Electronic Devices and Circuits Lab (EE2301) Experiment 9 : Boolean Function using Universal Gates

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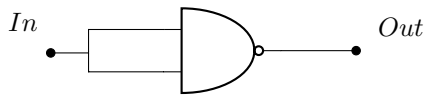
1 Aim

our aim here is to understand how to use Universal gates to make given Boolean function..

Universal Gate

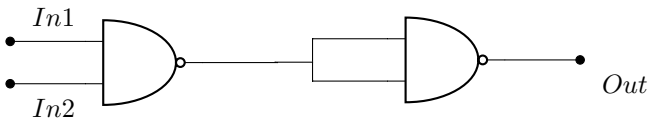
A Universal gate is a logic gate from which all other types of logic gates can be made. Some examples are NAND and NOR Gates.

NOT Gate using NAND Gate



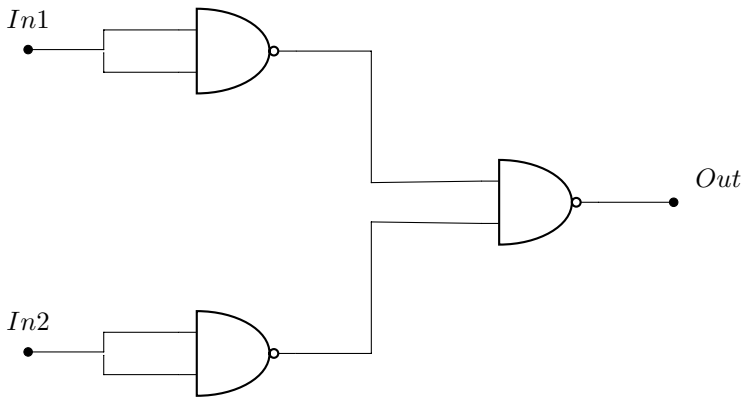
NOT Gate

AND Gate using NAND Gate



AND Gate

OR Gate using NAND Gate



OR Gate

• Now we have made above Logic gates using only NAND Gate which we will use to generate given boolean function derived from the below table.

Table for Logic Function

Input 1	Input 2	Output 1	Output 2
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

2 Problem statement(Group 1)

• Implement the above logic function in NgSPICE using NAND gates.

• Use subcircuits to reduce your work load.

• The outputs and input waveforms must be clearly visible. You can do this by shifting the level of the waveforms while plotting the voltages.

3 Procedure

• First we need to find the boolean function for the given table.

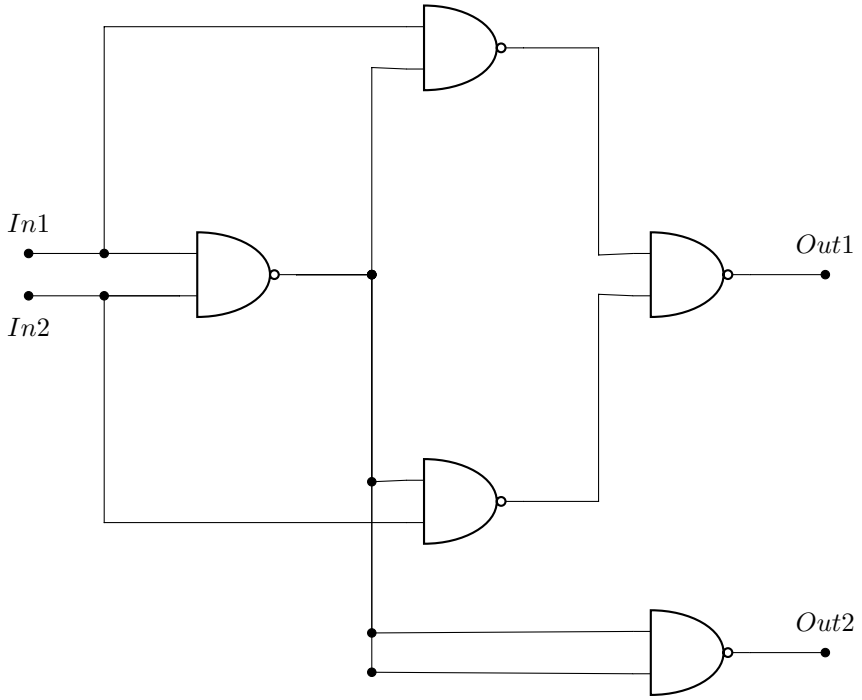
• We can clearly see that the above table is half adder truth table and therefore output 1 is given by XOR Gate and output 2 by AND Gate.

$$\mathbf{X1} = \mathbf{(A.\bar{B})+(B.\bar{A})} \tag{1}$$

$$\mathbf{X2} = \mathbf{(A.B)} \tag{2}$$

• We can also find the above function using Karnaugh maps.

