104 - Introduction to Computer Science - Quiz one

Name：________________ Student ID：________________

1. Define a computer based on the von Neumann model and briefly describe each component respectively. (5%)

   The von Neumann Model defines the components of a computer, which are memory, the arithmetic logic unit (ALU), the control unit and the input/output subsystems.

   a. Memory is the storage area used for programs and data.
   b. The arithmetic/logic unit (ALU) is where calculations and logical operations take place.
   c. The control unit controls the operations of the memory, ALU, and the input/output subsystem.
   d. The input subsystem accepts input data and the program from outside the computer; the output subsystem sends the result of the processing to the out-side.

2. Convert the following numbers with different patterns to binary without using a calculator, showing your work. (10%)

   a. $(122.25)_{10}$ 111 1010.01
   b. $(ABB)_{16}$ 1010 1011 1011

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

   a. $(51A)_{16}$ $(2432)_8$
   b. $(123.7)_8$ $(53.E)_{16}$

4. Without converting, find the minimum number of digits needed in the destination system for each of the following cases. (10%)

   a. Four-digit decimal converted to octal. 5
   b. Five-digit decimal converted to hexadecimal. 5

5. Internet addresses describe in the previous problem are also represented as patterns of bits. In this case, 32 bits are used to represent an address, eight bits for each symbol in dotted decimal notation. Show the bit representation of the following Internet addresses 14.56.234.56. (5%)

   0000 1110.0011 1000.1110 1010.0011 1000

6. Change the following decimal numbers to 16-bit two's complement integers and 8-bit two's complement number to decimal. (10%)

   a. -179 1111 1111 0100 1101
   b. 11010111 -41

7. Convert the following decimal numbers in 32-bit IEEE format. (10%)
   a. 7.1875 0 10000001 11001100000000000000000 (17)
   b. −0.375 1 01111101 10000000000000000000000 (22)
8. Answer the following questions about floating-point representation of real numbers: (12%)
   a. Why is normalization necessary? (4%)
   b. What is the mantissa? (4%)
   c. After a number is normalized, what kind of information does a computer store in memory? (4%)
   a. Normalization is necessary to make calculations easier.
   b. Mantissa is the bit sequence to the right of the decimal point after normalization.
   c. The computer stores the sign of the number, the exponent, and the mantissa.
9. We know that the operation of one's complement simply reverses (flips) each bit, and the each number must be 0 and 1 (not over two). The two's complement of number is to first take the one's complement and then add 1 to the result. So assuming three-digit allocation, find the ten's complement of the following decimal numbers. (10%)
   a. -125 875
   b. 234 234
10. We know that the images can be stored in computer using two techniques: raster graphics and vector graphics. Nowadays, a smartphone takes the photographs with higher one million pixels. If there are eight million pixels used by iPhone 6 Plus, find the number of bits need to be stored using the True-Color scheme. (6%)
    8,000,000 * 24bits (True-Color) = 192,000,000 bits
11. Facebook is a popular website for community. Many posts or messages are frequently sent to many users. We would like to use the bit pattern to represent each like on Facebook. There is a post on Facebook with four hundred likes, so what is the minimum number of bits for the system of representation? If the like of this post increase six hundred likes, so what is the minimum number of bits we need to add? And how many patterns are unassigned eventually? (12%)
    a. 9-bit system
    b. Add 1 bit to the system
    c. Rest 24 patterns (1024-1000 = 24)