

Half adder:

for input A & B

$$\text{Sum} = A \oplus B$$

$$\text{Carry} = AB$$

Half Subtractor:

for input A & B,

$$\text{Difference} = A \oplus B$$

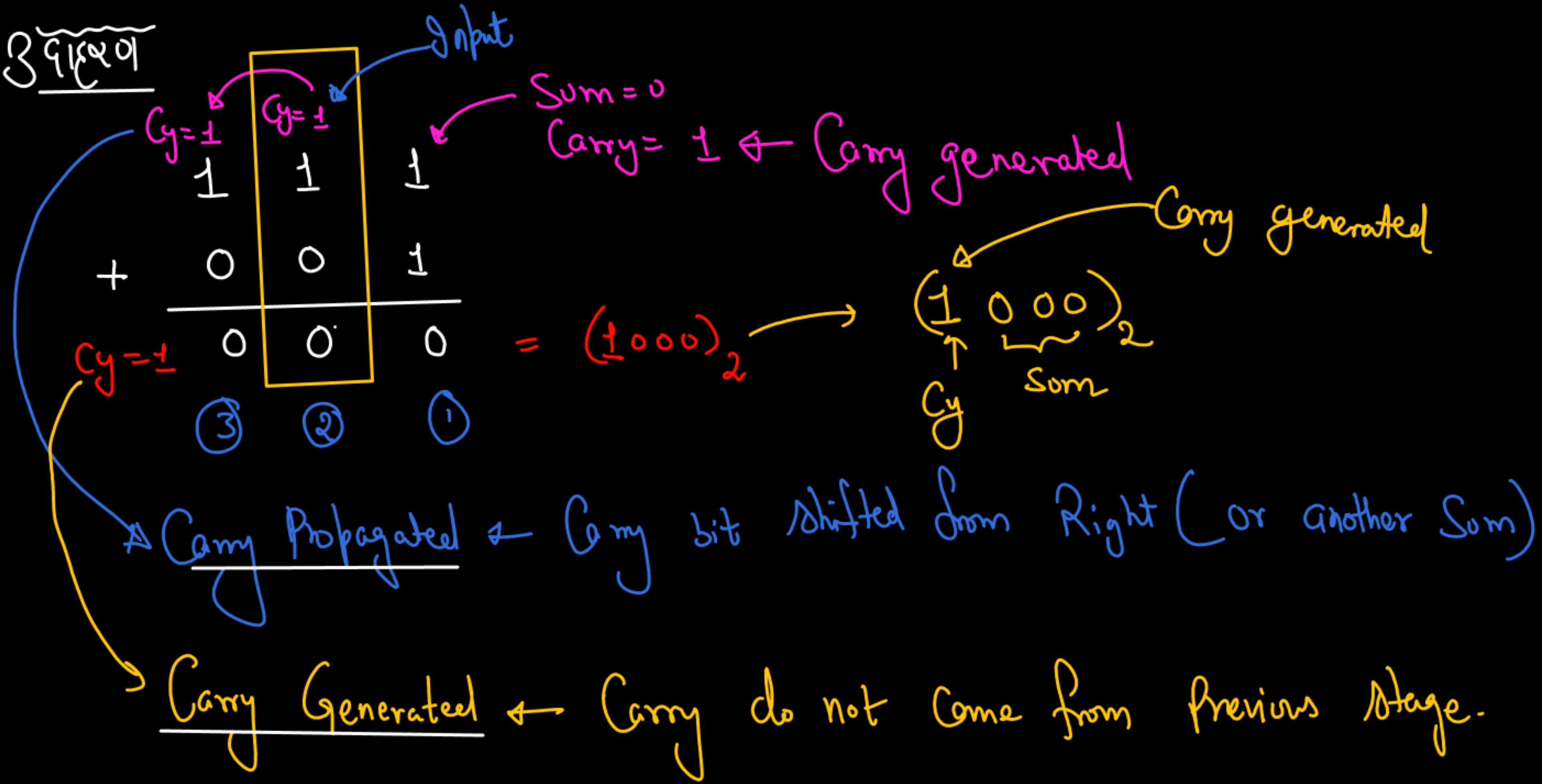
$$\text{Borrow} = \bar{A}B$$

Full adder: A, B, C_{in}

$$\text{Sum} = A \oplus B \oplus C_{in}$$

$$\begin{aligned} C_{out} &= AB + BC_{in} + AC_{in} \leftarrow \text{K-Maps (AND-OR)} \\ &= (A \oplus B)C_{in} + AB \end{aligned}$$

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full adder using Half Adder:

Half adder:

for input A & B

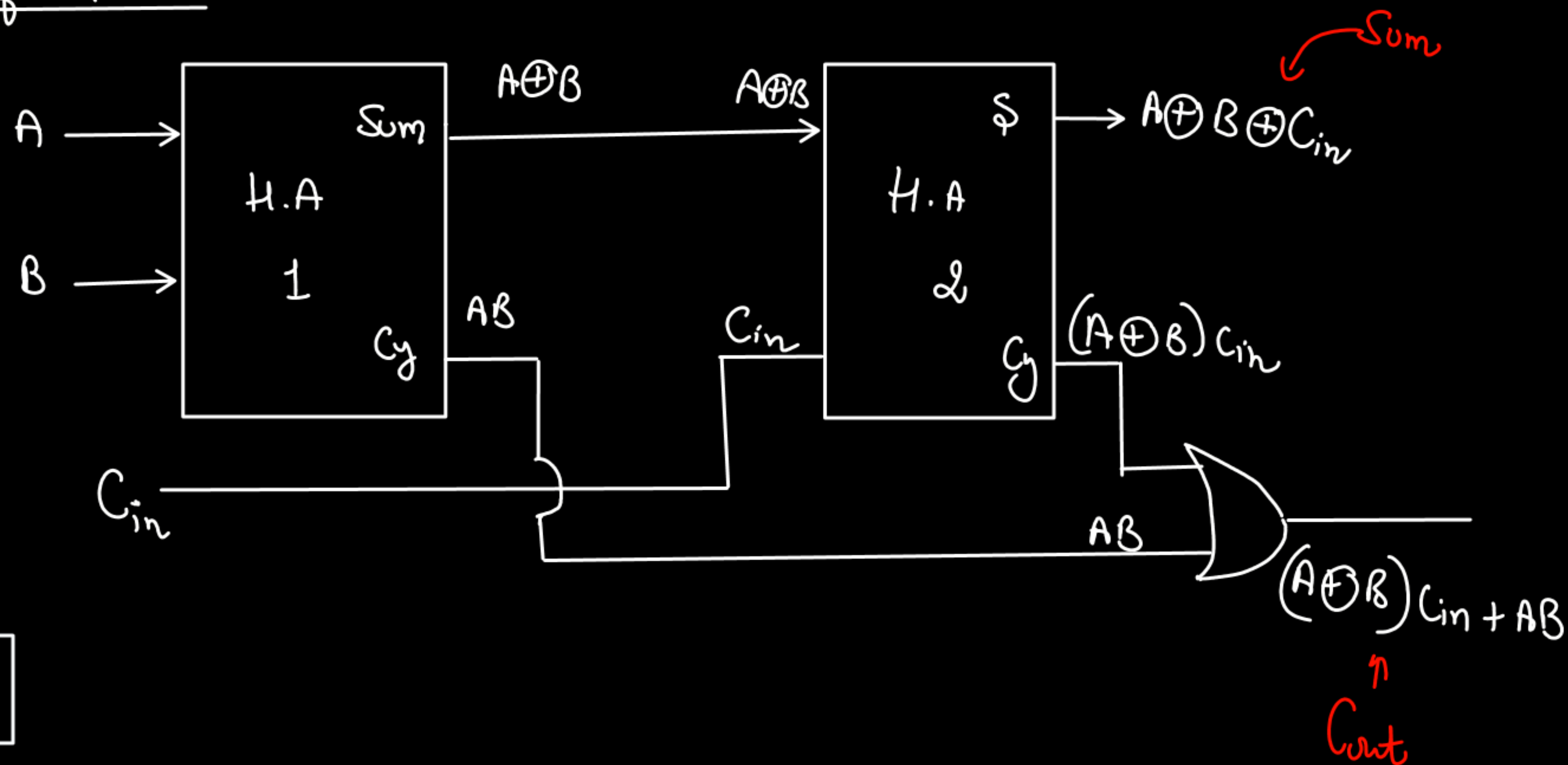
$$\text{Sum} = A \oplus B$$

$$\text{Carry} = AB$$

full adder: A, B, C_{in}

$$\text{Sum} = A \oplus B \oplus C_{in}$$

$$\begin{aligned} \text{Cout} &= AB + BC_{in} + AC_{in} \leftarrow \text{K-Maps (AND-OR)} \\ &= (A \oplus B)C_{in} + AB \end{aligned}$$

