

CSCE 210: Computer Hardware Foundations

Test 1 Study Guide

Topics: Chapters 1-4 (Englander), HW 1-2, ICA 1-2, Lectures 1 - 7

Closed book, closed notes. You may use a calculator only for calculations. You may have a "cheat sheet", i.e., an index card 3"x5" filled up (on both sides) with anything you want. You need to turn in this card with the test.

Materials covered:

1. Chapters 1-4 (Englander) to the extent they were covered in class or assigned explicitly for reading.
2. All lecture material and discussion from Lectures 1 – 7. See **BB > Course Documents** and **BB > Recordings**.
3. Homework Assignments (HWs) 1 – 2 and In-Class Activities (ICAs) 1 and 2. The solutions for Homework Assignments and In-Class Activities are posted in **BB > Assignments**.

Test format:

1. Multiple-choice questions on the mentioned material, similar to those in this study guide.
2. Short essay questions, similar to those in HWs and this study guide. Also, look at the Reading Review Questions and Exercises following chapters 1, 2, and 4 (Englander).
3. Short numerical problems to work, similar to those in HWs and ICAs.
4. Fill-in-the-blanks, similar to those in this study guide. Memorize the description of the keywords (those in bold) used in text.

I. MC, T/F, and fill in blanks questions.

1. What entity do the following abbreviations (A-D) describe? Fill in the blanks with the appropriate brief description (A-D). Fill in the blanks (E-G).
 - A. *H.264* _____
 - B. *MIDI* _____
 - C. *TCP/IP* or *HTTP* _____
 - D. *IBM z/OS*, *iOS*, or *Android* _____
 - E. What digits does the octal system use? _____
 - F. Four bytes contain _____ bits. (How many?)
 - G. A declaration *double x* typically consumes _____ bytes. (How many?)
2. The architecture of the computer system rests on a solid foundation that has changed only slightly and gradually since the _____.
 - A. late 1930s
 - B. late 1940s
 - C. late 1950s
 - D. late 1960s
3. As a matter of necessity, network interfaces must conform to standard agreements, known as _____, for messages to be understood by both computers during a message exchange between a pair of computers.
 - A. protocols
 - B. I/O services
 - C. device controllers
 - D. Ethernet standards
4. The _____ provides the physical mechanisms to input and output data, to manipulate and process data, and to electronically control the various input, output, and storage components.
 - A. data
 - B. network
 - C. computer hardware
 - D. computer software

5. Which of the following is not part of the conceptual view of a CPU?
- A. ALU
 - B. Control Unit
 - C. Interface Unit
 - D. Main memory
6. The idea that the program instructions and data are both stored in memory while being processed is known as the
- A. processing concept.
 - B. stored program concept.
 - C. data-instruction concept.
 - D. memory-data-instruction concept.
7. The operating system's _____ acts as an interface for application programs and utilities to access the internal services provided by the operating system.
- A. monitoring system
 - B. supervising system
 - C. application subsystem
 - D. application program interface
8. The fact that different types of computers can work together, share files, and communicate successfully is known as
- A. supercomputing
 - B. open computing
 - C. distributed computing
 - D. coupled systems computing
9. _____ are agreements among interested parties, often manufacturers, to assure that various system components will work together interchangeably.
- A. Manuals
 - B. Standards
 - C. References
 - D. Operating procedures
10. MPEG-4 is a(n)
- A. text standard
 - B. video standard
 - C. audio standard
 - D. graphic standard
11. A bundle of wires that can carry signals, power, data, commands, and instructions is called a _____.
- A. channel
 - B. bus
 - C. interface unit
 - D. communication channel
 - E. protocol
12. 1,099,511,627,776 bytes is exactly _____.
- A. 100GB
 - B. 10GB
 - C. 10TB
 - D. 1TB
 - E. 4TB

