

Review Chapter 3

1. True or False? Information is data that has been organized and/or processed in a useful way.
2. True or False? Bandwidth is the term that describes the size of the wires connecting two computers in a network.
3. True or False? Analog data is a continuous representation of the information it represents.
4. True or False? A mercury thermometer is a digital device.
5. True or False? Electronic signals are easier to manage if they transfer only binary data.
6. True or False? It's possible to represent four things with two bits.
7. True or False? Every additional bit used doubles the number of things that can be represented by a binary string.
8. True or False? In a signed-magnitude representation of numbers there are two representations of zero.
9. True or False? Negative numbers cannot be represented using the fixed-sized number representation technique.
10. True or False? Overflow occurs when a two's complement number is used in a signed-magnitude calculation.
11. True or False? The term radix point is used instead of decimal point in bases other than 10.
12. True or False? A character set is a list of characters and their numeric codes.
13. True or False? The ASCII character set is an international set that represents most of the world's languages.
14. True or False? Keyword encoding is a type of text compression.
15. True or False? Run-length encoding replaces common words with shorter symbols.
16. True or False? Huffman encoding uses variable length binary strings to represent particular characters.

17. True or False? Audio data is often represented on a computer by sampling the continuous signal that represents a sound wave.
18. True or False? An audio sampling rate of about 40 times per second is generally enough to create a reasonable sound reproduction.
19. True or False? A compact disk (CD) stores audio information as an analog signal.
20. True or False? The MP3 audio format uses both lossy and lossless compression.
21. True or False? An RGB value is made up of three values that represent the relative contributions of the primary colors red, green, and blue.
22. True or False? Thicker monitors produce more vibrant colors because they have a higher color depth.
23. True or False? A picture's resolution is determined by the color depth of the device that displays it.
24. True or False? The JPEG image format is best used for line art, while the GIF format is superior for photographic images.
25. True or False? A video codec specifies how a movie is compressed.
26. What is the primary reason for compressing data?
- A. expensive storage devices
 - B. limited size of storage devices
 - C. limited network bandwidth
 - D. limited online availability of crucial data
 - E. expensive transfer rates for auxiliary memory
27. What does pulse-code modulation (PCM) describe?
- A. the behavior of a continuous analog signal
 - B. the behavior of a digital signal, which jumps between two extremes
 - C. the behavior of a compressed signal
 - D. the loss of data as a signal degrades
 - E. the loss of data due to compression
28. How many things can be represented using two bits?
- A. 2
 - B. 4
 - C. 6
 - D. 8
 - E. 10

29. How many things can be represented using three bits?

- A. 3
- B. 4
- C. 6
- D. 8
- E. 12

30. How many things can be represented using four bits?

- A. 4
- B. 8
- C. 12
- D. 16
- E. 32

31. In general, how many things can be represented by n bits?

- A. $2n$
- B. $2n + 1$
- C. n^2
- D. n^4
- E. 2^n

32. What is the minimum number of bits needed to represent 16 things?

- A. 2
- B. 3
- C. 4
- D. 8
- E. 16

33. What is the minimum number of bits needed to represent 6 things?

- A. 2
- B. 3
- C. 4
- D. 6
- E. 8

34. Which technique for representing numeric data has two forms of zero?

- A. signed-magnitude
- B. fixed-sized numbers
- C. floating point
- D. ten's complement
- E. scientific notation

35. Which technique for representing numeric data uses ten's complement to represent negative values?

- A. signed-magnitude
- B. fixed-sized numbers

- C. floating point
- D. radix point
- E. scientific notation

36. Which technique for representing numeric data uses the mantissa to hold the significant digits of a value?

- A. signed-magnitude
- B. fixed-sized numbers
- C. floating point
- D. ten's complement
- E. scientific notation

37. What causes numeric overflow?

- A. using fixed-sized numbers in a floating-point calculation
- B. a calculation producing an invalid result
- C. a calculation producing a value that won't fit into the allotted space
- D. using a radix point instead of a decimal point
- E. using a radix point in a fixed-sized number calculation

38. Which of the following characters are not represented in the ASCII character set?

- A. uppercase letters (A-Z)
- B. lowercase letters (a-z)
- C. punctuation such as a period or comma
- D. Cyrillic characters
- E. non-printable characters such as ESC (escape) and DEL (delete)

39. Which of the following best describes the number of characters that can be represented in the Unicode character set?

- A. 256
- B. 1024
- C. over 10,000
- D. over 65,000
- E. over 100,000

40. Which text compression technique replaces a frequently used word with a single character?

- A. run-length encoding
- B. character set encoding
- C. keyword encoding
- D. Huffman encoding
- E. ASCII encoding

41. Which text compression technique replaces a long series of repeated characters with a count of the repetition?

- A. run-length encoding
- B. character set encoding

- C. keyword encoding
- D. Huffman encoding
- E. ASCII encoding

42. Which text compression technique uses variable-length binary strings to represent characters, assigning frequently used characters short codes?

