School of Computer Science
CS 2614: Computer Organization
Fall 2024
Homework 2

Assigned: 8/28/24
Due: 9/7/24
Quiz: 9/10/24

Textbook problems

1) Problem 3-7 (a, b, c, d). Note: A 1-bit register can only store a single value of 0 or 1.
2) Problem 3-9
3) Problem 3-12
4) Problem 3-15 (a, b, c, d). Note: Verify by doing the subtractions in decimal

Gray code conversion

5) Convert the following numbers to gray code:
    a. 01001_2
    b. 43_{10}
    c. $3A_{16}$
    d. 11111_2
    e. 55_8
    f. 101001_2
    g. 110101_2
6) Convert the following numbers represented in gray code to the bases shown:
    a. 1001 to binary
    b. 10011 to hexadecimal
    c. 10001 to octal
    d. 11111 to decimal

Two's complement representation

7) Find the binary number of 42 (decimal) using 8-bit two's complement representation.
8) Find the binary number of -42 (decimal) using 8-bit two's complement representation.
9) Consider this two's complement binary number: 10011110. What is its decimal value?
10) Find the 8-bit two's complement binary number representation of 137 (decimal). Briefly describe what went wrong, and what that implies about the limits of this representation scheme?
11) Represent the following numbers using 8-bit 2's complement representation
    a. -47_{10}
    b. -123_8
    c. $5C_{16}$
12) Perform the following arithmetic operations on the two's complement numbers given below. Indicate whether an overflow occurs or not. The first bit in each number is a sign bit.
    a. 10110 + 11001
    b. 11001 + 11000
13) Convert the following 2's complement binary numbers to decimal.
    a. 0110
    b. 1101

c. 0110 1111
d. 1101 1011 0001 1100

14) The following binary numbers are 4-bit 2's complement binary numbers. Which of the following operations generate overflow? Justify your answers by translating the operands and results into decimal.
    a. 0011 + 1100
    b. 0111 + 1111
    c. 1110 + 1000
    d. 0110 + 0010

Fixed point addition

15) Consider the following numbers as 4-bit signed binary number. Indicate whether the result will generate any overflow, or not?
    a. 1111 + 1000
    b. 1100 + 0100
    c. 0100 + 0011
    d. 0001 + 0111
16) Consider the following numbers. Indicate whether the addition operation will generate any overflow. Show the results, considering the numbers as (i) signed and (ii) unsigned
    a. $12_{10} + 8_{10}$ (Represent the numbers in 5-bit binary)
    b. $A_{16} + 24_{16}$ (Represent the numbers in 6-bit binary)

IEEE 754 floating point

17) What is the 32-bit IEEE 754 floating point representation for 3.5?
18) If $(42510000)_{16}$ is the 32-bit IEEE 754 representation of a floating-point number, what is the floating point number?
19) Show the IEEE 754 binary representation for the following floating-point numbers
    a. 356.75
    b. -11.5
20) Convert the following numbers represented in IEEE 754 floating point representation to their equivalent decimal numbers.
    a. 0 111 1111 1 000 0100 0100 1111 0000 0000
    b. 0 101 1100 1 010 0100 0100 0000 0000 0000
    c. 1 000 1101 1 011 0110 1000 0000 0000 0000
    d. 1 000 0000 0 011 1011 0000 0000 0000 0000
21) The floating-point representations of X and Y are given below. Perform X + Y ('+' symbol means addition here not 'OR').
    X = 1 011 1011 1 100 1000 0000 0000 0000 0000
    Y = 0 100 0100 1 001 0100 1000 0000 0000 0000
    Put the addition result in IEEE 754 representation.

Floating point addition

22) Floating-Point Addition: add the following binary numbers
    a. $1.000 * 2^{-1} + 1.110 * 2^{-2}$
    b. $1.000 * 2^{-1} + -1.110 * 2^{-2}$ or, $1.000 * 2^{-1} + (-1.110 * 2^{-2})$
    c. $1.010 * 2^{-2} + 1.110 * 2^{-3}$

23) Floating-Point Addition: add the following numbers (converting into binaries first, before adding)
    a. $5.75_{10} + 2.25_{10}$
    b. $3.5_{10} + 0.25_{10}$

Parity bit

24) Write the parity bit (both even and odd) for the following binary numbers:
    a. 1100
    b. 1000
    c. 0000
    d. 1101