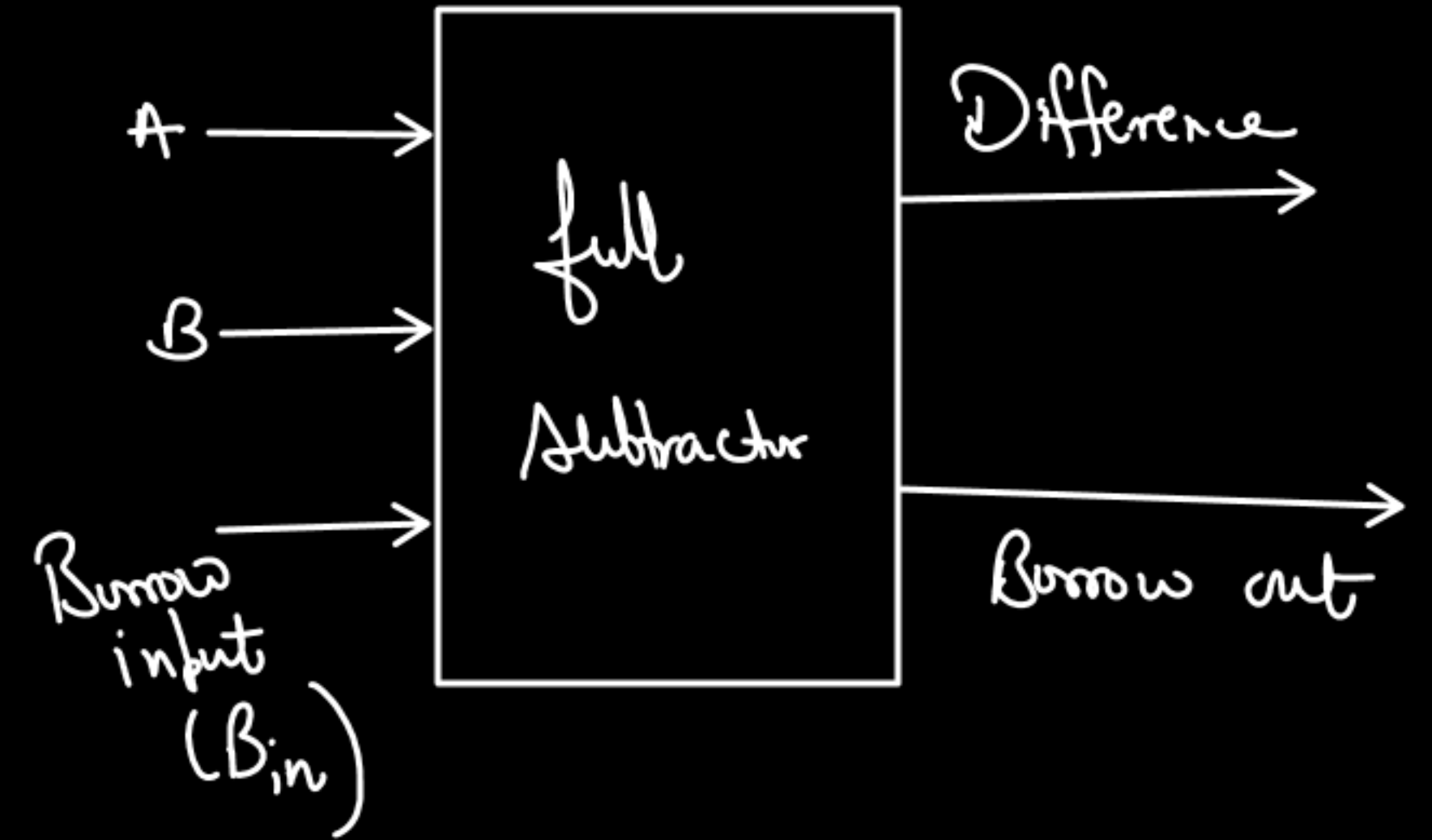


Full Subtractor:

→ Calculate difference b/w 3 bits.

