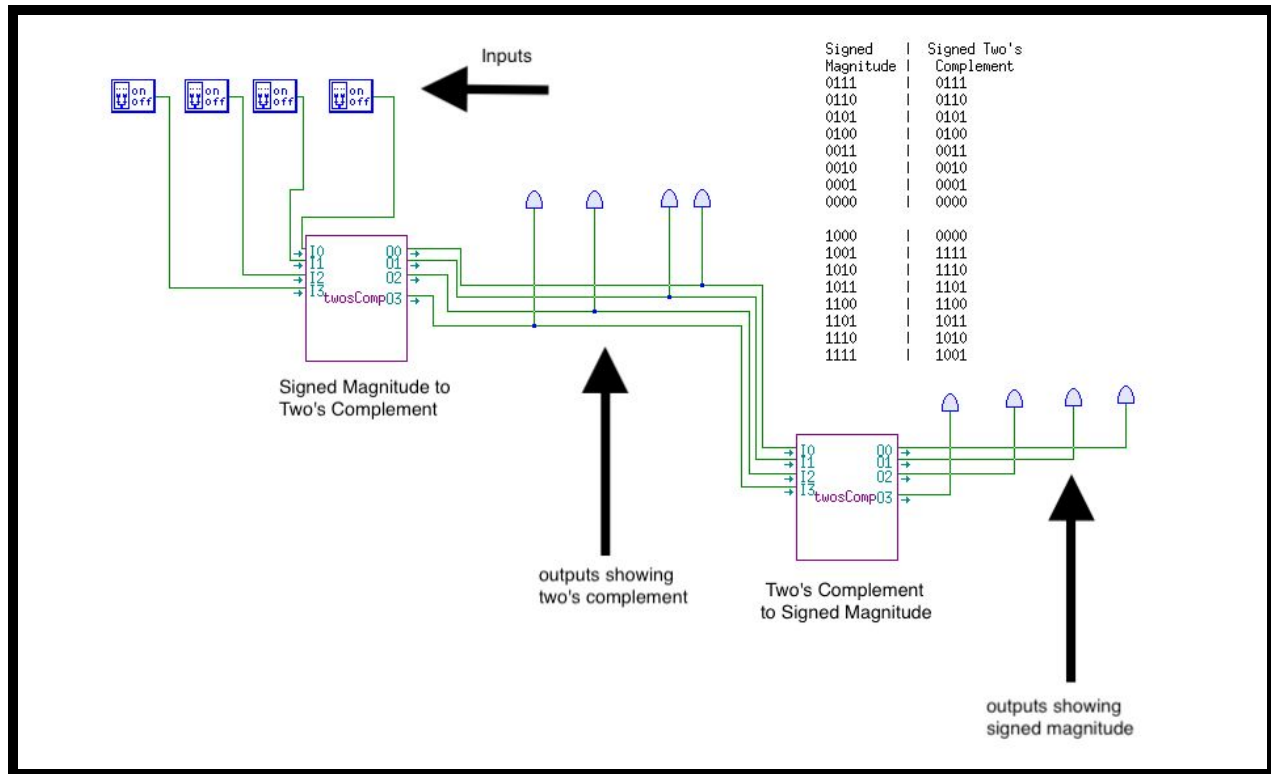


Thuy Thai

CS 320 Principles of Computer Organization

Tkgate Project

This is the main module.



Each of the four switches represent a bit. The most significant bit is represented by the leftmost switch.

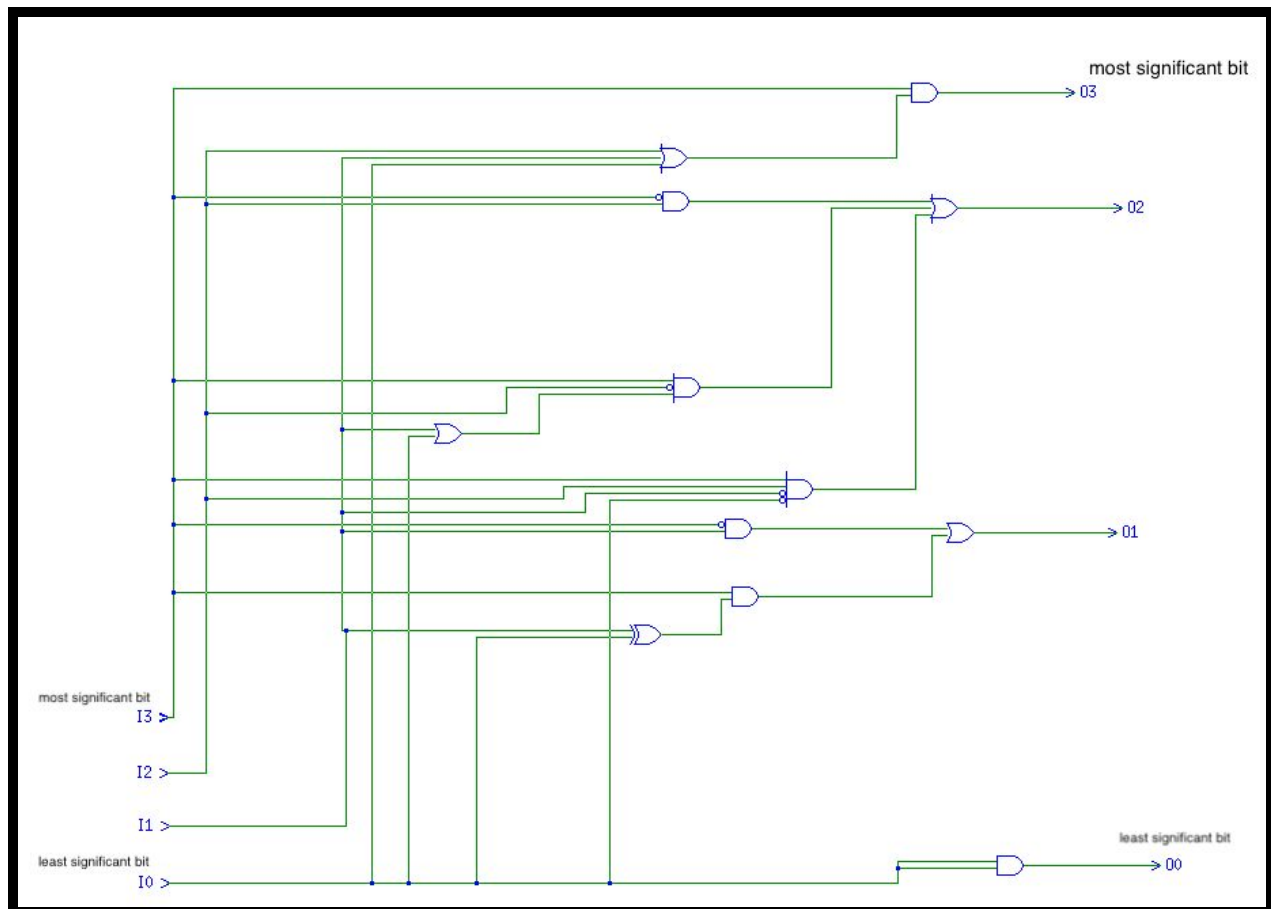
The module for converting **Signed Magnitude to Two's Complement** and **Two's Complement to Signed Magnitude** are the same.

The 4 LEDs in the middle of the modules represent the outputs of **Signed Magnitude to Two's Complement** converter.

The 4 LEDs at the right end of the modules represent the outputs of **Two's Complement to Signed Magnitude** converter.

When you run **Simulation in TkGate**, you can see that the inputs (the 4 switches) and the final output (the 4 LEDs on the right of the module) always have the same values.

This is Two's Complement Module.



This module serves as both **Signed Magnitude to Two's Complement** and **Two's Complement to Signed Magnitude** converters.

On the left we have the inputs for each bit.

The inputs are I3, I2, I1, and I0.

I3 is the most significant bit.

On the right we have the outputs for each bit.

The outputs are O3, O2, O1, and O0.

O3 is the most significant bit.

The most significant bit (O3) is built based on the following logic function

$$O3 = I3 \cdot (I2 + I1 + I0)$$

#first = a.(b+c+d)

The 2nd most significant bit (O2) is built based on the following logic function

$$O2 = (\text{not}I3 \cdot I2) + (I3 \cdot \text{not}I2 \cdot (I1 + I0)) + (I3 \cdot I2 \cdot \text{not}I1 \cdot \text{not}I0)$$

#second = (nota. b) + (a.notb.(c + d)) + (a.b.notc.notd)

The 3rd most significant bit (O1) is built based on the following logic function

$$O3 = (\text{not}I3 \cdot I1) + (I3 \cdot (I1 \text{ xor } I0))$$

#third = (nota.c) + (a.(c or d))

The least significant bit (O0) is built based on the following logic function

$$O0 = I0$$

#fourth = d

Example

Suppose we want to convert 1001 from Signed Magnitude to Two's Complement, we will turn the four switches in the main Module to On, Off, Off, On (1001). Then the 4 LEDs in the middle of the module will become On, On, On, On, which represents 1111 in Two's Complement. The 4 LEDs at the right end of the module will become On, Off, Off, On, which represents 1001 in Signed Magnitude, which is the same as our original inputs.

Note

You can see the enlarged circuits diagrams in the submitted folder.