

Single
or Cell

Design of a Full Adder (1bit)

Step 1: Generate truth table

With 3 inputs, we have 8 different combinations.

Inputs
A, B, Cin

Outputs
S, Cout

	Inputs			Outputs	
	A	B	Cin	S	Cout
1	0	0	0	0	0
2	0	0	1	1	0
3	0	1	0	1	0
4	0	1	1	0	1
5	1	0	0	1	0
6	1	0	1	0	1
7	1	1	0	0	1
8	1	1	1	1	1

Binary 10b

10b

A=1, B=0
Cin=0

Binary

1
0
0
1

Step 2: Determine the logical Expression

$$S = \bar{A} \bar{B} C_{in} + \bar{A} B \bar{C}_{in} + A \bar{B} \bar{C}_{in} + A B C_{in}$$

$$C_{out} = \bar{A} B C_{in} + A \bar{B} C_{in} + A B \bar{C}_{in} + A B C_{in}$$

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Step 3. Simplify Equation or logical Expression

$$S = \bar{A}\bar{B}C_{in} + \bar{A}B\bar{C}_{in} + A\bar{B}\bar{C}_{in} + ABC_{in}$$

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

Simplify Using K-map

	BC _{in}			
	00	01	11	10
A				
0	0	1	0	1
1	1	0	1	0

$$C_{out} = \bar{A}BC_{in} + A\bar{B}C_{in} + A\bar{B}\bar{C}_{in} + AB\bar{C}_{in}$$

$$= AC_{in} + AB + BC_{in}$$

Simplify Using K-map

	BC _{in}			
	00	01	11	10
A				
0	0	0	1	0
1	0	1	1	1

Imp-1 (grouping 01 and 11 in row A=1)

Imp-2 (grouping 11 and 10 in row A=1)

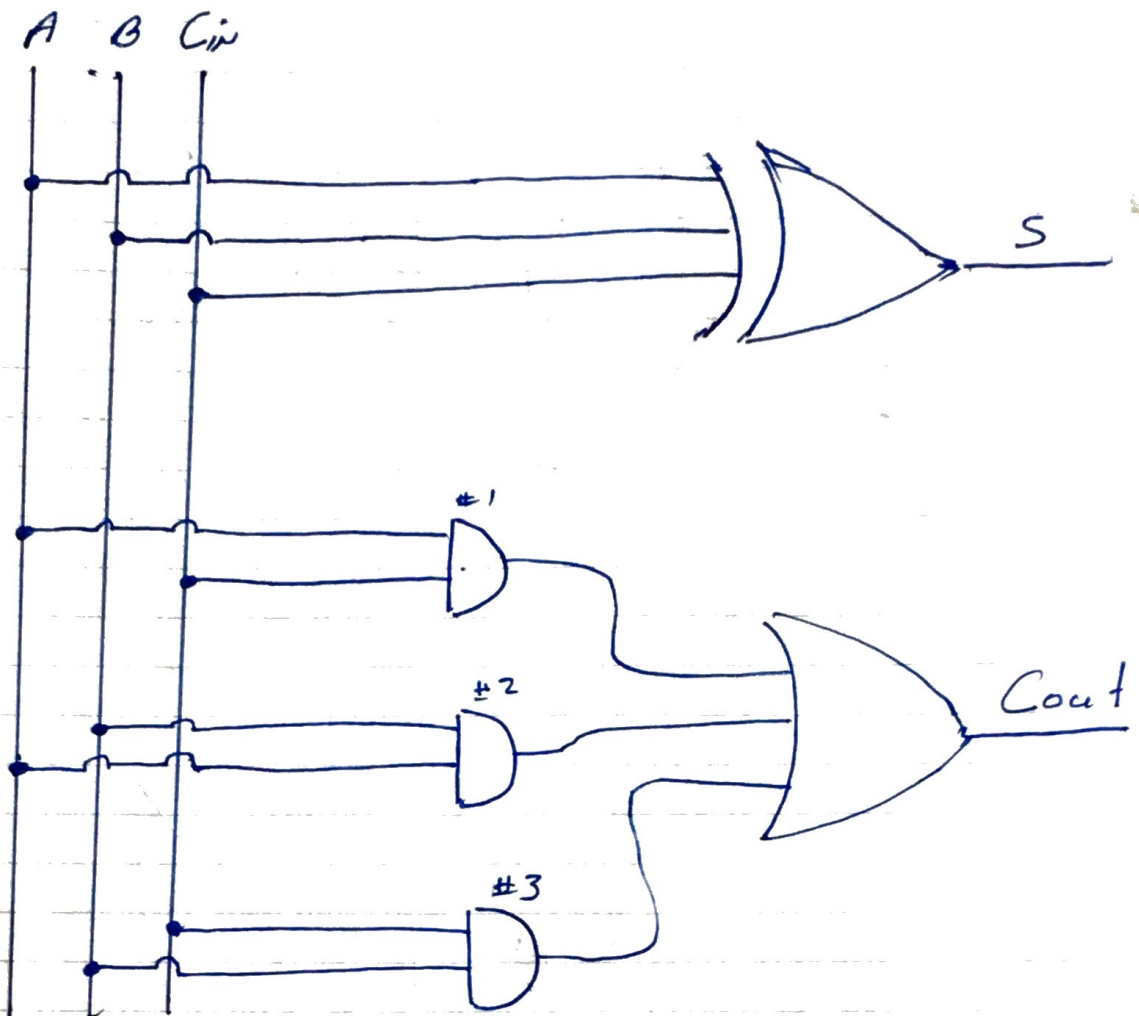
Imp-3 (grouping 11 in column A=0)

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Step 4: Design of the Circuit

✓ $S = A \oplus B \oplus C_{in}$

✓ $C_{out} = \underbrace{AC_{in}}_{AND1} + \underbrace{AB}_{AND2} + \underbrace{BC_{in}}_{AND3}$



Configured

NAND



Inverter



X	X	Y
0	0	1
1	1	0

X	Y
0	1
1	0

