Assignment 1: Using Logical Circuits

Documentation for Calculator
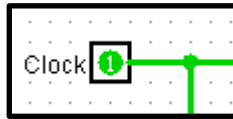
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Course: 1004QBT Foundations of Computing

Tutor: Shahrzad Saremi

Tutorial: Thursday, 9:30am – 12:30pm

Due Date: Friday, 26th August, 2016

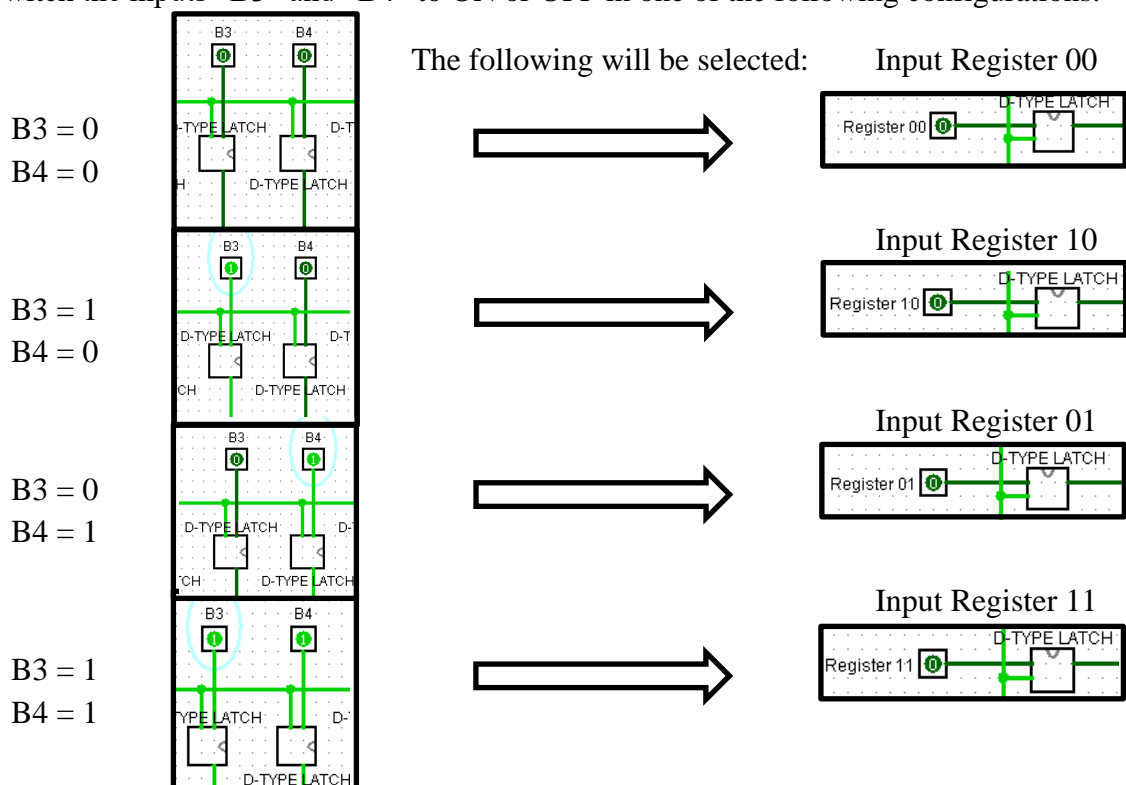Date Submitted: Friday, 26th August, 2016

Steps to Operate the Calculator

Step 1: Turn the clock to its ON (1) state.

Step 2: To select the one of the four operations, turn the inputs of "B1" and "B2" to one of the corresponding configurations:

XOR

OR

NAND

ADD
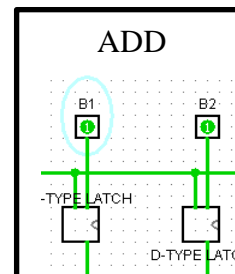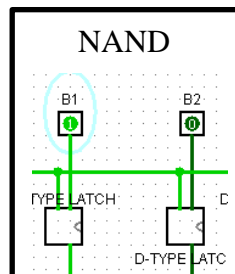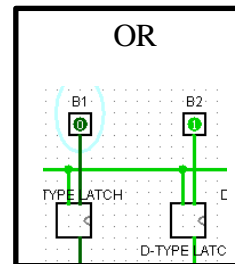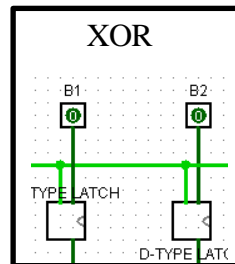
Step 3: To select which Input Register will be chosen as the first input to the operation, switch the inputs "B3" and "B4" to ON or OFF in one of the following configurations:

The following will be selected:

B3 = 0
B4 = 0

Input Register 00

B3 = 1
B4 = 0

Input Register 10

B3 = 0
B4 = 1

Input Register 01

B3 = 1
B4 = 1

Input Register 11

Step 4: To select which Input Register will be chosen as the second input to the operation, switch the inputs "B5" and "B6" to ON or OFF in one of the following configurations:
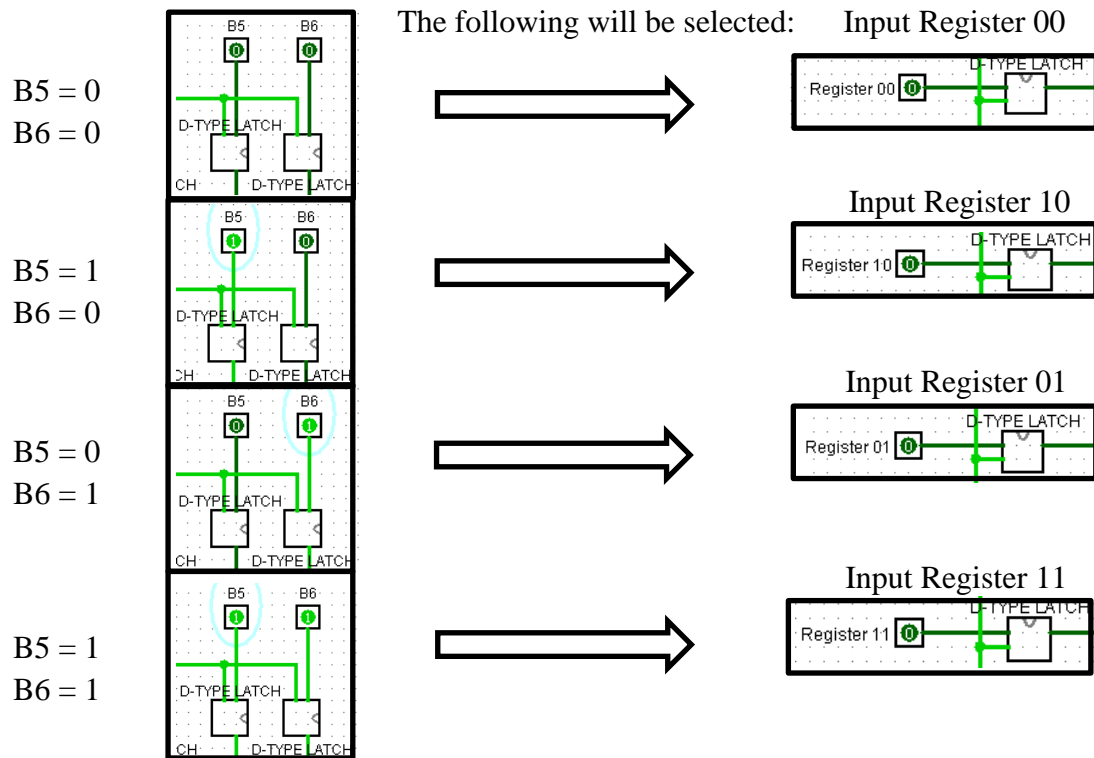

Step 5: Turn the corresponding input registers selected in steps 3 and 4 to the desired ON or OFF state to calculate an output based on the operation you selected in step 2. If the ADD (11) operation was selected in step 2, the carry in can be used in the calculation by switching the "Carry in" input to ON or OFF. The carry out will be displayed by the "Carry out" output.

For example, if the registers selected in steps 3 and 4 were Register 00 and Register 01, and the operation selected in step 2 was the OR (01) operation. Turning Register 00 ON and Register 01 OFF will result in the output displaying an ON state.

