National University of Computer and Emerging Sciences

FAST School of Computing | Spring-2024 | Islamabad Campus

Question 1 [20 Marks]

10.5

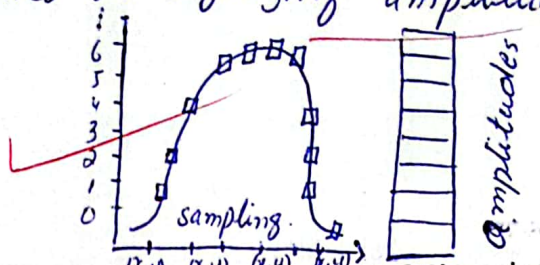
Write short answers to the following questions:

a) **Explain the processes of sampling and quantization for a digital image with an example waveform.**

⟹ Sampling can be defined as Digitizing "Spatial Coordinate"

⟹ Quantization can be defined as Digitizing "amplitude" of given coordinates.

4



b) **In spatial filtering, how can the image size be reduced while using appropriate padding? Give a short example.**

Image Size can changed through up sampling & Down Sampling.

0.5 for size reduction we use Down Sampling procedure.

c) **Can there be any scenario where convolution and correlation operations are the same? If yes, give an example.**

2

Yes in one Scenario convolution & correlation would be same in effect.

if

a	b	c
d	e	f
g	h	i

*

x	y	x
y	p	y
x	y	x

(after 180° degree tilt the effect would be same as of convolution and correlation).

d) **How can identity transformation be achieved using gamma correction? Justify your answer.**

4 Identity transformation can be achieved if gamma is put 1 ($\gamma = 1$).

1. system/matrix would be in same state as before.
2. ~~if $\gamma < 1$ (brighter) if $\gamma > 1$ (Darker) if $(\gamma = 1)$ no effect.~~

e) **How can an RGB image be converted to a grayscale image? Give an example.**

2 We can convert RGB image into Grayscale by taking negative of that image. Subtracting intensity$_{max}$ from given Pixels.

(RGB) $(S = L - 1 - \gamma)$

Example:

128	115	111
121	120	50
60	70	10

→ apply $T(\gamma) = L - 1 - \gamma$ on it.

Question 2 [10 Marks]

10

a) Perform bit-plane slicing on the following 3-bit image.

3	3	2
3	1	0
0	1	1

⇒

011	011	010
011	001	000
000	001	001

5

1st plane

0	0	0
0	0	0
0	0	0

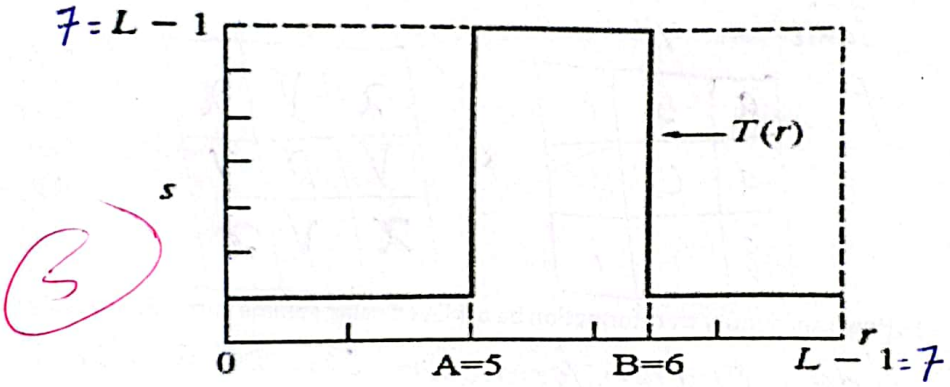
2nd plane

1	1	1
1	0	0
0	0	0

3rd plane.

1	1	0
1	1	0
0	1	1

b) Consider the following 3-bit image. Apply the given transformation T(r) on the following input image.



5

5	4	0
6	3	2
5	1	6

Input Image

7	1	1
7	1	1
7	1	7

Output Image

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Question 3 [10 Marks]

Take the modulus of your roll no. with 4 and design an average filter using that number. Apply the filter on the following image without padding and stride 1.

If the modulus is 0, then use value = 6.

770 % 4 = 2

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

correlation

2	2	2	2	2	2
2	2	2	2	2	2
2	2	2	2	2	2
2	2	2	2	2	2
2	2	2	2	2	2

output

Applying filter by Truncating Borders.

2	2	2	2
2	2	2	2
2	2	2	2
2	2	2	2

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Question 4 [10 Marks]

Perform histogram equalization on the following image. You must show all the steps.

2	1	4	0	2
4	3	2	1	0
2	2	1	6	2
2	0	5	0	3
2	1	3	2	2

10

r	Occurrence	Probability	CDF	7 x CDF
0	4	4/25 = 0.16	0.16	7 x 0.16 = 1.12 ≈ 1
1	4	0.16	0.32	7 x 0.32 = 2.24 ≈ 2
2	10	0.4	0.72	7 x 0.72 = 5.04 ≈ 5
3	3	0.12	0.84	7x0.84 = 5.88 ≈ 6
4	2	0.08	0.92	7 x 0.92 = 6.44 ≈ 6
5	1	0.04	0.96	7 x 0.96 = 6.72 ≈ 7
6	1	0.04	1	1 x 7 = 7
7	0	0	1	1 x 7 = 7

Total: 25

⇒

5	2	6	1	5
6	6	5	2	1
5	5	2	7	5
5	1	7	1	6
5	2	6	5	5