13. A 4GB memory has exactly _____ bytes.
 - A. 4,000,000,000
 - B. 4,294,967,296
 - C. 2,147,483,648
 - D. 4,194,304
 - E. 1,073,741,824
14. The _____ stored in ROM loads the remainder of the operating system from disk or network into RAM.
 - A. application program
 - B. bootstrap program
 - C. IPO program
 - D. embedded program
 - E. virtual program
15. In the concept of _____ computing, each computer can do part of the processing for higher overall efficiency.
 - A. open
 - B. closely-coupled
 - C. loosely-coupled
 - D. distributed
 - E. shared
16. The links between the components of a system must be physical (True / False).
17. The diagram of a system drawn on paper is very often an abstraction of the real system (True / False).
18. To simplify analysis, understanding, and maintenance of a system, one can decompose the system into _____.
 - A. clients
 - B. servers
 - C. subsystems
 - D. peers
 - E. procedures
19. The relationship between a client and a server in the client-server model can be
 - A. 1 to 1.
 - B. 1 to many.
 - C. many to 1.
 - D. many to many.
 - E. All of the above.
20. How many computers would typically be involved in 3-tier architecture? _____
21. The problem of solving incompatibilities between the application software residing on different computers that have to work together is often assigned to special software called _____.
 - A. operating system
 - B. application program
 - C. I/O drivers
 - D. middleware
 - E. shared server
22. The different types of “*n*-tier architectures” mainly concern distributing the processing load among *n* computers involved (True / False).

23. Anything outside the system boundary represents the _____ that the system operates.
- A. interface
 - B. subsystem
 - C. environment
 - D. super system
24. The division of a system or subsystem into its components and linkages is called
- A. itemization
 - B. reconstruction
 - C. decomposition
 - D. categorization
25. Which of the following are not input devices?
- A. stylus
 - B. headphones
 - C. touch screen
 - D. mouse and keyboard
26. A web-browser connected to a web-server is an example of
- A. multiprocessing
 - B. cluster computing
 - C. n-tier architecture
 - D. client-server technology
27. The protocol that makes communication between a Web server and a database application possible is called
- A. SQL
 - B. HTTP
 - C. Database Control Language
 - D. Common Gateway Interface
28. Scalability is the ability of a system to
- A. handle a growing amount of work.
 - B. allow access to information when it is needed.
 - C. protect data against unauthorized access or modification.
 - D. allow configuration, monitoring, and maintaining operation.
29. Data security is the ability of a system to
- A. handle a growing amount of work.
 - B. allow access to information when it is needed.
 - C. protect data against unauthorized access or modification.
 - D. allow configuration, monitoring, and maintaining operation.
30. In a client-server architecture, the only limitations to running multiple applications on a single server are the potential slowdowns that may result from the load on the server computer and
- A. traffic on the Internet.
 - B. load on client computer.
 - C. users who open many web browsers.
 - D. the traffic on the network to that server.
31. The organization's internal network, is commonly called a(n)
- A. intranet
 - B. employee network
 - C. corporation network
 - D. organizational network

32. What is not a benefit of cloud services?
- A. Backup and offsite storage
 - B. Additional computing capability when and where it is needed
 - C. Lower hardware and software investments
 - D. Added security
33. A 2GB memory has exactly _____ bytes.
- A. 4,000,000,000
 - B. 4,294,967,296
 - C. 2,147,483,648
 - D. 4,194,304
 - E. 1,073,741,824
34. 107374182400 bytes is exactly _____.
- A. 100GB
 - B. 10GB
 - C. 10TB
 - D. 1TB
 - E. 4TB
35. The relationship between a client and a server in the client-server model can be 1 to 1, 1 to many, or many to many (True/False). _____
36. How many computers would typically be involved in a four-tier architecture? _____ (Fill in)
37. To store a string "*Madam*" in Unicode, the computer would use _____ bytes. (Do not count "s.")
- A. 1 byte
 - B. 5 bytes
 - C. 10 bytes
 - D. 15 bytes
38. Assume that some older computers used a 10-bit word to store numbers. The decimal range for this word size for unsigned numbers is _____.
- A. [0,1023]
 - B. [0,511]
 - C. [0,1024]
 - D. [-512,511]
39. An image has a resolution of 800x1200 pixels. Assuming that each pixel would consume 2 bytes, this image would use _____ bytes of storage.
- A. 960,000
 - B. 1,920,000
 - C. 2,880,000
 - D. 3,840,000
40. _____ images are made up of lines and curves that can be defined mathematically.
- A. bit map
 - B. object/vector
 - C. pixel
 - D. compressed
41. The ISA, USB, PCI, AGP or SCSI are the names of popular _____ used in contemporary computers.
- A. device drivers
 - B. motherboard
 - C. interrupt lines
 - D. buses/interfaces

