Digital Electronics

Experiment – 5

Name: Ayush Jain

SAP ID: 60004200132

Div: B1 **Branch:** Computer Engineering

DE Expt-5

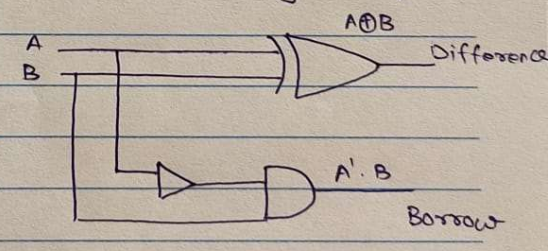
Aim: To verify the truth table of half subtractor and full subtractor by using XOR, NOT and AND gates for half subtractor and XOR, AND, NOT and OR gates for full subtractor.

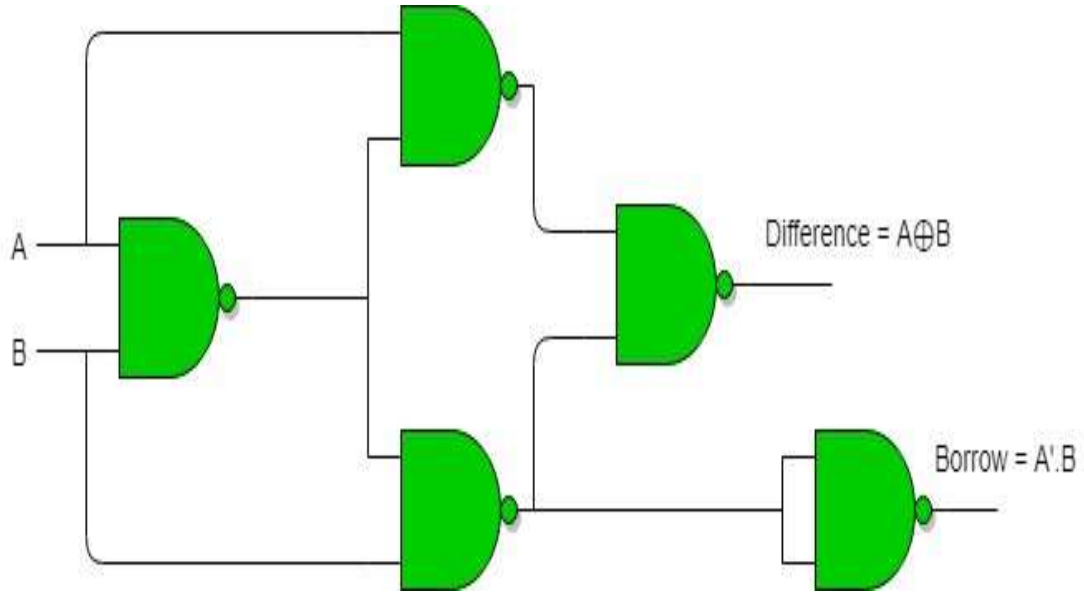
Theory:

Half Subtractor: Half subtractor is a combinational circuit which is used to perform subtraction of two binary numbers. If we assume A and B as the two bits whose subtraction is to be performed, a truth table for half subtractor with A, B as inputs and difference, borrow as outputs can be tabulated. The difference output is similar to that of an X-OR operation. While borrow output is similar to an AND operation between A' and B

