Introduction to Computer Science -103

Quiz_1

1. Convert the following decimal numbers to binary without using a calculator, showing your work. (10%)

   a.   1234 $(10011010010)_2$

   b.   124.56 $(1111100.10001111)_2$

2. Convert the following octal numbers to hexadecimal and hexadecimal to octal without using a calculator, showing your work. (10%)

   a. $(511)_8$ $(149)_{16}$

   b. $(1256.74)_{16}$ $(11126.35)_8$

3. A common base used on the Internet is b = 256. We need 256 symbols to represent a number in this system. Instead of creating this large number of symbols, the designers of this system have used decimal numbers to represent a symbol: 0 to 255. In other words, the set of symbols is S = {0, 1, 2, 3, ..., 255}. A number in this system is always in the format $S_1.S_2.S_3.S_4$ with four symbols and three dots that separate the symbols. This system is used to define Internet addresses. This number system is called dotted decimal notation.

   Find the decimal value of each of the following Internet addresses. (10%)

   a.   10.200.14.72

   $10 \times 256^3 + 200 \times 256^2 + 14 \times 256^1 + 72 \times 256^0 = 180,883,016$

   b.   24.56.13.11

   $24 \times 256^3 + 56 \times 256^2 + 13 \times 256^1 + 11 \times 256^0 = 406,326,539$

4. Answer the following questions about floating-point representation of real numbers: (12%)

   a. Why is normalization necessary? (4%)

   Normalization is necessary to make calculations easier.

   b. What is the mantissa? (4%)

   Mantissa is the bit sequence to the right of the decimal point after normalization.

   c. After a number is normalized, what kind of information does a computer store in memory? (4%)

   The computer stores the sign of the number, the exponent, and the mantissa.

5. Change the following decimal numbers to 16-bit two's complement integers. (10%)

   a.   534   Convert   534 to binary   0 0 0 0 0 0 1 0 0 0 0 1 0 1 1 0

   b.   -1067   Convert -1067 to binary   1 1 1 1 1 0 1 1 1 1 0 1 0 1 0 1

6. An alternative method to find the two's complement of number of an integer is to first take the one's complement *and then add 1 to the* result. Try both methods using the following numbers. Compare and contrast the results. (10%)
   （題目已更正並送分）

   a.   11111100

        One's complement =   00000011   Two's complement = 00000100
                                    +1
                                00000100

   b.   01110100

        One's complement =   10001011   Two's complement = 10001100
                                    +1
                                10001100

7. An audio signal is sampled 8,000 times per second. Each sample is represented by 256 different levels. How many bits per second are needed to represent this signal? (5%)

   256 level can be represented by 8 bits because $2^8 = 256$. Therefore, the number of bits per seconds is

   (8000 sample/ sec) $\times$ (8 bits / sample) = 64,000 bits /seconds

8. Convert the following decimal numbers in the Excess_127 format. (10%)

   a.   -32.6125

        $-32.6125 = (100000.10011100)_2 = 2^5 \times 1.0000010011100$

        S = 1

        E = 5 + 127 = 132 = $(10000100)_2$

        M = 00000100111 (plus 12 zero at the right)

        → 1 10000100 00000100111000000000000

   b.   31.8

        $31.8 = (11111.11001100)_2 = 24 \times 1.111111001100$

        S = 0

        E = 4 + 127 = 131 = $(10000011)_2$

        M = 1111110011 (plus 13 zero at the right)

        → 0 10000011 11111100110000000000000

9. The bit pattern $(01000000101110000000000000000000)_2$ is stored in memory in Excess_127 format. Show what the value of the number is in decimal notation. (5%)

5.75

10. Convert the following decimal numbers to Roman numbers and Roman to decimal. (8%)

    a. 99   XCIX
    b. CLVII   157

11. What is the function of the ALU subsystem in a computer? (5%)

    The arithmetic/logic unit (ALU) is where calculations and logical operations take place.