42. What is the only requirement for data to be manipulated and processed by a computer?
- A. The data type must be numeric.
 - B. The data must be represented in binary form.
 - C. The data type must be alphanumeric, graphic, sound or color.
 - D. The size of the data must be smaller than the capacity of the hard drive.
43. Increasing or decreasing the number of pixels per inch changes the
- A. codec.
 - B. amplitude.
 - C. resolution.
 - D. color depth.
44. Lossless data compression must be used for all of these EXCEPT
- A. text files.
 - B. program files.
 - C. multimedia files.
 - D. numerical data files.
45. The main memory, often known as primary storage, working storage, or RAM (for random access memory), holds
- A. data.
 - B. program instructions.
 - C. program instructions and data.
 - D. program instructions, data, and instructions for booting the computer.
46. Unicode is a(n)
- A. character encoding standard
 - B. video encoding standard
 - C. audio encoding standard
 - D. graphic encoding standard
47. MP3 is a(n)
- A. text standard
 - B. video standard
 - C. audio standard
 - D. graphic standard
48. How many binary digits (bits) does it take to represent the decimal number 2013?
- A. 16
 - B. 8
 - C. 11
 - D. 2013
49. How many bytes does it take to store the binary equivalent of the decimal number 1945?
- A. 1
 - B. 2
 - C. 4
 - D. 10
50. The largest number that can be represented with 8 bits without considering a sign is
- A. 15
 - B. 255
 - C. 256
 - D. 65,535

51. The largest single digit in octal is
- A. 1
 - B. 7
 - C. 8
 - D. 10
52. The binary number 10110011_2 is equivalent to the decimal number
- A. 113
 - B. 179
 - C. 133
 - D. 10,110,011
53. The number of different items that can be represented by a given number of digits, n , in a particular base, b , is given by the formula: b^n equals _____.
- A. field
 - B. radix
 - C. range
 - D. parameter
54. The octal number 12_8 is equivalent to the decimal number
- A. 9
 - B. 10
 - C. 24
 - D. 12
55. The hexadecimal number $1A_{16}$ is equivalent to the decimal number
- A. 9
 - B. 17
 - C. 26
 - D. 110
56. In order to divide a number by its base we can perform
- A. a bit op
 - B. a left shift
 - C. a right shift
 - D. a complex equation
57. In order to multiply a number by its base we can perform
- A. a bit op
 - B. a left shift
 - C. a right shift
 - D. a complex equation
58. Which of the following is true?
- A. $1_2 < 1_8$
 - B. $10_2 < 1_8$
 - C. $101_2 < 10_8$
 - D. $101_2 < 5_8$
59. Which of the following is true?
- A. $0.1_2 > 0.1_8$
 - B. $0.1_2 = 0.1_8$
 - C. $0.1_2 < 0.1_8$
 - D. None of these

60. Which of the following is true?
- A. $101_8 < 10_{16}$
 - B. $10_8 < 1_{16}$
 - C. $11_8 < 10_{16}$
 - D. $12_8 < A_{16}$
61. To convert from binary to octal by grouping, one octal digit corresponds to how many binary digits?
- A. one
 - B. two
 - C. three
 - D. eight
62. To convert from binary to hexadecimal by grouping, one hexadecimal digit corresponds to how many binary digits?
- A. two
 - B. four
 - C. eight
 - D. sixteen
63. The binary number 10.01_2 is equivalent in decimal to
- A. 2.01
 - B. 2.25
 - C. 4.25
 - D. 10.01
64. The octal number 1.2_8 is equivalent in decimal to
- A. 1.25
 - B. 8.16
 - C. 8.25
 - D. 12
65. The hexadecimal number $B.4_{16}$ is equivalent in decimal to
- A. 10.25
 - B. 10.5
 - C. 11.25
 - D. None of these
66. The decimal fraction $\frac{1}{4}$ (0.25) is equivalent to
- A. 0.1_2
 - B. 0.1_8
 - C. 0.1_{16}
 - D. None of these
67. Which of the following is NOT one of the common alphanumeric codes?
- A. ASCII
 - B. Unicode
 - C. Ordinal
 - D. EBCDIC
68. When recording sound, the data that describes how long a time period each captured sound measurement represents is known as the
- A. MIDI
 - B. WAVE
 - C. amplitude
 - D. sampling rate

