

## **Solution of Quiz # 1**

**Course:** CPE415 – Digital Image Processing  
**Semester:** 8<sup>th</sup> (FA19-BCE-A/B)  
**Total Marks = 15**

**Date:** 21-03-2023  
**Time Allowed:** 40 min

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**Question 1: Relate the concepts of image fundamentals and filtering in spatial domain to answer the following questions.**

1. State the names of two kinds of light sensors in the human eye. (1)  
**Cones and Rods are two main types of light sensors in the human eye.**
2. What is a blind spot in the structure of a human eye? (1)  
**In human eye, a blind spot is a part of the retina where there are no sensors i.e. cones or rods. An optic nerve passes through this point to provide the sensor's information to the visual cortex.**
3. When we enter the cinema in a sunny day, we can't see anything. However, after few seconds, we can see people and chairs around us. What is this phenomenon called? (1)  
**This phenomenon is called brightness adaption.**
4. How many gray levels are there in an 8-bit image? (1)  
**There are 256 gray levels in an 8-bit image.**
5. How many bits are required to store a grayscale image of resolution 120×80? (1)  
**The total number of bits required to store a grayscale image are:  $120 \times 80 \times 8 = 76800$ .**
6. When does Aliasing occur (in context with Nyquist criteria for sampling)? (1)  
**Aliasing occurs when sampling frequency is less than twice of the highest frequency of the signal.**
7. What kind of interpolation produces blocky affect? (1)  
**Nearest neighbor interpolation produces blocky affect.**
8. In digital image processing, which kind of affine transformation produces the same result as the original image? (1)  
**Identity affine transformation produces the same image as the input image.**
9. Generate the new samples via interpolating in the following scanned row at 1/3<sup>rd</sup> pixel. Produce the new sample values using linear interpolation. (3)

2	11	8	14
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The new samples generated at 1/3<sup>rd</sup> interpolation are shown as **a, b, c, d, e, and f**.

2	<b>a</b>	<b>b</b>	11	<b>c</b>	<b>d</b>	8	<b>e</b>	<b>f</b>	14
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The values for the new samples using linear interpolation are computed as follows:

$$\mathbf{a} = 2(2/3) + 11(1/3) = 4/3 + 11/3 = 15/3 = 5$$

$$\mathbf{b} = 2(1/3) + 11(2/3) = 2/3 + 22/3 = 24/3 = 8$$

$$\mathbf{c} = 11(2/3) + 8(1/3) = 22/3 + 8/3 = 30/3 = 10$$

$$\mathbf{d} = 11(1/3) + 8(2/3) = 11/3 + 16/3 = 27/3 = 9$$

$$\mathbf{e} = 8(2/3) + 14(1/3) = 16/3 + 14/3 = 30/3 = 10$$

$$\mathbf{f} = 8(1/3) + 14(2/3) = 8/3 + 28/3 = 36/3 = 12$$

2	5	8	11	10	9	8	10	12	14
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10. For the following image, show the individual bit planes (i.e., 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> bit planes). Reconstruct the image using 1<sup>st</sup> bit (LSB) and 3<sup>rd</sup> bit (MSB) and show the resultant image. (4)

0	1	2
3	4	5
6	7	7

000	001	010
011	100	101
110	111	111

(Binary Equivalent)

0	1	0
1	0	1
0	1	1

(1<sup>st</sup> Bit Plane - LSB)

0	0	1
1	0	0
1	1	1

(2<sup>nd</sup> Bit Plane)

0	0	0
0	1	1
1	1	1

(3<sup>rd</sup> Bit Plane - MSB)

0	1	0
1	0	1
0	1	1

(1<sup>st</sup> Bit Plane - Weight)

0	0	0
0	4	4
4	4	4

(3<sup>rd</sup> Bit Plane - Weight)

0	1	0
1	4	5
4	5	5

(Reconstructed Image = 1<sup>st</sup> + 3<sup>rd</sup> Bit plane weights)