Calculator

Below in figure 1 we have the entire two bit binary calculator.
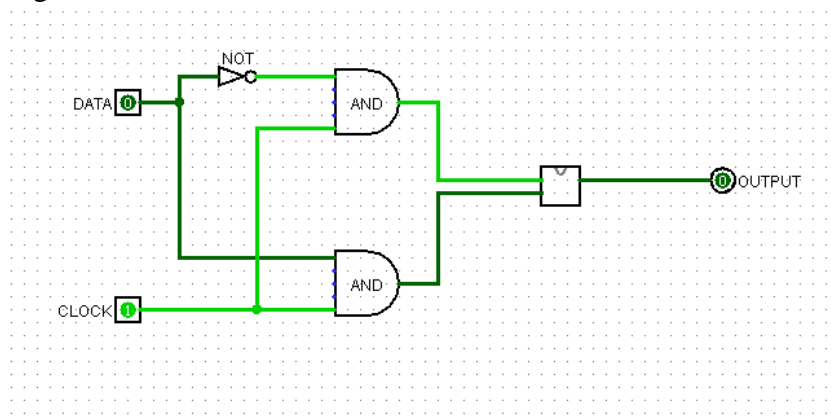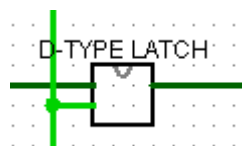
Figure 1
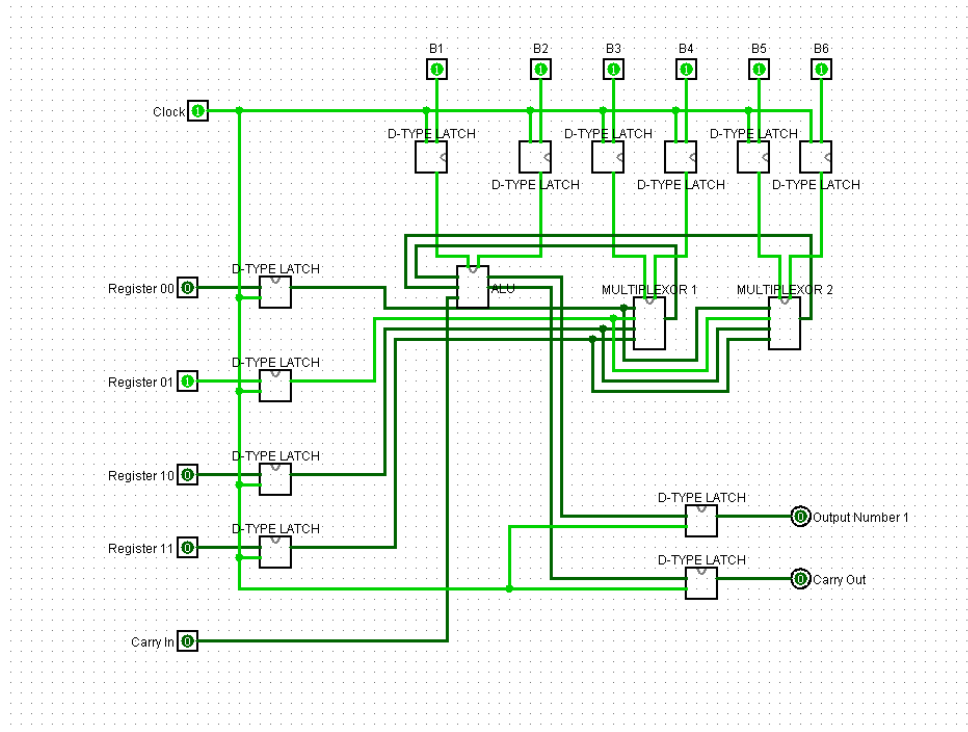
D-Type Latch