- A. run-length encoding
- B. character set encoding
- C. keyword encoding
- D. Huffman encoding
- E. ASCII encoding

43. In which text compression technique is it invalid for a bit string that represents a character to be the prefix of any other string used to represent a character?

- A. run-length encoding
- B. character set encoding
- C. keyword encoding
- D. Huffman encoding
- E. ASCII encoding

44. Recording the voltage level of an audio signal at regular intervals is called what?

- A. sampling
- B. peak analysis
- C. pulse-code modulation
- D. MP3 analysis
- E. CD simulation

45. Which audio format is the most popular today?

- A. WAV
- B. AU
- C. AIFF
- D. VQF
- E. MP3

46. Which of the following is true about representing color as an RGB value?

- A. it mimics the way color is perceived by the human eye
- B. it cannot represent the color black
- C. it cannot represent the color white
- D. it cannot represent transparency
- E. it is composed of four separate numbers

47. Which of the following is not a raster-graphics format?

- A. BMP
- B. GIF
- C. JPEG
- D. PNG

E. Flash

48. Which of the following is true about vector graphics?

- A. they represent real-world images very well
- B. they do not represent every pixel individually
- C. JPEG is a vector graphics format
- D. GIF is a vector graphics format
- E. they rely on spatial compression

49. Which of the following makes use of keyframes and delta frames?

- A. temporal compression of audio
- B. spatial compression of audio
- C. temporal compression of video
- D. spatial compression of video
- E. audio extraction from video data

50. _____ is data that has been organized and/or processed in a useful way.

51. Data _____ is the process of reducing the amount of space needed to store a piece of data.

52. Networks have _____ restrictions that limit the number of bytes that can be transmitted from one place to another in a fixed amount of time.

53. The _____ is defined as the size of the compressed data divided by the size of the original data.

54. In _____ data compression, the data can be retrieved without any loss of information.

55. In _____ data compression, some information is lost in the process of compaction.

56. _____ data is a continuous representation, analogous to the information it represents.

57. _____ data is a discrete representation, in which information is broken down into pieces and the individual pieces represented.

58. A mercury thermometer is an example of a(n) _____ device.

59. Electrical signals are easier to maintain if they transfer only _____ data.

60. The behavior of a digital electronic signal, whose voltage jumps sharply between extremes, is called _____.
61. Two bits can represent up to _____ unique things.
62. Three bits can represent up to _____ unique things.
63. _____ combinations of 0 and 1 can be made from n bits.
64. When representing numbers using _____, there are two representations for zero.
65. _____ occurs when a calculated value cannot fit into the number of digits reserved for it.
66. The decimal point in a number, when working in other bases, is called the _____ point.
67. A _____ is a list of characters and the codes used to represent each one.
68. The extended _____ character set contains 256 characters that support English but is not suited for international use.
69. The acronym ASCII stands for _____.
70. The _____ character set is an attempt to represent characters and symbols for all languages in the world.
71. Substituting one character for a frequently used word is called _____.
72. In _____, a long series of repeated characters is replaced with a count of the repetition.
73. _____ uses a variable-length binary string to represent a character so that frequently used characters have short codes.
74. _____ is the process of periodically measuring the voltage of a signal.
75. The most popular audio format used today is the _____ format.
76. An _____ is represents a color using three numbers that represent the relative contributions of three primary colors.
77. An RGB value of (0, 0, 0) represents the color _____.

78. The amount of data used to represent a color is called the _____.
79. The number of pixels used to represent a picture is called the _____.
80. A _____ stores image information on a pixel-by-pixel basis.
81. The most popular vector graphics format used on the Web today is _____.
82. A video _____ represents the methods used to compress the size of a movie clip.
83. _____ compression of video uses delta frames to represent changes from one frame to the next.
84. _____ compression removes redundant information within each frame of a video.
85. Name five types of data that can be stored in a computer.
86. What is data compression?
87. Why is data compression important?
88. Explain what is meant by a compression ratio of 3/4.
89. What is a lossless compression technique?
90. What is a lossy compression technique?
91. Why will computers always fail to represent real-world information exactly?
92. In what ways are numbers infinite?
93. Describe analog data.

94. Describe digital data.

95. Give two examples of analog information.

96. How does a computer represent analog information?

97. What is a digital signal?

98. What is pulse-code modulation (PCM)?

99. Why is a digital signal easier to maintain than an analog signal?

100. How many things can be represented using 4 bits? Why?

101. List all possible combinations of three bits.

102. Generally, how many things can be represented in n bits?

103. How many things can be represented using a byte? Why?

104. If you wanted to represent 19 different things, how many bits would you need? Why?

105. Explain signed-magnitude representation of negative values.

106. What is the problem with signed-magnitude representations?

107. How can subtraction be expressed as addition?

108. Using a fixed-sized number scheme to represent negative and positive integers with

two decimal digits, what is the range of the values that can be represented?

