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Homework # 3

Chapter 2 Problem 4: Show a truth table for the following function

(b) $G = xy + (x' + z)(y + z')$

x	y	z	xy	(x' + z)	(y + z')	(x' + z)(y + z')	G
0	0	0	0	1	1	1	1
0	0	1	0	1	0	0	0
0	1	0	0	1	1	1	1
0	1	1	0	1	1	1	1
1	0	0	0	0	1	0	0
1	0	1	0	1	0	0	0
1	1	0	1	0	1	0	1
1	1	1	1	1	1	1	1

Chapter 2 problem 8: Using boolean Algebra, reduce the following expression to a minimum sum of products form.

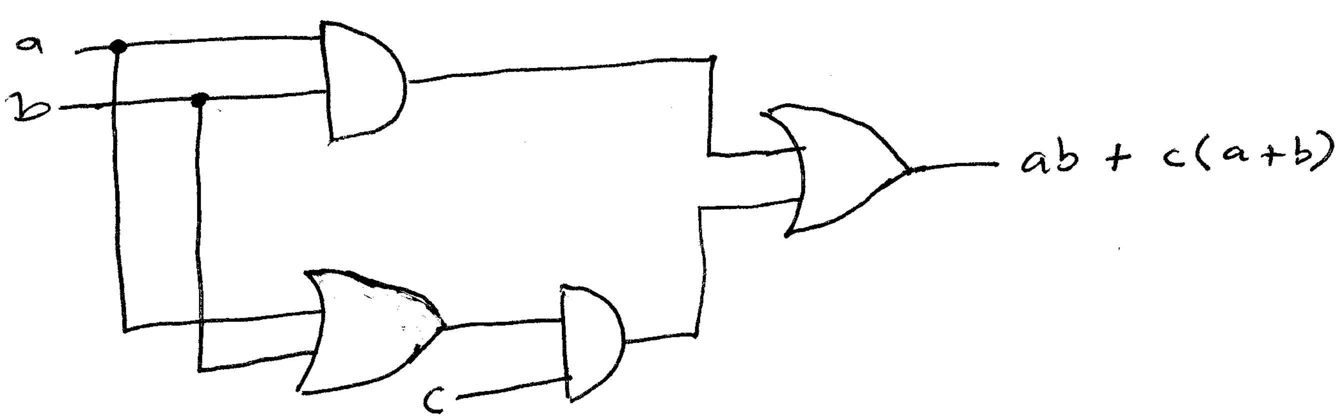
(d) $a'b'c' + a'b'c + abc + ab'c$

$= a'b'c' + a'b'c + abc + ab'c = a'b'(c' + c) + ac(b + b')$

$= a'b' + ac$

Chapter 2 Problem 10: Show a block diagram of a system using AND, OR, and NOT gates to implement the following function. Assume the variables are available only uncomplemented. Do not manipulate the algebra

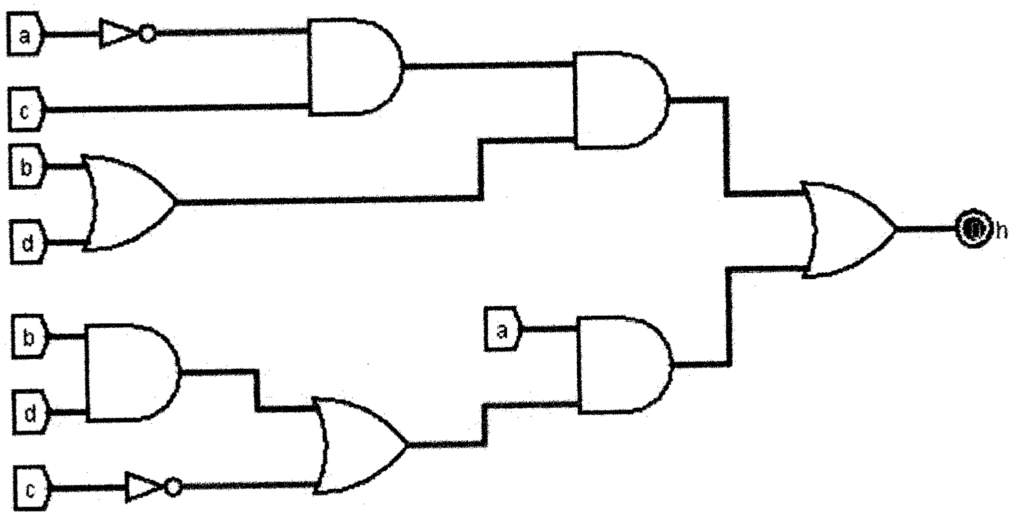
(b) $ab' + c(a+b)$



Chapter 2 problem 11: For the following Circuit,

(i) Find an algebraic expression

(ii) put it in sum of product form



(i) $h = a'c(b+d) + (bd+c')a$

(ii) $h = a'c(b+d) + bd+c')a$

$= a'cb + a'cd + abd + ac'$

Chapter 2 problem 14: For the function g in the following truth table:

	a	b	c	g
0	0	0	0	1
1	0	0	1	1
2	0	1	0	0
3	0	1	1	0
4	1	0	0	1
5	1	0	1	1
6	1	1	0	1
7	1	1	1	0

