Task 1: Data Rep. and Boolean logic

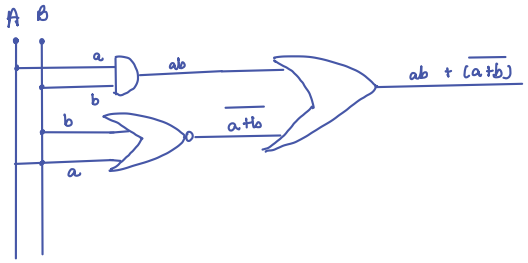
Save this document in your repository for Unit 2 with name:
data_rep_boolean_log.md

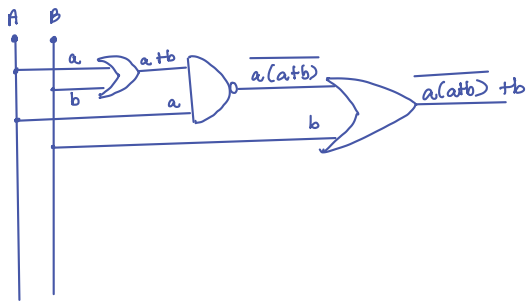
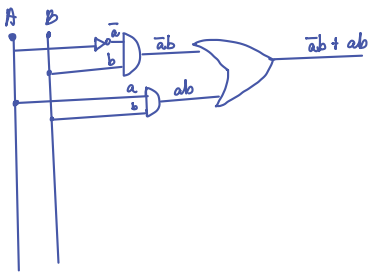
🤔 Resources (Learning Log):

4	Notes Topic 2:	Computer Architecture
5	Boolean Algebra	Video about boolean algebra
6	Examples Base Conversion	Whiteboard notes on conversion of numbers with different bases

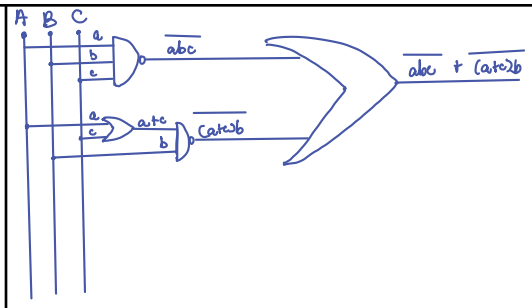
Boolean Logic

Draw the circuit for the boolean equations provided

Boolean Equation	Circuit
$AB+\overline{(A + B)}$	

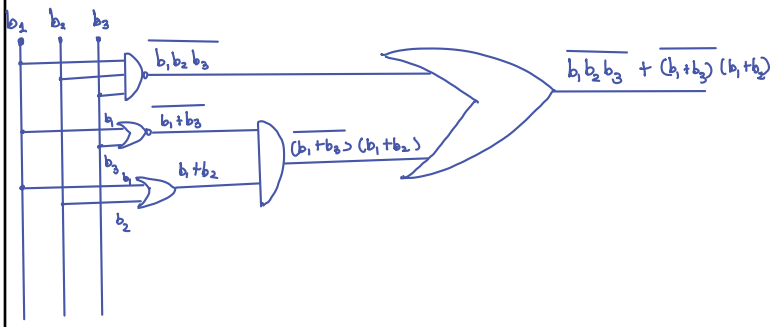
$\overline{A(A + B)} + B$	
((not A) and B) or (A and B)	

$\overline{ACB} + \overline{(A + C)B}$



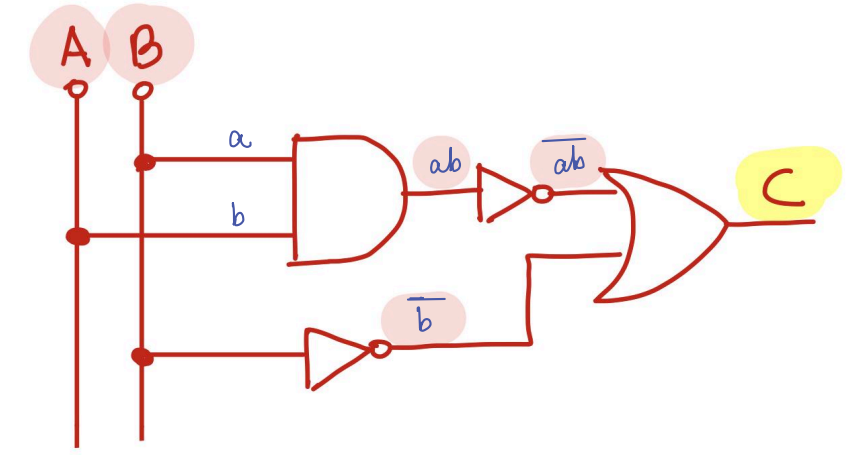
[HL]

$\overline{b1b2b3} + \overline{(b1 + b3)}(b1 + b2)$

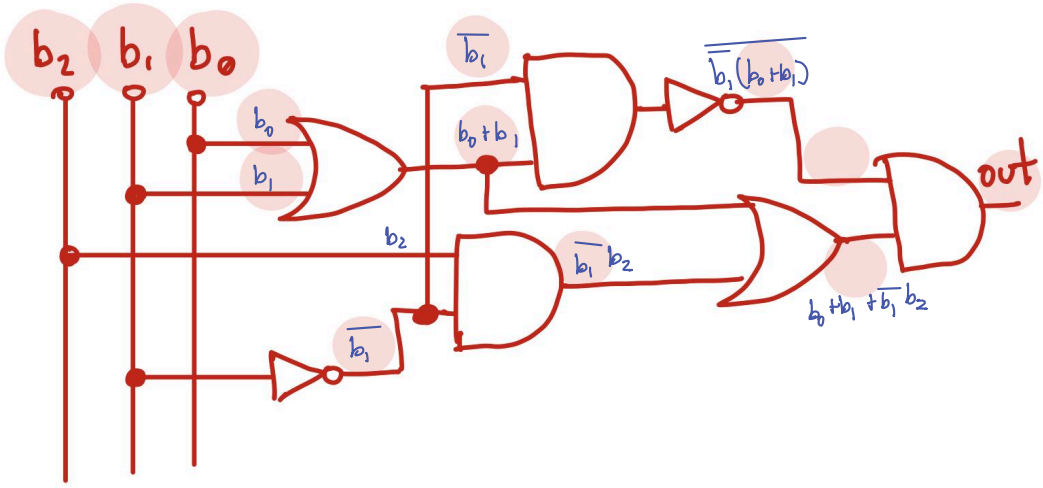


Get the Equation

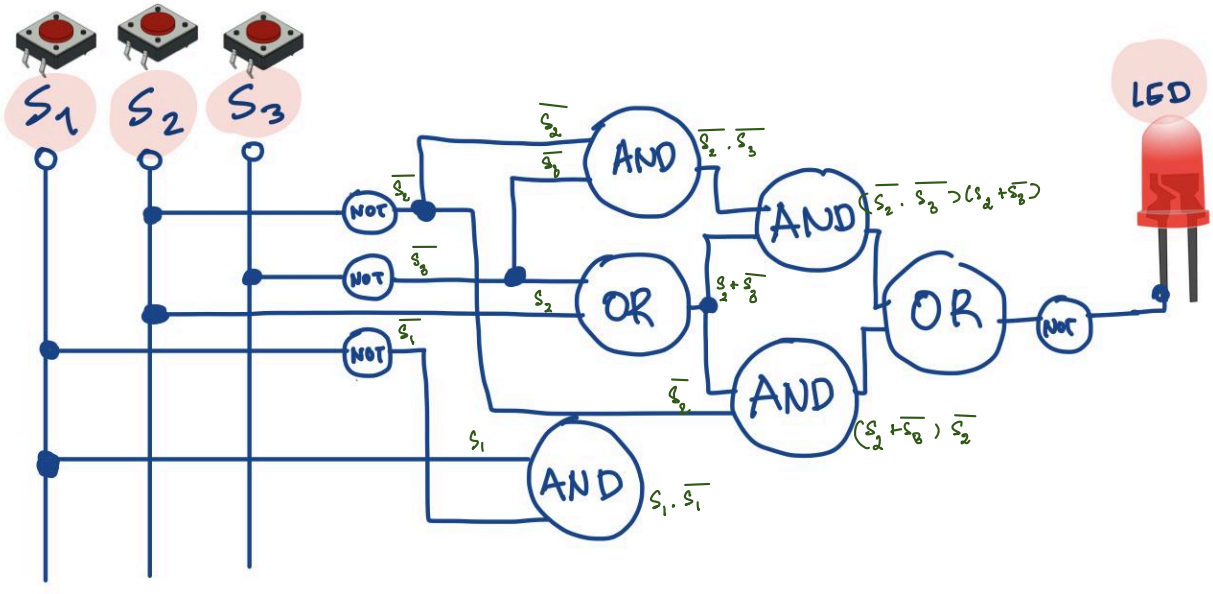
Write the boolean equation for the circuit shown



$C = \overline{b} + \overline{ab}$



$out = (b_0 + b_1 + \overline{b_1}\,b_2)\left(\overline{\overline{b_1}(b_0 + b_1)}\right)$



LED = $\overline{(\overline{S_2}\cdot\overline{S_3})(S_1+\overline{S_3}) + (S_2+\overline{S_3})\,\overline{S_2}}$

Truth table

Write the truth table for the equations below

Boolean Equation	Truth Table
X = A and B	
Out = input1 or input2	
Light = $\overline{S_1} + \overline{(S_2 + S_3)} + S_1 S_2 \overline{S_3}$	
PARITY = A⊕B⊕C	#Parity checker
[HL] Login = $\overline{P_1 P_2 P_3} + \overline{(P_3 \overline{P_2} P_1)} + \overline{P_1 + P_3}$	

Data Conversion

Information can be represented in different systems, for example the number `10` in decimal (system base 10) can be represented in binary (system base 2) as `1010` or `12` in base 8.

It is critical for you to understand how to represent information in different ways, this will help you visualize how the computer processes data.

General Rule:

Decimal → Binary: Divide the decimal by the base number
Take the remainders and read from bottom to top.

