DHARMSINH DESAI UNIVERSITY, NADIAD
FACULTY OF TECHNOLOGY
ONLINE SESSIONAL EXAMINATION

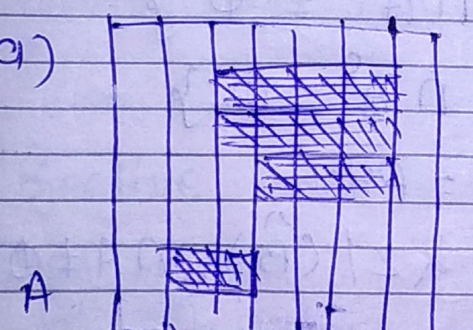
B.Tech (CE) sem → 7
subject : Image processing

Roll no. → 142
signature → Prakit

Date : 24/10/2020
Time : 20:15 to 21:30
total pages : 10

Q.1)

(a)



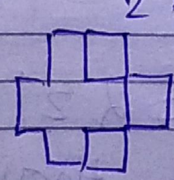
further showing shaded area by [1]

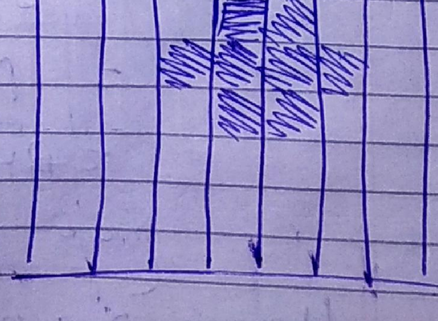
(1) iterating in 1st 4 rows

(2) iterating in next 3 rows

result

only 2 fits





(b) Erosion & dilation are duals of each other.

i.e. prove that

$(A \ominus B)^c = A^c \oplus \hat{B}$ and

$(A \oplus B)^c = A^c \ominus \hat{B}$

→ 1st

LHS = $(A \ominus B)^c$

$= \{z / (B)_z \cap A^c = \phi\}^c$

$= \{z / (B)_z \cap A^c \neq \phi\}$

$= A^c \oplus \hat{B}$ = RHS

$(\because A \oplus B = \{z / (\hat{B})_z \cap A \neq \phi\}$

→ 2nd

LHS = $(A \oplus B)^c$

$= \{z / (\hat{B})_z \cap A \neq \phi\}^c$

$= \{z / (\hat{B})_z \cap A^c = \phi\}$

$= A^c \ominus \hat{B}$

= RHS

$(\because A \ominus B = \{z / (B)_z \cap A^c = \phi\})$

Hence proved that they are duals.

(c) morphological boundary extraction

formula :→ $\beta(A) = A - (A \ominus B)$

B is structural element

→ we can get Boundary of image by getting a difference of image & eroded image by element B.

→ width of boundary depends on element B

→ finding boundary in binary image may help in extracting boundary in grey image also.

(d) Objective fidility criteria.

→ level of info. loss can be expressed as a fn of input & compressed output images. or decompressed

consider M x N image $f(x,y)$. its compressed - then - decompressed image is $\hat{f}(x,y)$

then error $e(x,y) = \hat{f}(x,y) - f(x,y)$

total error $= \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} [\hat{f}(x,y) - f(x,y)]$

$$e_{rms} = \sqrt{\frac{1}{MN} \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} [\hat{f}(x,y) - f(x,y)]^2}$$

(4)

$$SNR_{ms} = \frac{\sum_{x=0}^{M-1}\sum_{y=0}^{N-1} \hat{f}(x,y)^2}{\sum_{x=0}^{M-1}\sum_{y=0}^{N-1} \left[\hat{f}(x,y) - f(x,y)\right]^2}$$

(e)

entropy $$\overline{H} = -\sum_{k=0}^{L-1} p_r(r_k) \log_2 p_r(r_k)$$

8 bit image, $\rightarrow L = 256$

size = 4×4 $\rightarrow$ 16 pixel

$\therefore P(215) = \frac{3}{16}$

$P(217) = \frac{3}{16}$

$P(210) = \frac{5}{16}$

$P(200) = \frac{5}{16}$

$$\therefore \overline{H} = -\left(\frac{3}{16}\log_2\left(\frac{3}{16}\right) + \frac{3}{16}\log_2\left(\frac{3}{16}\right) + \frac{5}{16}\log_2\left(\frac{5}{16}\right) + \frac{5}{16}\log_2\left(\frac{5}{16}\right)\right)$$

$$= -\left(2\left(\frac{3}{16}\right)(-2.4150375) + 2\left(\frac{5}{16}\right)(-1.6780719)\right)$$

(5)

$$z = -(-0.905839063 - 1.648794 94)$$

$$z = 1.954434$$

(f) types of data redundancies

(1) coding redundancy

→ redundancy due to excess length of code to represent intensity value which is not needed & unnecessarily increase image size

(2) spatial / temporal redundancy.

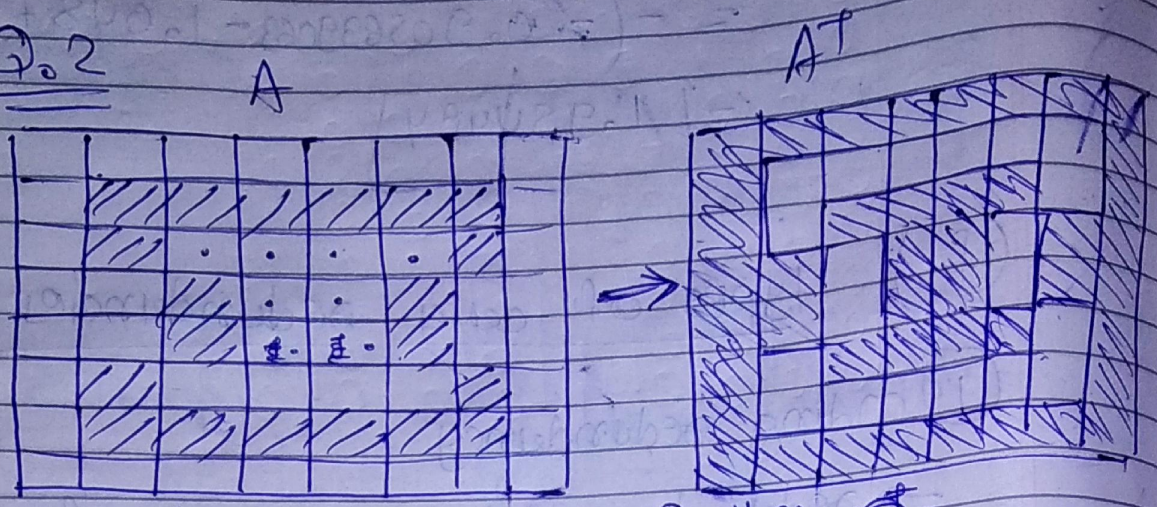
→ due to unnecessary replication of spatially related pixels in terms of intensity.

(3) Irrelevant info

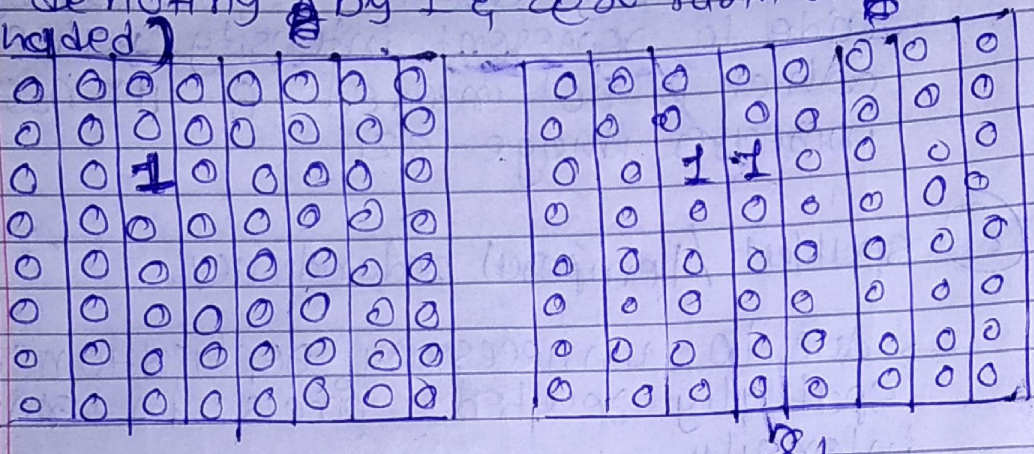
→ 2-D intensity array containing info that is ignored by human eye cant see hense it is not useful.

