VE270 Homework 3

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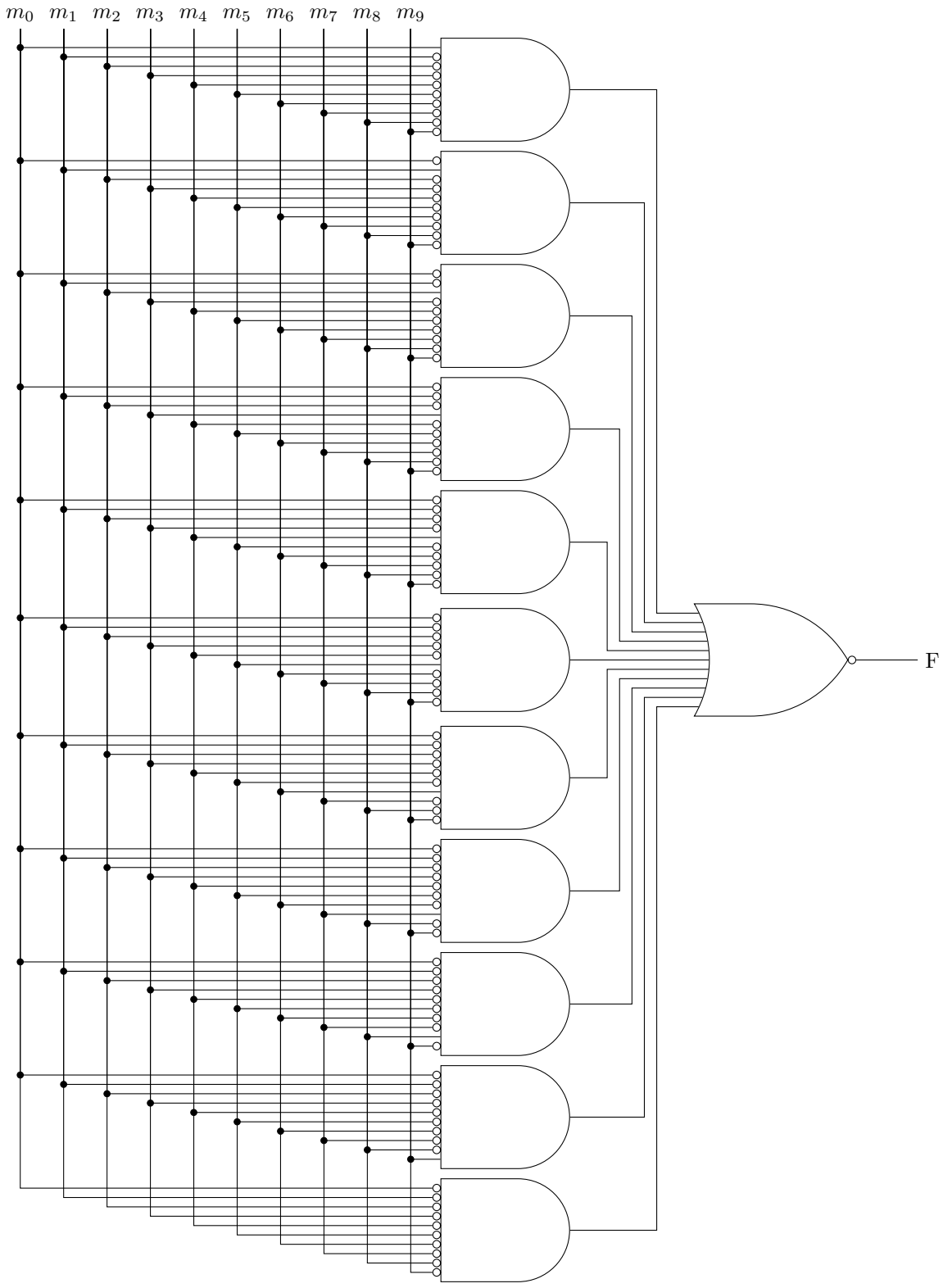
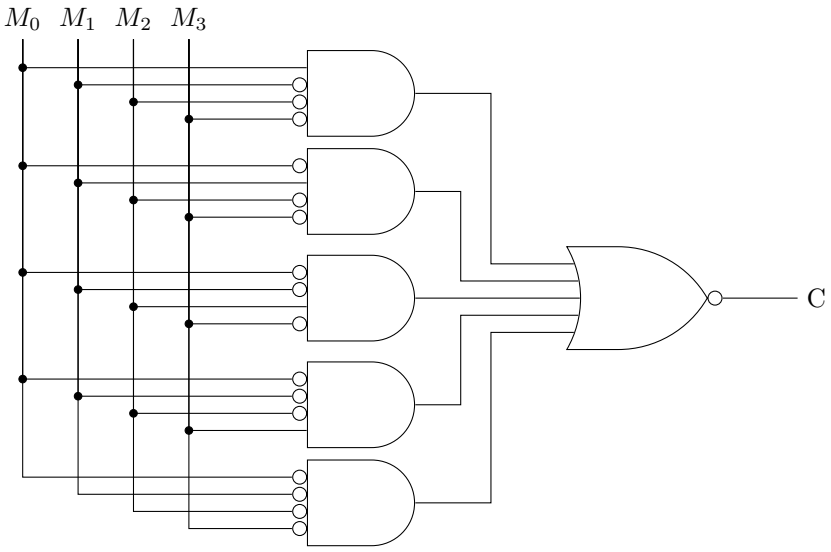
Problem 1.

