CSE 220: Systems Fundamentals I

Stony Brook University

Number Representations

Homework 1

Due Date: Sep 17th, 2023 12:00 AM sharp

Each question is worth 5 points

1. Convert the following decimal numbers to binary, octal, and hexadecimal:

    a. 1337_{10}

    b. 2120_{10}

2. Convert the following numbers from their base to decimal using the multiplication method.

    a. $CAFE_{16}$

    b. $BABE_{16}$

    c. 10011001_{2}

3. Which of the following would be valid numbers for bases 3, 7, 8, 13, 15 and 16?

    a. DEADBEAF

    b. DC4A

    c. 122

4. What are the smallest and largest numbers which can be represented with 3 digits for the corresponding base n? What is the decimal value of the largest number?

    a. binary

    b. base 3

    c. base 5

    e. base 9

5. Convert the following binary numbers to base 3, 4, 6, 8 (octal) and 16 (hexadecimal).

    a. 1001_{2}

    b. 111111_{2}

6. Convert 101_6 to base 9.

7. Convert the number 423_{10} to the following bases:
   a. Base 2 (Binary)
   c. Base 5

8. Assume numbers are 7-bit. What is the range for numbers that can be stored in each representation? a. sign/magnitude
   b. 1's complement
   c. 2's complement
   d. unsigned

9. Given the following 1's complement values, convert them from 1's complement to 2's complement.

   a. 10011001_2
   b. 11101101_2

10. Given the following 2's complement, values convert them from 2's complement to 1's complement.
    a. 10011001_2
    b. 11101101_2

11. Given the following sign/magnitude values, convert them from sign/ magnitude to 2's complement
    a. 10011001_2
    b. 11101101_2

12. Encode each of the following numbers as 16-bit sign magnitude, 1's complement, and 2's complement numbers.
    a. 220_{10}
    b. 32767_{10}
    c. -309_{10}

13. In 1's complement, 2's complement, and signed magnitude number format
    a. How many representations for zero are there?
    b. Using 6-bits, specify all representations of zero for each format.

14. What is the range of values for n-bit two's complement? (Give a generic form)

15. Consider the 5-bit binary number 11011_2, what is the base 10 value of this binary representation in the following encodings.

    a. Unsigned Binary

    b. Signed Magnitude

    c. One's Complement

    d. Two's Complement

16. Consider the following additional problems for 8-bit 2's complement numbers. What is the result of the calculation? Did overflow/underflow occur?

    a. $10101010_2 + 01010101_2$

    d. Under what general conditions will overflow occur?

17. The following binary floating-point numbers consist of a sign bit; an excess-64, radix-2 exponent; and a 16-bit fraction. Convert them to "binary'" scientific notation.

    a. 010000000001010100000001

    b. 001111110000001111111111

18. Show the binary representation for the following decimal floating point values in IEEE single-precision format.

    a. 7.4

    b. -13/64

    c. 6.125

19. Convert the following values to their IEEE single precision encodings.

    a. $3.22_{10} \times 2^{13}$

    b. $8.123_{10} \times 2^{-14}$