

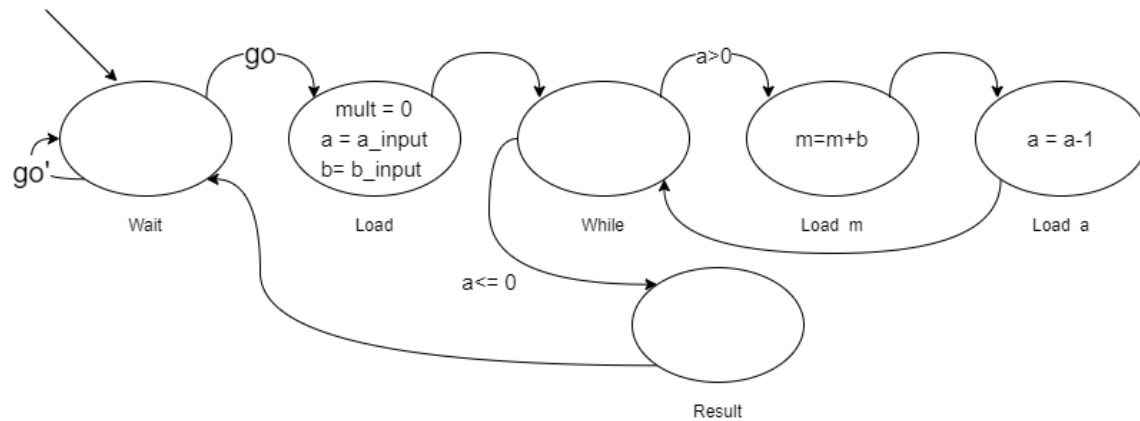
CSE 232 SPRING 2020

PROJECT 2

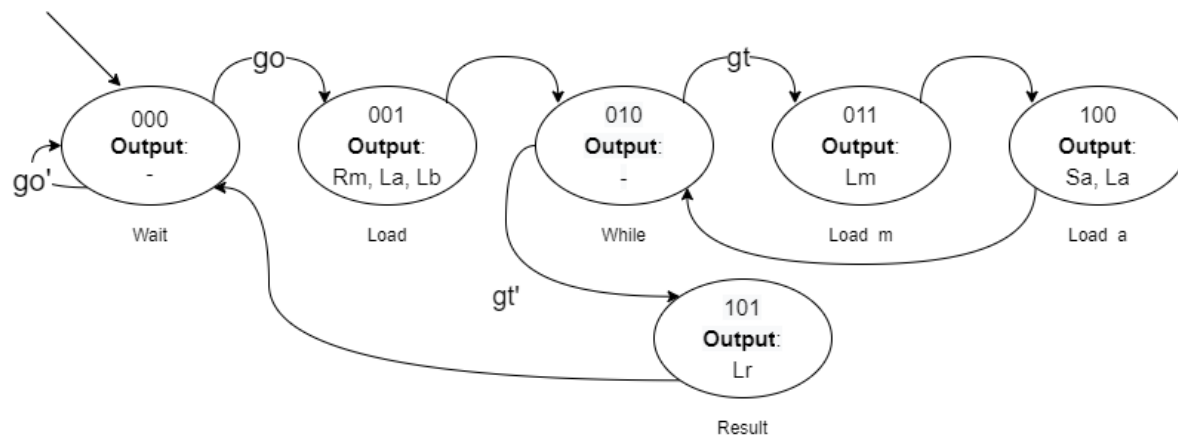
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Diagram of C code:



State Diagram of FSM:



Go: Start signal of calculation.

Gt: Value of "while(a>0)". Gt = 1 when $a > 0$.

Rm: Reset Mult(mult=0).

