University Kasdi Merbah-Ouargla
Departement of computer science and IT
Module : Digital Image
Duration : 1.5H
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# EXAM

**Q1.** Fill in the table below with the appropriate word from: *sclera, iris, fovea, retina, lens*

| **Role** | **Organ** |
|---|---|
| Contains light receptors | Retina |
| Offer the ability to see visual details | Fovea |
| Controls the amount of light entering to the eye | Iris |
| Provide nutrition to the eye | Sclera |
| Refract the light entering to the eye | Lens |

**Q2.** We have two waves $w1$ and $w2$, such that the wavelength of $w1$ is much higher than the wavelength of $w2$ ($w1 = 10^{13} \times w2$). The energy of photons that correspond to each wave are respectively denoted by $E1$ and $E2$. Select the suitable answer from ($E1 = E2,\ E1 > E2,\ E1 < E2$).

**Q3.** To capture an image for an object with a diameter $10^{-7}m$, we should use a light source which emits waves with a wavelength of (Select the suitable answer from: $10^{7}$, $10^{-9}$, $10^{1}$, $10^{-6}$)

**Q4.** By increasing the sampling ratio, the image quality will decrease? (True / False)

**Q5.** In CMYK color space, which mix of colors we should use to produce the white color?

No mix is needed, the white color is the background on which the other colors are supplied (white paper).

**Q6.** In CMYK, mixing magenta, yellow and cyan (with 100% for each) produces the black color?

No, the produced color is a shade of gray.

**Q7.** In CMYK, to produce the blue color, which are the two color we have to use?

Cyan and Magenta

**Q8.** Given two color: *C1* and *C2* that are represented in the HSV color space, suppose that the *value* of the both colors equal to 1, what is the difference between them if you know that *saturation* of *C1* > *saturation* of *C2?*

*C1* is more pure / darker than *C2*

**Q9.** How many bits we need to represent $100 \times 100$ image in HSV color space (H is represented using 6 bins)?

If H is represented with 6 bins, thus, it needs 3 bits for representation. As for S and V (0-100), we need 7 bits for each. Therefore, in total, we need 7+7+3 = 17 bits.

100x100x17 = 17 00 00 bits.

**Q10.** Suppose we are given an $N \times N$ image, with a bit depth equal to $B$. We need 125000 bits to store this image. By decreasing the image size by 25 pixels (in rows and columns), and increasing the bit depth by 1, we need 90000 bits to store the new image. Find $N$ and $B$?

We need to solve the two equations

$$N \times N \times B = 125000$$

$$(N - 25) \times (N - 25) \times (B + 1) = 90000$$

$$N = 125, B = 8$$

**Q11.** Normalize the following image [310 181 284 91 78 208 327 0 15] to the range of [0 255]?

We use the equation

$$New = 255 \times \frac{x - X_{min}}{X_{max} - X_{min}}$$

$$New = 255 \times \frac{310 - 0}{327 - 0} = 241.74$$

[241.74 141.14 221.46 70.96 60.82 162.20 1 0 11.69]

**Q12.** Given the two following images (1x8): A=11010110 and B=00111001, calculate the output image of XNOR(((A and B) or B) XOR A), B)?

(11010110 and 00111001) = 00010000

(00010000 or 00111001) = 00111001

(00111001 XOR 11010110) = 11101111

(11101111 XNOR 00111001) = 00101001

**Q13.** Transform the following image [71 29 36 11 2 0 1 9 52] using the linear transformation $f(x) = 2x + 1$?

[143 59 73 23 5 1 3 19 105]

**Q14.** Perform the erosion and dilation on the image below using a structuring element at right (use zero-padding)

| | | | | | |
|---|---|---|---|---|---|
| 0 | 1 | 1 | 1 | 1 | 0 |
| 1 | 1 | 1 | 0 | 0 | 1 |
| 1 | 1 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 | 0 |

| | | |
|---|---|---|
| 0 | 1 | 0 |
| 1 | 1 | 1 |
| 0 | 1 | 0 |

Erosion

| | | | | | |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 |

Dilation

| | | | | | |
|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 |

**Q15.** Fill in a 5x5 Gaussian filter, if you know that the central value = 0.72, and each time by going far away from the center the value decreases by 10%?

| | | | | |
|---|---|---|---|---|
| 0.41 | 0.45 | 0.51 | 0.45 | 0.41 |
| 0.45 | 0.57 | 0.64 | 0.57 | 0.45 |
| 0.51 | 0.64 | **0.72** | 0.64 | 0.51 |
| 0.45 | 0.57 | 0.64 | 0.57 | 0.45 |
| 0.41 | 0.45 | 0.51 | 0.45 | 0.41 |

**Q16.** Verify that Laplacian of Gaussian can be written as $\Delta^2 G = \frac{1}{\sigma^2}\left(\frac{x^2+y^2}{\sigma^2}\right) G(x,y)$ such that $G(x,y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{\sigma^2}}$?

Simple proof!

**Q17.** Apply $3 \times 3$ mean, median, and vertical sobel filters on the following image (do not use zero padding)?

| | | | | |
|---|---|---|---|---|
| 1 | 2 | 0 | 7 | 9 |
| 7 | 0 | 4 | 2 | 4 |
| 8 | 3 | 1 | 3 | 6 |
| 9 | 2 | 1 | 0 | 3 |
| 5 | 5 | 0 | 0 | 1 |

Mean filter

| | | | | |
|---|---|---|---|---|
| X | X | X | X | X |
| X | 2.88 | 2.44 | 4 | X |
| X | 3.88 | 1.77 | 2.33 | X |
| X | 3.77 | 1.66 | 1.66 | X |
| X | X | X | X | X |

Median filter

| | | | | |
|---|---|---|---|---|
| X | X | X | X | X |
| X | 2 | 2 | 4 | X |
| X | 3 | 2 | 3 | X |
| X | 3 | 1 | 1 | X |
| X | X | X | X | X |

Vertical sobel

| | | | | |
|---|---|---|---|---|
| X | X | X | X | X |
| X | -14 | 5 | 14 | X |
| X | -25 | 0 | 12 | X |
| X | -28 | -9 | 10 | X |
| X | X | X | X | X |

**Q18.** Apply hysteresis thresholding on the following magnitude image, where *TLow* = 31 and *Thigh* = 92? Mark edge pixels using 1 and 0 otherwise.

| | | | | | | |
|---|---|---|---|---|---|---|
| 12 | 7 | 88 | 26 | 30 | 0 | 1 |
| 189 | 55 | 13 | 145 | 169 | 23 | 2 |
| 74 | 247 | 231 | 118 | 221 | 224 | 45 |
| 65 | 62 | 165 | 36 | 14 | 10 | 2 |
| 254 | 10 | 19 | 15 | 5 | 236 | 65 |
| 0 | 2 | 255 | 1 | 3 | 78 | 0 |
| 0 | 7 | 7 | 0 | 0 | 17 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Points = (1+1+1+1+1+1+1+1+1+1+1+1+1+1+1+1+1+3+1)**