$$\text{diff} = A - B - B_{in}$$

	A	B	B _{in}	Diff	Bout
0	0	0	0	0	0
1	0	0	1	1 m ₁	1 m ₁ ✓
2	0	1	0	1 m ₂	1 m ₂
3	0	1	1	0	1 m ₃
4	1	0	0	1 m ₄	0
5	1	0	1	0	0
6	1	1	0	0	0
7	1	1	1	1 m ₇	1 m ₇



$$\text{diff} = \sum m(1, 2, 4, 7) \leftarrow \text{Cubbing Not possible}$$

$$d = A \oplus B \oplus B_{in} \leftarrow \text{Same as sum}$$

$$\text{Borrow out} = \sum m(1, 2, 3, 7)$$

$$Borrow_{out} = \sum m(1, 2, 3, 7)$$

A \ B B _{in}		B B _{in}			
		$\bar{B}\bar{B}_i$ 00	$\bar{B}B_i$ 01	$B\bar{B}_i$ 11	BB_i 10
\bar{A} 0	0		1	1	1
A 1	4			1	

$\bar{A}B$ (points to minterms 1, 2, 3)
 $\bar{A}B_i$ (points to minterm 1)
 BB_i (points to minterm 7)

$$\begin{aligned}
 f &= \bar{A}B + \bar{A}B_i + BB_i \\
 &= \bar{A}B + B_i(\bar{A} + B)
 \end{aligned}$$

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DYS

$$\begin{aligned}
 \text{Difference} &= A \oplus B \oplus B_{in} \\
 B_{out} &= \bar{A}B + B_{in}(\bar{A} + B)
 \end{aligned}$$

$$B_{out} = \sum m(1, 2, 3, 7)$$

$m_1 \quad m_2 \quad m_3 \quad m_7$

$$B_{out} = \underbrace{\bar{A}\bar{B}B_{in}}_{m_1} + \underbrace{\bar{A}B\bar{B}_{in}}_{m_2} + \underbrace{\bar{A}BB_{in}}_{m_3} + \underbrace{AB B_{in}}_{m_7}$$

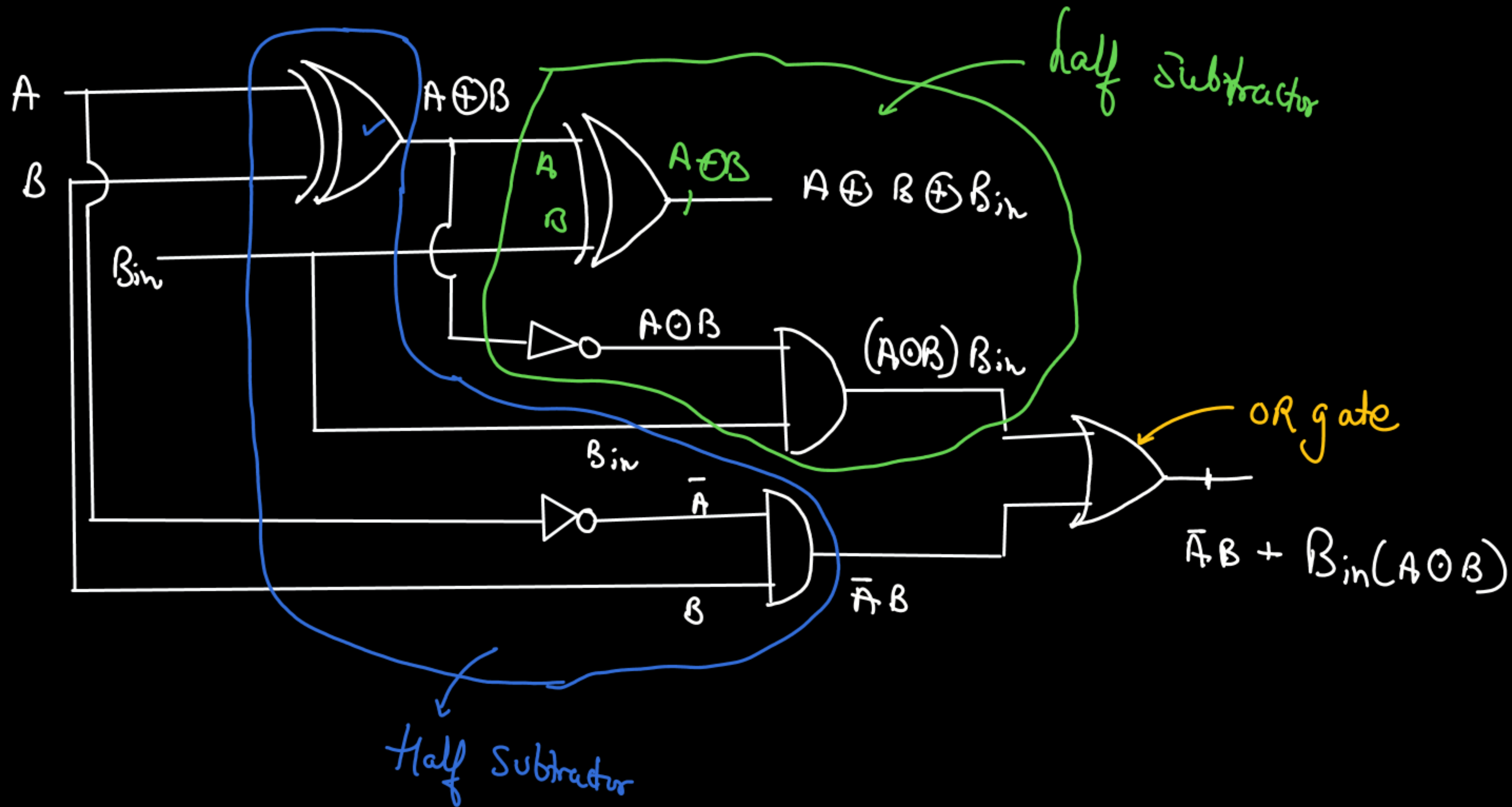
$$B_{in}(\bar{A}\bar{B} + AB) + \bar{A}B(\bar{B}_{in} + B_{in})$$