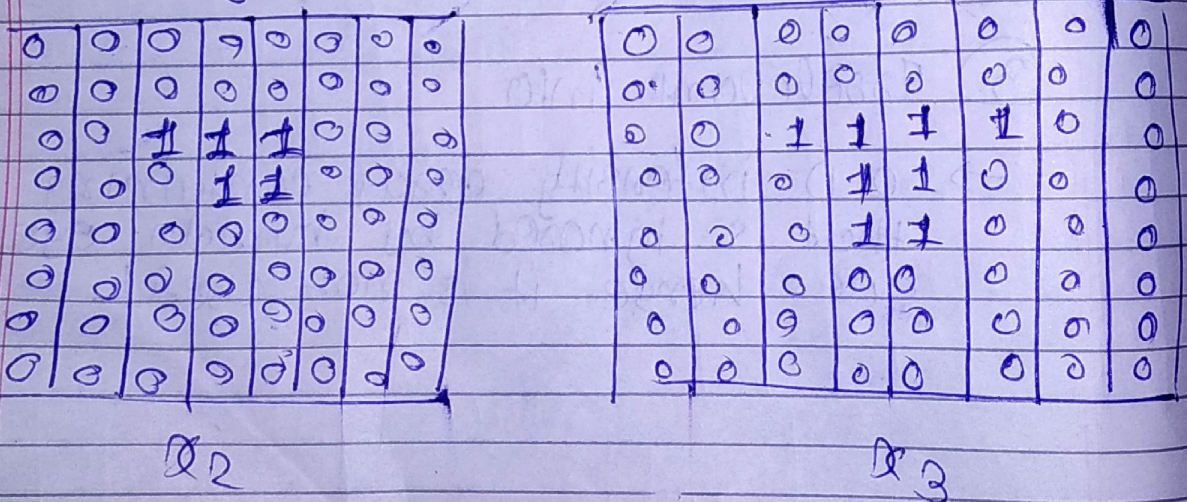
Q. 2

(a)



now denoting by 1 & zero further.
(1 → shaded)





(7)

X_4

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	1	1	1	1	0	0
0	0	1	1	0	0	0
0	0	1	1	0	0	0
0	1	1	1	1	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

$Q_4 \cup A$

0	0	0	0	0	0	0	0
0	1	1	1	1	1	1	0
0	1	1	1	1	1	1	0
0	0	1	1	1	1	0	0
0	0	1	1	1	1	0	0
0	1	1	1	1	1	1	0
0	1	1	1	1	1	1	0
0	0	0	0	0	0	0	0

(c) Thinning

$$A \otimes B = A - (A * B) = A \cap (A * B)^c$$

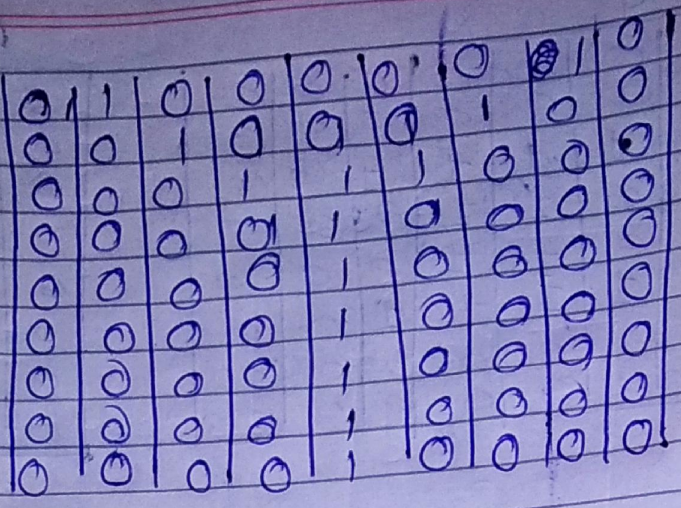
Step 1

$$\left[\begin{array}{|c|c|c|c|c|c|c|c|c|}
\hline
0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ \hline
0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 \\ \hline
0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 \\ \hline
0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 \\ \hline
0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 \\ \hline
0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 \\ \hline
0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 \\ \hline
0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 \\ \hline
\end{array}\right]$$