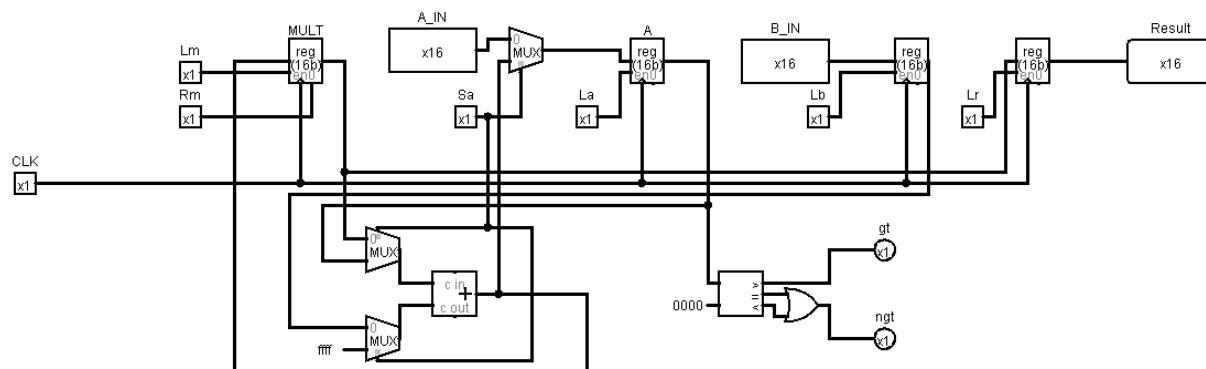
La: Load a ($a = \text{input_a}$ // $a = a-1$).

Lb: Load b ($b = \text{input_b}$).

Lm: Load mult ($\text{mult} = \text{mult} + b$)

Sa: Select a.

Lr: Load result ($\text{result} = \text{mult}$).

DataPath:

Truth table for state outputs:

S2	S1	S0	GO	GT	N2	N1	N0
0	0	0	0	0	0	0	0
0	0	0	0	1	0	0	0
0	0	0	1	0	0	0	1
0	0	0	1	1	0	0	1
0	0	1	0	0	0	1	0
0	0	1	0	1	0	1	0
0	0	1	1	0	0	1	0
0	0	1	1	1	0	1	0
0	1	0	0	0	1	0	1
0	1	0	0	1	0	1	1
0	1	0	1	0	1	0	1
0	1	0	1	1	0	1	1
0	1	1	0	0	1	0	0
0	1	1	0	1	1	0	0
0	1	1	1	0	1	0	0
0	1	1	1	1	1	0	0
1	0	0	0	0	0	1	0
1	0	0	0	1	0	1	0
1	0	0	1	0	0	1	0
1	0	0	1	1	0	1	0
1	0	1	0	0	0	0	0
1	0	1	0	1	0	0	0
1	0	1	1	0	0	0	0
1	0	1	1	1	0	0	0
1	1	0	0	0	0	0	0
1	1	0	0	1	0	0	0
1	1	0	1	0	0	0	0
1	1	0	1	1	0	0	0
1	1	1	0	0	0	0	0
1	1	1	0	1	0	0	0
1	1	1	1	0	0	0	0
1	1	1	1	1	0	0	0

N2: GO does not effect this output. GO is effective in only 000 > 0001.

$S2'S1S0'GT' + S2'S1S0GT' + S2'S1S0GT$

>> $S2'S1S0'GT' + S2'S1S0GT' = \mathbf{S2'S1GT'}$

>> $S2'S1S0GT' + S2'S1S0GT = \mathbf{S2'S1S0}$

N2 = $S2'S1GT' + S2'S1S0$

N1: GO does not effect this output. GO is effective in only 000 > 0001.

$S2'S1'S0GT' + S2'S1'S0GT + S2'S1S0'GT + S2S1'S0'GT' + S2S1'S0'GT$

>> $S2'S1'S0GT' + S2'S1'S0GT = \mathbf{S2'S1'S0}$

>> $S2S1'S0'GT' + S2S1'S0'GT = \mathbf{S2S1'S0'}$

>> **$S2'S1S0'GT$**

N1 = $S2'S1'S0 + S2S1'S0' + S2'S1S0'GT$

N0: GT does not affect this output. Because GT is effective in 010 > 011 and 010 > 101. In both states N0 is 1 so it does not effect.

$S2'S1'S0'GO + S2'S1S0'GO' + S2'S1S0'GO$

>> $S2'S1'S0'GO + S2'S1S0'GO = \mathbf{S2'S0'GO}$

>> $S2'S1S0'GO' + S2'S1S0'GO = \mathbf{S2'S1S0'}$

N0 = $S2'S0'GO + S2'S1S0'$

Truth table for DataPath outputs:

S2	S1	S0	Rm	La	Lb	Lm	Sa	Lr
0	0	0	0	0	0	0	0	0
0	0	1	1	1	1	0	0	0
0	1	0	0	0	0	0	0	0
0	1	1	0	0	0	1	0	0
1	0	0	0	1	0	0	1	0
1	0	1	0	0	0	0	0	1
1	1	0	0	0	0	0	0	0
1	1	1	0	0	0	0	0	0