69. Which image file format is best used for photographs of real-world objects?
- A. GIF
 - B. PNG
 - C. MP3
 - D. JPEG
70. The nature of display technology makes it much more convenient and cost effective for regular printers and display screens to display and print all images as
- A. palettes.
 - B. bitmaps.
 - C. equations.
 - D. pseudocode.
71. Increasing or decreasing the number of pixels per inch changes the
- A. codec.
 - B. amplitude.
 - C. resolution.
 - D. color depth.
72. Making the pixels smaller and increasing their number will result in a
- A. corrupt file.
 - B. clearer image.
 - C. loss of quality.
 - D. smaller file size.
73. What is the format used to coordinate the sounds and signals between a computer and connected musical instruments, particularly keyboards?
- A. MOD
 - B. VOC
 - C. WAV
 - D. MIDI
74. What is the primary contributor to the small MP3 file size?
- A. Lossless compression
 - B. Psychoacoustic lossy compression
 - C. Compression, using an algorithm called LZW
 - D. Compression, similar to that used in .WAV files
75. Lossless data compression must be used for all of these EXCEPT
- A. text files.
 - B. program files.
 - C. multimedia files.
 - D. numerical data files.
76. ZIP files use
- A. lossy algorithms only.
 - B. lossless algorithms only.
 - C. mix of both lossless and lossy algorithms.
 - D. depends on the nature of the data being compressed.
77. The binary numbers in a computer might represent
- A. images.
 - B. numbers.
 - C. characters.
 - D. All of the above

II. Make the following conversions. (If you need help from the Octal and Hex charts, see the tables below.) Do not use a calculator that provides direct conversion. Assume unsigned numbers.

Octal Binary		Octal Binary		Hex Binary		Hex Binary	
0	000	4	100	0	0000	8	1000
1	001	5	101	1	0001	9	1001
2	010	6	110	2	0010	A	1010
3	011	7	111	3	0011	B	1011
				4	0100	C	1100
				5	0101	D	1101
				6	0110	E	1110
				7	0111	F	1111

a. Change $(BE7)_{16}$ to Binary form.

b. Change $(11010111)_2$ to Octal form.

c. Change $(11101001)_2$ to Decimal form.

d. Change $(772)_8$ to Hexadecimal form.

e. Change $(101011010)_2$ to:

Decimal: _____
 Octal: _____
 Hexa: _____

f. Change $(147)_{10}$ to:

Binary: _____
 Octal: _____
 Hexa: _____

g. Change $(5D3)_{16}$ to:

Binary: _____
 Octal: _____
 Decimal: _____

h. Change $(1234)_8$ to:

Binary: _____
 Hexa: _____
 Decimal: _____

i. Change $(5.25)_{10}$ to Binary.

j. Change $(1.101)_2$ to decimal.

k. Change $(27.625)_{10}$ to Hexadecimal.

III. Make the following calculations. Do not use a calculator that provides direct conversion.

1. Calculate the largest positive integer that can be stored in 2 bytes (assuming unsigned integers).
2. If true color requires 3 bytes per pixel, how much storage space is required for a minute's worth of output for a video camera producing full screen 1024×768 pixel true-color images at a frame rate of thirty frames per second? Explain any assumptions you make about your calculations.

IV. Short essay questions

See the HWs and Reading Review Questions and Exercises following chapters 1, 2, and 4. More examples of essay questions follow.

1. What do the following computing devices have in common: workplace computers, tablets, smartphones, and computers embedded in other equipment?
2. Suppose you are writing a program that needs to represent a maximum 50,000 whole things (i.e. integer data type). What would be better: to use a short integer (16 bits) or long integer (64 bits)? Why?
3. What data type would likely be used for a phone number and why?
4. What shortcomings of ASCII led to the development of Unicode?

5. What is the general concept behind psychoacoustic compression?
6. What is the main assumption regarding lossy compression?
7. Any computer system, large or small, can be represented by the four elements of an IPO model. Draw an IPO model; clearly label each of the four elements of your drawing. Use the IPO model to analyze the process of *purchasing a soft drink from a vending machine*. Keep it simple!
8. What are the differences between client-server computing and peer-to-peer computing? Why is most modern computing in organizations based on client-server models?
9. Explain cloud computing in simple terms. Briefly discuss the major advantages and risks to an organization when considering the adoption of cloud computing.
10. What are the principal responsibilities of a system architect?

