EECS 151/251A Discussion 4

Friday, Feb 9th, 2024

Problem 1: K-Maps

1. Given the following truth table, first construct a Karnaugh map.

a	b	c	d	y
0	0	0	0	1
0	0	0	1	X
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	X
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	X
1	1	0	0	0
1	1	0	1	X
1	1	1	0	0
1	1	1	1	X

Table 1: Truth Table

2. Using the Karnaugh Map, give the most simplified SOP expression to describe truth table.
3. With the same Karnaugh Map, give the most simplified POS expression to describe the truth table.

Solution:

1. Karnaugh Map

	$\overline{c}\overline{d}$	$\overline{c}d$	cd	$c\overline{d}$
$\overline{a}\overline{b}$	1	X	1	0
$\overline{a}b$	0	X	1	0
ab	0	X	X	0
$a\overline{b}$	1	0	X	0

2.

	$\overline{c}\overline{d}$	$\overline{c}d$	cd	$c\overline{d}$
$\overline{a}\overline{b}$	1	X	1	0
$\overline{a}b$	0	X	1	0
ab	0	X	X	0
$a\overline{b}$	1	0	X	0

$y = cd + b'c'd'$

3.

	$\overline{c}\overline{d}$	$\overline{c}d$	cd	$c\overline{d}$
$\overline{a}\overline{b}$	1	X	1	0
$\overline{a}b$	0	X	1	0
ab	0	X	X	0
$a\overline{b}$	1	0	X	0

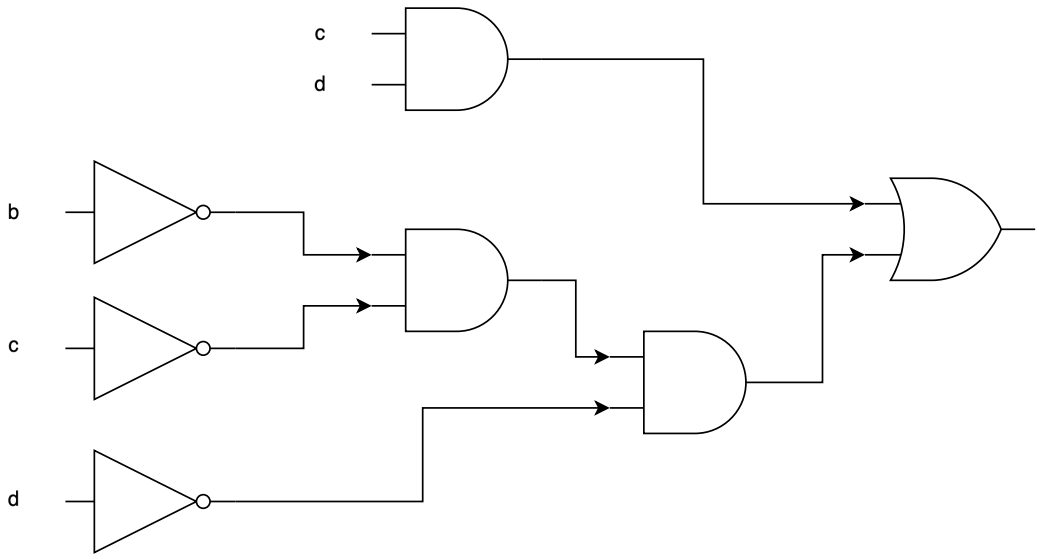
y = (a' + d')(b' + c)(c' + d)

Problem 2: Converting to a NAND circuit

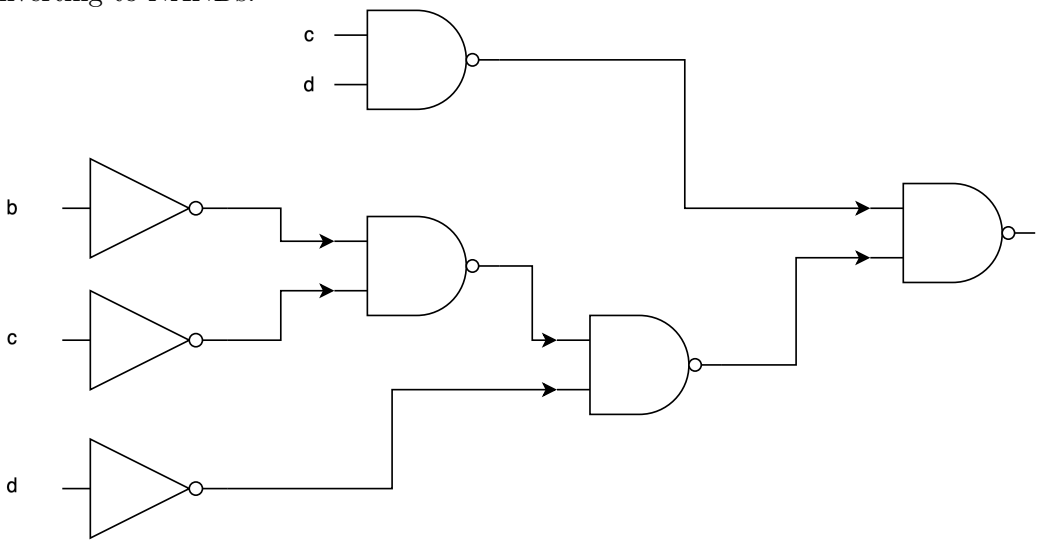
1. From the previous SOP expression, please give the AND/OR circuit diagram described by the expression.
2. Convert the previous diagram to a circuit with only NANDs and Inverters.

Solution:

1. Using the solution from above:



2. Converting to NANDs:



Problem 3: State Machine to Detect 3 Divisibility

Draw the State Diagram (Moore) which takes as input a single bit of an n-bit binary number, and outputs whether the number is divisible by 3. The first bit received will be the MSB. For example for the bit stream 1,1,0,0,1,0,1,0,1 (receiving from the left first) we will have:

Input Bit	Total Number	Output of Machine
1	1	0
1	3 (11)	1
0	6 (110)	1
0	12 (1100)	1
1	25 (11001)	0
0	50 (110010)	0
1	101 (1100101)	0
0	202 (11001010)	0
1	405 (110010101)	1

Solution: