Integrated Circuit Design
Homework #2
SPICE

Deadline: Oct. 18

4-bit ripple adder

Write the SPICE netlist for a 4-bit carry propagation adder. The circuit of the 4-bit adder and full adder are shown below.

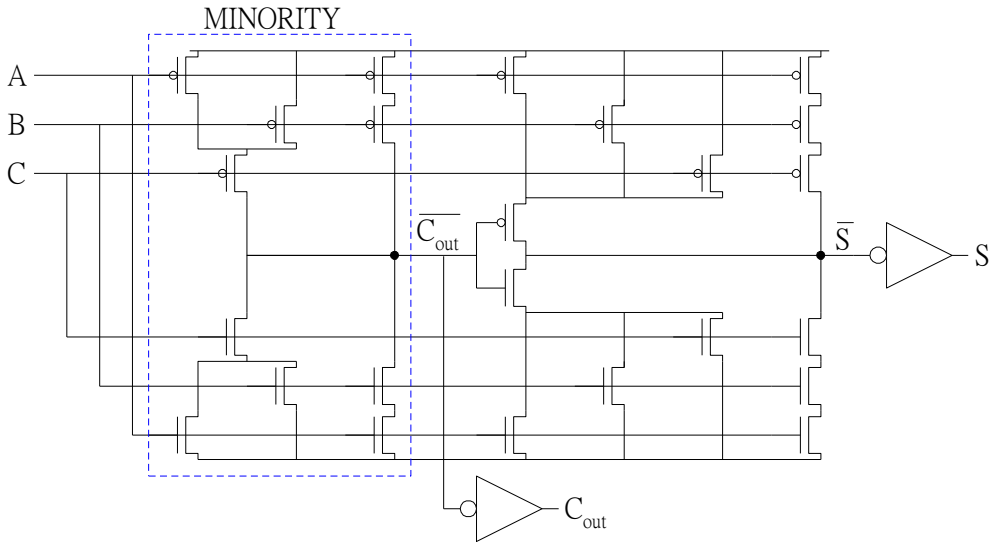


Fig. 1. Full adder.

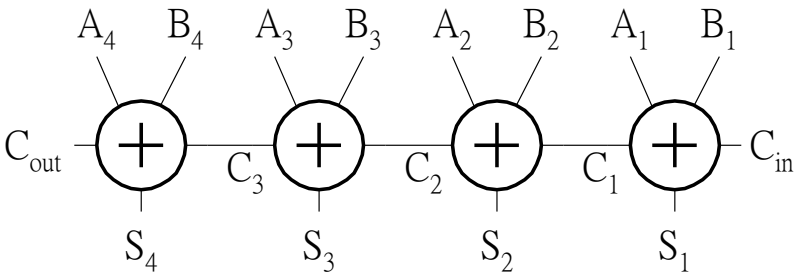


Fig. 2. 4-bit adder.

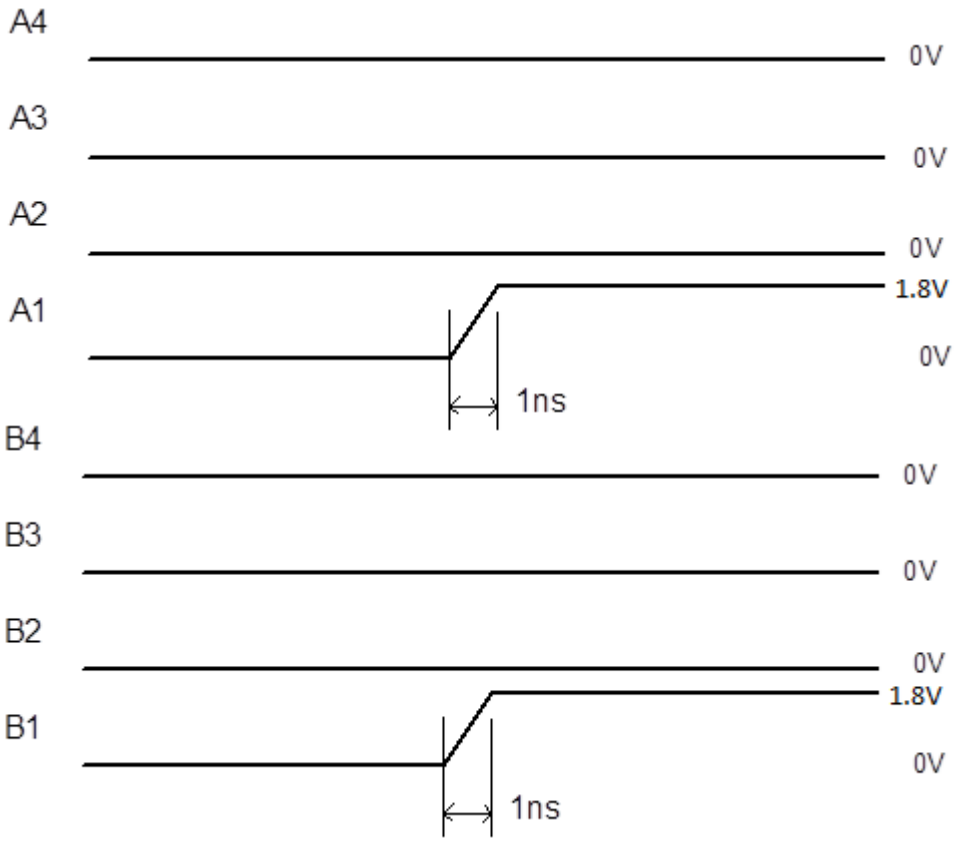
Hint:

Write one full adder as sub-circuit, and use the sub-circuit to assemble the 4-bit ripple propagation adder as Fig. 2. Please refer to the page 18 of the slides “HSPICE introduction.” Note the VDD setting in the inverter example is not correct. It should be **1.8V** instead of 5V. Please modify it in your homework.

Requirements:

1. Print out the spice source code (*.sp) in your report.

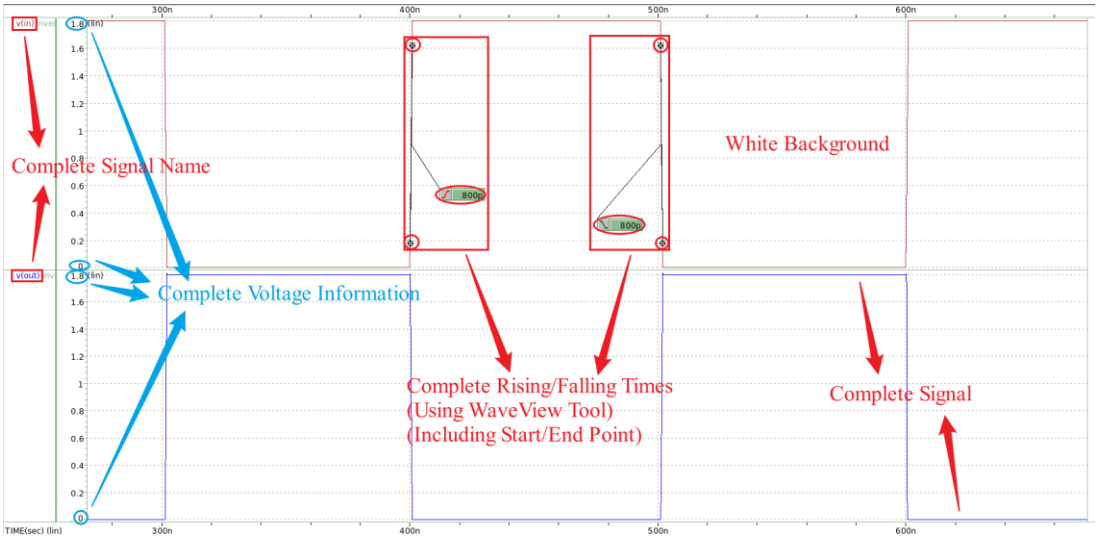
2. Use the full adder to do the following addition:
   a) 0001+0001
   b) 1111+0001
   c) 0101+1010
   For example, for a), the input waveform should be:



Note that, the rising time (10% to 90%) and falling time (90% to 10%) of this homework is 1ns. (The input voltage of all input signals must initially be 0V)
Please print out the waveform of A1, A2, A3, A4, B1, B2, B3, B4, Cin, S1, S2, S3, S4, and Cout in your report.

The waveform should contain complete signals, complete rising/falling times (WaveView tool), complete input/output, complete signal names, complete voltage information, and white background.

Example:



3. From these waveforms, how is the output delay of your adder? The output delay is the delay from the last input signal transitioning to 50% to the last output signal transitioning to 50%. (hint: for the addition 1111+0001, the latest output signal is Cout)

APPENDIX

Preparation

1. Download MobaXterm (Link)

2. Make directory
   $ mkdir ICD
   $ cd ./ICD/
   $ mkdir Hspice

3. Move to directory
   $ cd ./Hspice/

4. Copy necessary files to your directory
   $ cp /home/raid7_4/raid1_1/.cshrc ~/.cshrc_icd
   $ cp /home/raid7_4/raid1_1/cic/vlsi/cic18/model/cic018.l ./

5. Source the environment-setting file
   $ source ~/.cshrc_icd

Tool

1. Hspice
   $ hspice -i your_design.sp -o your_design.lis

2. WaveView
   $ wv &