

[CS M51A FALL 19] SOLUTION TO QUIZ 1

Duration: 30 minutes. Total: 40 points

TAs

10/11/2019

Problem 1 (15 Points)

a. What is the minimum number of bits needed to represent the date (month, day, year) if the dates go up to the year 2100? Use a vector of three components and represent each component in binary number system.

Represent November 15, 2076 in binary:

b. Find y : $(937)_{13} + (314)_5 = (y)_8$

Solution

a. For months: 4 bits. For days, max 31, hence we need 5 bits (ceil of $\log_2 31$);
For year, we need 12 bits (ceil of $\log_2 2100$) Hence, in total we need $4 + 5 + 12 = 21$ bits.

November 15, 2076 is represented as 1011 01111 100000011100

$$b. (937)_{13} = (9 * 13 + 3) * 13 + 7 = (1567)_{10}$$

$$(314)_5 = (3 * 5 + 1) * 5 + 4 = (84)_{10}$$

Their sum is $(1651)_{10}$

Convert to radix 8:

$$1651 = 206 * 8 + 3$$

$$206 = 25 * 8 + 6$$

$$25 = 3 * 8 + 1$$

$$3 = 0 * 8 + 3$$

Thus $y = (3163)_8$

Problem 2 (10 points)

Show that $a' + a(a'b + b'c)' = a' + b + c'$.

Solution

$$\begin{aligned} a' + a(a'b + b'c)' &= a' + (a'b + b'c)' \\ &= a' + (a + b')(b + c') \\ &= a' + ab + ac' + bb' + b'c' \\ &= a' + b + c' \end{aligned}$$

Problem 3 (15 points)

You have a digital circuit with three inputs a, b, and c, and one output f. You need to determine its function $f(a,b,c)$ by trying all input combinations and recording the output f. After experimenting with input and output signals you obtain the following table.

a	1	1	1	1	0	0	0	0
b	1	1	0	0	1	1	0	0
c	1	0	1	0	1	0	1	0
f	1	0	0	1	0	1	0	1

Obtain the minterm expression for the function f, find a simple sum of product expression, and draw a circuit diagram using gate symbols.

Solution

$f(a,b,c) = \sum m(0, 2, 4, 7)$. A simpler Sum of Products is $f(a,b,c) = a'c' + b'c' + abc$. This is implemented by the following gate network:

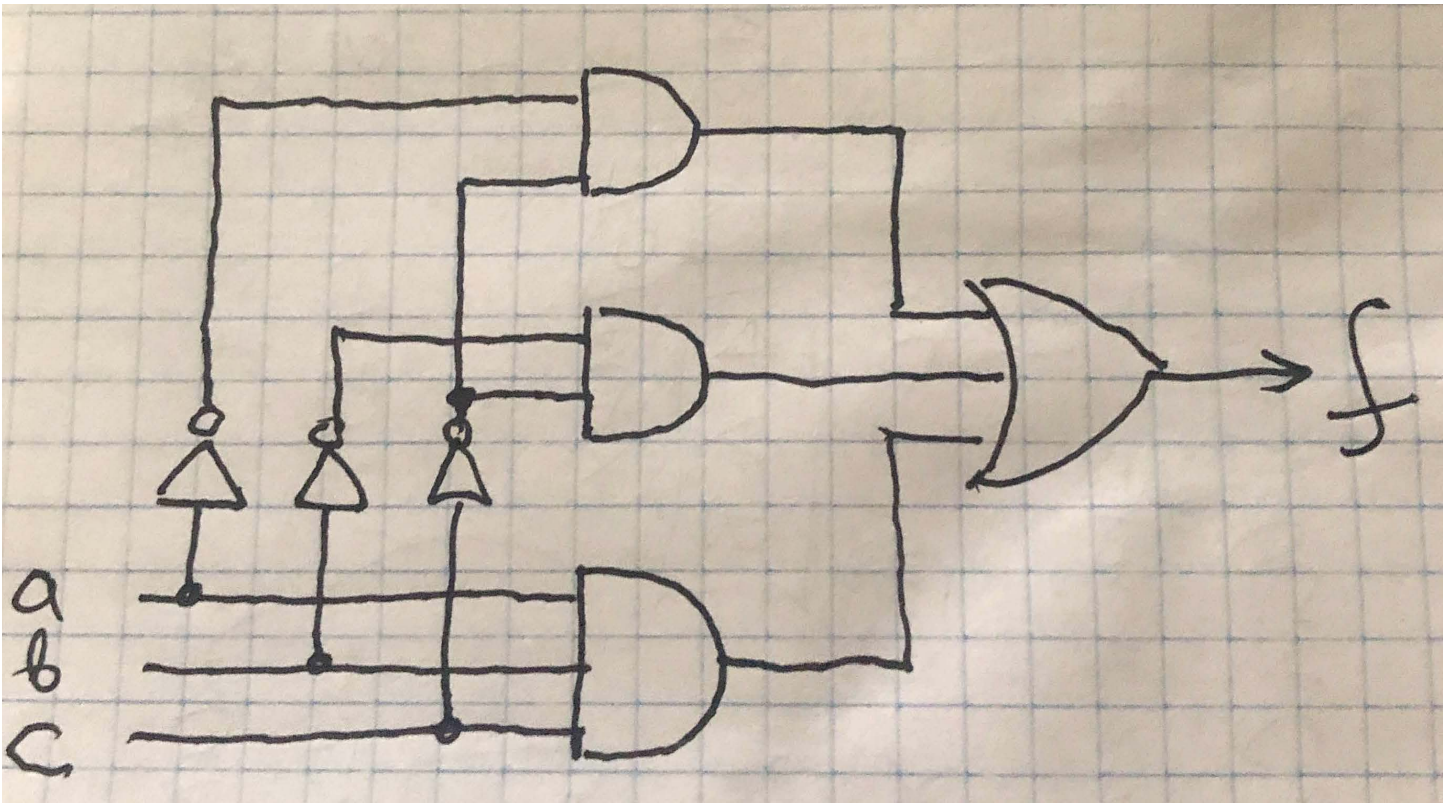


Figure 1: Gate network