

PROBLEMS

SECTION 0.1: NUMBERING AND CODING SYSTEMS

1. Convert the following decimal numbers to binary.
(a) 12 (b) 123 (c) 63 (d) 128 (e) 1000
2. Convert the following binary numbers to decimal.
(a) 100100 (b) 1000001 (c) 11101 (d) 1010 (e) 00100010
3. Convert the values in Problem 2 to hexadecimal.
4. Convert the following hex numbers to binary and decimal.
(a) 2B9H (b) F44H (c) 912H (d) 2BH (e) FFFFH
5. Convert the values in Problem 1 to hex.
6. Find the 2's complement of the following binary numbers.
(a) 1001010 (b) 111001 (c) 10000010 (d) 111110001
7. Add the following hex values.
(a) 2CH + 3FH (b) F34H + 5D6H (c) 20000H + 12FFH (d) FFFFH + 2222H
8. Perform hex subtraction for the following.
(a) 24FH - 129H (b) FE9H - 5CCH (c) 2FFFFH - FFFFFH (d) 9FF25H - 4DD99H
9. Show the ASCII codes for numbers 0, 1, 2, 3, ..., 9 in both hex and binary.
10. Show the ASCII code (in hex) for the following string:
"U.S.A. is a country" CR, LF
"in North America" CR, LF
CR is carriage return
LF is line feed

SECTION 0.2: DIGITAL PRIMER

11. Draw a 3-input OR gate using a 2-input OR gate.
12. Show the truth table for a 3-input OR gate.
13. Draw a 3-input AND gate using a 2-input AND gate.
14. Show the truth table for a 3-input AND gate.
15. Design a 3-input XOR gate with a 2-input XOR gate. Show the truth table for a 3-input XOR.
16. List the truth table for a 3-input NAND.
17. List the truth table for a 3-input NOR.
18. Show the decoder for binary 1100.
19. Show the decoder for binary 11011.
20. List the truth table for a D-FF.

SECTION 0.3: INSIDE THE COMPUTER

21. Answer the following:
 - (a) How many nibbles are 16 bits?
 - (b) How many bytes are 32 bits?
 - (c) If a word is defined as 16 bits, how many words is a 64-bit data item?
 - (d) What is the exact value (in decimal) of 1 meg?

- (e) How many K is 1 meg?
 - (f) What is the exact value (in decimal) of 1 giga?
 - (g) How many K is 1 giga?
 - (h) How many meg is 1 giga?
 - (i) If a given computer has a total of 8 megabytes of memory, how many bytes (in decimal) is this? How many kilobytes is this?
22. A given mass storage device such as a hard disk can store 2 gigabytes of information. Assuming that each page of text has 25 rows and each row has 80 columns of ASCII characters (each character = 1 byte), approximately how many pages of information can this disk store?
 23. In a given byte-addressable computer, memory locations 10000H to 9FFFFH are available for user programs. The first location is 10000H and the last location is 9FFFFH. Calculate the following:
 - (a) The total number of bytes available (in decimal)
 - (b) The total number of kilobytes (in decimal)
 24. A given computer has a 32-bit data bus. What is the largest number that can be carried into the CPU at a time?
 25. Below are listed several computers with their data bus widths. For each computer, list the maximum value that can be brought into the CPU at a time (in both hex and decimal).
 - (a) Apple 2 with an 8-bit data bus
 - (b) IBM PC with a 16-bit data bus
 - (c) IBM PC with a 32-bit data bus
 - (d) Cray supercomputer with a 64-bit data bus
 26. Find the total amount of memory, in the units requested, for each of the following CPUs, given the size of the address buses.
 - (a) 16-bit address bus (in K)
 - (b) 24-bit address bus (in megabytes)
 - (c) 32-bit address bus (in megabytes and gigabytes)
 - (d) 48-bit address bus (in megabytes, gigabytes, and terabytes)
 27. Regarding the data bus and address bus, which is unidirectional and which is bidirectional?
 28. Which register of the CPU holds the address of the instruction to be fetched?
 29. Which section of the CPU is responsible for performing addition?
 30. List the three bus types present in every CPU.