109. How is addition performed using fixed-sized numbers?

110. Using the following number line representation, what does the value 502 represent?

500 501 502 ... 997 998 999 0 1 2 3 ... 497 498 499

-500 -499 -498 ... -3 -2 -1 0 1 2 3 ... 497 498 499

111. Using the following number line representation, what values are added to calculate $498 + (-7)$? What is the result and what does that result represent?

500 501 502 ... 997 998 999 0 1 2 3 ... 497 498 499

-500 -499 -498 ... -3 -2 -1 0 1 2 3 ... 497 498 499

112. Using the following number line representation, what values are added to calculate $-5 + (-2)$? What is the result and what does that result represent?

500 501 502 ... 997 998 999 0 1 2 3 ... 497 498 499

-500 -499 -498 ... -3 -2 -1 0 1 2 3 ... 497 498 499

113. Using the following number line representation, what values are added to calculate $5 - 8$? What is the result and what does that result represent?

500 501 502 ... 997 998 999 0 1 2 3 ... 497 498 499

-500 -499 -498 ... -3 -2 -1 0 1 2 3 ... 497 498 499

114. In the formula for ten's complement shown below, what does k represent?

Negative(I) = $10^k - I$

115. What is ten's complement?

116. What is the binary equivalent of ten's complement?

117. Using two's complement notation, what is the leftmost digit of a negative number?

118. What is the fixed-sized representation of -55534 if the number of digits is 6?

119. What is the fixed-sized representation of 123456 if the number of digits is 6?
120. What is the nine's complement of -23456 if the number of digits is 6?
121. What is the ten's complement of -34 if the number of digits is 6?
122. What is overflow?
123. What is a radix point?
124. Describe the floating-point representation of a number.
125. How is the decimal number 32.0001 represented as a floating-point number?
126. Convert the following floating-point value into decimal notation: 1342×10^{-3} ?
127. How is the decimal number 0.25 represented in binary?
128. How is the decimal number 0.76 represented in binary?
129. How is the decimal number 3.89 represented in binary?
130. What is scientific notation?
131. Why is it important for the letters in a character set to be in alphabetical order?
132. Why does the most common Unicode mapping use two bytes to represent each character?
133. Define keyword encoding.

134. Apply keyword encoding to the following text, substituting the most commonly used word with '+' and the second most commonly used word with '*'. Ignore case.

The sun is shining and the birds are singing. Singing birds make any day brighter. Singing birds create singing hearts, even on rainy days.

135. Define run-length encoding.

136. Is run-length encoding useful for English text? Explain.

137. Using the "#" character as the flag in run-length encoding, how would the following string be represented?

XXXXXXYYZZZAABBBBBBXXX

138. Expand the following string, assuming it was compressed with run-length encoding using '#' as the flag character.

#N5#M4#O4SSS

139. Given the following Huffman codes, encode the string "codat".

| c | a | t | d | o | g |
|------|----|----|-----|----|------|
| 1111 | 00 | 10 | 110 | 01 | 1110 |

140. Given the following Huffman codes, decode the string "111100100010110011110".

| c | a | t | d | o | g |
|------|----|----|-----|----|------|
| 1111 | 00 | 10 | 110 | 01 | 1110 |

141. What is the basic concept behind Huffman encoding?

142. How does a human being perceive sound?

143. Describe an analog audio signal.

144. How is an analog audio signal digitized?

145. How does the sampling rate relate to sound quality?
146. What sampling rate is needed to create reasonable sound reproduction?
147. How do vinyl record albums and compact discs differ in the way they represent sound?
148. What is color?
149. Describe the photoreceptor cone cells in the eyes of a human being.
150. What is an RGB value?
151. What does an RGB value of (0, 130, 255) mean?
152. What color does an RGB value of (0, 0, 0) represent?
153. What is color depth?
154. How is a color represented in HiColor?
155. How is a color represented in TrueColor?
156. How is a picture digitized?
157. What is a picture's resolution and how does it relate to picture quality?
158. How does a raster-graphics format represent a picture?
159. Name three raster-graphics formats.
160. What is indexed color?
161. Which raster-graphics format uses indexed color?

162. Describe the representation of a JPEG image. What is this format best used for?

163. What are vector graphics?

164. What is a video codec?

165. Which video compression technique also applies to still images?

Essay-type

166. Explain why a mercury thermometer is an analog device.

167. Compare and contrast an electric analog signal and an electric digital signal.

168. Compare and contrast the ASCII character set and the Unicode character set.

169. Compare and contrast keyword encoding and Huffman encoding.

170. How does the process of sampling an audio signal result in a digitized representation of music that can be played back?