Answers

I. MC, T/F, and fill in blanks questions.

1. What entity do the following abbreviations (a-d) describe? Fill in the blanks with the appropriate brief description (a-d). Fill in the blanks (e-i).
 - a. Video standard/format
 - b. Sound standard/format
 - c. Internet protocols
 - d. Operating systems
 - e. 0 through 7 (0-7) only
 - f. 32 bits
 - g. 8 bytes
2. late 1940s
3. protocols
4. computer hardware
5. Main memory
6. stored program concept.
7. application program interface
8. open computing
9. Standards
10. video standard
11. bus
12. 1TB
13. 4,294,967,296
14. bootstrap program
15. distributed
16. False
17. True
18. Subsystems
19. All of the above
20. 3
21. middleware
22. True
23. environment
24. decomposition
25. headphones
26. client-server technology
27. Common Gateway Interface

28. handle a growing amount of work.
29. protect data against unauthorized access or modification.
30. the traffic on the network to that server.
31. Intranet
32. Added security
33. 2,147,483,648
34. 100GB
35. True
36. 4
37. 10 bytes
38. [0,1023]
39. 1,920,000
40. object/vector
41. buses/interfaces
42. The data must be represented in binary form.
43. Resolution
44. multimedia files
45. program instructions and data.
46. character encoding standard
47. audio standard
48. 11
49. 2
50. 255
51. 7
52. 179
53. range
54. 10
55. 26
56. a right shift
57. a left shift
58. $101_2 < 10_8$
59. $0.1_2 > 0.1_8$
60. $11_8 < 10_{16}$
61. three
62. four
63. 2.25
64. 1.25
65. 11.25
66. None of these
67. Ordinal
68. sampling rate
69. JPEG
70. bitmaps.
71. resolution.
72. clearer image.
73. MIDI
74. Psychoacoustic lossy compression
75. multimedia files.
76. lossless algorithms only.
77. All of the above

II. Make the following conversions.

- a. $(BE7)_{16} = (101111100111)_2$
- b. $(11010111)_2 = (327)_8$
- c. $(11101001)_2 = (233)_{10}$

d. $(772)_8 = (1FA)_{16}$

e. Change $(101011010)_2$ to:

Decimal: $(346)_{10}$
 Octal: $(532)_8$
 Hexa: $(15A)_{16}$

f. Change $(147)_{10}$ to:

Binary: $(10010011)_2$
 Octal: $(223)_8$
 Hexa: $(93)_{16}$

g. Change $(5D3)_{16}$ to:

Binary: $(10111010011)_2$
 Octal: $(2723)_8$
 Decimal: $(1491)_{10}$

h. Change $(1234)_8$ to:

Binary: $(1010011100)_2$
 Hexa: $(29C)_{16}$
 Decimal: $(668)_{10}$

i. $(5.25)_{10} = (101.01)_2$

j. $(1.101)_2 = (1.625)_{10}$

k. $(27.625)_{10} = (1B.A)_{16}$

III. Make the following calculations.

1. Calculate the largest positive integer that can be stored in 2 bytes (assuming unsigned integers).

$$\begin{aligned} \text{Largest positive integer} &= 2^{16} - 1 \\ &= 65536 - 1 \\ &= 65,535 \end{aligned}$$

2. If true color requires 3 bytes per pixel, how much storage space is required for a minute's worth of output for a video camera producing full screen 1024×768 pixel true-color images at a frame rate of thirty frames per second? Explain any assumptions you make about your calculations.

$$\begin{aligned} \text{Bytes in one frame} &= (1024 \times 768 \text{ pixels})(3 \text{ bytes/pixel}) = 2,359,296 \text{ bytes/frame} \\ \text{Bytes in one minute} &= (2,359,296 \text{ bytes/frame})(30 \text{ frames/sec})(60 \text{ sec/min}) \\ &= 4,246,732,800 \text{ bytes/min} \\ \text{Convert to MB} &= (4,246,732,800 \text{ bytes})(M/1,048,576) \\ &= 4,050 \text{ MB in one minute.} \end{aligned}$$

Assume MB = 1,048,576 ($1024 * 1024$) for capacity calculations.