$$B_{out} = B_{in}(A \odot B) + \bar{A}B$$

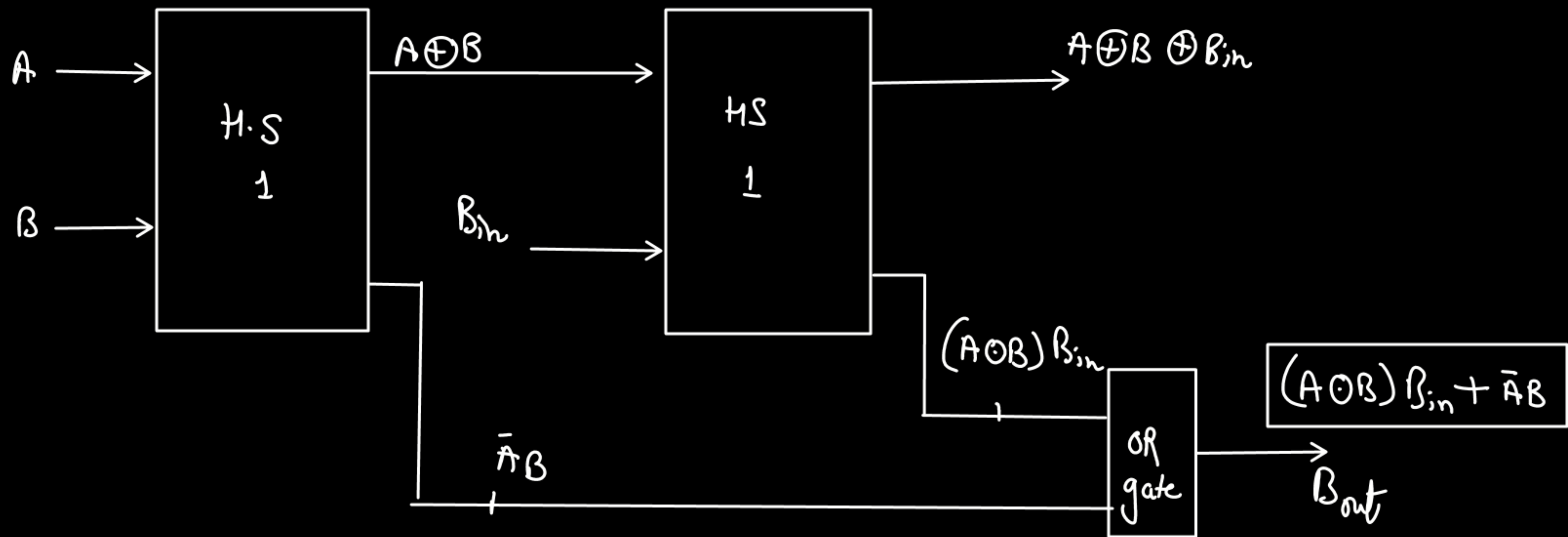
$$\text{Diff} = A \oplus B \oplus B_{in}$$

$$B_{out} = \underline{B_{in} (A \odot B)} + \bar{A} B$$

Full Subtractor = 2 half Subtractor + OR gate



full Subtractor using Half Subtractor



Block Diagram

tomorrow

↳ Parallel Circuit →

↳ Code Converter (Introduction) ← Imp