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Assignment 1 - Binary Number System

ECE 222 - Digital Logic Design Lab

120200033 CSE Section 01
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Questions 1:3

1) What is the exact number of bytes in a system that contains?

- a. 32K bytes.
- b. 64M bytes.
- c. 6.4G bytes.

Solution:

a) 32K bytes $\rightarrow 32 \times 2^{10}$ bytes $\rightarrow 32768$ bytes

b) 64M bytes $\rightarrow 64 \times 2^{20}$ bytes $\rightarrow 67108864$ bytes

c) 6.4G bytes $\rightarrow 6.4 \times 2^{30}$ bytes $\rightarrow 6871947673.6 \approx 6871947673$ bytes

2) Convert the following numbers with the indicated bases to decimal:

- a. $(4310)_5$
- b. $(198)_{12}$
- c. $(435)_8$
- d. $(345)_6$

Solution:

a) $(4310)_5 \rightarrow 4 \times 5^3 + 3 \times 5^2 + 1 \times 5^1 + 0 \times 5^0 \rightarrow (580)_{10}$

b) $(198)_{12} \rightarrow 1 \times 12^2 + 9 \times 12^1 + 8 \times 12^0 \rightarrow (260)_{10}$

c) $(435)_8 \rightarrow 4 \times 8^2 + 3 \times 8^1 + 5 \times 8^0 \rightarrow (285)_{10}$

d) $(345)_6 \rightarrow 3 \times 6^2 + 4 \times 6^1 + 5 \times 6^0 \rightarrow (137)_{10}$

3) Determine the base of the numbers in each case for the following operations to be correct:

- a. $14/2 = 5$.
- b. $54/4 = 13$.
- c. $24 + 17 = 40$.

Solution:

a) $(14)_r = (2)_r \times (5)_r \rightarrow 1 \times r^1 + 4 \times r^0 = (2 \times r^0) \times (5 \times r^0) \rightarrow r + 4 = 10 \Rightarrow r = 6$

b) $(54)_r = (4)_r \times (13)_r \rightarrow 5 \times r^1 + 4 \times r^0 = (4 \times r^0) \times (1 \times r^1 + 3 \times r^0) \rightarrow 5r + 4 = 4r + 12 \Rightarrow r = 8$

c) $(24)_r + (17)_r = (40)_r \rightarrow 2 \times r^1 + 4 \times r^0 + 1 \times r^1 + 7 \times r^0 = 4 \times r^1 + 0 \times r^0 \rightarrow 3r + 11 = 4r \Rightarrow r = 11$

Questions 4:6

4) Convert the hexadecimal number 64CD to binary, and then convert it from binary to octal.

Solution:

To Binary: $(64CD)_{16} \rightarrow (0110010011001101)_2$

To Octal: $(110010011001101)_2 \rightarrow (62315)_8$

5) Express the following numbers in decimal:

- a. $(10110.0101)_2$
- b. $(16.5)_{16}$
- c. $(26.24)_8$
- d. $(DADA.B)_{16}$
- e. $(1010.1101)_2$

Solution:

a) $(10110.0101)_2 \rightarrow 1 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^{-2} + 1 \times 2^{-4} \Rightarrow (22.3125)_{10}$

b) $(16.5)_{16} \rightarrow 1 \times 16^1 + 6 \times 16^0 + 5 \times 16^{-1} \Rightarrow (22.3125)_{10}$

c) $(26.24)_8 \rightarrow 2 \times 8^1 + 6 \times 8^0 + 2 \times 8^{-1} + 4 \times 8^{-2} \Rightarrow (22.3125)_{10}$

d) $(DADA.B)_{16} \rightarrow 13 \times 16^3 + 10 \times 16^2 + 13 \times 16^1 + 10 \times 16^0 + 11 \times 16^{-1} \Rightarrow (56026.6875)_{10}$

e) $(1010.1101)_2 \rightarrow 1 \times 2^3 + 1 \times 2^1 + 1 \times 2^{-1} + 1 \times 2^{-2} + 1 \times 2^{-4} \Rightarrow (10.8125)_{10}$

6) Convert the following binary numbers to hexadecimal and to decimal:

- a. 1.10010
- b. 110.010. Explain why the decimal answer in (b) is 4 times that in (a).

Solution:

a) To decimal:$(1.10010)_2 \rightarrow 1 \times 2^0 + 1 \times 2^{-1} + 1 \times 2^{-4} \Rightarrow (1.5625)_{10}$
To Hexadecimal:$(0001.10010)_2 \Rightarrow (1.9)_{16}$

b) To decimal$(110.010)_2 \rightarrow 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^{-2} \Rightarrow (6.25)_{10}$
To Hexadecimal:$(0110.0100)_2 \Rightarrow (6.4)_{16}$

Explanation: As the decimal point has moved two digits to the right without changing the value of the corresponding bits this is equivalent to multiplication by 4 (2^2), similar to multiplying by 10 in decimal numbers (base 10) which moves the decimal point one step to the right but here as we work with base 2 a multiplication by 2 moves the floating point one step to the right

Question 7

7) Do the following conversion problems:

- a. Convert decimal 27.315 to binary.
- b. Calculate the binary equivalent of 2/3 out to eight places. Then convert from binary to decimal. How close is the result to 2/3?
- c. Convert the binary result in (b) into hexadecimal. Then convert the result to decimal. Is the answer the same?

Solution:

a) $(27.315)_{10} \approx (11011.010100)_2$

b) $(2/3)_{10} \approx (0.10101010)_2$
$(0.10101010)_2 \rightarrow 1 \times 2^{-1} + 1 \times 2^{-3} + 1 \times 2^{-5} + 1 \times 2^{-7} = (0.6640625)_{10}$
Abs error $= (2/3) - 0.6640625 = 2.6041667 \times 10^{-3}$

c) To Hexadecimal: $(0.10101010) \rightarrow (0.AA)$

To Decimal: $(0.AA) \rightarrow 10 \times 16^{-1} + 10 \times 16^{-2} = 0.6640625$

Yes, they are the same as there is a finite representation of the number in binary and hexadecimal

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- Texmaker 5.0.4

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