Binary → Decimal: write a table with base^power of available slot

If your base is 2^n → divide binary into smaller parts → multiple + add

Original Number	Convert to
256 (Decimal) Base 10	Base 2 (Binary) $256 = 2^8$ → 100000000 → base 8 (2^3) * for the powers of 2^n → "1" + "0" × n 100 000 000 4 0 0 $256_{(10)} = 1000\ 000\ 00_{(2)}$ $= 400_{(8)}$ Base 4 256 | 4 16 | 4 → 10000 (4) 0 0 1 Base 6 256 | 6 16 | 4 2 4 7 | 0 1 | 1 → $1104_{(6)}$
433 (Base 5)	Base 10 (Decimal) want from base ≠2 → Decimal : Draw table ở nhanh lên 5^2 | 5^1 | 5^0 4 | 3 | 3 $4 \times 25 + 15 + 3$ $= 118_{(10)}$ Base 8 (Octal) 118 | 2 58 - 0 29 - 1 14 - 1 → 0011 1011 (2) = $166_{(8)}$ 7 - 0 3 - 1 1 - 1 Base 2^4 16 (Hexadecimal) → 0011 1011 (2) = $076_{(16)}$
FA32 (Base 16)	Base 10 256 16^3 | 16^2 | 16^1 | 16^0 F | A | 3 | 2 → $15 \times 4096 + 10 \times 256 + 3 \times 16 + 2$ 61440 2560 48 2 64050 (10)

Base 2

64054 | 2

32027 – 0
16013 – 1
8006 – 1
4003 – 0
2001 – 1
1000 – 1
500 – 0
250 – 0
125 – 0
62 – 1
31 – 0
15 – 1
7 – 1
3 – 1
1 – 1

→ 1 111 101 000 110 110 (2)

1 7 5 0 6 6 (8)

Base 8

Truth Table:

①

2^1 a	2^0 b	x (a∨b)
0	0	0
0	1	0
1	0	0
1	1	1

②

2^1 input$_1$	2^0 input$_2$	out (i_1+i_2)
0	0	0
0	1	1
1	0	1
1	1	1

③

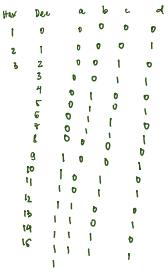
2^2 S_1	2^1 S_2	2^0 S_3	$\overline{S_1}$	$\overline{S_2+S_3}$	$\overline{S_1S_2S_3}$	Light
0	0	0	1	1	1	1
0	0	1	1	0	1	1
0	1	0	1	0	1	1
0	1	1	1	0	1	1
1	0	0	0	1	1	1
1	0	1	0	0	1	1
1	1	0	0	0	1	1
1	1	1	0	0	0	0

④

2^2 A	2^1 B	2^0 C	A⊕B	Parity
0	0	0	0	0
0	0	1	0	1
0	1	0	1	1
0	1	1	1	0
1	0	0	1	1
1	0	1	1	0
1	1	0	0	0
1	1	1	0	1

⑤

2^2 P_1	2^1 P_2	2^0 P_3	$\overline{P_1P_2P_3}$	$\overline{P_2P_1}$	$\overline{(P_3\overline{P_2P_1})}$	$\overline{P_1+P_3}$	Login
0	0	0	1	1	1	1	1
0	0	1	1	1	0	0	1
0	1	0	1	1	1	1	1
0	1	1	1	1	0	0	1
1	0	0	1	1	1	0	1
1	0	1	1	1	0	0	1
1	1	0	1	1	1	0	1
1	1	1	0	0	1	0	1



502 | 2

252 — 0
126 — 0
63 — 1
31 — 1
15 — 1
7 — 1
3 — 1
1 — 1

$502_{(10)} = 111110110_{(2)}$

$= 111110110$

1 F 6

0
1
10

$3220_{(4)} \rightarrow ?_{(2)}$?=

4^3	4^2	4^1	4^0
3	2	1	0

$= 3\times4^3 + 2\times16 + 4$

$= 384 + 32 + 4 = 228$

(long 8 bit)

Instead of dividing 228 by 2, we can use the table

128	64	32	16	8	4	2	1
1	1						

$1011_{(5)} \rightarrow$ binary $= 01000011 = 103_{(8)} = 83_{(16)}$

125	25	5	1
1	0	1	1

$125 + 5 + 1 = 131$

131 | 2
65 — 1
32 — 1
16 — 0
8 — 0
4 — 0
2 — 0
1 — 0

$FAB = 1111\,1010\,1011_{(2)} \rightarrow 4011_{(10)}$

16^2	16^1	16^0
F	A	B

$3840 + 160 + 11$

$= 4011$

15
×15
75
30
75
30
3840

Exit Ticket:

$00 - 45 - E2 - 7D - 4B - 18_{(16)}$

$0 - 69 - 236 - 112 - 71 - 24_{(10)}$

$16\times4 + 5 = 69$

$16\times14 + 2 = 234 + 2 = 236$

$7\times16 + 13 = 112$

$4\times16 + 11 = 71$

$16 + 8 = 24$