Chapter 30

1. A digital radiographic image is viewed in the \_\_\_\_\_\_\_\_\_ domain.
2. Spatial
3. Intensity
4. Frequency
5. Kernel

2. All of the following are general domains in which a digital image can be processed *except:*

a. intensity

b. amplitude

c. frequency

d. spatial

3. Sorting an image by the *location* of its pixels results in a(n):

a. LUT

b. frequency distribution

c. histogram

d. matrix

4. Sorting an image by the *size* of the structures within it results in a(n):

a. LUT

b. frequency distribution

c. histogram

d. matrix

5. A *histogram* is the result when a digital image is sorted by the:

a. values contained by each pixel

b. size of the structures within it

c. location of each pixel

d. location of each structure within it

6. Every image begins and ends in the \_\_\_\_\_\_\_\_\_\_ domain:

a. intensity

b. amplitude

c. frequency

d. spatial

7. Point, area, and global operations are all subcategories within the \_\_\_\_\_\_\_\_ domain:

a. intensity

b. amplitude

c. frequency

d. spatial

8. Inverting an image top-for-bottom would be a(n) \_\_\_\_\_\_\_\_\_ operation:

a. point

b. area

c. global

d. kernel

9. An example of an area operation would be:

a. a window width adjustment

b. darkening the image overall

c. translating the image left-for-right

d. zoom (magnification)

10. For gradation (gradient) processing, the Q values from the rescaled data set are fed into a(n):

a. anatomical LUT

b. permanent LUT

c. band-pass filter

d. kernel

e. DAC

11. An anatomical LUT is a table generated by applying a(n) \_\_\_\_\_\_\_\_ to the incoming data set:

a. intensity transformation formula

b. algebraic formula

c. algebraic function curve

d. any of these

e. none of these

12. Whenever a displayed image is leveled, which of the following default processes is re-

applied:

1. Band-pass filtering
2. Uniformity correction
3. Gradation processing
4. Detail processing
5. Dynamic range compression

13. Which of the following is the most appropriate term when describing the capabilities of a

hardware device such as a display monitor:

1. Bit depth
2. Dynamic range
3. Gray scale
4. Compression ratio

14. If the dynamic range of a digital processing system is too limited, it is possible for \_\_\_\_\_\_\_\_

to occur when the displayed image is later windowed:

1. Quantum mottle
2. Electronic noise
3. Image reversal
4. Data clipping
5. Excessive contrast

15. A more accurate term describing what dynamic range compression really does is *gray scale:*

a. truncation

b. lengthening

c. shortening

d. compression

e. leveling

16. In digital image processing, high-pass and low-pass filtering are methods of:

a. histogram analysis

b. frequency processing

c. re-scaling

d. partitioned pattern recognition

17. One main reason that the dynamic range of a digital image processing system must be much

greater than the actual gray scale used in the image is to prevent data clipping when the:

a. image is acquired

b. histogram is constructed

c. image is windowed for brightness or contrast

d. image is re-scaled for brightness or contrast

e. image is compressed

18. Which of the following works best for suppressing random mottle of various sizes:

a. Segmentation

b. Kernels

c. Frequency processing

d. Exposure field recognition

19. When routine radiographic techniques are used, which of the following are dramatic benefits

of dynamic range compression (equalization)?

*1. Computer memory space is saved*

*2. Lung tissue is better demonstrated*

*3. Soft tissues are better demonstrated*

a. 2 & 3 only

b. 1 & 3 only

c. 1 & 2 only

d. 1, 2, & 3

20. Equalization or dynamic range compression *cannot* improve:

a. underpenetrated portions of the image

b. light areas of cortical bone in the image

c. dark areas of lung tissue in the image

d. computer memory storage space

21. In any image, the very smallest details present can be collectively represented as:

a. short waves with low frequencies

b. short waves with high frequencies

c. long waves with low frequencies

d. long waves with high frequencies

22. Frequency processing is most ideal for removing:

a. Periodic mottle

b. Quantum mottle

c. Material mottle

d. False mottle

23. Noise in the image caused by electronic malfunctions is normally *periodic*, occurring at

regular intervals across the image, (rather than random, such as quantum mottle). This

periodic type of noise is best eliminated from a digital image using:

a. processing in the frequency domain

b. processing in the spatial domain

c. gradation processing

d. histogram analysis

24. The application of a single mathematical operation equally to each and every pixel in the

image is a(n):