(a) show the minterms in numerical form

$$g(a,b,c) = \Sigma m(0,1,4,5,6)$$

(b) show the canonical algebraic expression in sum of products form.

$$g = a'b'c' + a'b'c + ab'c' + ab'c + abc'$$

(c) show a minimum SOP expression.

$$g = a'b'c' + a'b'c + ab'c' + ab'c + abc'$$

$$= a'b'(c'+c) + ac'(b'+b) + ab'c$$

$$= a'b' + ac' + ab'c$$

$$= a'b' + a(c'+b'c)$$

$$= a'b' + a(c'+b')$$

$$= a'b' + ac' + ab'$$

$$= b' + ac'$$

(d) show the minterms in numeric form

$$g'(a,b,c) = \Sigma m(2,3,7)$$

(e) show the canonical algebraic expression in product of sums form

$$g'(a,b,c) = \Sigma m(2,3,7)$$

$$g = a'bc' + a'bc + abc$$

$$g = (a+b'+c)(a+b'+c')(a'+b'+c')$$

(f) Show a minimum POS expression

$$g' = a'bc' + a'bc + abc$$
$$= a'b(c'+c) + abc$$
$$= a'b + abc$$
$$= b(a' + ac)$$
$$= b(a'+c)$$
$$= a'b + bc$$
$$g = (a+b')(b'+c')$$

Chapter 2 Problem 15: For each of the following functions

$$F = AB' + BC + AC$$
$$G = (A+B)(A+C') + AB'$$

(a) show a truth table

ABC	A + B	A + C'	AD'	(A + B) (A + C')	G
					0
000	0	1	0	0	0
001	0	0	0	0	
010	1	1	0	1	1
011	1	0	0	0	0
100	1	1	1	1	1
101	1	1	1	1	1
110	1	1	0	1	1
111	1	1	0	1	1

A B C	AB'	BC	AC	F
0 0 0	0	0	0	0
0 0 1	0	0	0	0
0 1 0	0	0	0	0
0 1 1	0	1	0	1
1 0 0	1	0	0	1
1 0 1	1	0	1	1
1 1 0	0	0	0	0
1 1 1	0	1	1	1

(b) Show the canonical algebraic expression in sum of products form.

$$F(A,B,C) = \sum m(3,4,5,7)$$
$$= A'BC + AB'C' + AB'C + ABC$$

$$G(A,B,C) = \sum m(2,4,5,6,7)$$
$$= A'BC' + A'BC + AB'C + ABC' + ABC$$

(c) show a minimum SOP expression

$$F = A'BC + AB'C' + AB'C + ABC$$
$$= A'BC + ABC + AB'C' + AB'C$$
$$= BC(A' + A) + AB'(C' + C)$$
$$= BC + AB'$$

$$G = A'BC' + A'BC + AB'C + ABC' + ABC$$
$$= A'BC + A'BC + AB'C + ABC + ABC'$$
$$= A'B(C' + C) + AC(B' + B) + ABC'$$
$$= A'B + AC + ABC'$$
$$= A'B + A(C + BC')$$
$$= A'B + A(C + B)$$
$$= A'B + AC + AB$$
$$= B(A' + A) + AC$$
$$G = B + AC$$

(d) show the minterms of the complement of each function in numeric form

$$F(A,B,C) = \Sigma m(3,4,5,7)$$
$$F'(A,B,C) = \Sigma m(0,1,2,6)$$

$$G(A,B,C) = \Sigma m(2,4,5,6,7)$$
$$G'(A,B,C) = \Sigma m(0,1,3)$$

(e) Show the canonical algebraic expression in product of sums form.

