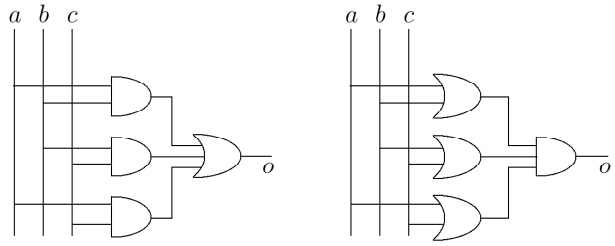
CSC258 Computer Organization (Winter 2009)
Assignment 1

Due Monday, Feb. 2 at 6:00pm in BA2220

1 [10] Using two different methods, prove that the following circuits are functionally equivalent.



2 [10] Simplify the following boolean expression. Show your work.

$$\Big((a \leq c) \neq (b \leq c)\Big) \vee \Big(\big((a \leq b) \triangle (b \leq a)\big) \wedge c\Big)$$

3 Show that
(a) [5] $\{\leq\}$ is not complete.
(b) [5] Using only 2-input $\bigtriangledown$ gates, one can build the circuit $a \leq b$.

4 [15] Consider the encrypt/decrypt function $f(x) = 3x \mod 8$.

For any integer $0 \leq x < 8$, $y = f(x)$ is a number that can be considered the encrypted code of x. For example, the encryption of 2 is $f(2) = (3 \times 2) \mod 8 = 6$, *i.e.*, 2 is encrypted into 6.

To decrypt, simply apply the function to the encrypted code y, and obtain $x = f(y)$. For the example above, $f(6) = (3 \times 6) \mod 8 = 18 \mod 8 = 2$, *i.e.*, 6 is decrypted and the original number 2 is obtained.

Design a circuit that computes, for any integer input $0 \leq x < 8$, the encrypt/decrypt function $f(x)$.