$$
\begin{aligned}
\mathrm{F} = (&\mathrm{m}_0\mathrm{m}_1'\mathrm{m}_2'\mathrm{m}_3'\mathrm{m}_4'\mathrm{m}_5'\mathrm{m}_6'\mathrm{m}_7'\mathrm{m}_8'\mathrm{m}_9' + \\
&\mathrm{m}_0'\mathrm{m}_1\mathrm{m}_2'\mathrm{m}_3'\mathrm{m}_4'\mathrm{m}_5'\mathrm{m}_6'\mathrm{m}_7'\mathrm{m}_8'\mathrm{m}_9' + \\
&\mathrm{m}_0'\mathrm{m}_1'\mathrm{m}_2\mathrm{m}_3'\mathrm{m}_4'\mathrm{m}_5'\mathrm{m}_6'\mathrm{m}_7'\mathrm{m}_8'\mathrm{m}_9' + \\
&\mathrm{m}_0'\mathrm{m}_1'\mathrm{m}_2'\mathrm{m}_3\mathrm{m}_4'\mathrm{m}_5'\mathrm{m}_6'\mathrm{m}_7'\mathrm{m}_8'\mathrm{m}_9' + \\
&\mathrm{m}_0'\mathrm{m}_1'\mathrm{m}_2'\mathrm{m}_3'\mathrm{m}_4\mathrm{m}_5'\mathrm{m}_6'\mathrm{m}_7'\mathrm{m}_8'\mathrm{m}_9' + \\
&\mathrm{m}_0'\mathrm{m}_1'\mathrm{m}_2'\mathrm{m}_3'\mathrm{m}_4'\mathrm{m}_5\mathrm{m}_6'\mathrm{m}_7'\mathrm{m}_8'\mathrm{m}_9' + \\
&\mathrm{m}_0'\mathrm{m}_1'\mathrm{m}_2'\mathrm{m}_3'\mathrm{m}_4'\mathrm{m}_5'\mathrm{m}_6\mathrm{m}_7'\mathrm{m}_8'\mathrm{m}_9' + \\
&\mathrm{m}_0'\mathrm{m}_1'\mathrm{m}_2'\mathrm{m}_3'\mathrm{m}_4'\mathrm{m}_5'\mathrm{m}_6'\mathrm{m}_7\mathrm{m}_8'\mathrm{m}_9' + \\
&\mathrm{m}_0'\mathrm{m}_1'\mathrm{m}_2'\mathrm{m}_3'\mathrm{m}_4'\mathrm{m}_5'\mathrm{m}_6'\mathrm{m}_7'\mathrm{m}_8\mathrm{m}_9' + \\
&\mathrm{m}_0'\mathrm{m}_1'\mathrm{m}_2'\mathrm{m}_3'\mathrm{m}_4'\mathrm{m}_5'\mathrm{m}_6'\mathrm{m}_7'\mathrm{m}_8'\mathrm{m}_9 + \\
&\mathrm{m}_0'\mathrm{m}_1'\mathrm{m}_2'\mathrm{m}_3'\mathrm{m}_4'\mathrm{m}_5'\mathrm{m}_6'\mathrm{m}_7'\mathrm{m}_8'\mathrm{m}_9')'
\end{aligned}
$$


m_0
m_1
m_2
m_3
m_4
m_5
m_6
m_7
m_8
m_9
F

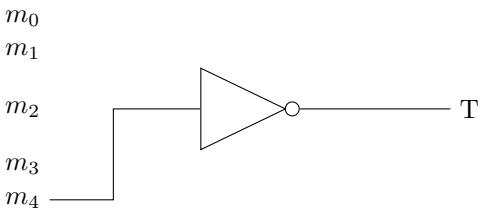
Problem 2.