a. frequency processing operation

b. gradation processing operation

c. normalization operation

d. point processing operation

25. A smaller “core” matrix of mathematical values which is passed through the entire image

matrix, multiplying the value of each image pixel sequentially by the numbers in it, is

called a(n):

a. region of interest

b. look-up table

c. kernel

d. Fourier transform

e. interpolation chart

26. If an image detail is defined as a *pair* of densities, one black and one white, then the highest

frequency that can be demonstrated along one line of a display screen that is only 8 pixels

across is:

a. 2 cycles or 2 details

b. 4 cycles or 4 details

c. 8 cycles or 8 details

d. 16 cycles or 16 details

27. In a digital image, low frequencies represent:

a. large objects

b. small objects

c. bright details

d. dark details

28. If an entire digital image was composed only of low frequencies, the image would have:

a. high contrast

b. low contrast

c. high sharpness

d. poor sharpness

29. *High-pass filtering* only allows to pass through processing to the final displayed image:

a. high frequencies

b. low frequencies

c. high pixel values

d. low pixel values

30. The mathematical method by which a complex wave form representing one line of a digital

image can be broken down into a set of the different individual wavelengths that make it up is known as:

a. pryamidal decomposition

b. the Fourier transform

c. the calculus

d. dual-energy subtraction

31. Which of the following is associated with the digital image edge-enhancement feature:

a. low-pass filtering

b. high-pass filtering

c. a steep gradient curve

d. a shallow gradient curve

e. subtraction

32. What problem can the over-use of edge-enhancement features cause in a digital image:

a. loss of diagnostic details

b. loss of contrast

c. increased fog

d. increased noise

33. During spatial band-pass filtering, what problem can the use of too small a kernel cause:

a. loss of diagnostic details

b. loss of contrast

c. increased fog

d. increased noise

34. One of the main advantages of multi-scale digital processing is that a narrow band of \_\_\_\_\_\_\_\_\_\_ can be separated and have its signal boosted to enhance visualization of a specific size of structures:

a. pixel values

b. pixel sizes

c. frequencies

d. histogram points

35. An *inverse* Fourier transform is used to:

a. construct a histogram

b. de-construct a histogram

c. decompose the different wavelengths in an image

d. re-assemble the different wavelengths in an image

e. reverse an image for the “black bone” feature

36. During pyramidal decomposition of an image, the lowest-frequency image, the “bottom image in the stack”:

a. requires the least computer storage space

b. requires the most computer storage space

c. contains the highest-contrast details

d. contains the smallest details

37. As part of post-processing, after detail processing and noise reduction are completed, the

image has an alien look to it. In final preparation for display, in order to conform the image to human perception, it is subjected to an additional round of:

a. multiscale processing

b. uniformity corrections

c. equalization

d. gradation processing

38. Dual-energy subtraction takes advantage of marked differences in absorption between

soft tissues and bone:

a. general

b. compton

c. classical

d. photoelectric

39. For dual energy subtraction to produce *bone only* and *soft tissue only* images, it must first use

either variable filters or variable kVp settings to obtain high and low - images:

a. SNR

b. CNR

c. energy

d. exposure

e. gray scale

40. To subtract grid lines from an image produced with a stationary grid, *grid line suppression*

software defines and treats these lines as:

a. low-frequency structures with a single axis

b. low-frequency structures with no particular axis

c. high-frequency structures with a single axis

d. high-frequency structures with no particular axis

41. While a histogram graph plots the number of pixels against each pixel value, a *frequency*

*distribution* plots the number of \_\_\_\_\_\_\_\_\_ against their size:

1. Objects
2. Pixels
3. Pixel values
4. Pixel counts

42. The *rescaling (processing)* step is best considered as a subset of the *preprocessing* category

because rescaling can be thought of as making:

1. Refinements to the image according to procedure or pathology
2. Corrections for flaws in image acquisition
3. Operator adjustments to the initially displayed image
4. Adjustments to initial exposure conditions

43. What concept is defined as the difference in signal contribution (intensity) between two

specific tissue areas, divided by the background noise level:

1. Just noticeable differences (JNDs)
2. Granularity
3. Signal-to-noise ratio (SNR)
4. Contrast-noise ratio (CNR)

44. As a mathematical treatment in the intensity domain, a histogram *cannot* be used to describe

the \_\_\_\_\_\_\_\_\_\_ characteristics of an image.