171. How does an RGB value represent a color?

172. Explain the two general forms of compression applied to video.

173. What are the two main organizations in computing?

174. List two similarities and two differences between the IEEE code of ethics and the ACM code of ethics.

Answers

1. True or False? Information is data that has been organized and/or processed in a useful way.

Answer: True

2. True or False? Bandwidth is the term that describes the size of the wires connecting two computers in a network.

Answer: False

3. True or False? Analog data is a continuous representation of the information it represents.

Answer: True

4. True or False? A mercury thermometer is a digital device.

Answer: False

5. True or False? Electronic signals are easier to manage if they transfer only binary data.

Answer: True

6. True or False? It's possible to represent four things with two bits.

Answer: True

7. True or False? Every additional bit used doubles the number of things that can be represented by a binary string.

Answer: True

8. True or False? In a signed-magnitude representation of numbers there are two representations of zero.

Answer: True

9. True or False? Negative numbers cannot be represented using the fixed-sized number representation technique.

Answer: False

10. True or False? Overflow occurs when a two's complement number is used in a signed-magnitude calculation.

Answer: False

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Answer: True

13. True or False? The ASCII character set is an international set that represents most of the world's languages.

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14. True or False? Keyword encoding is a type of text compression.

Answer: True

15. True or False? Run-length encoding replaces common words with shorter symbols.

Answer: False

16. True or False? Huffman encoding uses variable length binary strings to represent particular characters.

Answer: True

17. True or False? Audio data is often represented on a computer by sampling the continuous signal that represents a sound wave.

Answer: True

18. True or False? An audio sampling rate of about 40 times per second is generally enough to create a reasonable sound reproduction.

Answer: False

19. True or False? A compact disk (CD) stores audio information as an analog signal.

Answer: False

20. True or False? The MP3 audio format uses both lossy and lossless compression.

Answer: True

21. True or False? An RGB value is made up of three values that represent the relative contributions of the primary colors red, green, and blue.

Answer: True

22. True or False? Thicker monitors produce more vibrant colors because they have a higher color depth.

Answer: False

23. True or False? A picture's resolution is determined by the color depth of the device that displays it.

Answer: False

24. True or False? The JPEG image format is best used for line art, while the GIF format is superior for photographic images.

Answer: False

25. True or False? A video codec specifies how a movie is compressed.

Answer: True

Multiple Choice

26. What is the primary reason for compressing data?

- A. expensive storage devices
- B. limited size of storage devices
- C. limited network bandwidth
- D. limited online availability of crucial data
- E. expensive transfer rates for auxiliary memory

Answer: C

27. What does pulse-code modulation (PCM) describe?

- A. the behavior of a continuous analog signal
- B. the behavior of a digital signal, which jumps between two extremes
- C. the behavior of a compressed signal
- D. the loss of data as a signal degrades
- E. the loss of data due to compression

Answer: B

28. How many things can be represented using two bits?

- A. 2
- B. 4
- C. 6
- D. 8
- E. 10

Answer: B

29. How many things can be represented using three bits?

- A. 3
- B. 4
- C. 6
- D. 8
- E. 12

Answer: D

30. How many things can be represented using four bits?

- A. 4
- B. 8
- C. 12
- D. 16
- E. 32

Answer: D

31. In general, how many things can be represented by n bits?

- A. $2n$
- B. $2n + 1$

- C. n^2
- D. n^4
- E. 2^n

Answer: E

32. What is the minimum number of bits needed to represent 16 things?

- A. 2
- B. 3
- C. 4
- D. 8
- E. 16

Answer: C

33. What is the minimum number of bits needed to represent 6 things?

- A. 2
- B. 3
- C. 4
- D. 6
- E. 8

Answer: B

34. Which technique for representing numeric data has two forms of zero?

- A. signed-magnitude
- B. fixed-sized numbers
- C. floating point
- D. ten's complement
- E. scientific notation

Answer: A

35. Which technique for representing numeric data uses ten's complement to represent negative values?

- A. signed-magnitude
- B. fixed-sized numbers
- C. floating point

- D. radix point
- E. scientific notation

Answer: B

36. Which technique for representing numeric data uses the mantissa to hold the significant digits of a value?

- A. signed-magnitude
- B. fixed-sized numbers
- C. floating point
- D. ten's complement
- E. scientific notation

Answer: C

37. What causes numeric overflow?

- A. using fixed-sized numbers in a floating-point calculation
- B. a calculation producing an invalid result
- C. a calculation producing a value that won't fit into the allotted space
- D. using a radix point instead of a decimal point
- E. using a radix point in a fixed-sized number calculation

Answer: C

38. Which of the following characters are not represented in the ASCII character set?

- A. uppercase letters (A-Z)
- B. lowercase letters (a-z)
- C. punctuation such as a period or comma
- D. Cyrillic characters
- E. non-printable characters such as ESC (escape) and DEL (delete)

Answer: D

39. Which of the following best describes the number of characters that can be represented in the Unicode character set?

- A. 256
- B. 1024
- C. over 10,000

- D. over 65,000
- E. over 100,000

Answer: D

40. Which text compression technique replaces a frequently used word with a single character?

- A. run-length encoding
- B. character set encoding
- C. keyword encoding
- D. Huffman encoding
- E. ASCII encoding

Answer: C

41. Which text compression technique replaces a long series of repeated characters with a count of the repetition?

- A. run-length encoding
- B. character set encoding
- C. keyword encoding
- D. Huffman encoding
- E. ASCII encoding

Answer: A

42. Which text compression technique uses variable-length binary strings to represent characters, assigning frequently used characters short codes?

