Embedded Real-Time Systems (AME 3623)
Homework 1

February 8, 2005

This homework assignment is due on Thursday, February 17 at 5:00pm. It must be handed in using the blackboard digital dropbox (use the "send file" option) in either postscript or pdf format.

Question 1

Consider the following function:

A	B	C	D	f
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	0
1	1	1	0	1
1	1	1	1	1

1. Show the corresponding Karnaugh map and a set of covering clusters.
2. What is the algebraic description of the reduced circuit?
3. Show the reduced circuit.
4. Starting with the original algebraic description of the function ($A'B'C'D'+ A'B'CD' + ...$), use the definitions and identities discussed in class to prove that it is equivalent to the reduced description that you gave above.

Question 2

Consider the following function:

A	B	C	D	f
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

1. Show the corresponding Karnaugh map and a set of covering clusters.
2. What is the algebraic description of the reduced circuit?

Question 3

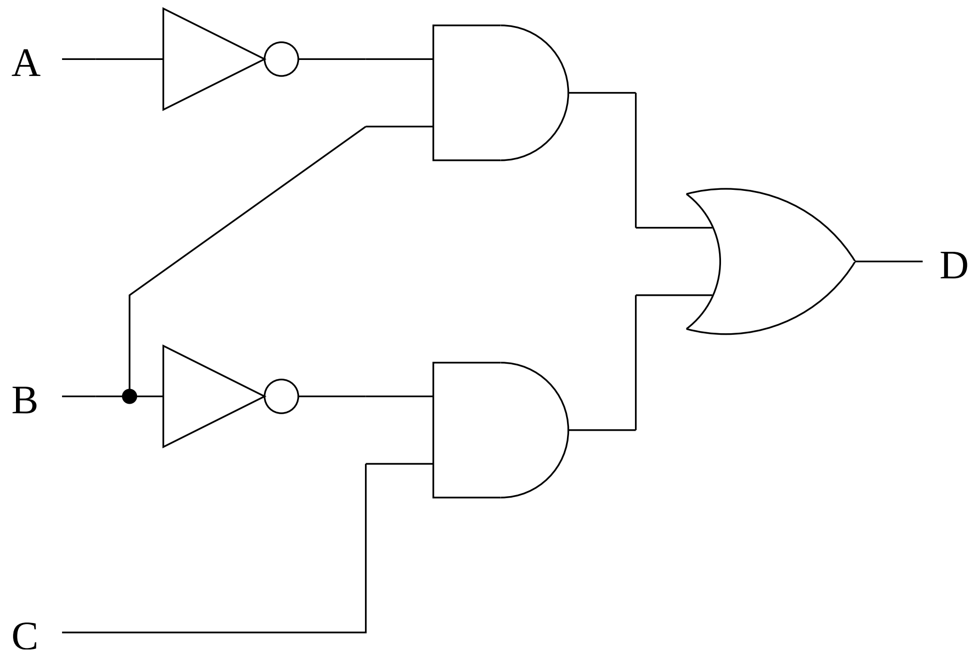
Consider the following function:

A	B	C	D	f
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

1. Show the corresponding Karnaugh map and a set of covering clusters.
2. What is the simplest algebraic description of the reduced circuit?
3. Show the reduced circuit.

Question 4

From the perspective of the transistor count, it is cheaper to implement a NAND gate than an AND gate (we typically implement an AND gate as a NOT - NAND). Consider the following circuit:



1. Redesign this circuit such that it implements the same function, but uses only NAND and NOT gates. Show this new circuit.
2. What can you generally conclude about functions that involve a set of AND gates that then provide inputs to an OR gate? Explain.

Question 5

Using the algebraic definitions and identities discussed in class, prove the following:

$$(A' + B' + C')' = ABC$$

Question 6

Using two-output demultiplexers (1 select line) and the basic gates (AND, OR, NOT, NOR, NAND, and XOR), design an eight-output demultiplexer (three select lines).

Question 7

The ripple counter that we designed in class using three D-type flip flops counts from zero to seven, and then rolls over to zero again. Modify this design such that the counter rolls over to zero after reaching six.

Question 8

How much time did you spend on this homework assignment?