Rm: $S2'S1'S0$

Lb: $S2'S1'S0$

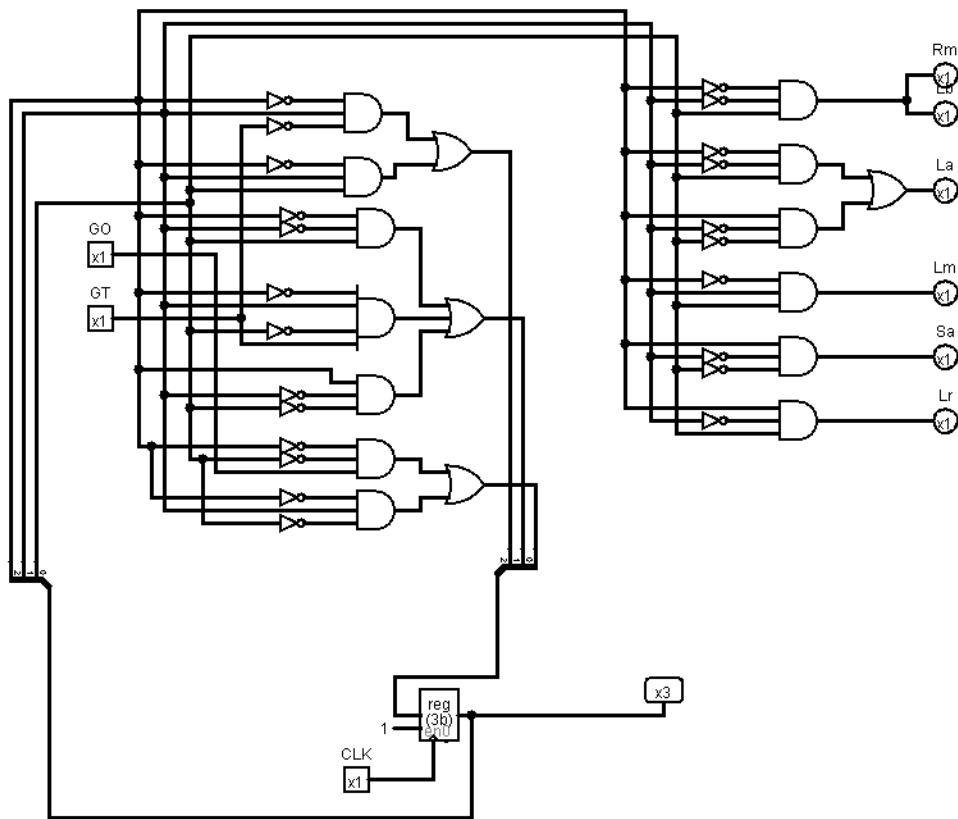
Lm: $S2'S1S0$

Sa: $S2S1'S0'$

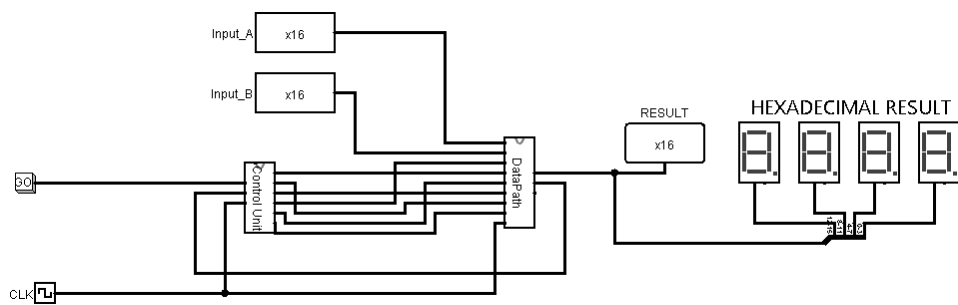
Lr: $S2S1'S0$

La: $S2'S1'S0 + S2S1'S0'$

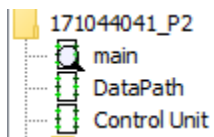
Control unit:



FINAL VERSION OF CIRCUIT:



.circ file of Project:



Details of program:

- Computes the multiplication of two numbers without using multiplier.
- Takes two 16-bit numbers and compute the multiplication result of these two numbers.
- One adder for addition and subtraction used.