Step 2

$$\left[\begin{array}{|c|c|c|c|c|c|c|c|c|}
\hline
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \hline
0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 \\ \hline
0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 \\ \hline
0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 \\ \hline
0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 \\ \hline
0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 \\ \hline
0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 \\ \hline
0 & 0 & 0 & 0 & 1 & 1 & 0 & 0 & 0 \\ \hline
\end{array}\right]$$

Step 3, 4



Q.3

(a) @$@ $ $@ $ #@ $ @ $$@

1	@
2	$
3	#

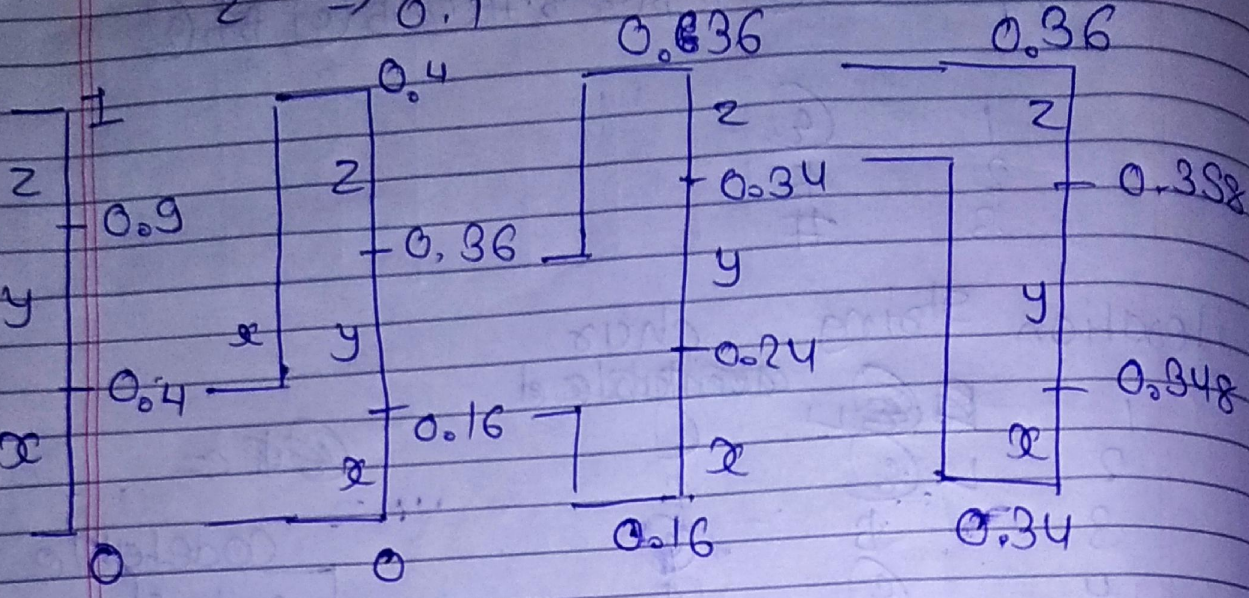
Iteration	String	Char added
1	@	@
2	@$	$
3	$	@
4	@	$
5	@$	$
6	@$$	@
7	@	$
8	$	#
9	@#	@
10	@	$
11	@$	@
12	@	$
13	$	$
14	$$	@
15	@	

Codetable

code	string
1	@
2	$
3	#
4	@$
5	$@
6	$$
7	$#
8	#@
9	@$$

(10)

(b) $x \Rightarrow 0.4$
$y \Rightarrow 0.5$
$z \Rightarrow 0.1$



0.8232 → not in [0.34, 0.36)
→ not in [0.16, 0.36)
→ not in [0.8, 0.4)
→ in [0.4, 0.9)

∴ decoding it as | y |

end of answer sheet