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- B. character set encoding
- C. keyword encoding
- D. Huffman encoding
- E. ASCII encoding

Answer: D

43. In which text compression technique is it invalid for a bit string that represents a character to be the prefix of any other string used to represent a character?

- A. run-length encoding

- B. character set encoding
- C. keyword encoding
- D. Huffman encoding
- E. ASCII encoding

Answer: D

44. Recording the voltage level of an audio signal at regular intervals is called what?

- A. sampling
- B. peak analysis
- C. pulse-code modulation
- D. MP3 analysis
- E. CD simulation

Answer: A

45. Which audio format is the most popular today?

- A. WAV
- B. AU
- C. AIFF
- D. VQF
- E. MP3

Answer: E

46. Which of the following is true about representing color as an RGB value?

- A. it mimics the way color is perceived by the human eye
- B. it cannot represent the color black
- C. it cannot represent the color white
- D. it cannot represent transparency
- E. it is composed of four separate numbers

Answer: A

47. Which of the following is not a raster-graphics format?

- A. BMP
- B. GIF
- C. JPEG

- D. PNG
- E. Flash

Answer: E

48. Which of the following is true about vector graphics?

- A. they represent real-world images very well
- B. they do not represent every pixel individually
- C. JPEG is a vector graphics format
- D. GIF is a vector graphics format
- E. they rely on spatial compression

Answer: B

49. Which of the following makes use of keyframes and delta frames?

- A. temporal compression of audio
- B. spatial compression of audio
- C. temporal compression of video
- D. spatial compression of video
- E. audio extraction from video data

Answer: C

Fill-in-the-Blank

50. _____ is data that has been organized and/or processed in a useful way.

Answer: Information

51. Data _____ is the process of reducing the amount of space needed to store a piece of data.

Answer: Compression

52. Networks have _____ restrictions that limit the number of bytes that can be transmitted from one place to another in a fixed amount of time.

Answer: Bandwidth

53. The _____ is defined as the size of the compressed data divided by the size of the original data.

Answer: compression ratio

54. In _____ data compression, the data can be retrieved without any loss of information.

Answer: Lossless

55. In _____ data compression, some information is lost in the process of compaction.

Answer: Lossy

56. _____ data is a continuous representation, analogous to the information it represents.

Answer: Analog

57. _____ data is a discrete representation, in which information is broken down into pieces and the individual pieces represented.

Answer: Digital

58. A mercury thermometer is an example of a(n) _____ device.

Answer: Analog

59. Electrical signals are easier to maintain if they transfer only _____ data.

Answer: Binary

60. The behavior of a digital electronic signal, whose voltage jumps sharply between extremes, is called _____.

Answer: pulse-code modulation (PCM)

61. Two bits can represent up to _____ unique things.

Answer: Four

62. Three bits can represent up to _____ unique things.

Answer: Eight

63. _____ combinations of 0 and 1 can be made from n bits.

Answer: 2^n

64. When representing numbers using _____, there are two representations for zero.

Answer: signed-magnitude representation

65. _____ occurs when a calculated value cannot fit into the number of digits reserved for it.

Answer: Overflow

66. The decimal point in a number, when working in other bases, is called the _____ point.

Answer: Radix

67. A _____ is a list of characters and the codes used to represent each one.

Answer: character set

68. The extended _____ character set contains 256 characters that support English but is not suited for international use.

Answer: ASCII

69. The acronym ASCII stands for _____.

Answer: American Standard Code for Information Interchange

70. The _____ character set is an attempt to represent characters and symbols for all languages in the world.

Answer: Unicode

71. Substituting one character for a frequently used word is called _____.

Answer: keyword encoding

72. In _____, a long series of repeated characters is replaced with a count of the repetition.

Answer: run-length encoding

73. _____ uses a variable-length binary string to represent a character so that frequently used characters have short codes.

Answer: Huffman encoding

74. _____ is the process of periodically measuring the voltage of a signal.

Answer: Sampling

75. The most popular audio format used today is the _____ format.

Answer: MP3

76. An _____ is represents a color using three numbers that represent the relative contributions of three primary colors.

Answer: RGB value

77. An RGB value of (0, 0, 0) represents the color _____.

Answer: Black

78. The amount of data used to represent a color is called the _____.

Answer: color depth

79. The number of pixels used to represent a picture is called the _____.

Answer: Resolution

80. A _____ stores image information on a pixel-by-pixel basis.

Answer: raster-graphics format

81. The most popular vector graphics format used on the Web today is _____.

Answer: Flash

82. A video _____ represents the methods used to compress the size of a movie clip.

Answer: Codec

83. _____ compression of video uses delta frames to represent changes from one frame to the next.

Answer: Temporal

84. _____ compression removes redundant information within each frame of a video.

Answer: Spatial

Short Answer

85. Name five types of data that can be stored in a computer.

Answer: Numbers, text, audio, graphics, and video.

86. What is data compression?

Answer: Reducing the amount of space needed to store a piece of data.