The D-Type Latch is shown below in figure 2, it is responsible for storing each input to be used in the calculation.
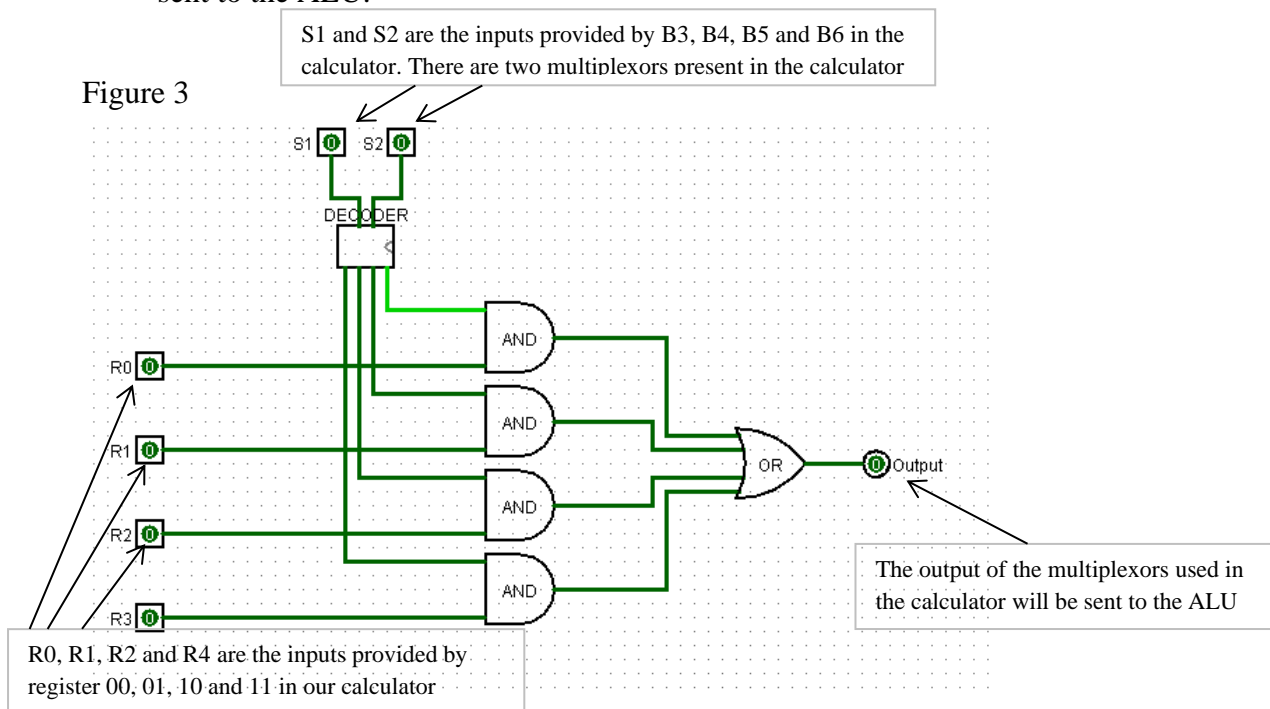
Figure 2
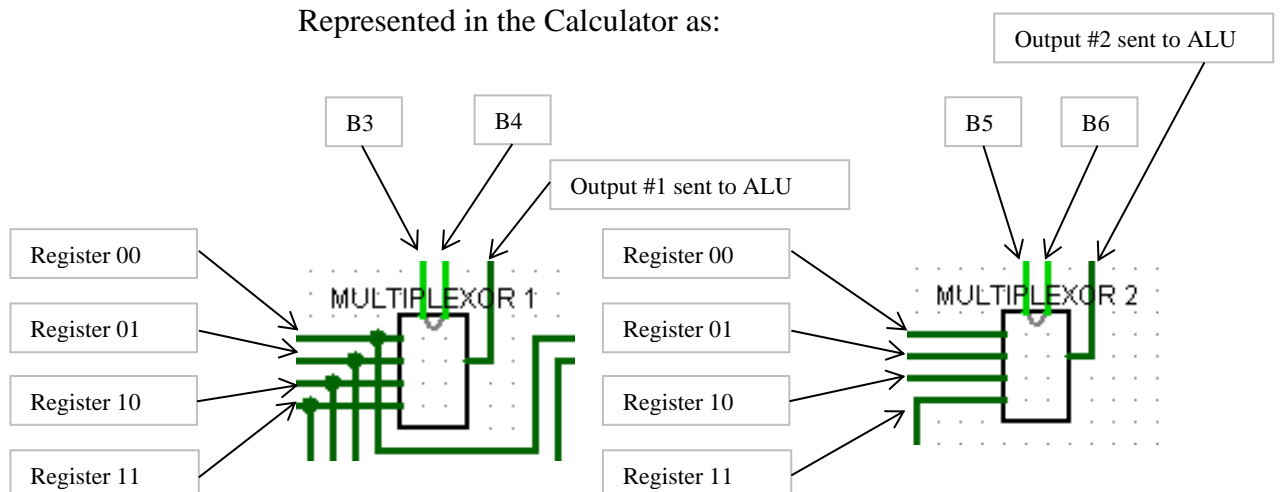

Represented in the Calculator as:

Multiplexor

The Multiplexor is shown below in figure 3, it is responsible for selecting which of the

four inputs will be sent to the ALU. The configuration of the opcodes labelled as S1

and S2 will determine which of the four operands labelled as R0, R1, R2 and R3 will be

sent to the ALU.