$$F'(A,B,C) = \Sigma m(0,1,2,6)$$
$$= A'B'C' + A'B'C + A'BC' + ABC'$$

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

$$G'(A,B,C) = \Sigma m(0,1,3)$$
$$= A'B'C' + A'B'C + A'BC$$

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

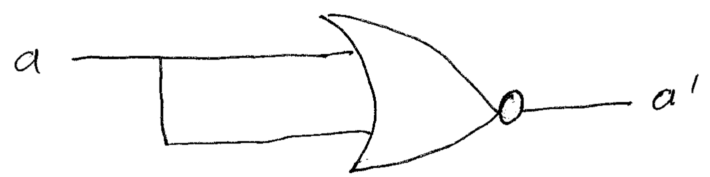
(F) Show a minimum POS expression

$$F'(A,B,C) = \Sigma m(0,1,2,6)$$
$$= A'B'C' + A'B'C + A'BC' + ABC'$$
$$= A'B'(C'+C) + BC'(A'+A)$$
$$= A'B' + BC'$$

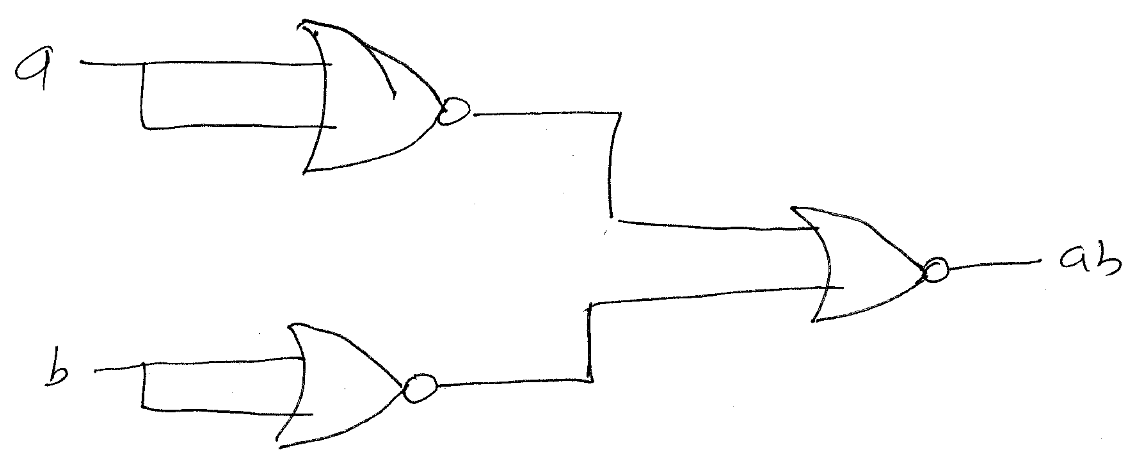
$$G'(A,B,C) = \Sigma m(0,1,3)$$
$$= A'B'C' + A'B'C + A'BC$$
$$= A'B'(C'+C) + A'BC$$
$$= A'B' + A'BC$$
$$= A(B'+BC)$$
$$= A'(B'+C)$$
$$= A'B' + A'C$$
$$G = (A+B)(A+C')$$

Chapter 2 problem 17: Show that the NOR is functionally complete by implementing a NOT, a two-input AND, and a two-input OR using only two-input NORs

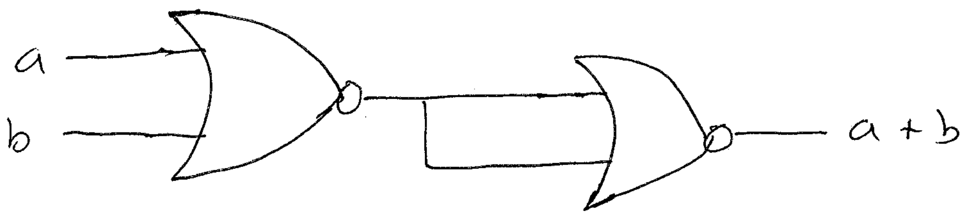
Implementing the NOT using two-input NORs.