$$\mathrm{C} = (\mathrm{M}_0\mathrm{M}_1'\mathrm{M}_2'\mathrm{M}_3' + \mathrm{M}_0'\mathrm{M}_1\mathrm{M}_2'\mathrm{M}_3' + \mathrm{M}_0'\mathrm{M}_1'\mathrm{M}_2\mathrm{M}_3' + \mathrm{M}_0'\mathrm{M}_1'\mathrm{M}_2'\mathrm{M}_3 + \mathrm{M}_0'\mathrm{M}_1'\mathrm{M}_2'\mathrm{M}_3')'$$

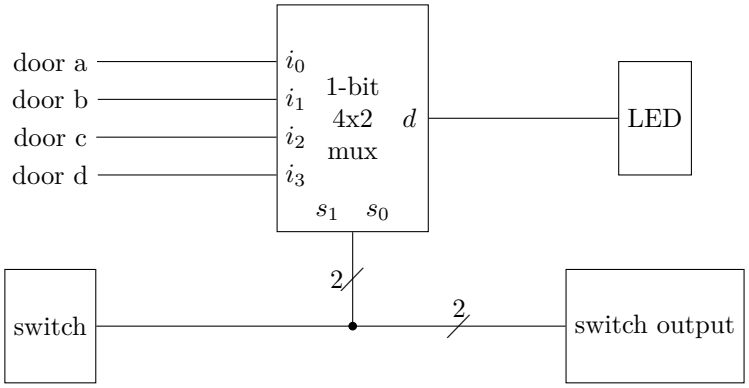


Problem 3.

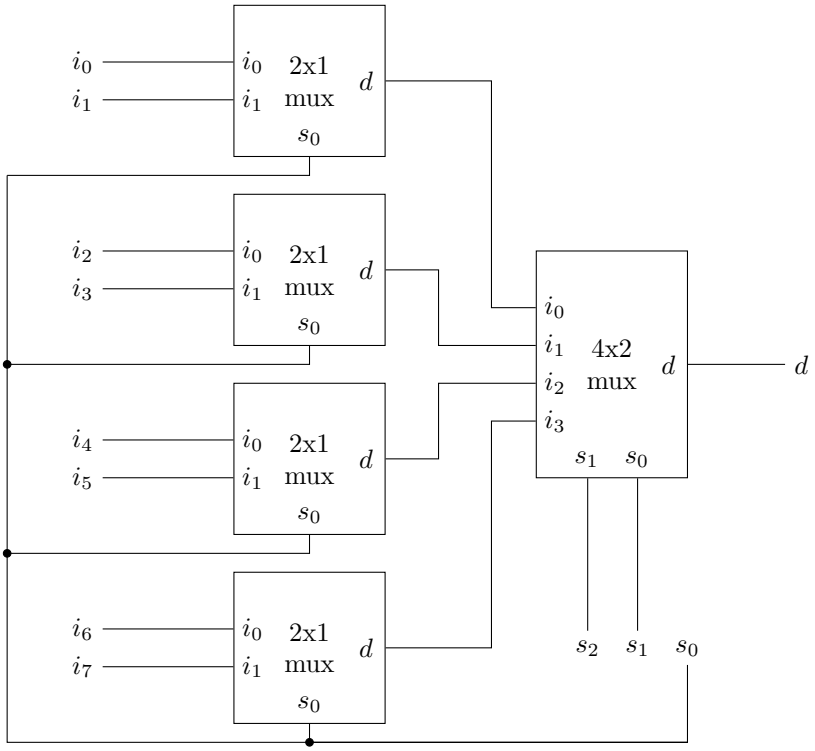
Suppose m_i, i=0,1,2,3,4, represents the ith bit of the current tire pressure.