87. Why is data compression important?

Answer: Networks have limited bandwidth, the maximum amount of data that can be transmitted per unit time.

88. Explain what is meant by a compression ratio of $3/4$.

Answer: The size of the compressed data divided by the size of the original data is $3/4$. Thus, the data was compressed by 25%.

89. What is a lossless compression technique?

Answer: One in which no information is lost; given the compressed data, the original data can be regenerated exactly.

90. What is a lossy compression technique?

Answer: One in which some information is lost; the original data cannot be generated exactly from the compressed data.

91. Why will computers always fail to represent real-world information exactly?

Answer: We are trying to map an infinite world onto a finite machine.

92. In what ways are numbers infinite?

Answer: Given any number, you can always name a number higher and a number lower than it. And given any two numbers, you can always name a number that is in between those two numbers.

93. Describe analog data.

Answer: Analog data represents information in a continuous form, analogous to the original.

94. Describe digital data.

Answer: Digital data represents information in a discrete form, representing the pieces separately.

95. Give two examples of analog information.

Answer: The spectrum of color, sound waves, temperature.

96. How does a computer represent analog information?

Answer: The analog information is digitized, breaking the original information down in some way and representing the pieces separately.

97. What is a digital signal?

Answer: An electric signal whose voltage jumps between two extremes, representing the binary digits 0 and 1.

98. What is pulse-code modulation (PCM)?

Answer: PCM is the term used to describe the behavior of a digital signal, whose voltage jumps between two extremes.

99. Why is a digital signal easier to maintain than an analog signal?

Answer: Any degradation of an analog signal changes the information it represents, whereas a digital signal can be periodically reclocked before any loss of information occurs.

100. How many things can be represented using 4 bits? Why?

Answer: 16, because there are 16 possible combinations of four bits

101. List all possible combinations of three bits.

Answer: 000, 001, 010, 011, 100, 101, 110, 111

102. Generally, how many things can be represented in n bits?

Answer: 2^n

103. How many things can be represented using a byte? Why?

Answer: 256, because there are eight bits in a byte and 2^8 is 256.

104. If you wanted to represent 19 different things, how many bits would you need? Why?

Answer: You would need five bits. Four bits can represent 16 things, which is not sufficient, whereas five bits can represent up to 32 things.

105. Explain signed-magnitude representation of negative values.

Answer: In sign-magnitude representation, the sign represents the ordering of the number (plus or minus) and the value represents the magnitude.

106. What is the problem with signed-magnitude representations?

Answer: There are two representations for zero: -0 and $+0$.

107. How can subtraction be expressed as addition?

Answer: We can subtract one number from another by adding the negative of the second to the first: $A - B = A + (-B)$

108. Using a fixed-sized number scheme to represent negative and positive integers with two decimal digits, what is the range of the values that can be represented?

Answer: -50 to 49

109. How is addition performed using fixed-sized numbers?

Answer: Add the numbers, discarding any carry digit.

110. Using the following number line representation, what does the value 502 represent?

500 501 502 ... 997 998 999 0 1 2 3 ... 497 498 499

-500 -499 -498 ... -3 -2 -1 0 1 2 3 ... 497 498 499

Answer: -498

111. Using the following number line representation, what values are added to calculate $498 + (-7)$? What is the result and what does that result represent?

500 501 502 ... 997 998 999 0 1 2 3 ... 497 498 499

-500 -499 -498 ... -3 -2 -1 0 1 2 3 ... 497 498 499

Answer: $498 + 993$ yields 491 (discarding the carry), which represents the value 491.

112. Using the following number line representation, what values are added to calculate $-5 + (-2)$? What is the result and what does that result represent?

500 501 502 ... 997 998 999 0 1 2 3 ... 497 498 499

-500 -499 -498 ... -3 -2 -1 0 1 2 3 ... 497 498 499

Answer: $995 + 998$ yields 993 (discarding the carry), which represents the value -9.

113. Using the following number line representation, what values are added to calculate $5 - 8$? What is the result and what does that result represent?

500 501 502 ... 997 998 999 0 1 2 3 ... 497 498 499

-500 -499 -498 ... -3 -2 -1 0 1 2 3 ... 497 498 499

Answer: $5 + 992$ yields 997, which represents the value -3.

114. In the formula for ten's complement shown below, what does k represent?

$$\text{Negative}(I) = 10^k - I$$

Answer: k represents the number of digits

115. What is ten's complement?

Answer: Ten's complement is a representation of negative numbers such that the negative of a number X is 10 raised the number digits minus X .

116. What is the binary equivalent of ten's complement?

Answer: Two's complement

117. Using two's complement notation, what is the leftmost digit of a negative number?

Answer: 1

118. What is the fixed-sized representation of -55534 if the number of digits is 6?

Answer: 944466

119. What is the fixed-sized representation of 123456 if the number of digits is 6?

Answer: 123456

120. What is the nine's complement of -23456 if the number of digits is 6?

Answer: 976543

121. What is the ten's complement of -34 if the number of digits is 6?

Answer: 999966

122. What is overflow?

Answer: Overflow occurs when a calculated value cannot fit into the number of digits reserved for it.