Implementing the AND using two-input NORS

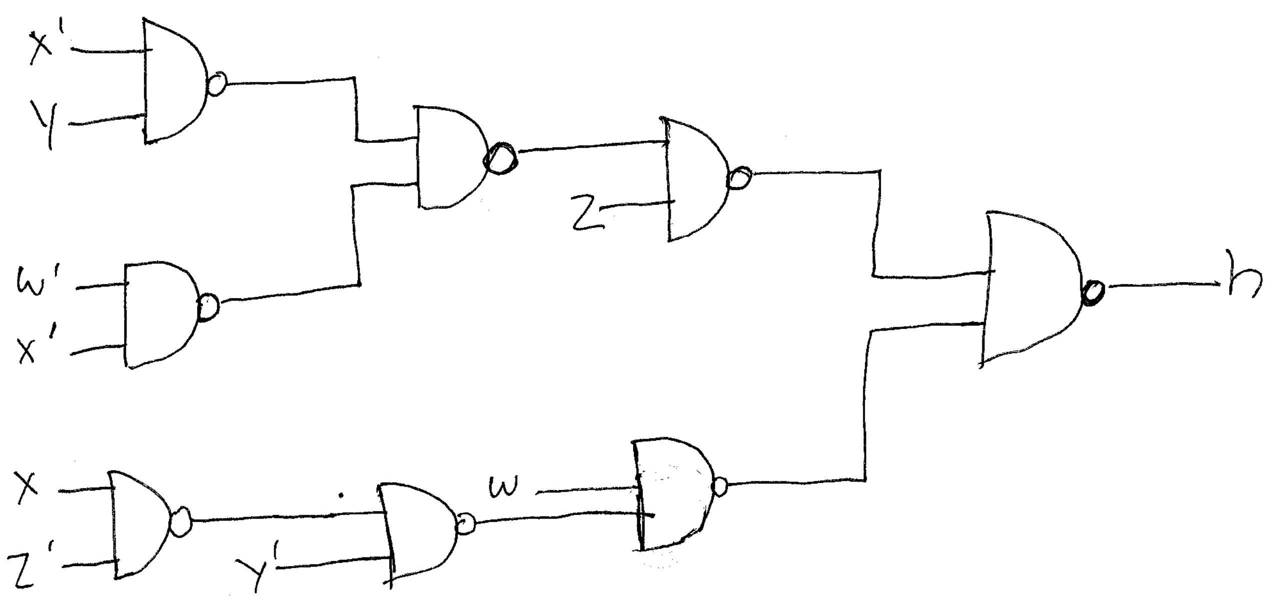


Implement OR function using two- input NORS



Chapter 2 problem 19: show a block diagram corresponding to each of the expressions below using only NAND gates. Assume all inputs are available both complemented and uncomplemented.

(C) $h = z(x'y + w'x') + w(y' + xy')$



Chapter 3 problem 2: For each of the following, find all of the minimum sum of products expressions:

(d) $f(a,b,c,d) = \sum m(1,2,3,5,6,7,8,11,13,15)$

cd \ ab	00	01	11	10
00				1
01	1	1	1	
11	1	1	1	1
10	1	1		

$f = a'c + a'd + bd + cd + ab'c'd'$

Chapter 3 problem 5: For the following, find all minimum sum of products expressions.

(a) $f(w,x,y,z) = \sum m(1,3,6,8,11,14) + \sum d(2,4,5,13,15)$

yz \ wx	00	01	11	10
00		X		1
01	1	X	X	
11	1		X	1
10	X	1	1	

yz \ wx	00	01	11	10
00		X		1
01	1	X	X	
11	1		X	1
10	X	1	1	

yz \ wx	00	01	11	10
00		X		1
01	1	X	X	
11	1		X	1
10	X	1	1	

$f_1 = wx'y'z' + xyz' + w'x'z + wyz$

$f_2 = wx'y'z' + xyz' + x'yz + w'y'z$

$f_3 = wx'y'z' + xyz' + w'x'z + x'yz$

Chapter 3 problem 7: for each of the following functions, find all minimum POS expressions

(a) $f(A,B,C,D) = \Sigma m(1,4,5,6,7,9,11,13,15)$

CD \ AB	00	01	11	10
00		1		
01	1	1	1	1
11		1	1	1
10		1		

CD \ AB	00	01	11	10
00		1		
01	1	1	1	1
11		1	1	1
10		1		

$f = C'D + A'B + AD$

CD \ AB	00	01	11	10
00	1		1	1
01				
11	1			
10	1		1	1

CD \ AB	00	01	11	10
00	1		1	1
01				
11	1			
10	1		1	1

$f' = AD' + B'D' + A'B'C$

$f = (A'+D)(B+D)(A+B+C')$

Chapter 3 problem 11: Find a minimum two-level circuit using AND and one OR gate per function for each of the following sets of functions

(a) $f(a,b,c,d) = \sum m(1,3,5,8,9,10,13,14)$

$g(a,b,c,d) = \sum m(4,5,6,7,10,13,14)$

cd \ ab	00	01	11	10
00				1
01	1	1	1	1
11	1			
10			1	1

f

cd \ ab	00	01	11	10
00		1		
01		1	1	
11		1		
10		1	1	1

g

cd \ ab	00	01	11	10
00				1
01	1	1	1	1
11	1			
10			1	1

f

cd \ ab	00	01	11	10
00		1		
01		1	1	
11		1		
10		1	1	1

g

$f = a'b'd + bc'd + ab'c' + acd$

$g = a'b + bc'd + acd$

7 gates (5 AND gates and 2 OR gates), 21 inputs