1. Pixel count
2. Visual
3. Statistical
4. Pixel value

45. The ability of frequency filtering to separate small detail components of the image from

larger gross tissue areas means that \_\_\_\_\_\_\_\_\_\_\_\_\_ contrast can be enhanced *without*

affecting the overall contrast of tissues very much:

1. Global or general
2. Volume of interest
3. Local or edge
4. Organ

46. The use of low-pass filtering (smoothing) will tend to:

a. increase the sharpness of the image field border

b. improve the alignment of images during subtraction

c. decrease the appearance of noise when very little data is available

d. eliminate the appearance of high-attenuation artifacts from the image

47. For the “black bone” processing feature, which inverts all brightness values within the image,

the gradation curve is:

1. Shifted to the left of the y axis of the graph
2. Shifted under the x axis of the graph
3. Reversed left-to-right
4. Shifted to the right

48. The purpose of default gradation processing is to refine image gray scale according to the:

a. permanent LUT

b. specific anatomy

c. general diagnostic level

d. personal preference.

49. Every image is subjected to gradation processing as part of \_\_\_\_\_\_\_\_\_ processing:

a. noise reduction

b. default

c. preprocessing

d. detail

50. When the gradient curve for an image is *steeper,* this indicates:

a. higher brightness

b. lower brightness

c. higher contrast

d. lower contrast.

51. The left-to-right position of an image gradient curve would be affected by changes to:

a. window level

b. window width.

c. dynamic range

d. magnification

52. The anatomical LUT to be applied is determined when the operator selects the \_\_\_\_\_\_ at the

console:

1. kVp
2. mAs
3. focal spot
4. anatomical procedure

53. A permanent anatomical \_\_\_\_\_\_ is stored by the computer for each procedure:

a. SNR

b. ADC

c. DAC

d. LUT

54. For gradation processing the \_\_\_\_\_\_\_\_\_\_ data set is fed into the anatomical LUT:

a. initial x-ray

b. acquired

c. rescaled

d. displayed

55. An actual look-up table is simply a:

a. formula

b. graph

c. list

d. diagram

56. All gradation processing takes place in the \_\_\_\_\_\_\_ domain:

a. spatial

b. intensity

c. frequency

d. kernel

57. Different parameters entered into an intensity transformation formula can change the *slope* of

the:

1. exposure curve
2. function curve
3. histogram
4. density trace

58. If the dynamic range is too short, data can be lost when \_\_\_\_\_\_\_\_ is increased:

a. window level

b. contrast

c. either of these

d. neither of these

59. *Equalization* is a visible form of:

a. signal-noise ratio

b. dynamic range compression

c. data clipping

d. SNR

60. Dynamic range compression is a(n) \_\_\_\_\_\_\_ of the extreme ends of the gray scale:

a. stretching

b. compressing

c. cutting off

d. amplifying

61. Dynamic range compression makes the image look “grayer” because:

a. the lightest and darkest shades are missing

b. there are more gray shades present

c. contrast is increased

d. brightness is reduced

1. Detail processing is characterized by its ability to enhance the \_\_\_\_\_\_\_ contrast of details

without changing *overall* contrast in the image:

1. Global
2. Area
3. Point
4. Local
5. Detail processing can be performed:
   1. In the spatial domain
   2. In the frequency domain
   3. Using kernels
   4. All of the above
6. When frequency processing is used to enhance or suppress details, Fourier transforms separate the image into distinct \_\_\_\_\_\_\_\_\_\_\_ that can each be treated.
   1. areas
   2. tissues
   3. layers
   4. densities
7. On a display monitor, compared to a row of alternating black and white pixels, a row of alternating gray and white pixels results in a sine-wave graph showing:
   1. More amplitude
   2. Less amplitude
   3. Shorter wavelengths
   4. Longer wavelengths
8. On the sine-wave graph of a row of alternating black and white monitor pixels, the *wavelength* is representative of the \_\_\_\_\_\_\_\_ of the pixels:
   1. Size
   2. Brightness
   3. Contrast
   4. Center
9. On a display monitor, if an *entire* row of pixels from left to right consists of 800 pixels, this row has a frequency of:
   1. 200 Hertz
   2. 400 Hertz
   3. 800 Hertz
   4. 1600 Hertz
10. On a display monitor, when considering the frequency of a row of alternating black and white pixels, each cycle is made up of \_\_\_ pixels:
    1. ½
    2. 1
    3. 2
    4. 4
11. If we define a “detail” as an object and an associated space within the image, it has a(n) \_\_\_\_\_\_\_\_\_ related to the number of pixels it occupies in each row:
    1. Amplitude
    2. Frequency
    3. Brightness
    4. Contrast
12. Across a particular row on a monitor screen, five-Hertz objects must be \_\_\_\_\_\_\_ than two-Hertz objects:
    1. Darker
    2. Lighter
    3. Smaller
    4. Larger
13. In frequency processing, the gray level of each object becomes the \_\_\_\_\_\_\_\_\_ of its associated waves:
    1. Height
    2. Width
    3. Attenuation coefficient
    4. Dynamic range
14. Mathematically, a complex wave form is the \_\_\_\_\_\_ of various waves with different frequencies:
    1. Sum
    2. Difference
    3. Product
    4. Ratio
15. During frequency processing, each computer *file* is an image layer composed only of details (pixel pairs) with a certain:
    1. Pixel value
    2. Wavelength
    3. Amplitude
    4. Contrast
16. In the digital image, the highest frequency layers depict only the \_\_\_\_\_\_\_\_\_\_ details:
    1. Brightest
    2. Darkest
    3. Largest
    4. Smallest
17. For an extremity view, the dark “background” density is missing from the high-frequency layers, because it is:
    1. Large
    2. Homogeneous
    3. Dark
    4. Random
18. Which of the following decomposes the image into 8 or more frequency layers:
    1. Dual-energy subtraction
    2. Low-pass filtering
    3. Unsharp mask filtering
    4. Multiscale processing
19. While they are separated into the frequency domain, \_\_\_\_\_\_ can be executed on any selected image layer:
    1. Noise reduction
    2. Gradation processing
    3. High-pass filtering
    4. All of the above
20. Which type of mottle can be made much less apparent by ensuring lots of signal in the original x-ray beam:
    1. Periodic mottle
    2. Quantum mottle
    3. Material mottle
    4. False mottle
21. By choosing which frequency layer to boost, we can choose which \_\_\_\_\_\_ of structures in the image to enhance:
    1. Type
    2. Size
    3. Density
    4. Height
22. Mottle that appears at consistent size and in a regular pattern is most likely:
    1. Periodic mottle
    2. Quantum mottle
    3. Material mottle
    4. False mottle
23. In the final image displayed on the monitor, the voltage applied to pixels along each row is controlled by the highs and lows of the complex waveform, thus varying the \_\_\_\_\_\_\_ of each pixel displayed:
    1. Brightness
    2. Sharpness
    3. Magnification
    4. Noise
24. Upon reconstructing the image, any image layer can be:
    1. Removed
    2. Suppressed
    3. Boosted
    4. All of the above
25. \_\_\_\_\_\_\_\_\_\_\_ is widely used to correct for del drop-out:
    1. High-pass filtering
    2. Low-pass filtering
    3. Unsharp mask filtering
    4. Dual energy subtraction
26. Electronic or *periodic* mottle tends to:
    1. Simulate real anatomy
    2. Be spread out across several image layers
    3. Concentrate in a single image layer
    4. Have been already corrected by gradation processing
27. Applied as a postprocessing feature at the console, *low-pass filtering* is generically known as:
    1. Unsharp mask filtering
    2. Background suppression
    3. Edge enhancement
    4. Smoothing
28. The trade-off for low-pass filtering, even if properly used, is a:
    1. Loss of some diagnostic details
    2. Loss of gray scale
    3. Increased fog
    4. Increased noise
29. Elimination of noise from the image generally requires that we accept the loss of some \_\_\_\_\_ along with it:
    1. Brightness
    2. Contrast
    3. Fine detail
    4. Dynamic range
30. High-pass filtering targets on or more mid- to low-frequency layers to be:
    1. Boosted
    2. Suppressed
    3. Removed
    4. Gradation processed
31. Quantum mottle tends to appear:
    1. At low exposure techniques
    2. In random distribution
    3. In variable sizes
    4. All of the above
32. The computer keeps track of the matrix \_\_\_\_\_\_\_ that different objects occupied, so they can be placed back after frequency processing is completed:
    1. Size
    2. Location
    3. Value
    4. Range
33. The use of *kernels* for detail processing is a \_\_\_\_\_\_ operation:
    1. Intensity
    2. Frequency
    3. Spatial
    4. Multi-scale
34. A kernel can perform detail processing when simple \_\_\_\_\_\_\_ factors are placed in its cells:
    1. Summing
    2. Subtracting
    3. Multiplication
    4. Exponential
35. The \_\_\_\_\_ of the kernel determines a transition frequency between what gets enhanced and what gets suppressed:
    1. Size
    2. Location
    3. Value
    4. Range
36. When a kernel is used for frequency processing, values of the surrounding pixels in the image matrix are:
    1. Multiplied, then summed
    2. Summed, then averaged
    3. Averaged only
    4. Multiplied only
37. The location of any kernel over the matrix is defined by which pixel its \_\_\_\_\_\_\_ is entered over:
    1. Top-left cell
    2. Middle cell
    3. Top row
    4. Bottom row
38. Depending on the *relationship* between the multiplying factors in a kernel, \_\_\_\_\_ of the image will result:
    1. Smoothing
    2. Edge enhancement
    3. Background suppression
    4. Any of these
39. Every detail processing effect that can be achieved in \_\_\_\_\_\_\_\_ can *also* be achieved using kernels:
    1. The frequency domain
    2. The intensity domain
    3. The x-ray beam
    4. Gradation processing
40. The larger the kernel (the more cells), the \_\_\_\_\_\_\_\_\_ the structures *suppressed* in the image:
    1. Darker
    2. Brighter
    3. Smaller
    4. Larger
41. Algorithms usually included within the display monitor itself *match* the \_\_\_\_\_ of the image from the computer to that of the monitor prior to display:
    1. Matrix size
    2. Dynamic range
    3. Both of these
    4. Neither of these
42. If an exponential formula is applied to a set of pixel values that makes it change in increments of 4 rather than 2, the final image will be displayed with:
    1. Increased brightness
    2. Decreased brightness
    3. Increased contrast
    4. Decreased contrast