• Now we need to implement the above functions using only NAND Gates.



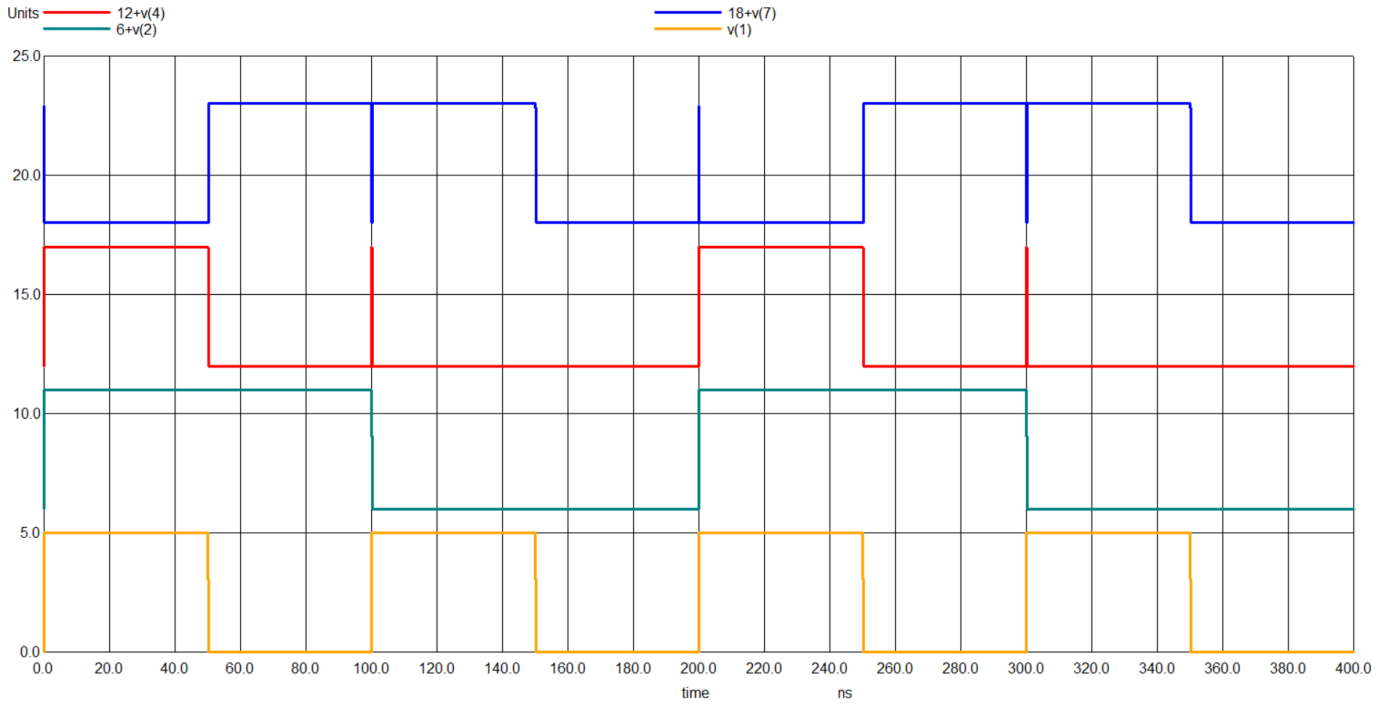
Half Adder Using NAND Gates

• Now we need to write spice script for the above circuit and use inputs of as square pulses of frequency one twice the other.

• Now verify the simulated output with desired output.

4 Results and observations

Half adder output



Plot: Input1 (Orange), Input2 (Tale), Output1 (Blue), Output2 (Red) Vs Time(ns)

• We can now verify from the above plot that simulated output matches with truth table given earlier.

5 Conclusions

• We have seen how to make gates in previous experiment now we have understood the use of gates by this experiment.

• Adders are extensively used in electronics nowadays.

• We also understood the power of universal gates i.e. when we have limited resources we could use universal gates.


thank
you