ANSWERS TO REVIEW QUESTIONS

SECTION 0.1: NUMBERING AND CODING SYSTEMS

1. Computers use the binary system because each bit can have one of two voltage levels: on and off.
2. $34_{10} = 100010_2 = 22_{16}$
3. $110101_2 = 35_{16} = 53_{10}$
4. 1110001
5. 010100
6. 461
7. 275

Review Questions

1. Name three features of the 8051.
2. What is the major difference between the 8051 and 8052 microcontrollers?
3. Give the size of RAM in each of the following.
(a) 8051 (b) 8052 (c) 8031
4. Give the size of the on-chip ROM in each of the following.
(a) 8051 (b) 8052 (c) 8031
5. The 8051 is a(n) _____-bit microprocessor.
6. State a major difference between the 8751, the AT89C51, and the DS89C420/30.
7. True or false. The DS89C420/30 is really an 8052 chip.
8. True or false. The DS89C420/30 has a loader embedded to the chip, therefore eliminating the need for ROM burner.
9. The DS89C420/30 chip has _____ bytes of on-chip ROM.
10. The DS89C420/30 chip has _____ bytes of RAM.

SUMMARY

This chapter discussed the role and importance of microcontrollers in everyday life. Microprocessors and microcontrollers were contrasted and compared. We discussed the use of microcontrollers in the embedded market. We also discussed criteria to consider in choosing a microcontroller such as speed, memory, I/O, packaging, and cost per unit. The second section of this chapter described various family members of the 8051, such as the 8052 and 8031, and their features. In addition, we discussed various versions of the 8051 such as the AT89C51 and DS89C4x0, which are marketed by suppliers other than Intel.

PROBLEMS

SECTION 1.1: MICROCONTROLLERS AND EMBEDDED PROCESSORS

1. True or False. A general-purpose microprocessor has on-chip ROM.
2. True or False. A microcontroller has on-chip ROM.
3. True or False. A microcontroller has on-chip I/O ports.
4. True or False. A microcontroller has a fixed amount of RAM on the chip.
5. What components are normally put together with the microcontroller into a single chip?
6. Intel's Pentium chips used in Windows PCs need external _____ and _____ chips to store data and code.
7. List three embedded products attached to a PC.
8. Why would someone want to use an x86 as an embedded processor?
9. Give the name and the manufacturer of some of the most widely used 8-bit microcontrollers.
10. In Question 9, which microcontroller has the most manufacture sources?

11. In a battery-based embedded product, what is the most important factor in choosing a microcontroller?
12. In an embedded controller with on-chip ROM, why does the size of the ROM matter?
13. In choosing a microcontroller, how important is it to have multiple sources for that chip?
14. What does the term "third-party support" mean?
15. If a microcontroller architecture has both 8-bit and 16-bit versions, which of the following statements is true?
 - (a) The 8-bit software will run on the 16-bit system.
 - (b) The 16-bit software will run on the 8-bit system.

SECTION 1.2: OVERVIEW OF THE 8051 FAMILY

16. The 8751 has _____ bytes of on-chip ROM.
17. The AT89C51 has _____ bytes of on-chip RAM.
18. The 8051 has _____ on-chip timer(s).
19. The 8052 has _____ bytes of on-chip RAM.
20. The ROM-less version of the 8051 uses _____ as the part number.
21. The 8051 family has _____ pins for I/O.
22. The 8051 family has circuitry to support _____ serial ports.
23. The 8751 on-chip ROM is of type _____.
24. The AT89C51 on-chip ROM is of type _____.
25. The DS5000 on-chip ROM is of type _____.
26. The DS89C420/30 on-chip ROM is of type _____.
27. Give the amount of ROM and RAM for the following chips.
 - (a) AT89C51
 - (b) DS89C420/30
 - (c) DS89C440
28. Of the 8051 family, which memory type is the most cost effective if you are using a million of them in an embedded product?
29. What is the difference between the 8031 and 8051?
30. Of the 8051 microcontrollers, which one is the best for a home development environment? (You do not have access to a ROM burner.)

ANSWERS TO REVIEW QUESTIONS

SECTION 1.1: MICROCONTROLLERS AND EMBEDDED PROCESSORS

1. True
2. A microcontroller-based system
3. (d)
4. (d)
5. It is dedicated since it is dedicated to doing one type of job.
6. Embedded system means that the application and processor are combined into a single system.
7. Having multiple sources for a given part means you are not hostage to one supplier. More importantly, competition among suppliers brings about lower cost for that product.