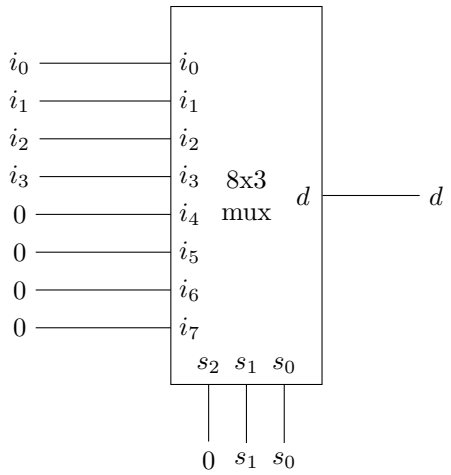
Problem 4.



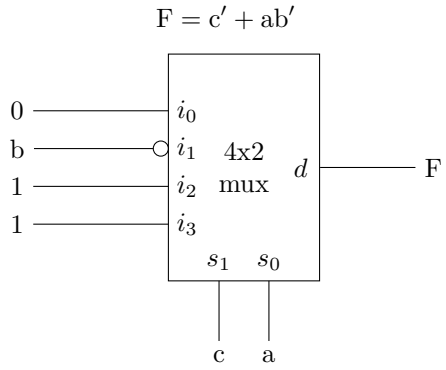
Problem 5.



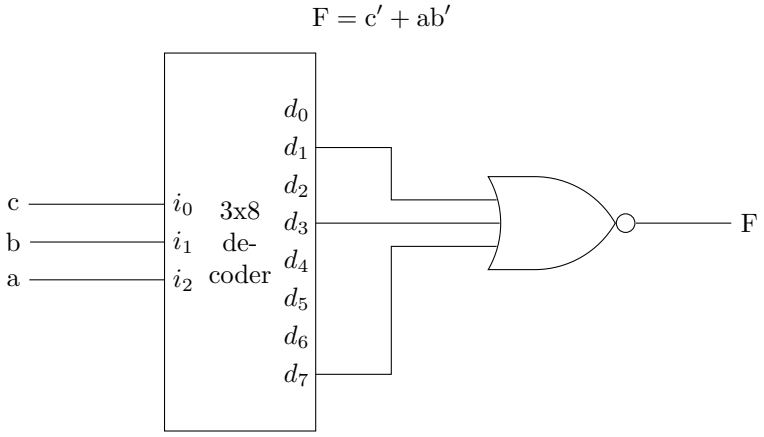
Problem 6.



Problem 7.

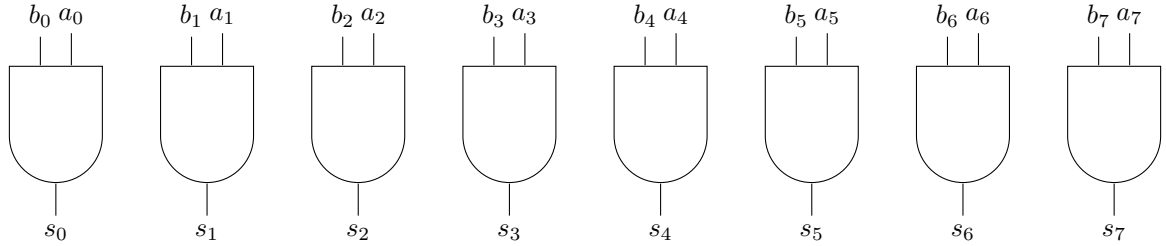


Problem 8.

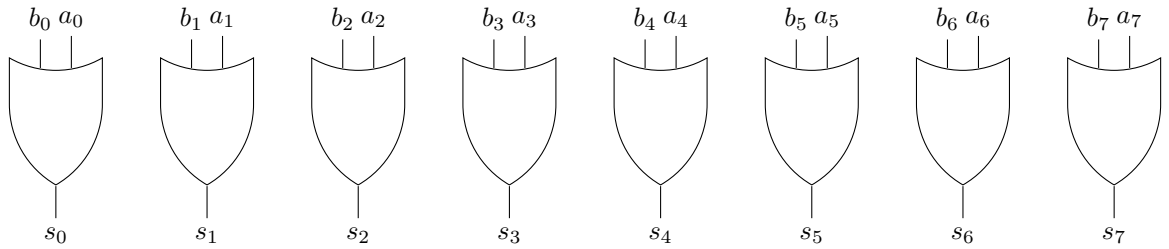


Problem 9.

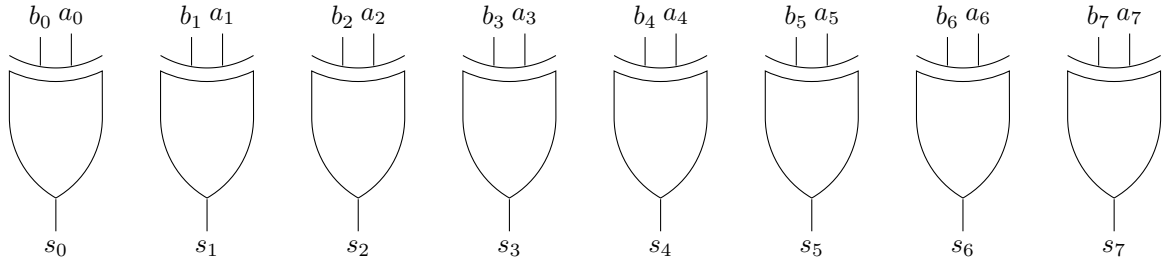
The inner design of 8-bit and gate:



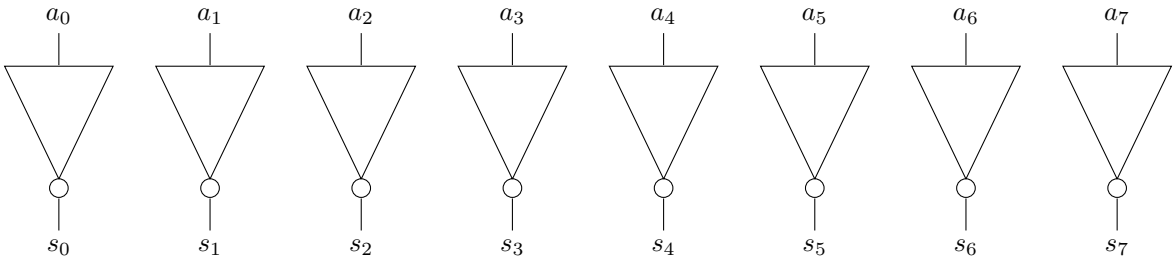
The inner design of 8-bit or gate:



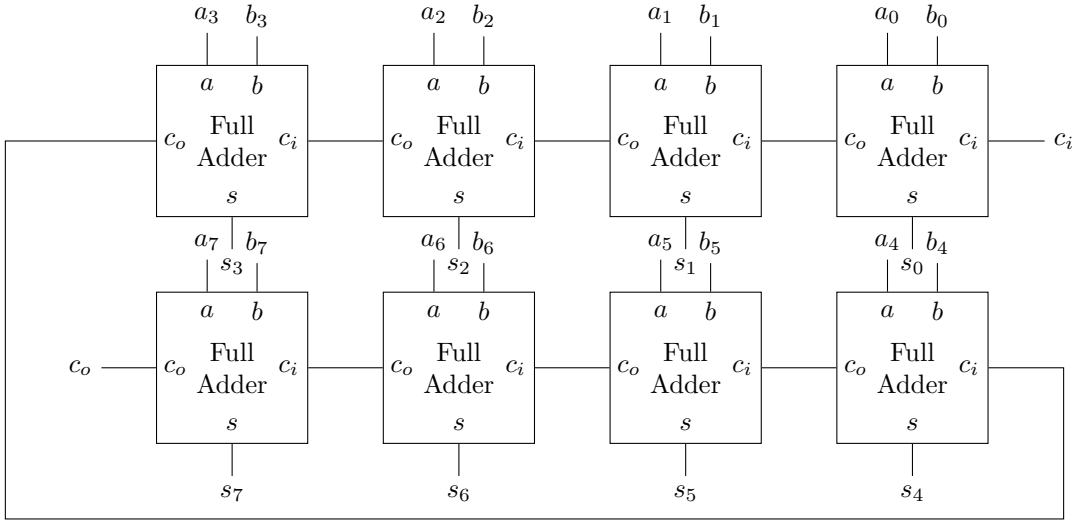
The inner design of 8-bit xor gate:



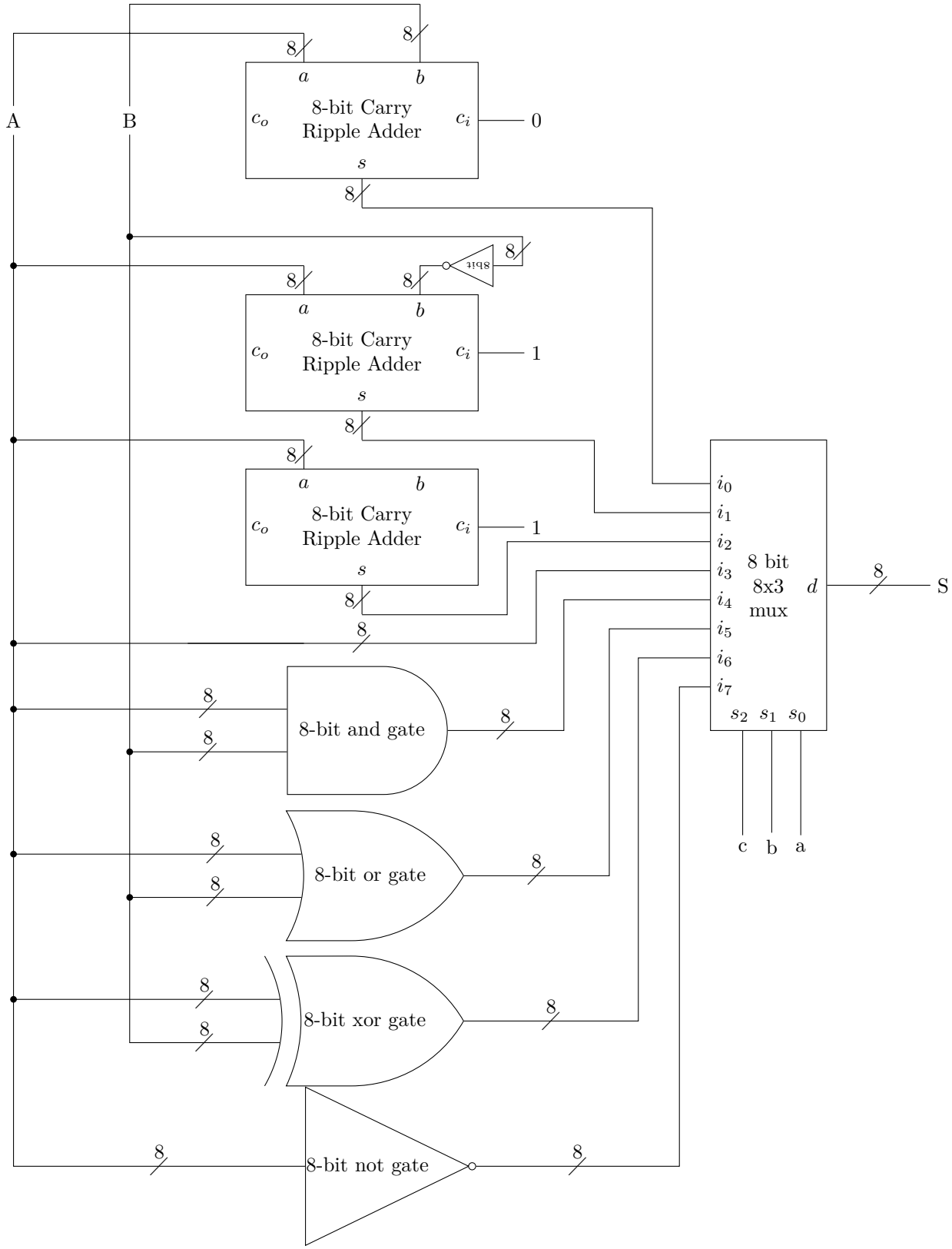
The inner design of 8-bit not gate:



The inner design of 8-bit Carry Ripple Adder:



The design of ALU:


A
B
8
a
b
c_o
8-bit Carry
Ripple Adder
c_i
0
s
1
1
8bit
i_0
i_1
i_2
i_3
i_4
i_5
i_6
i_7
8 bit
8x3
mux
d
S
s_2 s_1 s_0
c b a
8-bit and gate
8-bit or gate
8-bit xor gate
8-bit not gate

Problem 10.

$$t_a = t_b = 0.5 + 1 + 0.5 + 0.75 + 0.5 + 1 + 0.5 = 4.75\,\text{ns}$$

$$t_c = 0.5 + 0.75 + 0.5 + 1 + 0.5 = 3.25\,\text{ns}$$

One of the critical paths is shown below.