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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, July 2020

Course: B.Tech CSE+GG **Semester: VI**
Program: Digital Image Processing **Time : 02 hrs.**
Course Code: CSEG3001 **Max. Marks:**

Instructions:

End-Semester Online Examination - Digital Image Processing (CSEG 3001) – JULY 2020

1 Statement 1: A median filter is effective in minimising salt-and-pepper noise in an image.

Statement 2: A median filter is a linear filter.

Statements 1 and 2 are wrong

Statement 1 is correct and 2 is wrong

Statements 1 and 2 are true

Statement 2 is correct and 1 is wrong

2 The photosensitive 'detector' of the human eye is the

Eyelens

Iris

retina

cornea

3 The process of embedding one image in another is called

dithering

demosicing

watermarking

beamforming

4 The image processing operation that is not commutative is

matrix addition

convolution

dilation

erosion

5 In image restoration, the blurred image is often modelled as

(PSF stands for Point-Spread function)

Original image + PSF of blur

Original image - PSF of blur

Original image / PSF of blur

Convolution of original image with PSF of blur

6 If the Fourier transform of an image $f(m, n)$ is $F(k, l)$, and the Fourier transform of the kernel $g(m, n)$ is $G(k, l)$ then the Fourier transform of the function $4f(m, n)+ 5g(m, n)$ is:

$F(4k, 4l) + G(5k, 5l)$

$20F(k, l)G(k, l)$

$4F(k, l) + 5G(k, l)$

$(¼)F(k/4, l/4) + (⅕)F(k/5, l/5)$

7 If f represents the input image and B represents the structuring element then the morphological gradient is given by

(note: $\oplus$ and $\ominus$ denote dilation and erosion)

$(F \oplus B) – (F \ominus B)$

$(F \oplus B) + (F \ominus B)$

$(F \oplus B) (F \ominus B)$

$(F \oplus B) / (F \ominus B)$

8 The operator that can be used to detect the edges in an image is:

logarithm

exponential

gradient

average

9 Consider the original image *f* and reconstructed image *R* given here. The mean absolute error between the original image and reconstructed image is

$$f(m, n) \begin{vmatrix} 1 & 2 & 3 & 4 \\ 5 & 2 & 3 & 2 \\ 2 & 3 & 4 & 5 \\ 2 & 1 & 5 & 2 \end{vmatrix} \qquad R(m, n) \begin{vmatrix} 2 & 2 & 4 & 4 \\ 6 & 2 & 4 & 2 \\ 2 & 4 & 4 & 6 \\ 2 & 2 & 6 & 2 \end{vmatrix}$$

0.25

0.5

0.75

1.0

10 The application of a Laplacian operator to a 2D Gaussian function results in a

Haar wavelet

Maxican-hat wavelet

Daubechies wavelet

Coiflet

11 For the binary image shown in figure, calculate the number of white pixels left if it dilated by the structuring element shown in Fig. (b)

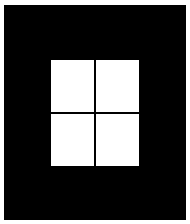


Fig. (a)

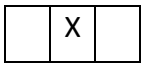


Fig. (b)

4

8

10

12

12 For the binary image shown in Fig. (a), calculate the number of white pixels left if it is eroded by the structuring element shown in Fig. (b)

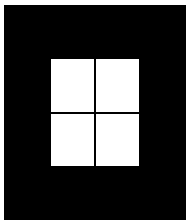


Fig. (a)

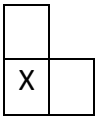


Fig. (b)

1

2

4

8

13 Consider the image segment in figure. Let the set of intensities be V = {1, 2}. The D_8 distance between the marked pixels is

3	1	2	**1**
2	2	0	2
1	2	1	1
1	0	1	2

6

3

∞

0

14 Two images *x* and *h* given in the figure are convolved to get the resultant image as

(Square marks display origin)

$$x(m, n) = \begin{vmatrix} 1 & \boxed{\mathbf{2}} \\ 3 & 4 \end{vmatrix} \qquad h(m, n) = \begin{vmatrix} 5 & \boxed{\mathbf{6}} \\ 7 & 8 \end{vmatrix}$$

(A)
5	**16**	12
22	60	40
21	52	32

(B)
5	16	**12**
22	60	40
21	52	32

(C)
5	16	12
22	**60**	40
21	52	32

(D)
5	16	12
22	60	**40**
21	52	32

15 Which of the following operations is idempotent?

Dilation

Erosion

Convolution

Closing

16 The impulse response of a filter is given by

$h(m, n) = 0.25\ (\delta(m + 1, n) + \delta(m - 1, n) + \delta(m, n + 1), \delta(m, n - 1))$.