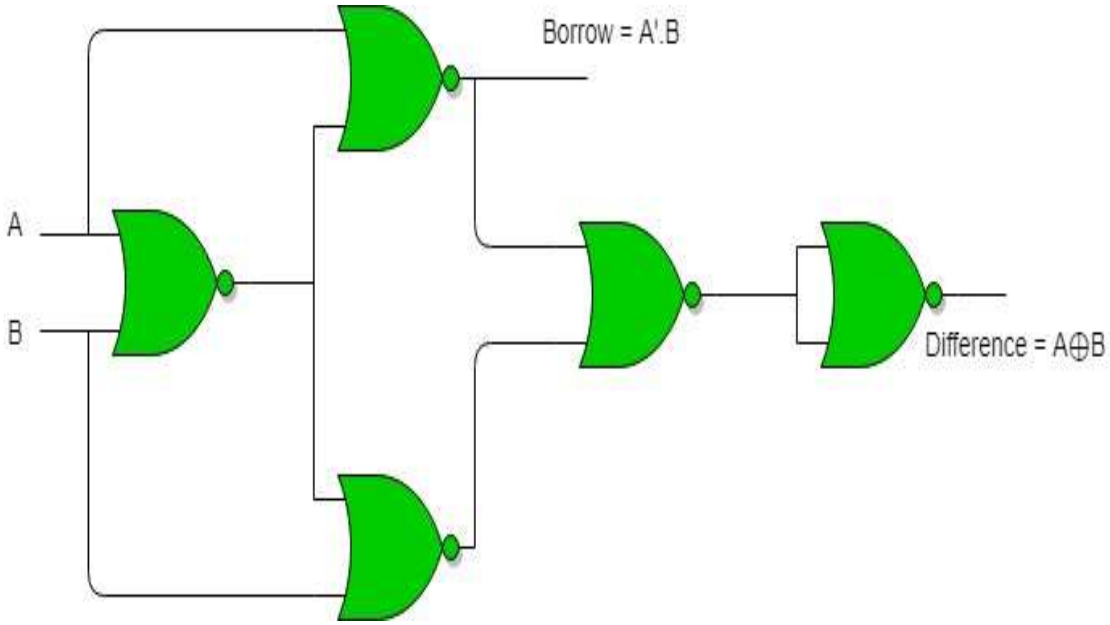
TRUTH TABLE			
INPUT		OUTPUT	
A	B	Difference	Borrow
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

Half subtractor logic diagram



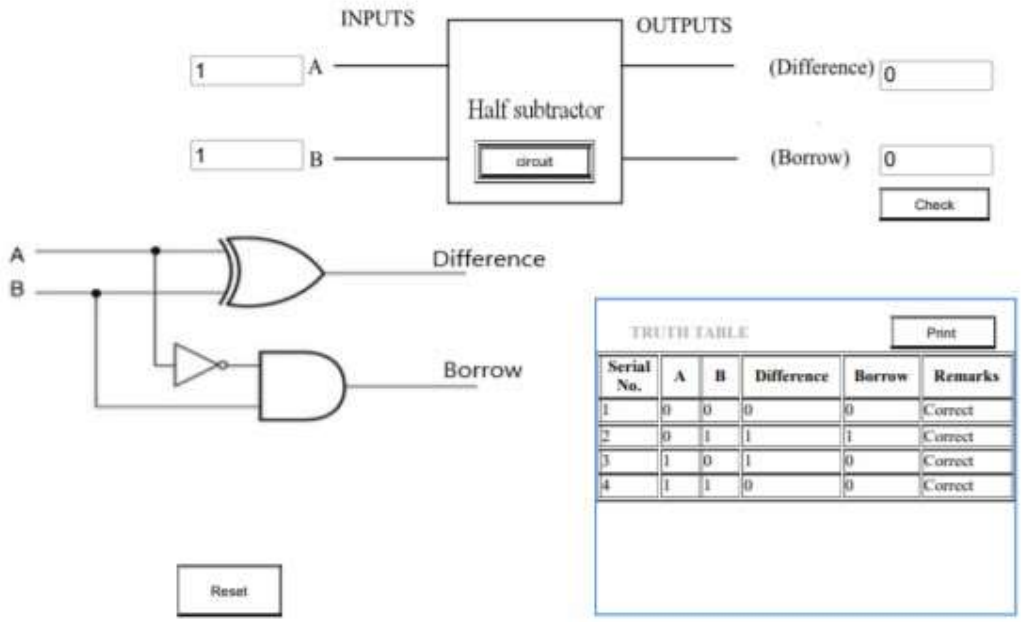


Realization of Half Subtractor using NAND gates



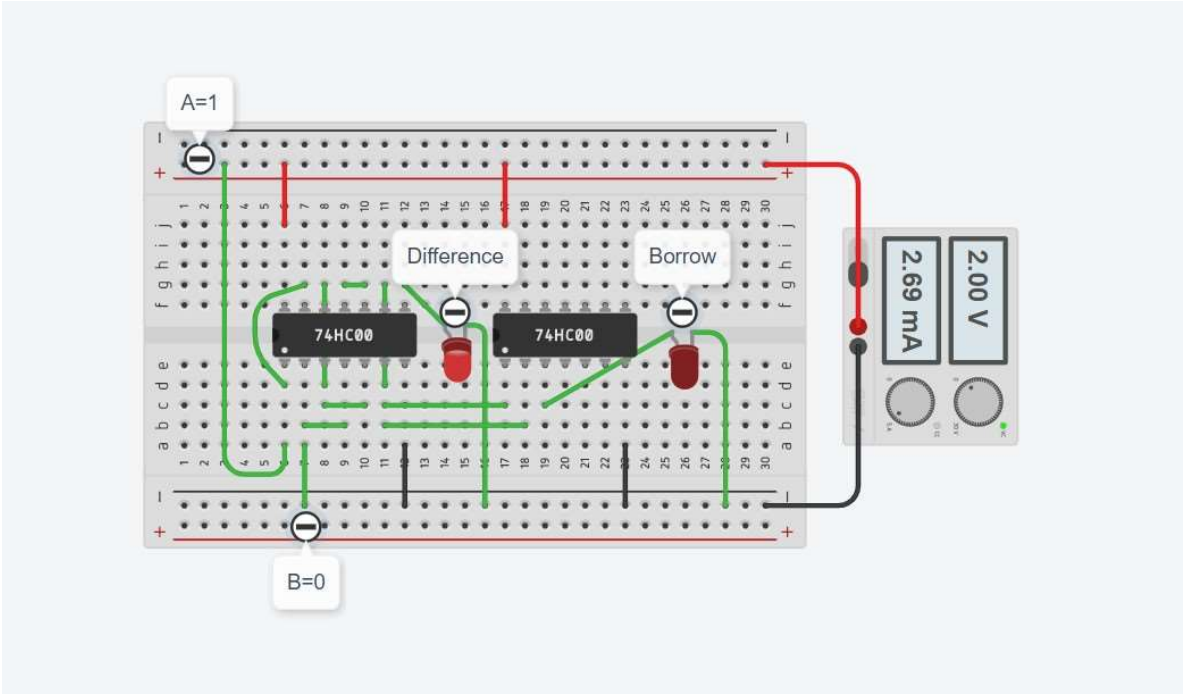
Realization of Half Subtractor using NOR gates

Verification of truth table for Half Subtractor Circuit



Serial No.	A	B	Difference	Borrow	Remarks
1	0	0	0	0	Correct
2	0	1	1	1	Correct
3	1	0	1	0	Correct
4	1	1	0	0	Correct

Tinkercad:



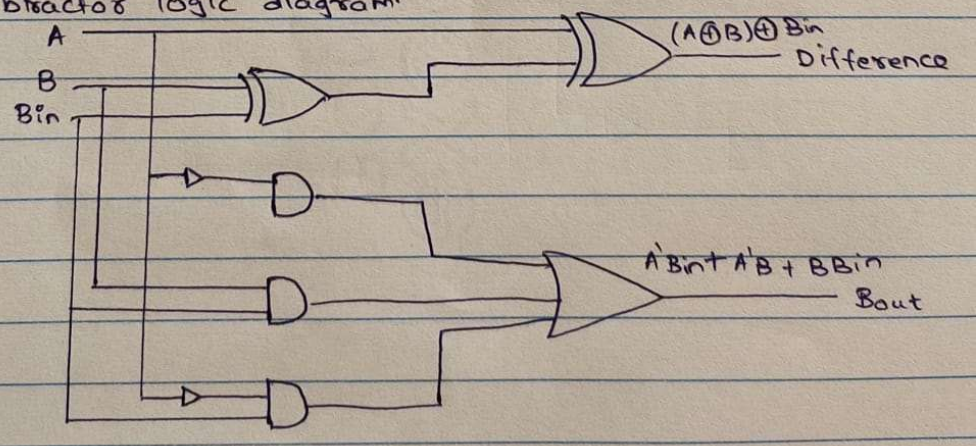
Half Subtractor using NAND gate with inputs 1 and 0

Full Subtractor: Full subtractor is a digital circuit used to perform subtraction of three binary bits. A, B, Bin are the three input bits and difference and Bout is the output. Bin is borrow from half subtractor and Bout is the output borrow. Difference is implemented using 2 X-OR gates $((A \oplus B) \oplus Bin)$ and Bout is $(A'Bin + A'B + BBin)$

TRUTH TABLE

INPUT			OUTPUT	
A	B	Bin	Difference	Bout
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

Full Subtractor logic diagram:



Full Subtractor

* K - MAP ($C = B_{in}$)

Difference

A \ BC	00	01	11	10
0	0	(1)	0	(1)
1	(1)	0	(1)	0

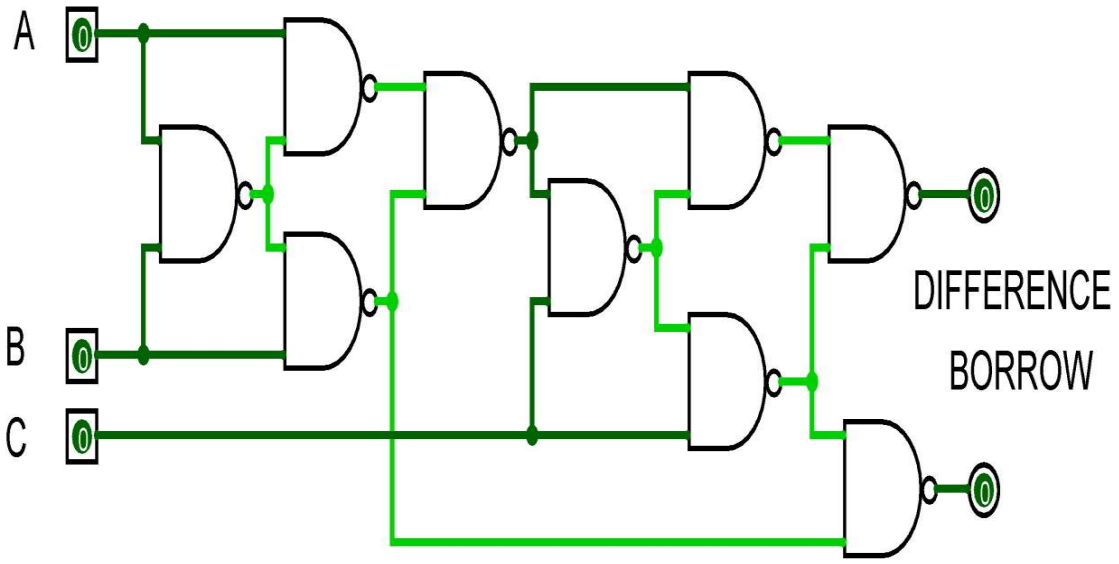
$\therefore$ Difference = $\bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C} + ABC$

$= (A \oplus B) \oplus C$

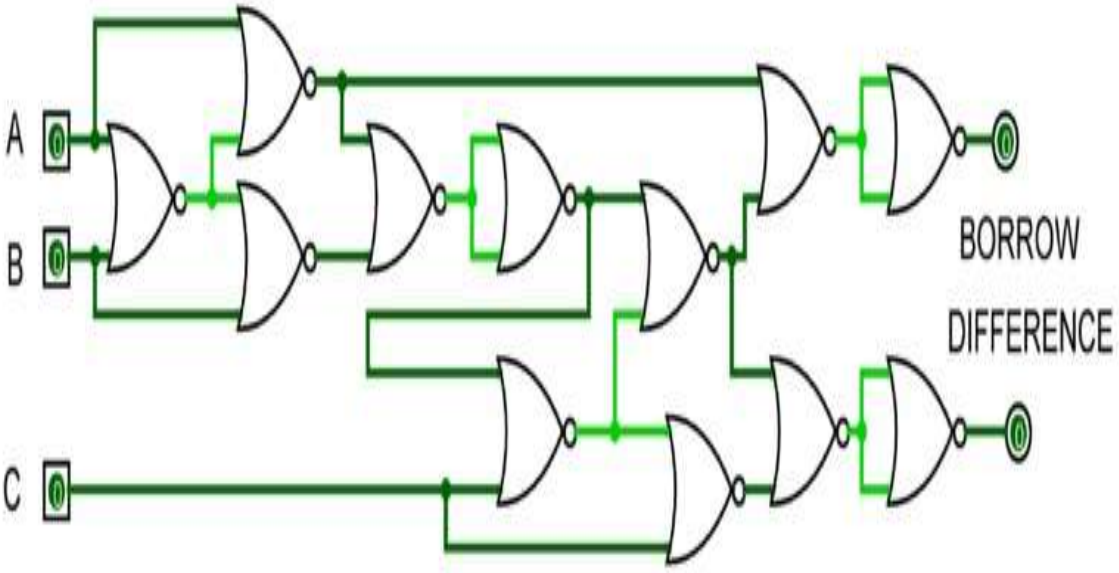
Borrow

A \ BC	00	01	11	10
0	0	1	1	1
1	0	0	1	0

$\therefore$ Borrow = $\bar{A}B + \bar{A}C + BC$

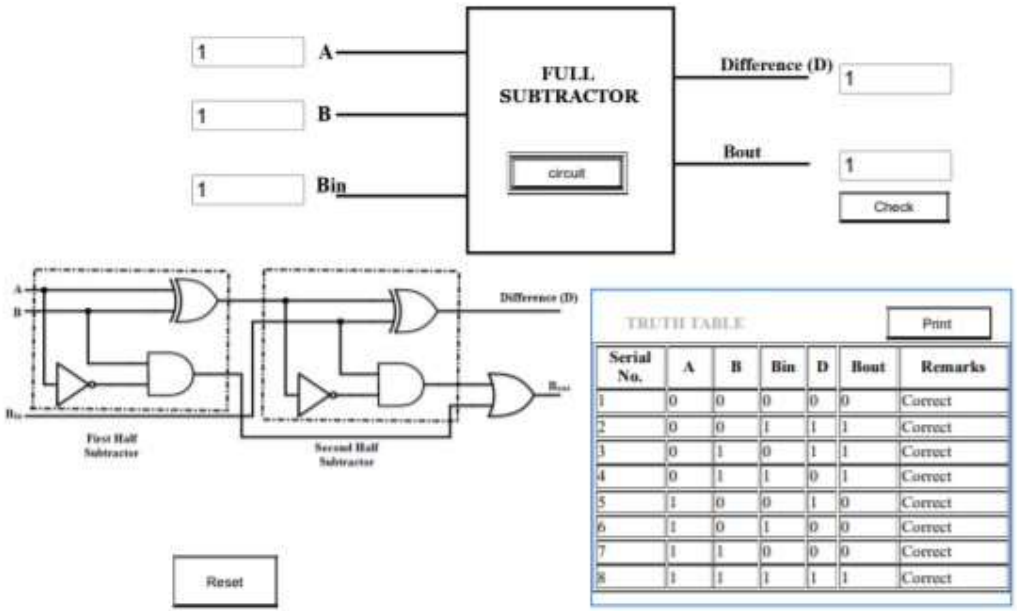


Realization of Full Subtractor using NAND gates



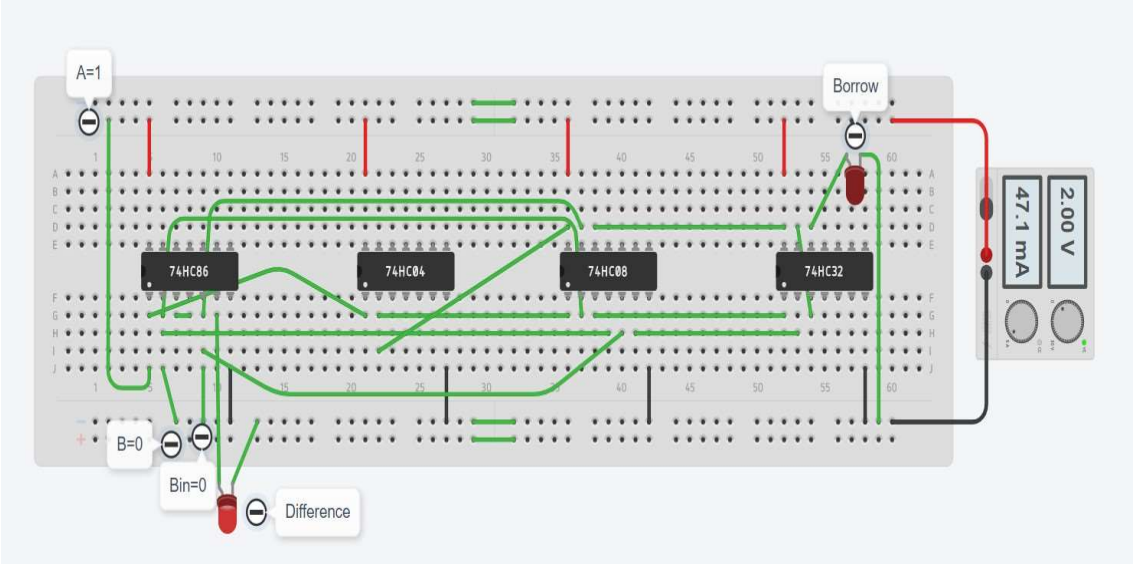
Realization of Full Subtractor using NOR gates

Verification of truth table for Full Subtractor Circuit



Serial No.	A	B	Bin	D	Bout	Remarks
1	0	0	0	0	0	Correct
2	0	0	1	1	1	Correct
3	0	1	0	1	1	Correct
4	0	1	1	0	1	Correct
5	1	0	0	1	0	Correct
6	1	0	1	0	0	Correct
7	1	1	0	0	0	Correct
8	1	1	1	1	1	Correct

Tinkercad:



Full Subtractor using XOR, NOT, AND, OR gates with inputs 1,0,0