123. What is a radix point?

Answer: A radix point is the dot that separates the whole part from the fractional part in a number in any base

124. Describe the floating-point representation of a number.

Answer: A floating-point number is stored as a sign, the mantissa (the significant digits), and the exponent that specifies the position of the radix point.

125. How is the decimal number 32.0001 represented as a floating-point number?

Answer: $320001 * 10^{-4}$

126. Convert the following floating-point value into decimal notation: $1342 * 10^{-3}$?

Answer: 1.342

127. How is the decimal number 0.25 represented in binary?

Answer: 0.01

128. How is the decimal number 0.76 represented in binary?

Answer: .11000010

129. How is the decimal number 3.89 represented in binary?

Answer: 11.11100011

130. What is scientific notation?

Answer: Scientific notation is a form of floating-point representation in which the decimal point is kept to the right of the leftmost digit.

131. Why is it important for the letters in a character set to be in alphabetical order?

Answer: The ordering established by the character set can be used under program control to put strings into alphabetical order.

132. Why does the most common Unicode mapping use two bytes to represent each character?

Answer: Unicode was designed to be able to represent characters in every language including Asian ideograms. One byte allows for only 256 distinct character, but two bytes allow for over 65,000 different characters.

133. Define keyword encoding.

Answer: Keyword encoding is a text compression technique that involves replacing common words with single characters that would not normally be in the text.

134. Apply keyword encoding to the following text, substituting the most commonly used word with '+' and the second most commonly used word with '*'. Ignore case.

The sun is shining and the birds are singing. Singing birds make any day brighter. Singing birds create singing hearts, even on rainy days.

Answer: The sun is shining and the * are +. + * make any day brighter. + * create + hearts, even on rainy days.

135. Define run-length encoding.

Answer: Run-length encoding is a text compression technique which replaces repeated characters with a flag character, the character being repeated, and the number of times it is repeated.

136. Is run-length encoding useful for English text? Explain.

Answer: Because English text does not contain many repeated characters, run-length encoding is not helpful for prose, but it is useful in special data sequences such as DNA data.

137. Using the "#" character as the flag in run-length encoding, how would the following string be represented?

XXXXXYYYZZZAABBBBBBXXX

Answer: #X5#Y4ZZZAA#B6XXX

138. Expand the following string, assuming it was compressed with run-length encoding using '#' as the flag character.

#N5#M4#O4SSS

Answer: NNNNNMMMMOOOOSSS

139. Given the following Huffman codes, encode the string "codat".

| c | a | t | d | o | g |
|------|----|----|-----|----|------|
| 1111 | 00 | 10 | 110 | 01 | 1110 |

Answer: 1111011100010

140. Given the following Huffman codes, decode the string "111100100010110011110".

| c | a | t | d | o | g |
|------|----|----|-----|----|------|
| 1111 | 00 | 10 | 110 | 01 | 1110 |

Answer: Catatdog

141. What is the basic concept behind Huffman encoding?

Answer: The most frequently used characters should have the shortest codes.

142. How does a human being perceive sound?

Answer: A sound wave is a series of air compressions that vibrate our eardrums which sends signals to our brain.

143. Describe an analog audio signal.

Answer: The voltage of an analog audio signal varies in direct proportion to the sound wave.

144. How is an analog audio signal digitized?

Answer: We periodically measure the voltage of the signal and record the appropriate numeric value, resulting in a series of numbers that represents the signal discretely.

145. How does the sampling rate relate to sound quality?

Answer: Higher sampling rates produce better sound quality because less information is lost and more data is used to reproduce the sound wave.

146. What sampling rate is needed to create reasonable sound reproduction?

Answer: Approximately 40,000 samples per second.

147. How do vinyl record albums and compact discs differ in the way they represent sound?

Answer: The groove in a vinyl record album is an analog representation of the sound, whereas compact discs store binary numeric values that approximate the sound wave.

148. What is color?

Answer: Color is our perception of the various frequencies of light that reach the retinas of our eyes.

149. Describe the photoreceptor cone cells in the eyes of a human being.

Answer: A human eye has three types of photoreceptor cells that respond to different frequencies of light corresponding to the colors red, green, and blue.

150. What is an RGB value?

Answer: An RGB value is one way to represent color on a computer and is made up of three numeric values representing the relative contributions of the primary colors red, green, and blue.

151. What does an RGB value of (0, 130, 255) mean?

Answer: There is no contribution of red, a medium contribution of green, and a full contribution of blue.

152. What color does an RGB value of (0, 0, 0) represent?

Answer: Black

153. What is color depth?

Answer: The amount of data that is used to represent a color.

154. How is a color represented in HiColor?

Answer: HiColor uses 16 bits to represent each color, using five bits per number in the RGB value and the extra bit for transparency.

155. How is a color represented in TrueColor?

Answer: TrueColor uses 24 bits to represent each color, using a full byte for each number in the RGB value.