The filter will act like a

low-pass filter

high-pass filter

band-pass filter

notch filter

17 The Fourier transform of a two-dimensional comb function is a two-dimensional

delta function

ramp function

step function

comb function

18 The edge detector which uses non-maximum suppression to thin edges is the

Robert operator

Canny operator

Sobel operator

Prewitt operator

19 Let $f(m, n)$ and $h(m, n)$ represent 2D signals. If $h(m, n)$ is a two-dimensional impulse then the convolution of $f(m, n)$ with $h(m, n)$ will result in

$h(m, n)$

***f*(*m*, *n*)**

$f(m, n) + h(m, n)$

$f(m, n) - h(m, n)$

20 The Wiener filter behaves like an inverse filter

in the presence of noise

in the absence of noise

in the presence of noise and degradation

Wiener filter will not resemble inverse filter under any condition

21 The negative of an 8 bit image $f(m, n)$ is obtained using the relation $g(m, n)=255 - f(m, n)$. This process is

linear

shift-invariant

both, linear and shift-invariant

neither linear nor shift invariant

22 If the first row of a circulant matrix is given by [1 –2 4], then the complete matrix is given by

(A) $\begin{vmatrix} 1 & 4 & -2 \\ -2 & 1 & 4 \\ 4 & -2 & 1 \end{vmatrix}$ (B) $\begin{vmatrix} 1 & -2 & -2 \\ -2 & 4 & 4 \\ 4 & 1 & 1 \end{vmatrix}$ (C) $\begin{vmatrix} 1 & 4 & 1 \\ -2 & 1 & 4 \\ 4 & -2 & -2 \end{vmatrix}$ (D) $\begin{vmatrix} 1 & 1 & -2 \\ -2 & 4 & 4 \\ 4 & -2 & 1 \end{vmatrix}$

23 The transform which is widely used to detect lines in an image is

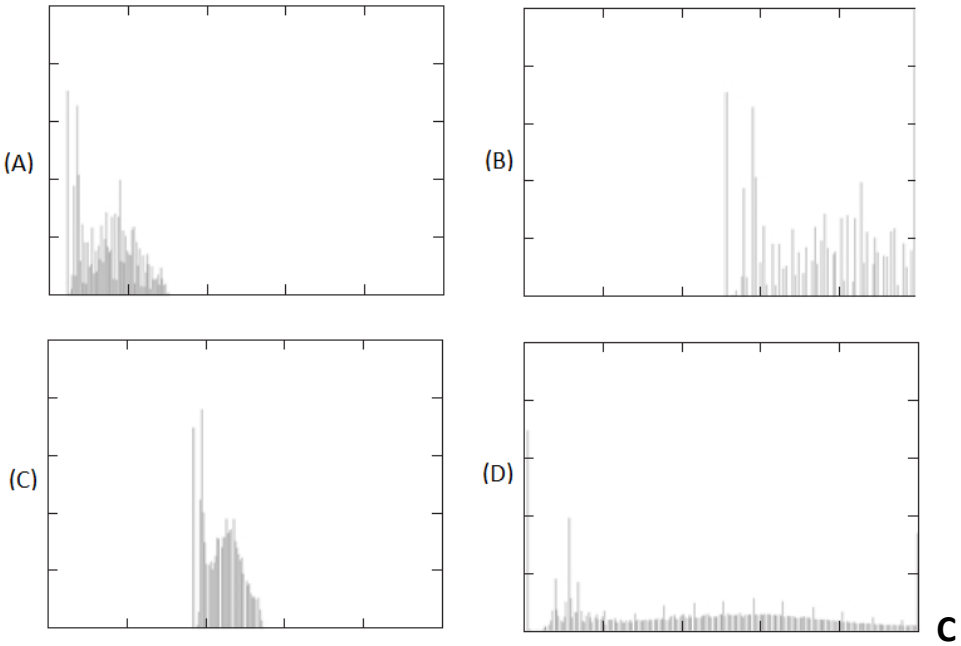
Fourier transform

Hough transform

Cosine transform

Haar transform

24 Which one of the histograms shown in the figure depicts a low-contrast image?



C

25 Otsu's algorithm deals with

image segmentation

image restoration

Image compression

Image registration

26 Snapshot of a fraction of an image is shown below. If the two most significant bit-planes of this image were used to reconstruct the image, values in the resulting image at the two marked positions would be

8	**10**	8
8	10	7
7	7	6

8, 8

10, 8

8, 10

8, 0

27 What is the value of the central pixel (marked) if it is smoothened by a 3 X 3 box filter:

$$\begin{vmatrix} 1 & 2 & 3 \\ 4 & \boxed{5} & 6 \\ 7 & 8 & 9 \end{vmatrix}$$

2 3 4 **5**

28 Which of the Laplacian filters given below are isotropic in the increments of 45 degrees

(A) $\begin{vmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{vmatrix}$ (B) $\begin{vmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{vmatrix}$ (C) $\begin{vmatrix} 1 & 1 & 1 \\ 1 & -8 & 1 \\ 1 & 1 & 1 \end{vmatrix}$

C A and B A and C A, B and C

29 In the subsequent expression, $g_{mask}(x, y)$ refers to the mask for an image $f(x, y)$ and $f'(x, y)$ refers to the blurred image.

$g_{mask}(x, y) = f(x, y) - f'(x, y)$

$g(x, y) = f(x, y) + k * g_{mask}(x, y)$

The resulting image $g(x, y)$ is sharpened image. With these expressions, unsharp masking can be achieved when

k = 1 k > 1 k < 1 k = 0

30 An image *f* contains the occurrences within the gray level range 2 to 12. Here, a gray-level is represented by 4 bits. This image *f* is stretched linearly over the entire gray-level range. The updated value for the gray-level value 8 would now be

10 8 12 **9**

31 False contouring is caused due to

Poor quantization

Poor Sampling

Narrow range of gray levels drifted towards one side of the spectrum

Low contrast

32 The number of shades of gray in an eight-bit image is

256 128 64 32

33 For the image patch *f* given below, what will be the value of the marked central pixel after applying a 3 X 3 Gaussian filter *g* given in the figure below?

$$\begin{vmatrix} 2 & 3 & 4 & 5 & 6 \\ 3 & 1 & 2 & 3 & 8 \\ 5 & 3 & \boxed{\mathbf{2}} & 1 & 3 \\ 4 & 1 & 2 & 3 & 2 \\ 3 & 2 & 1 & 4 & 2 \end{vmatrix}$$

Image *f*

$$\frac{1}{16}\begin{vmatrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{vmatrix}$$

Filter *g*

1 **2** 3 3.75

34 Expression of the second order derivative for one-dimensional signal is given as

f(x+1) + f(x-1) – 2f(x)

f(x+1) + f(x-1) – 4f(x)

f(x+1) – f(x-1) + 2f(x)

f(x+1) – f(x+1) + 4f(x)

35 Histogram specification refers to

Enhancing the image so that the Probability Density Function (PDF) of the resulting image matches to a given PDF

Enhancing the image so that the PDF of the resulting image is uniform

Enhancing the image so that PDF of the resulting image covers the full gray-level range

All the listed options are correct

36 The condition that is **not** applicable for the second derivative is

It must be zero in the area of constant intensity

Must be non-zero on the onset and end of the ramp or step

Must be non-zero along ramps

All the listed conditions are applicable

37 Utility of the log-transformation is that it

Maps a narrow range of low intensity values in the input into a wider range of output levels

Maps a wide range of high intensity values in the input into a narrower range of output levels

Both of the listed options are correct

Both of the listed options are incorrect

38 The 2D DFT of the image given below is:

$$\begin{vmatrix} 1 & 1 \\ 1 & 1 \end{vmatrix}$$

Image

(A) $\begin{vmatrix} 4 & 0 \\ 0 & 0 \end{vmatrix}$ (B) $\begin{vmatrix} 0 & 4 \\ 0 & 0 \end{vmatrix}$ (C) $\begin{vmatrix} 0 & 0 \\ 4 & 0 \end{vmatrix}$ (D) $\begin{vmatrix} 0 & 0 \\ 0 & 4 \end{vmatrix}$

39 Sampling is the process of

Digitizing the coordinate values

Digitizing the amplitude values

Digitizing both, coordinate and amplitude values

None of the given answers

40 Separability property makes it possible to decompose a 2D transformation in two 1D trasnsformations so that its complexity reduces to

***O*(2*n*³)**

O($n^2 \log n^2$)

O($n \log n$)

O(n^3)

41 A 1D Gaussian High Pass Filter (HPF) can be obtained by using the following expression:

A. $H(u) = A\left(1 - e^{-u^2/2\sigma^2}\right)$

B. $H(u) = A(\delta(u) - \sqrt{2\pi}\, e^{-2\pi^2\sigma^2u^2})$

C. $H(u) = Ae^{-u^2/2\sigma^2}$

D. $H(u) = \sqrt{2\pi}\, A - e^{-2\pi^2\sigma^2u^2}$

42 Which of the following expressions for Butterworth high pass filter will not generate ringing effect in the processed image:

A. $H(u,v) = \dfrac{1}{1 + \left[\dfrac{D_0}{D(u,v)}\right]}$

B. $H(u,v) = \frac{1}{1+\left[\frac{D_0}{D(u,v)}\right]^2}$

C. $H(u,v) = \frac{1}{1+\left[\frac{D_0}{D(u,v)}\right]^4}$

D. $H(u,v) = \frac{1}{1+\left[\frac{D_0}{D(u,v)}\right]^3}$

43 If we attenuate the frequency components nearby the centre of a frequency domain filter and retain the frequency components located distance away from the centre, we will have a

High pass filter

Low pass filter

Laplacian filter

Hybrid filter

44 In Weiner filtering, it is assumed that noise and image are

Different

Homogeneous

Correlated

Uncorrelated

45 Mean filters reduce noise using

Sharpening

Blurring

Restoration

Acquisition

46 Degraded image is produced using degradation process and

Additive noise

Destruction

Pixels

Coordinates

47 Order statistic filters are filters whose responses are based on

Additive noise

Probability Density Function

Pixels

Ranking

48 First derivative approximation says that values of constant intensities must be

1

0

Positive

Negative

49 For edge detection, we use

First order derivative

Second order derivative

Third order derivative

All the listed derivatives

50 Discontinuity approach of segmentation depends on

Low frequencies

Smooth changes

Abrupt changes

Contrast

51 Double line effect is produced by

First derivative

Second derivative

Both first and second derivatives

Neither first nor second derivatives

52 Degraded image is given in a

Frequency domain

Time domain

Spatial domain

Plane

53 Fourier spectrum of noises are constant and usually called

red noise

black noise

white noise

green noise

54 An image with 16 grey levels would require at the least _____ bit planes in the frame buffer.

8

1

16

4

55 One that is not measuring substance of the image is

Radiance

Refraction

Illumination

Brightness

56 Image linear interpolation is given by the formula

V(x, y) = ax + by + cxy + d

V(x, y) = ax + by + cxy

V(x, y) = ax + by + d

V(x, y) = ax + by + (a + b)xy

57 The common example of image interpolation is

Enhancement

Blurring

Sharpening

Resizing

58 2D Fourier transform and its inverse are infinitely

Periodic

Aperiodic

Linear

Nonlinear

59 The displacement of various sinusoids with respect to their origin is

Phase

AC component

DC component

Vector

60 For shifting the origin, a 1-D function is multiplied with

$(-1)^{x+y}$

-1

√-1

$(-1)^{x}$