101. All of the following are steps of default processing EXCEPT:

a. Histogram construction

b. Del drop-out corrections

c. Gradation processing

d. Operator adjustments

102. While the image is separated into the frequency domain, specific \_\_\_\_\_ of objects can be

targeted for enhancement or suppression:

1. Attenuation
2. Sizes
3. Pixel values
4. Matrices

103. In the intensity domain, each computer file contains a particular:

a. pixel location

b. density/brightness level

c. object size

d. matrix

104. A *kernel* is a \_\_\_\_\_\_\_\_ that is passed over the original pixels of the image executing some

mathematical function on them:

1. Grid
2. Filter
3. Matrix
4. Submatrix

105. Since a kernel is applied to re-set the value in each pixel, row by row, this is a \_\_\_\_\_\_-

processing operation:

1. Point
2. Area
3. Global
4. Frequency

106. Each cell in a kernel may hold a(n):

a. formula

b. multiplication factor

c. division factor

d. any of these

107. As a kernel moves across the image matrix, each pixel is finally subjected to the factors

contained in:

1. The bottom row of the kernel
2. The middle row of the kernel
3. The top row of the kernel
4. All cells in the kernel

108. A kernel moves across the image matrix:

a. horizontally only

b. vertically only

c. horizontally, then vertically

d. diagonally

109. All adjustments made after acquisition corrections have been completed, adjustments

targeted at refinement of the image according to the specific anatomical procedure,

defines:

a. Uniformity corrections

b. Preprocessing

c. Postprocessing

d. Rescaling

110. *Intensity domain* operations include all of the following EXCEPT:

a. histogram analysis

b. gradation processing

c. windowing

d. image inversion

111. Operations affecting pixels according to the value they hold, regardless of their location in

the matrix, are classified as:

1. Spatial operations
2. Intensity operations
3. Frequency operations
4. Kernel operations

112. *Frequency* operations include all of the following EXCEPT:

a. edge enhancement

b. smoothing

c. background suppression

d. histogram construction

113. For different manufacturers, the seven steps of *default* digital processing:

* 1. Are equally effective
  2. Are standardized between manufacturers
  3. Must always follow the same sequence
  4. Can be mixed or repeated

1. The “raw” digital image from the IR is both very noisy and so extremely “washed out” (low contrast) that it cannot be used for:
   1. Histogram construction
   2. Histogram analysis
   3. Processing
   4. Diagnosis
2. *Dual-energy subtraction* is a method of:
   1. Desuperimposing obstructing anatomy
   2. Filtering mottle
   3. Eliminating grid lines
   4. Enhancing contrast
3. *Grid line suppression* software empowers the computer to subtract grid lines from the digital image by leaving out the corresponding \_\_\_\_\_\_ layer upon reconstructing the image:
   1. Intensity
   2. Density
   3. Frequency
   4. Tomographic