IGNOU

MCS-230

30 MOST REPEATED QUESTIONS

Curated List of 30 Questions that are seen to be repeated frequently in the examinations.

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1 . What is the role of sampling and quantization in the process of image digitization?

Found in Dec 2022 (2 a), June 2023 (2 a), Dec 2023 (2 a), June 2024 (1 b)

Image digitization is the process of converting a continuous (analog) image into a discrete digital form that can be processed by a computer. This process mainly involves two fundamental steps: sampling and quantization, both of which play crucial roles in defining the quality and accuracy of the digital image.

Sampling refers to the process of converting a continuous image into a discrete grid of pixels. It determines the spatial resolution of the image. The original image is divided into small, equally spaced units, and each unit is represented by a pixel. A higher sampling rate means more pixels are used, resulting in finer detail and better image clarity. Conversely, low sampling leads to loss of detail and possible distortion, known as aliasing.

Quantization, on the other hand, deals with assigning intensity values to each sampled pixel. Since digital systems cannot represent infinite intensity levels, the continuous range of brightness values is divided into a finite number of levels.

Each pixel is then assigned the nearest available value. The number of quantization levels determines the image's gray-scale or color resolution. Higher quantization levels produce smoother transitions and more realistic images, while lower levels may cause banding or loss of detail.

Together, sampling controls spatial detail, and quantization controls intensity precision. Both must be carefully balanced to ensure efficient storage without significantly compromising image quality.

2 . Given a gray scale image with an aspect ratio and specific pixel resolution, calculate the dimensions and size of the image.

Found in Dec 2023 (2 b), June 2024 (2 a), Dec 2022 (3 b)

To calculate the dimensions and size of a grayscale image, we use the given aspect ratio, pixel resolution, and bit depth (for grayscale, typically 8 bits per pixel).

First, determine the image dimensions (width × height) using the aspect ratio. Suppose the aspect ratio is m:n and the total number of pixels is known (resolution = width × height). Let width = mx and height = nx. Then:

$$mx \times nx = \text{Total Pixels}$$

$$x^2(m \times n) = \text{Total Pixels}$$

Solve for xxx, then substitute back to find width and height.

For example, if resolution = 1,048,576 pixels and aspect ratio = 4:3:

$$(4x)(3x) = 1,048,576 \Rightarrow 12x^2 = 1,048,576$$

$$x^2 = 87,381.33 \Rightarrow x \approx 296$$

So, width ≈ 1184 pixels and height ≈ 888 pixels.

Next, calculate the image size (storage requirement). For a grayscale image:

Size (in bits)=Total Pixels×Bits per pixel

Since grayscale uses 8 bits (1 byte) per pixel:

Size=1,048,576×8=8,388,608 bits

=1,048,576×8=8,388,608 bits

=1,048,576 bytes=1024 KB=1 MB

Thus, dimensions are derived from aspect ratio and resolution, while size depends on total pixels and bit depth.

3 . Determine the number of samples required to preserve information in an image given its physical dimensions and frequency (dots per inch).

Found in June 2023 (2 b), Dec 2024 (1 b), Dec 2022 (3 b)

To determine the number of samples needed to preserve image information, we use the physical dimensions of the image along with the sampling frequency, typically expressed in dots per inch (DPI). Sampling ensures that sufficient detail is captured without loss of information.

First, convert the physical dimensions into total samples along each axis. If the image has width WWW inches and height HHH inches, and the resolution is DDD DPI, then:

- Number of samples along width = W×DW \times DW×D
- Number of samples along height = H×DH \times DH×D

The total number of samples (pixels) is:

Total samples=(W×D)×(H×D)

$$N=(W\cdot D)\times(H\cdot D)$$

For exa... ...ches at 300 DP...

4 . Differentiate between direct imaging systems and indirect imaging systems.

Found in Dec 2023 (1 a), Dec 2024 (1 a), June 2023 (1 a - via comparison), June 2024 (1 a - via comparison)

Direct and indirect imaging systems differ in how they capture and convert image information into digital form. The distinction mainly lies in whether the image is digitized in a single step or through intermediate stages.

Direct imaging systems capture images directly in digital form without intermediate conversion. Devices such as digital cameras and flatbed scanners use electronic sensors (like CCD or CMOS) to convert light energy into electrical signals instantly. This method ensures faster processing, higher accuracy and minimal information loss because the image is not subjected to multiple transformati[illegible] used in modern applications due to their efficiency, real-time output, and better im[illegible]

In contrast, indirect imaging systems involve one or more interme[illegible] digital. Typica[illegible] (such as on ph[illegible]

5 . Discuss the basic properties and utility of the Linear Discriminant Function.

Found in Dec 2022 (1 e), June 2023 (4 a), Dec 2024 (1 g)

The Linear Discriminant Function (LDF) is a fundamental tool in pattern recognition and classification, used to separate data into distinct classes based on a linear combination of features.

It is commonly applied in statistical classification and machine learning to make decisions about class membership.

A typical linear discriminant function is expressed as:

$$g(x) = w^T x + w_0$$

where x is the feature vector, w is the weight vector, and w0 is the bias. The sign of g(x) determines the class to which the input belongs.

6 . Explain Discrete Fourier Transform (DFT) and discuss its properties.

Found in Dec 2022 (1 c), Dec 2023 (3 a), June 2024 (1 e)

The Discrete Fourier Transform (DFT) is a mathematical technique used to convert a discrete signal from the spatial or time domain into the frequency domain. It is widely used in image processing, signal analysis, and data compression to study how different frequency components contribute to a signal.

The DFT of a discrete sequence x(n) of length N is given by:

$$X(k) = \sum_{n=0}^{N-1} x(n) e^{-j\frac{2\pi}{N}kn}$$

7 . Compare image enhancement with image restoration and explain the term "image degradation."

Found in Dec 2022 (1 d), June 2023 (3 b), June 2024 (3 b)

Image enhancement and image restoration are two important techniques in digital image processing, but they differ in purpose, approach, and methodology. Both aim to improve image quality, yet they operate under different principles.

Image enhancement focuses on improving the visual appearance of an image for human interpretation. It is subjective and does not rely on any mathematical model of the degradation process. Techniques such as contrast stretching, histogram equalization, and filtering are used to highlight important features, suppress noise, or make the image more visually appealing. The results depend on the observer's perception and the intended application.

In contrast, image restoration aims to reconstruct or recover the original image from a degraded version using mathem [illegible] bjective proces [illegible] cts of degrada [illegible]

8 . Explain the types of noises based on their probability distributions (such as Gaussian, Rayleigh, and Salt & Pepper).

Found in Dec 2022 (5 e), June 2023 (5 e), Dec 2023 (5 e, 5 f), June 2024 (4 a), Dec 2024 (4 a)

Noise in digital images refers to random variations in pixel intensity that degrade image quality. Based on probability distributions, common noise types include Gaussian, Rayleigh, and Salt & Pepper noise, each with distinct characteristics and effects.

Gaussian noise is the most common type and follows a normal distribution. It is caused by electronic circuit noise and sensor imperfections during image acquisition. The probability [illegible] is bell-shaped, where most values cluster around the mean with small variations. It affects all [illegible] appearance. Gaussian noise is mathematically modeled as:

$$p(z) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(z-\mu)^2}{2\sigma^2}}$$

Rayleig[illegible] s radar and u[illegible] kewed distribu[illegible] tive and concentrated near lower intensities.

9 . Describe the quantities used to represent any colour, specifically Hue, Saturation, and Intensity (or Brightness and Contrast).

Found in Dec 2022 (5 c, 2 c, 5 a), June 2023 (4 c), Dec 2023 (4 c)

Color representation in digital image processing is commonly described using perceptual quantities such as Hue, Saturation, and Intensity (HSI). These components align closely with human visual interpretation and are widely used in color models.

Hue refers to the actual color perceived, such as red, green, or blue. It is determined by the dominant wavelength of light and is usually represented as an angle (0°–360°) on a color wheel. For example, 0° corresponds to red, 120° to green, and 240° to blue. Hue distinguishes one color from another.

Saturation indicates [illegible] vividness of a color. A fully saturated color is rich and intense, while a less saturated color appears faded or washed out. It measures the am[illegible]e. High saturat[illegible]uration leads to [illegible]

10 . Discuss the various categories of frequency domain filters, including low-pass and high-pass filters.

Found in Dec 2022 (5 d), June 2023 (1 d, 5 d), Dec 2023 (1 d, 5 d), Dec 2024 (3 b)

Frequency domain filtering is a technique in digital image processing where an image is transformed into the frequency domain (using transforms like the DFT), modified, and then converted back. These filters operate on frequency components to enhance or suppress specific details.

The two primary categories are **low-pass filters (LPF)** and **high-pass filters (HPF)**.