CS311 - Computer Architecture - Spring 2017
Homework 4 – 75 points
Due: March 8

1. (5 points) Exercise C.10, pg. C-81 (on CD). HINT: You can use some hard-wired 0's and 1's.
2. (10 points) Exercises C.11 and C.12, pg. C-81.
3. (10 points) Exercise C.14, pg. C-81, describes a simple switching network.
   (a) Assuming all inputs and outputs are 1 bit long, create a truth table detailing the behavior of this switching network.
   (b) Using sum-of-products come up with a Boolean expression for the outputs C and D based on the inputs A, B and S.
   (c) Simplify these two expressions using Boolean algebra (show your steps) and create a circuit to implement the switching network (you should not use multiplexors in your circuit).
4. (5 points) Exercise C.25, pg. C-83. The reference in the problem should be to Figure 3.2, pg. 226.
5. (10 points) Consider the following function description:

Inputs			Outputs		
A	B	C	D	E	F
0	0	0	1	1	0
0	0	1	0	1	0
0	1	0	1	1	1
0	1	1	0	0	0
1	0	0	1	1	0
1	0	1	1	1	1
1	1	0	1	1	0
1	1	1	1	0	0

   (a) Create a PLA which implements this truth table.
   (b) Simplify the truth table for outputs D and E using don't cares and implement each separately using simpler circuits (not PLA's).

(over)

6. (5 points) Assume we are using 6-bit long 2's complement integers and want to multiply 0x33 by 0x16. Treating the first as the multiplier and the second as the multiplicand, show the steps used to multiply these two numbers together using the third algorithm discussed in class (the one which used one register for both the multiplier and the product). If either of these numbers represent a negative value, convert them to their positive version before multiplying, then negate your answer (if necessary). Give your answer in terms of a 12-bit integer in hex.

7. (5 points) Exercise 3.6.5, pg. 288. Use F6 as the multiplier and 7F as the multiplicand instead of the values given in the problem.

8. (5 points) Show the steps that the non-restoring division algorithm uses when dividing 61 by 6, using 6-bit unsigned operands. How many additions/subtractions are saved over the restoring algorithm?

9. (10 points) Show how the following numbers would be represented as single precision floating point numbers using the IEEE 754 standard:

   (a) 2017

   (b) 12702379 (population of PA according to 2010 Census)

   (c) 1/1024

10. (5 points) Find the smallest positive integer x such that x and $x+1$ are represented the same in the IEEE 754 standard, assuming rounding to even is used.

11. (5 points) Find the IEEE 754 single precision representation of 1/21. (HINT: Find a pattern in the binary representation and then prove that it is correct).