CMPE 12 Homework #1

John Allard
Lab Section #2

October 20th, 2014

1. If you had a black box that takes two inputs and adds them, and another black box that takes two numbers and multiplies them, can you combine these boxes in a certain way to create the functions given below?

   (a) $ax + b$
   Answer : $M(n_1, n_2) = n_1 * n_2$, $A(n_1, n_2) = n_1 + n_2$. Then $ax + b = A(M(a, x), b)$

   (b) The average of four input numbers, w, x, y, z
   Answer : Average$(w, x, y, z) = M(\frac{1}{4}, A(w, A(x, A(y, z))))$

   (c) $a^2 + 2ab + b^2$
   Answer : $a^2 + 2ab + b^2 = M(A(a, b), A(a, b))$

2. Two computers are identical except that the first one has no subtraction command, and the second one does. They both can add and take the negative of a given number, which is able to solve more problems?
   Answer : The two machines can do exactly the same functions and can solve the exact same problems. There are two explanations for this, first, the Turing thesis which states that any two computers can perform the exact same calculations. This means that it might take one of the computers longer to perform a computation, but it can still perform everything that any other computer can. A more intuitive reason for this being true is that subtraction is equivelant to addition of a negative number. So the computer without the subtraction command can simply add the negative of the number that it is trying to subscribe.

3. Normally one ISA is implemented per microarchitecture. It is possible for many different varieties of microarchitectures to implement the same ISA though.

4. We would need $\text{int}(\log_2(26) + 1) = 5$ bits to represent all 26 characters. If we wanted to also include lower case, we would need $\text{int}(\log_2(52) + 1) = 6$ bits.

5. Convert the following numbers to 8-bit two's compliment binary numbers.

   (a) 102 **Answer :** 001100110

   (b) 64 **Answer :** 001000000

   (c) 33 **Answer :** 000100001

   (d) -128 **Answer :** 101111111

   (e) 127 **Answer :** 001111111

6. Compute the following, write you results in binary.

   (a) 01010111 AND 11010111 **Answer :** 01010111

   (b) 101 AND 110 **Answer :** 100

   (c) 11100000 AND 10110100 **Answer :** 10100000

   (d) 00011111 AND 10110100 **Answer :** 00010100

   (e) (0011 AND 0110) AND 1101 **Answer :** 0000

   (f) 0011 AND (0110 AND 1101) **Answer :** 0000

7. Compute the following :

   (a) NOT(1011) OR NOT(1100) **Answer :** 0111

   (b) NOT(1000 AND (1100 OR 0101)) **Answer :** 0111

(c) NOT(NOT(1101)) **Answer :** 1101

(d) (0100 OR 0000) AND 1111 **Answer :** 0100

8. Translate the following ASCII codes into strings of characters by interpreting each group of 8 bits as an ASCII character.

   (a) x48656c6c6f21 **Answer :** Hello!

   (b) x68454c4c4f21 **Answer :** Hello!

9. Convert the following hexidecimal representation of two's compliment numbers in their binary form.

   (a) xF0 **Answer :** 1111 0000 = -(00001111) = -15

   (b) x7FF **Answer :** 0111 1111 1111 = 2047

   (c) x16 **Answer :** 0001 0110 = 22

   (d) x8000 **Answer :** 1000 0000 0000 0000 = -(0111 1111 1111 1111) = -32,768

10. We will now be working in quad (base-4).

    (a) Max unsigned decimal value that can represented with 3 quad digits? **Answer :** $4^3 = 64$

    (b) Max unsigned ..... with n quad digits? **Answer :** 4^n

    (c) Add the two unsigned quad numbers 023 and 221 **Answer :** $023_4 = 11_{10}$. $221_4 = 41_{10}$. $41+11 = 52_{10}$

    (d) What is the quad representation of 42 in quad? **Answer :** $42_{10} = 222_4$

11. Complete a truth table for the transistor-level circuit in Figure 3.34 (Page 83, Textbook).

Answer :

A	B	C	Out
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0

12. The circuit in Figure 1 is implementing equation (1). Label the circuit to fit the equation.

$$Y = \text{NOT}(A \text{ AND } (B \text{OR} C)) \tag{1}$$

13.

14. If a byte-addressable memory has 14-bit addresses, how many nibbles of storage are in this memory?
    Answer : 16,384 bytes = 32,768 nibbles

15.

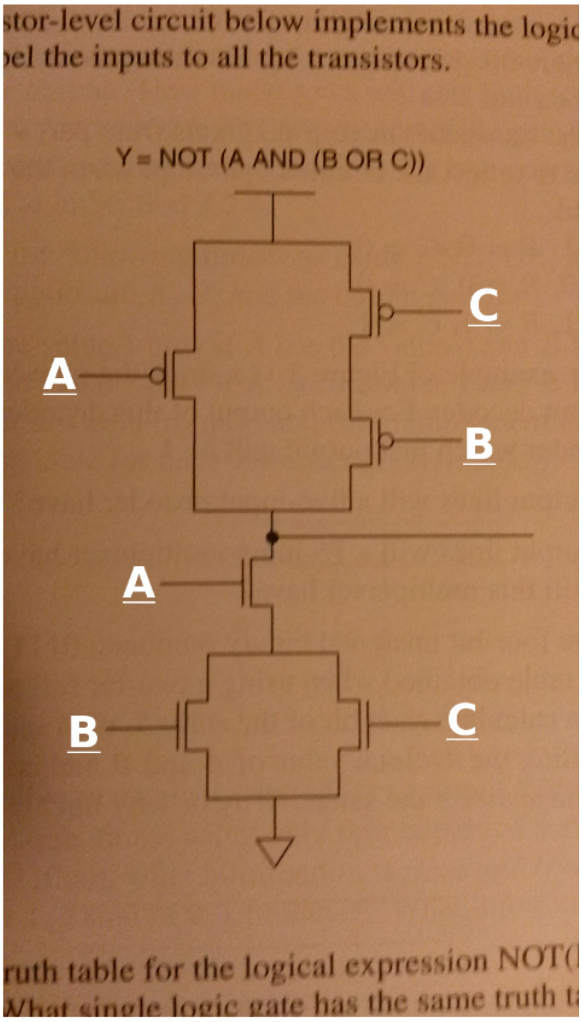

Figure 1: Labeled Circuit for Problem #12