Figure 3

S1 and S2 are the inputs provided by B3, B4, B5 and B6 in the
calculator. There are two multiplexors present in the calculator

R0, R1, R2 and R4 are the inputs provided by
register 00, 01, 10 and 11 in our calculator

The output of the multiplexors used in
the calculator will be sent to the ALU

Represented in the Calculator as:

Output #2 sent to ALU

B3   B4

Output #1 sent to ALU

B5   B6

Register 00

Register 01

Register 10

Register 11

MULTIPLEXOR 1

Register 00

Register 01

Register 10
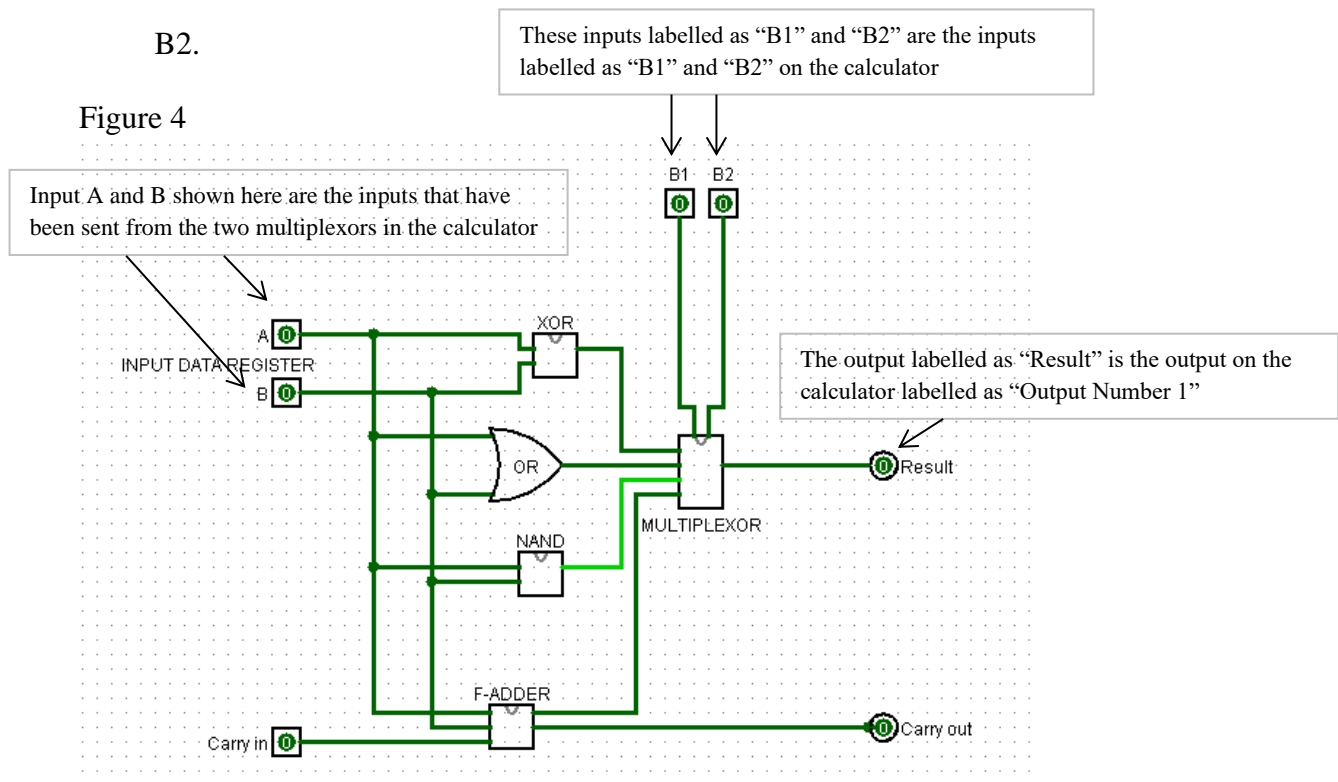
Register 11

MULTIPLEXOR 2

ALU

The ALU is shown below in figure 4, it is responsible for selecting which one of the

four operations, XOR, OR, NAND or ADD is applied to the inputs supplied by the

multiplexors. We can select one of the four operations: XOR, OR, NAND or ADD by

inputting one of the following configurations 00, 01, 10 or 11 with the inputs B1 and

B2.

These inputs labelled as "B1" and "B2" are the inputs
labelled as "B1" and "B2" on the calculator

Figure 4

Input A and B shown here are the inputs that have
been sent from the two multiplexors in the calculator

The output labelled as "Result" is the output on the
calculator labelled as "Output Number 1"

Represented in the Calculator as: