Embedded Real-Time Systems (AME 3623)
Homework 1 Solutions

February 2, 2006

Question 1

Consider the following function:

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

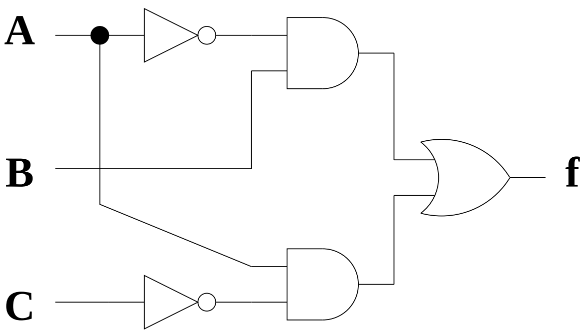
1. (10pts) Show the corresponding Karnaugh map and a set of covering clusters.

				A	
AB			B		
C	00	01	11	10	
C 0	0	1	1	1	
1	0	1	0	0	

2. (10pts) What is the algebraic description of the reduced circuit?

   $f = A\bar{C} + \bar{A}B$

3. (10pts) Show the reduced circuit.



4. (10pts) Starting with the original algebraic description of the function $(A'BC' + A'BC + AB'C' + ABC')$, use the definitions and identities discussed in class to prove that it is equivalent to the reduced description that you gave above. At each step of the proof, show the transformed expression and the algebraic rule that you used to perform the transformation.

$$\begin{array}{rl}
\bar{A}B\bar{C} + \bar{A}BC + A\bar{B}\bar{C} + AB\bar{C} & \\
(\bar{A}B\bar{C} + \bar{A}BC) + (A\bar{B}\bar{C} + AB\bar{C}) & \quad \textit{Associative} \\
(\bar{A}B(\bar{C} + C)) + (A\bar{C}(\bar{B} + B)) & \quad \textit{Distributive} \\
\bar{A}B * 1 + A\bar{C} * 1 & \quad X + \bar{X} = 1 \\
\bar{A}B + A\bar{C} & \quad X * 1 = X \\
A\bar{C} + \bar{A}B & \quad \textit{Commutative}
\end{array}$$

Question 2

Consider the following function:

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

1. (10pts) Show the corresponding Karnaugh map and a set of covering clusters.

				A	
	AB		B		
C		00	01	11	10
C	0	0	0	0	1
	1	1	0	0	1

2. (10pts) What is the algebraic description of the corresponding circuit?

   $f = A\bar{B} + C\bar{B}$

3. (10pts) What is the algebraic description of the simplest circuit (in terms of the number of logic gates)?

   $f = (A + C)\bar{B}$

Question 3

Consider the following function:

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

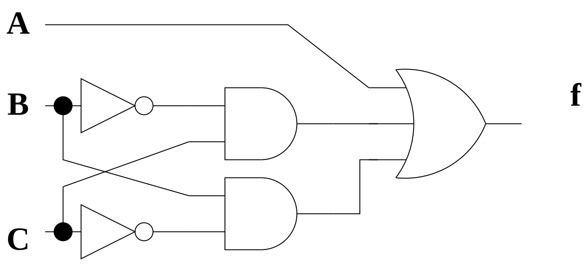
1. (10pts) Show the corresponding Karnaugh map and a set of covering clusters.

			A	
		B		
C \ AB	00	01	11	10
0	0	1	1	1
1	1	0	1	1

2. (10pts) What is the corresponding algebraic description of the reduced circuit?

   $A + B\bar{C} + \bar{B}C$

3. (10pts) Show the reduced circuit.

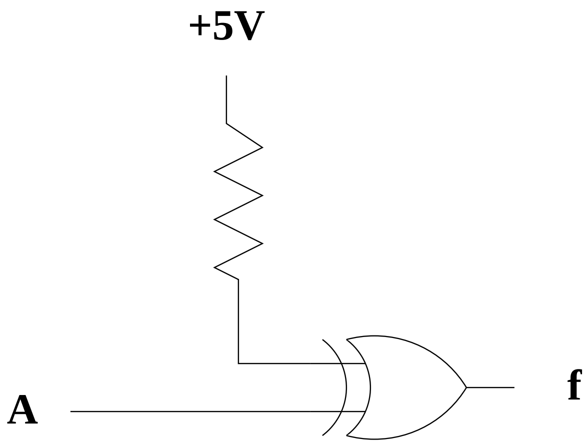


Question 4

Suppose you need a circuit to perform an inversion (i.e., implement the NOT operator), but that you only have XOR gates.

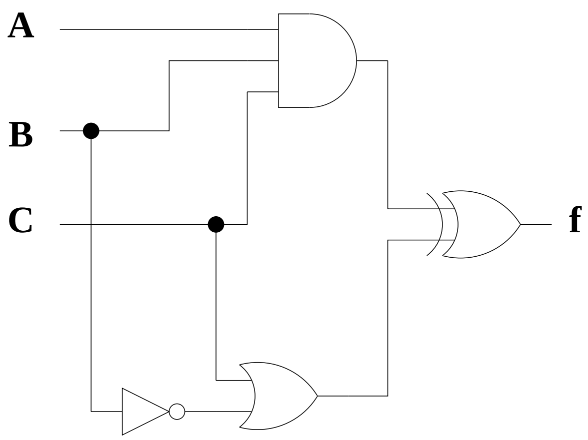
(10 pts) How is this circuit wired (give a circuit diagram)?

If we wire the other input such that it is a constant **1**, then f will always be the inverse of A.



Question 5

Consider the following circuit.



(10 pts) What is the corresponding truth table?

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