M A S S A C H U S E T T S I N S T I T U T E O F T E C H N O L O G Y
DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

6.111 Introductory Digital Systems Laboratory
Fall 2008

Lecture PSet #2
Due: Thu, 09/11/08

Problem 1. A certain function F has the following truth table:

A	B	C	F
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

(A) Write a sum-of-products expression for F.

(B) Write a minimal sum-of-products expression for F (use Karnaugh maps). Show a combinational circuit that implements F using only INV and NAND gates.

(C) Implement F using one 4-input MUX and one inverter.

(D) Write a minimal sum-of-products expression for NOT(F).

Problem 2.

(A) Give minimal sum-of-products expressions for each of the following

$F = \overline{A + B}$

$G = A \cdot B \cdot C + \overline{A} \cdot B \cdot C + \overline{A} \cdot \overline{B} \cdot C + \overline{A} \cdot B \cdot \overline{C} + A \cdot \overline{B} \cdot C + A \cdot B \cdot \overline{C}$

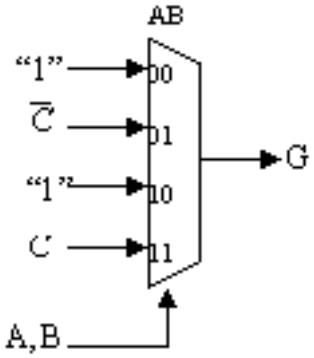
(B) What is the maximum number of product terms in a minimal sum-of-products expression with 3 variables?

(C) True or false: A Boolean function of N variables with greater than 2^{N-1} product terms can *always* be simplified to an expression using fewer product terms.

(D) Suppose the stockroom is very low on components has only *five* 2-input NAND gates on hand. Would we be able to buid an implementation of any arbitrary 2-input Boolean function?

(see other side)

Problem 3. A certain 3-input function G(A,B,C) has the implementation shown to the right. Give a minimal sum-of-products expression for G.



Problem 4. (Katz, problem 4.9) Implement the 2-bit adder function (i.e., 2-bit binary number AB plus 2-bit binary number CD yields a 3-bit result XYZ) using three 8:1 multiplexers.

(A) Give the truth table showing the values for the outputs X, Y and Z given all possible combinations of the inputs A, B, C and D.

(B) Show how to implement X, Y and Z using three 8:1 multiplexers. You can assume you have the constants 0 and 1, along with the inputs and their complements.