156. How is a picture digitized?

Answer: A picture is digitized by representing it as a series of individual dots, called pixels. To store the picture, we store the color of each pixel.

157. What is a picture's resolution and how does it relate to picture quality?

Answer: A picture's resolution is the number of pixels used to represent it. The higher the resolution, the more realistic the picture looks when presented.

158. How does a raster-graphics format represent a picture?

Answer: Raster graphics store picture data on a pixel-by-pixel basis.

159. Name three raster-graphics formats.

Answer: Bitmap (BMP), GIF, JPEG, and PNG.

160. What is indexed color?

Answer: Indexed color is a technique in which an application supports only a certain number of specific colors, creating a palette from which to choose. The palette color closest to the actual color is displayed by the application.

161. Which raster-graphics format uses indexed color?

Answer: GIF

162. Describe the representation of a JPEG image. What is this format best used for?

Answer: The JPEG format stores averages out of the color hues over short distances. This format is superior for photographic color images.

163. What are vector graphics?

Answer: Vector graphics describe an image in terms of lines and geometric shapes.

164. What is a video codec?

Answer: A video codec, which stands for COmpressor/DECompressor, is a technique for representing and compressing video data.

165. Which video compression technique also applies to still images?

Answer: Spatial compression removes redundant information within a given frame of a video, and therefore uses techniques that apply to the compression of a still image.

Essay

166. Explain why a mercury thermometer is an analog device.

Answer: An analog device represents information in a continuous manner. Mercury expands in direct proportion to the temperature. The thermometer manufacturer calibrates and marks a tube in which the mercury resides so that the temperature can be read based on the level of mercury. And even though we tend to read the temperature in whole degrees, the mercury level might actually indicate a temperature between one degree and the next. The limitations on the result are due mainly to the size of the tube and the accuracy of the calibrated markings.

167. Compare and contrast an electric analog signal and an electric digital signal.

Answer: Both types of signal represent the voltage level on a line. The voltage of an analog signal fluctuates continuously through its range, creating a smooth wave, whereas the voltage of a digital signal jumps from a high extreme to a low extreme, creating a blocky wave. An analog signal fluctuates in direct proportion to the information it represents, such as a sound wave, whereas a digital signal represents binary digits, corresponding to the two extremes. Both signals degrade, but a digital signal loses less information since there are only two possibilities to consider.

168. Compare and contrast the ASCII character set and the Unicode character set.

Answer: Both character sets are composed of a list of characters and their numerical representation. They both establish a relative ordering on the characters in the set. ASCII represents 256 characters, which is much smaller than Unicode, which represents over 65,000 characters. Unicode is an attempt to represent characters from all of the world's languages. ASCII is a subset of Unicode.

169. Compare and contrast keyword encoding and Huffman encoding.

Answer: Both encoding techniques are an attempt to compress the size of textual data. Keyword encoding substitutes common words with a single character, but uses the same length binary string to represent every character. Huffman uses different size binary strings for each character, using shorter strings for frequent characters and longer strings for infrequent characters.

170. How does the process of sampling an audio signal result in a digitized representation of music that can be played back?

Answer: A sound wave can be represented as an analog signal, which has a voltage that fluctuates continuously, creating a smooth wave. Sampling is the process of digitizing the wave by recording that voltage at regular intervals. The data between the intervals is lost, but if the sampling rate is high enough (if the measurements are taken close enough together), the loss is not significant. To replay the sound, the changes between the sample values are interpolated, creating a signal that is close enough to the original to satisfy the human ear.

171. How does an RGB value represent a color?

Answer: Based on the biology of the human eye, a color can be represented as a combination of the primary colors red, green, and blue. An RGB value is a group of three numbers that correspond to the relative contributions of those three colors. Each number is limited to a specific range, such as 0 to 255, so that 0 represents no contribution of that color and 255 represents the maximum contribution of that color. Based on the three values, over 16 million colors can be represented by an RGB value.

172. Explain the two general forms of compression applied to video.

Answer: Video can be temporally compressed by recording only the changes that occur between each frame of the video. Steady backgrounds and slow moving objects create a lot of repetitive data that there is no need to reproduce for each frame. A keyframe is established, then delta frames record only the parts of a frame that change until another keyframe is established. Video can also be spatially compressed, which removes redundant information within a give frame. This technique borrows the approaches used to compress any single still image.

173. What are the two main organizations in computing?

Answer: IEEE (hardware side) and ACM (software side).

174. List two similarities and two differences between the IEEE code of ethics and the ACM code of ethics.

Answer:

- Similarities:
 - IEEE: *make decisions consistent with safety, health* → ACM: *Avoid harm to others*
 - IEEE: *honest and realistic in stating claims or estimates* → ACM *provide appropriate professional review and Give comprehensive and thorough evaluations of computer systems.*
- Constrasts:
 - IEEE: avoid conflicts of interests → No explicit counterpart in ACM
 - IEEE: reject bribery → No explicit counterpart in ACM
 - ACM: respect privacy → No explicit counterpart in IEEE