~$P_k(E_k)$~~ Probability	1	2	3	4	5
F	0.45 (1)	0.45	0.45	0.45	0.55 (0)	1
E	0.16 (000)	0.16	0.25 (10)	0.35 (00)	0.45 (1)	
D	0.13 (010)	0.14 (001)	0.16 (000)	0.25 (01)		
C	0.12 (011)	0.13 (010)	0.14 (001)			
B	0.09 (0010)	0.12 (011)				
A	0.05					

011 0011 0010
C A B

→ code Decode করা, left থেকে scan করে
হবে

Decoding

scanned symbol	stored symbol	Decoded symbol
0	0	—
01	01	—
1	011	C
0	0	—
0	00	—
1	001	—
01	00101	A
0	0	—
0	00	—
1	001	—
0	0010	B

→ Compression means reducing the size of an image file so it uses less storage space & takes less time to send / load.

→ lossy – some image data is removed permanently.
– The image may lose a bit of quality, but the file becomes smaller.
example - JPEG.

→ loselss – no data is removed. The image can be restored exactly as the original.
– file size is reduced, but not as much as lossy.
example – PNG
Compress without losing any information.

→ Run length pair is a way to represent repeated values in a compressed form.

Pixel row –

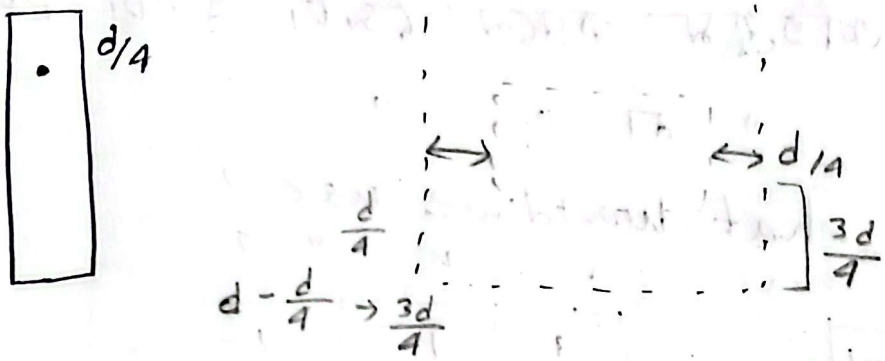
[5, 5, 5, 5, 5, 2, 2, 9]

R.L. pair → (5, 5), (2, 2), (9, 1) ✗

21/10/25

Morphology

$A \ominus B$ → erosion



Dialation

What is morphological analysis in DIP.?

3/11/25

Opening –
→ erosion
→ dialation

vs

closing –
→ dialation
→ erosion

10/11/25

Chap - 10

Image segmentation

slide-710

1st order derivative Vs. 2nd order derivative

Threshold অতিক্রম করলে সেটা একটা point

" না " "

if point white what would we use?

" black " " " " ?

-1	-1	-1
-1	8	-1
-1	-1	-1

1	1	1
1	-8	1
1	1	1

→

10^{-1}	10^{-1}	10^{-1}	10
8^{-1}	250^{8}	9^{1}	12
11^{-1}	10^{-1}	10^{-1}	8
11	12	10	10

$250 \times 8 = 2000$

$-1 \times 10 + (-1) \times 10 + (-1) \times 10 + (-1) \times 8) + (-1) \times 9$
$+ (-1) \times 11 + (-1) \times 10 + (-1) \times 10$

$= -78$

Line detection Carnel -

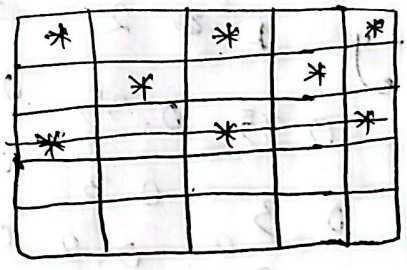
Horizontal +45° vertical -45°

→

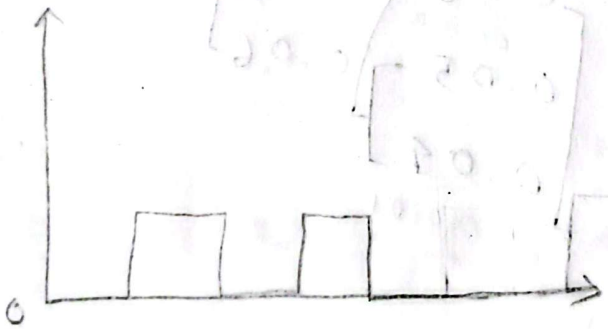
10^{-1}	10^{-1}	11^{-1}	12
50^{2}	51^{2}	51^{2}	51
12^{-1}	11^{-1}	10^{-1}	10
10	12	12	11

Threshold value কম হলে edge clearly চেনা যাবে;

chess baard



intensity profiling



slide - 716 three steps for edge detection.

Comparison → Roberts Vs Prewitt vs Sobel

practice scenarios

Justify answers based on -

$$R = 1 - \frac{1}{C}, \quad C = \frac{b}{b'}$$

$$P_r(r_k) = \frac{n_k}{MN}, \quad L_{avg} = \sum_{k=0}^{L-1} l(r_k) P_r(r_k)$$

$$\tilde{H} = -\sum^{L-1} P_r(r_k) \log_2 P_r(r_k)$$