Introduction to Computer Science-101
Quiz_1

1. Convert the following octal numbers to decimal without using a calculator, showing your work. (10%)
   a. $(2731)_8$ 1497
   b. $(617.7)_8$ 399.875

2. Convert the following binary numbers to hexadecimal without using a calculator, showing your work. (10%)
   a. $(01101)_2$ $(0D)_{16}$
   b. $(011110.01)_2$ $(1E.4)_{16}$

3. 32 bits are used to represent an address, eight bits for each symbol in dotted decimal notation. For example, the address 10.200.14.72 can also be represented as 00001010 11001000 00001110 01001000. Show the bit representation of the following Internet addresses. (10%)
   a. 14.56.234.56 00001110 00111000 11101010 00111000
   b. 110.14.56.78 01101110 00001110 00111000 01001110

4. Answer the following question about floating-point representation of real numbers: (10%)
   a. Why is normalization necessary?
      Normalization is necessary to make calculations easier.
   b. What is the mantissa?
      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?
      The computer stores the sign of the number, the exponent, and the mantissa.

5. A company has decided to assign a unique bit pattern to each employee. If the company has 900 employees, what is the minimum number of bits needed to create this system of representation? How many patterns are unassigned? If the company hires another 300 employees, should it increase the number of bits? Explain your answer. (10%)
   $2^n = 900 \rightarrow n \approx 10$ or $\log_2 900 = 9.81 \rightarrow 10$. With n = 10 we can uniquely assign $2^{10} = 1024$ bit pattern. Then 1024 − 900 = 124 patterns are unassigned. These unassigned patterns are not sufficient for extra 300 employees. If the company hires 300 new employees, it is needed to increase the number of bits to 11.

6. Change the following decimal numbers to 16-bit unsigned integers. (10%)
   a. 41 $(0000\ 0000\ 0010\ 1001)_2$
   b. 1234 $(0000\ 0100\ 1101\ 0010)_2$

7. Change the following 8-bit two's complement numbers to decimal. (10%)
   a. 0111 0111 + 119
   b. 1111 1100 -4

8. Convert the following numbers in 64-bit IEEE format. (10%)

a. $-2^{-5} \times 1.01101000$

S = 1

E = −5 + 1023 = $(01111111010)_2$

M = 01101000 (plus 44 zero added at the right)

→ 1 01111111010

01101000000000000000000000000000000000000000000000000000

b. $+2^{3} \times 1.111111$

S = 0

E = 3 + 1023 = 1026 = $(10000000010)_2$

M = 111111 (plus 46 zero added at the right)

→ 0 10000000010

11111100000000000000000000000000000000000000000000000000

9. Convert the following numbers in 32-bit IEEE format. (10%)

a. 7.1875

S = 0

E = 2 + 127 = 129 = $(10000001)_2$

M = 110011 (plus 17 zero at the right)

→ 0 10000001 11001100000000000000000

b. -0.375

S = 1

E = −2 + 127 =125 = $(01111101)_2$

M = 1 (plus 22 zero at the right)

→ 1 01111101 10000000000000000000000

10. What is the function of the ALU subsystem in a computer? (10%)

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