

Chapter 2 - Digital Imaging Processing Concepts

TRUE/FALSE

1. All digital radiography imaging modalities including CR, flat-panel digital radiography, digital mammography, and digital fluoroscopy, utilize digital image processing as a central feature of their operations.

ANS: T PTS: 1 REF: Brief History

2. Digital image processing has become rare in digital radiology departments and is now part of the specialized skills of technologists and radiologists.

ANS: F PTS: 1 REF: Definition of Digital Image Processing

3. There are several operations used in digital image processing to transform an output image into an input image to suit the needs of the human observer.

ANS: F PTS: 1 REF: Classes of Digital Image Processing Operations

4. A digital image can be described with respect to several characteristics or fundamental parameters, including the matrix, pixels, voxels, and the bit depth.

ANS: T PTS: 1 REF: Characteristics of the Digital Image

5. The matrix size has an effect on the detail, or bit depth, of the image.

ANS: F PTS: 1 REF: Characteristics of the Digital Image

6. Both past and current day processing technologies include a wide range of image processing algorithms for use in digital radiology.

ANS: T PTS: 1
REF: Digital Image Processing Operations: General Concepts

7. Image processing operations are intended to change the intensity values of the pixels in the input image and display the resulting changes in the output image, with the goal of changing the characteristics of the image to suit the needs of the observer in order to enhance diagnosis.

ANS: T PTS: 1
REF: Digital Image Processing Operations: General Concepts

8. If the values of the histogram are concentrated in the upper end of the range of values, the image appears dark.

ANS: F PTS: 1
REF: Digital Image Processing Operations: General Concepts

9. Geometric operations result in the scaling, sizing, rotation, and translation of images to enhance diagnosis.

ANS: T PTS: 1

REF: Digital Image Processing Operations: General Concepts

10. Digital image pre-processing is a range of techniques that allow the user to change the appearance of a digital image displayed on a monitor for viewing and interpretation.

ANS: F PTS: 1

REF: Image Post-Processing: An Essential Tool for Technologists

MULTIPLE CHOICE

1. In radiology, what is the viewing task of the radiologist?
- a. Manipulate images.
 - b. Generate digital images.
 - c. Assess image quality.
 - d. Detect pathology.

ANS: D PTS: 1 REF: Introduction

2. The processing of images using a computer is called ____.
- a. digital radiology
 - b. image representation
 - c. diagnostic imaging
 - d. digital image processing

ANS: D PTS: 1 REF: Definition of Digital Image Processing

3. Which of the following would generate an output signal in which its intensity varies continuously depending on the location of the light on the image?
- a. ADC
 - b. PMT
 - c. MRI
 - d. FOV

ANS: B PTS: 1 REF: Image Formation and Representation

4. In digital radiography, which of the following is a numerical representation of the patient?
- a. analog image
 - b. analog-to-digital converter
 - c. photomultiplier
 - d. digital image

ANS: D PTS: 1 REF: Image Formation and Representation

5. What can be located using the X-Y coordinate system?
- a. X-axis
 - b. pixel
 - c. Y-axis
 - d. spatial location

ANS: B PTS: 1 REF: Image Formation and Representation

6. Where do MRIs acquire data from the patient?
- a. spatial frequency domain
 - b. horizontal location domain
 - c. horizontal frequency domain
 - d. spatial location domain

ANS: A PTS: 1 REF: Image Formation and Representation

7. The purpose of the ____ class of processing is to generate an image that is more pleasing to the observer.
- a. image restoration
 - b. image analysis
 - c. image compression
 - d. image enhancement

ANS: D PTS: 1 REF: Classes of Digital Image Processing Operations

8. What class of digital image processing allows measurements and statistics to be performed, as well as image segmentation, feature extraction, and classification of objects?
- a. image analysis
 - b. image synthesis
 - c. image compression
 - d. image restoration

ANS: A PTS: 1 REF: Classes of Digital Image Processing Operations

9. The pixels that make up the matrix are generally ____.

- a. horizontal
- b. rectangular
- c. square
- d. vertical

ANS: C PTS: 1 REF: Characteristics of the Digital Image

10. Pixels in a digital image represent the information contained in a volume of tissue in the patient. What is this volume called?

- a. bit depth
- b. voxel
- c. spatial resolution
- d. pixel

ANS: B PTS: 1 REF: Characteristics of the Digital Image

11. What is the first step in digitizing an image in which the image is first divided into an array of pixels?

- a. sampling
- b. quantization
- c. resolution
- d. scanning

ANS: D PTS: 1 REF: Steps in Digitizing an Image

12. ____ is a process whereby the brightness levels obtained from sampling are assigned an integer (zero or a negative or positive number), called a gray level.

- a. Quantization
- b. Scanning
- c. Digitizing
- d. Resolution

ANS: A PTS: 1 REF: Steps in Digitizing an Image

13. Which of the following processing operations is simple and the one most frequently used in digital diagnostic imaging?

- a. gray-scale
- b. local
- c. contrast
- d. point

ANS: D PTS: 1
REF: Digital Image Processing Operations: General Concepts

14. Since digital radiographic detectors have wide exposure latitude and a linear response, an image displayed without processing might appear as a ____.

- a. high-contrast image
- b. low-contrast image
- c. no-contrast image
- d. dual-contrast image

ANS: B PTS: 1
REF: Digital Image Processing Operations: General Concepts

15. ____ involves averaging a set of images to reduce image noise.

- a. Local processing
- b. Windowing
- c. Temporal averaging
- d. Gray-scale processing

ANS: C PTS: 1
REF: Digital Image Processing Operations: General Concepts

16. A ____ histogram implies more contrast and a ____ histogram will show less contrast.
- | | |
|-----------------|-----------------|
| a. narrow; long | c. narrow; wide |
| b. wide; narrow | d. wide; long |
- ANS: B PTS: 1
REF: Digital Image Processing Operations: General Concepts
17. A digital image is made up of numbers; by definition, the range of the numbers is the ____ and the center of the range is defined as the ____.
- | | |
|------------|------------|
| a. LUT; WW | c. WL; WW |
| b. WW; WL | d. LUT; WL |
- ANS: B PTS: 1
REF: Digital Image Processing Operations: General Concepts
18. Which process is intended to sharpen an input image in the spatial domain that appears blurred?
- | | |
|-----------------------|------------------------|
| a. low-pass filtering | c. masking |
| b. convolution | d. high-pass filtering |
- ANS: D PTS: 1
REF: Digital Image Processing Operations: General Concepts
19. Which of the following is intended to reduce noise and the displayed brightness levels of pixels?
- | | |
|----------------|--------------|
| a. smoothing | c. filtering |
| b. convolution | d. masking |
- ANS: A PTS: 1
REF: Digital Image Processing Operations: General Concepts
20. Which of the following is now a routine activity in digital medical imaging, and also an essential tool in the PACS environment?
- | | |
|-------------------------|--------------------------|
| a. image pre-processing | c. image post-processing |
| b. global processing | d. low-pass filtering |
- ANS: C PTS: 1
REF: Image Post-Processing: An Essential Tool for Technologists

COMPLETION

1. Digital imaging modalities such as CT, MRI, diagnostic ultrasound, and nuclear medicine incorporate digital image processing as an essential tool to manipulate and enhance _____.
- ANS: digital images
- PTS: 1 REF: Brief History
2. It is important that technologists and radiologists alike become well versed in the nature, scope, and principles of _____.
- ANS: digital image processing
- PTS: 1 REF: Brief History

3. The classical sine wave is a continuous function that can be converted into a discrete function, both of which will generate two categories of images, namely, analog and _____ images.

ANS: digital

PTS: 1 REF: Image Formation and Representation

4. The output from a digital radiography detector is an analog (electrical) signal, which is sent to a(n) _____.

ANS:
analog-to-digital converter
analog to digital converter

PTS: 1 REF: Image Formation and Representation

5. The images obtained in radiology can be represented in two domains, based on how they are acquired: the spatial location domain, and the _____ domain.

ANS: spatial frequency

PTS: 1 REF: Image Formation and Representation

6. The inverse _____, denoted by FT^{-1} , is used to transform an image in the frequency domain back to the spatial location domain for viewing by radiologists and technologists.

ANS: Fourier Transform

PTS: 1 REF: Image Formation and Representation

7. The purpose of _____ of digital images is to reduce the size of the image in order to decrease transmission time and reduce storage space.

ANS:
image compression
compression

PTS: 1 REF: Classes of Digital Image Processing Operations

8. A more recent form of compression that has been receiving attention in digital diagnostic imaging is that of _____ compression.

ANS: wavelet

PTS: 1 REF: Classes of Digital Image Processing Operations

9. A digital image is made up of a 2D array of numbers called a(n) _____.

ANS: matrix

PTS: 1 REF: Characteristics of the Digital Image

10. The number of bits per pixel is the _____.
- ANS: bit depth
- PTS: 1 REF: Characteristics of the Digital Image
11. The third step in digitizing an image is _____.
- ANS: quantization
- PTS: 1 REF: Steps in Digitizing an Image
12. The greater the _____, the more accurately the signals from the detectors can be digitized for a faithful reproduction of the original signal.
- ANS: bits
- PTS: 1 REF: Steps in Digitizing an Image
13. A(n) _____ is a graph of the number of pixels in the entire image or part of the image having the same gray levels (density values) plotted as a function of the gray levels.
- ANS: histogram
- PTS: 1 REF: Digital Image Processing Operations: General Concepts
14. The digital image processing technique known as _____ is also intended to change the contrast and brightness of an image.
- ANS: windowing
- PTS: 1 REF: Digital Image Processing Operations: General Concepts
15. Temporal averaging involves averaging a set of images to reduce image _____.
- ANS: noise
- PTS: 1 REF: Digital Image Processing Operations: General Concepts
16. In the act of _____, the kernel scans across the entire image, pixel by pixel.
- ANS: processing
- PTS: 1 REF: Digital Image Processing Operations: General Concepts
17. The digital image processing technique of unsharp masking uses the _____ image produced from the low-pass filtering process and subtracts it from the original image to produce a sharp image.
- ANS: blurred
- PTS: 1 REF: Digital Image Processing Operations: General Concepts

18. One popular _____ operation is to use the FT in filtering images in the frequency domain rather than in the spatial location domain.

ANS: global

PTS: 1 REF: Digital Image Processing Operations: General Concepts

19. The term _____ implies that all the pixels in the entire input image are used to change the value of a pixel in the output image.

ANS: global

PTS: 1 REF: Digital Image Processing Operations: General Concepts

20. Education programs for both technologists and _____ are also beginning to incorporate digital image processing as part of their curriculum.

ANS: radiologists

PTS: 1 REF: Image Post-Processing: An Essential Tool for Technologists