IV. Short essay questions

See the HWs and Reading Review Questions and Exercises following chapters 1, 2, and 4. More examples of essay questions follow.

1. What do the following computing devices have in common: workplace computers, tablets, smartphones, and computers embedded in other equipment?

From the text; "All contain at least one central processing unit (some contain more) and memory. All provide a facility for interacting with long-term storage and other devices and with users. What may be less obvious to you is that the programs that they run are also essentially similar, differing mostly in the details required by the different components of the particular system and by the nature of the applications."

2. Suppose you are writing a program that needs to represent a maximum 50,000 whole things (i.e. integer data type). What would be better: to use a short integer (16 bits) or long integer (64 bits)? Why?

First check that 16 bits is sufficient: $2^{16} = 65,536$ greater than 50,000, so it possible to use short integer.

From the text: "The longer integer formats may require multiple-word calculation algorithms, and as such are slower to execute than short formats. The short format is preferable when it is sufficient for the values that you expect. It may also be necessary to consider the limitations of other systems that the same program may have to operate on."

3. What data type would likely be used for a phone number and why?

Text (string of characters). Phone numbers are not commonly manipulated mathematically, so there is no reason to store phone numbers in numeric form. Also, phone numbers are more commonly used in text-based queries, which are more easily handled by text-based manipulation.

4. What shortcomings of ASCII led to the development of Unicode?

Extended ASCII is 8-bit giving a total representation space 256 symbols. This is a severe limitation for representing other languages besides English. Alternatively, ASCII cannot encode enough symbols to represent languages that use other than the basic Latin alphabet.

5. What is the general concept behind psychoacoustic compression?

From the text: "Psychoacoustic compression is based on the assumption that there are sounds that a listener cannot hear or will not notice, which can then be eliminated. As an example, a soft sound in the background is not usually noticeable against a loud foreground sound. The level of compression depends on the tolerable level of sound quality, but also on the nature of the audio being compressed."

6. What is the main assumption regarding lossy compression?

From the text: "Lossy algorithms operate on the assumption that some data can be sacrificed without significant effect, based on the application and on known properties of human perception."

7. Any computer system, large or small, can be represented by the four elements of an IPO model. Draw an IPO model; clearly label each of the four elements of your drawing. Use the IPO model to analyze the process of *purchasing a soft drink from a vending machine*. Keep it simple!

IPO model: See Englander (Ch. 1, pp. 10-11)

**Analysis of *purchasing a soft drink from a vending machine*:
(More sophisticated responses are possible, but here is a simplistic model)**

Input: Money in the form of paper bills or coins; drink selection

Processing: Check the integrity of the money; calculate the change

Output: dispense the change and drink

8. What are the differences between client-server computing and peer-to-peer computing? Why is most modern computing in organizations based on client-server models?

See Englander (Ch. 2, pp. 51-55, 59)

9. Explain cloud computing in simple terms. Briefly discuss the major advantages and risks to an organization when considering the adoption of cloud computing.

See Englander (Ch. 2, pp. 56-58)

10. What are the principal responsibilities of a system architect?

There are a lot of responsibilities listed in the text. Some are listed below.

1. **Design and implement systems that meet an organization's information technology (IT) needs.**
2. **Know the cost and capabilities of the components that you select.**
3. **Justify the set of computer system components and the system architecture that are appropriate for a particular job.**
4. **Determine the tradeoffs between other possible system architectures.**
5. **Assist management in making intelligent decisions about system strategy.**
6. **Differentiate between simple technological obsolescence and major advances that suggest a real need to replace older equipment.**
7. **Understand the tradeoffs inherent in the use of cloud and other remote services.**
8. **Read and understand the technical specifications.**
9. **Know the differences between various CPU technologies and the advantages and disadvantages of each.**
10. **Know what is required to build an intranet, and what the speed, and size, and performance limitations of a particular system.**
11. **Compare the features of OS/X, Windows, and Linux knowledgeably and decide which ones are important.**
12. **Apply your basic understanding of computers to new technologies and concepts such as mobile IT, new network protocols, virtual machines and cloud services as they appear.**
13. **Learn to understand the jargon used by computer salespeople and judge the validity of their sales claims.**