CS240
Lecturer: Simina Fluture, PhD.

CS240 – Homework 2
I WILL NOT GRADE THIS HOMEWORK
IT IS STRONGLY RECOMMENDED TO COVER IT AS PREPARATION FOR QUIZZES AND THE MIDTERM EXAM

PART 1

PROBLEM 1 (give a brief explanation) 15 points

a. What is the range of unsigned integer numbers that can be represented with
4 bits
n bits

b. What is the range of numbers in signed magnitude format that can be represented with
4 bits
n bits

c. What is the range of integers in signed 2's complement that can be represented with
4 bits
n bits

d. What is the range of decimal floating point numbers (IEEE 754 representation) that can be represented with
32 bits
64 bits

e. Explain why the bias for the exponent in the IEEE754 has the value: $2^{k-1} - 1$?

PROBLEM 2 (30 points)

A. Convert the following (unsigned) decimal numbers to the indicated bases:
Note: if the fraction has very many or infinitely many digits truncated to 3 digits after the point

35.125	to binary
28.250	to octal
131.69	to hexa
26.60	to binary
255	to binary, octal, and hexadecimal

B. Convert the following (**unsigned**) binary numbers to:

- Octal
- Hexadecimal

$1011\ 1011\ 0000\ 1110\ 0101\ 1011\ 1111.110_2$
$1110\ 1011\ 1001\ 1001\ 1011.1110101_2$

C. Convert the hexadecimal number B4C36A to binary and octal.

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PROBLEM 3 (9 points)
Perform the arithmetic operations (-8) + (11), (+80) + (60) and (-25) + (-18), in binary using the signed 2's complement representation. Use 8-bit registers.

PROBLEM 4 (10 points)
Use Booth's multiplication algorithm for computing:
(-4) x (11) (-7) x (10)
NOTE: YOU CANNOT SWITCH THE ORDER BETWEEN M AND Q (THE ORDER IS MXQ)

PROBLEM 5 (12 points)
Convert +41.50 in a IEEE 754 single precision format.
Convert - 72.125 in a IEEE 754 double precision format.

PROBLEM 6 (6 points)
What is the decimal floating number represented by the 32-bit word
1000 1110 0001 0100 0000 0000 0000 0000

PROBLEM 7 (12 points) Explain your answer; don't just give the final value. For the first 3 subpoints have it as sum of powers of 2.

Give the decimal number represented by the 32-bit word 1011 0011 1101 0000 0000 0000 0000 0000 if

a. An unsigned representation has been used
b. A sign magnitude representation has been used
c. A signed 2's complement representation has been used
d. A 754 IEEE representation has been used

Problem 8: Given the following Boolean function: F = A'C + A'B + AB'C + BC
Express it as sum of minterms

Problem 9:
Show that the dual of the exclusive-OR is equal to its complement.

Problem 10:
Simplify the Boolean expressions using three-variables and four-variables maps: a.
F(x,y,z) = ∑(0,2,3,4,7)
b. F(A,B,C,D) = AB'C + B'C'D' + BCD + ACD' + A'B'C + A'BC'D
c. F(x,y,z,w) = ∑(2,3,9,10,12,13,14,15)

Problem 11:
Design a combinational circuit with 3 inputs xyz and three outputs ABC. When the binary input value is 0,1,2,3 the binary output value is one greater than the input. When the binary input is 4,5,6,7 the binary output is two less than the input.

Problem 12:
Implement F(A,B,C) using a multiplexer.
F(A,B,C) = ∑(0,1,5,7)

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Problem 13: (from last semester midterm)

$A(x,y,z) = \sum(2,3,4,5,6)$
$B(x,y,z) = x'y'z' + xy' + x'yz'$
$C(x,y,z) = xy'z' + x'y + xyz'$

a. Tabulate the truth table for a ROM that implements the 3 Boolean functions A,B,C. **Draw the circuit.** Specify the **size of the ROM**.

b. **Draw the PLA circuit** that will implement A,B,C
Minimize the number of product terms. **Simplify** the functions.
<u>You don't need to give the PLA table.</u>

c. Implement B(x,y,z) using a **multiplexer**.