CSE 331

COMPUTER ORGANIZATION

ASSIGNMENT 3

REPORT

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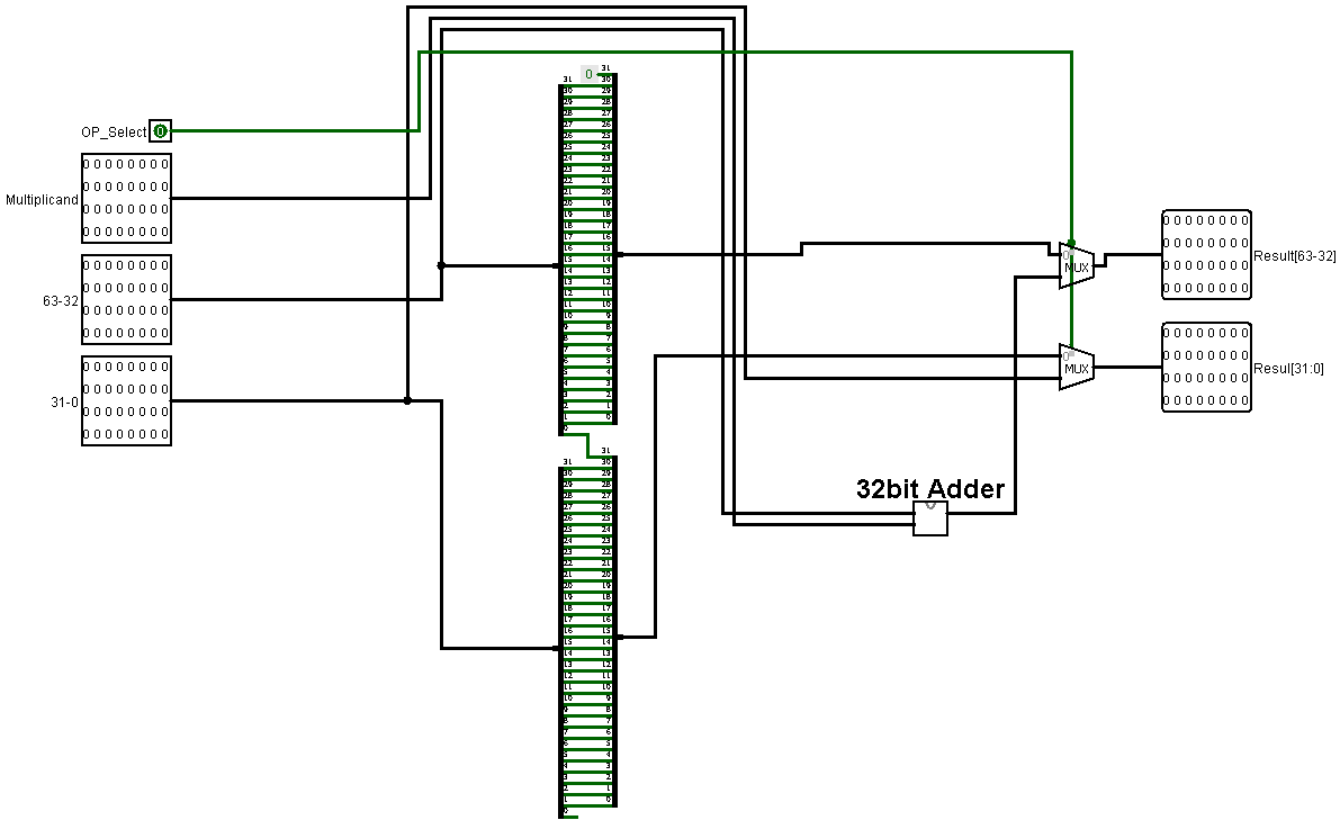
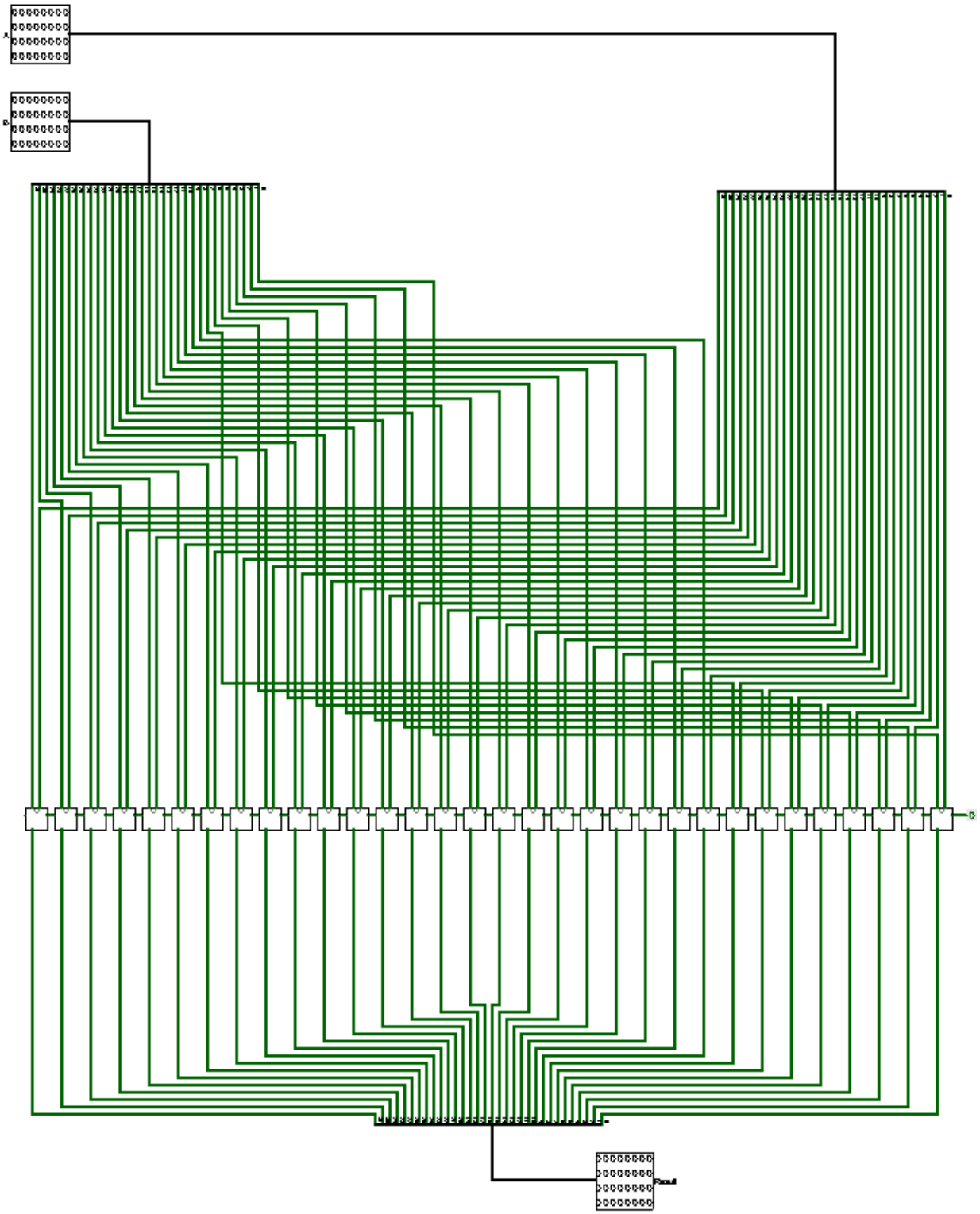
ALU DESIGN:

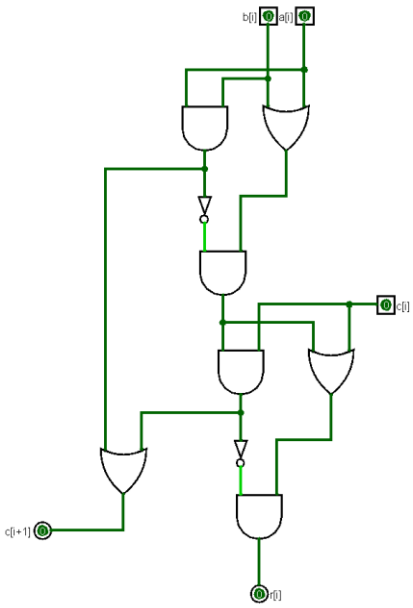


- Since we need to use this ALU just for multiplying purposes, we don’t have to implement all things inside of general purpose ALUs.
- We need implement a 64-bit shifter and 32-bit adder.
- Instead of using a multiplexer to every single bit of product for shifting like you taught us during the lessons, I used two multiplexers for what operator we are doing.

32-bit Adder:

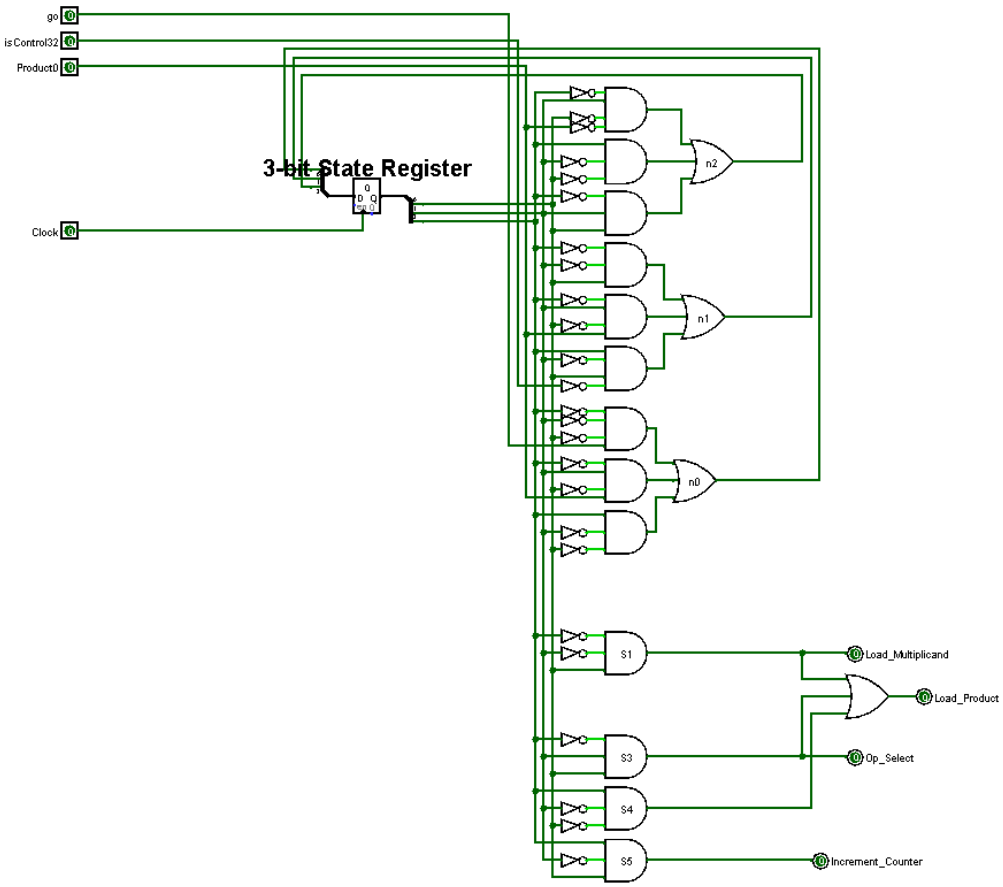


1-bit Adder:



Exact copy 1-bit Adder from course slides

Control Unit:



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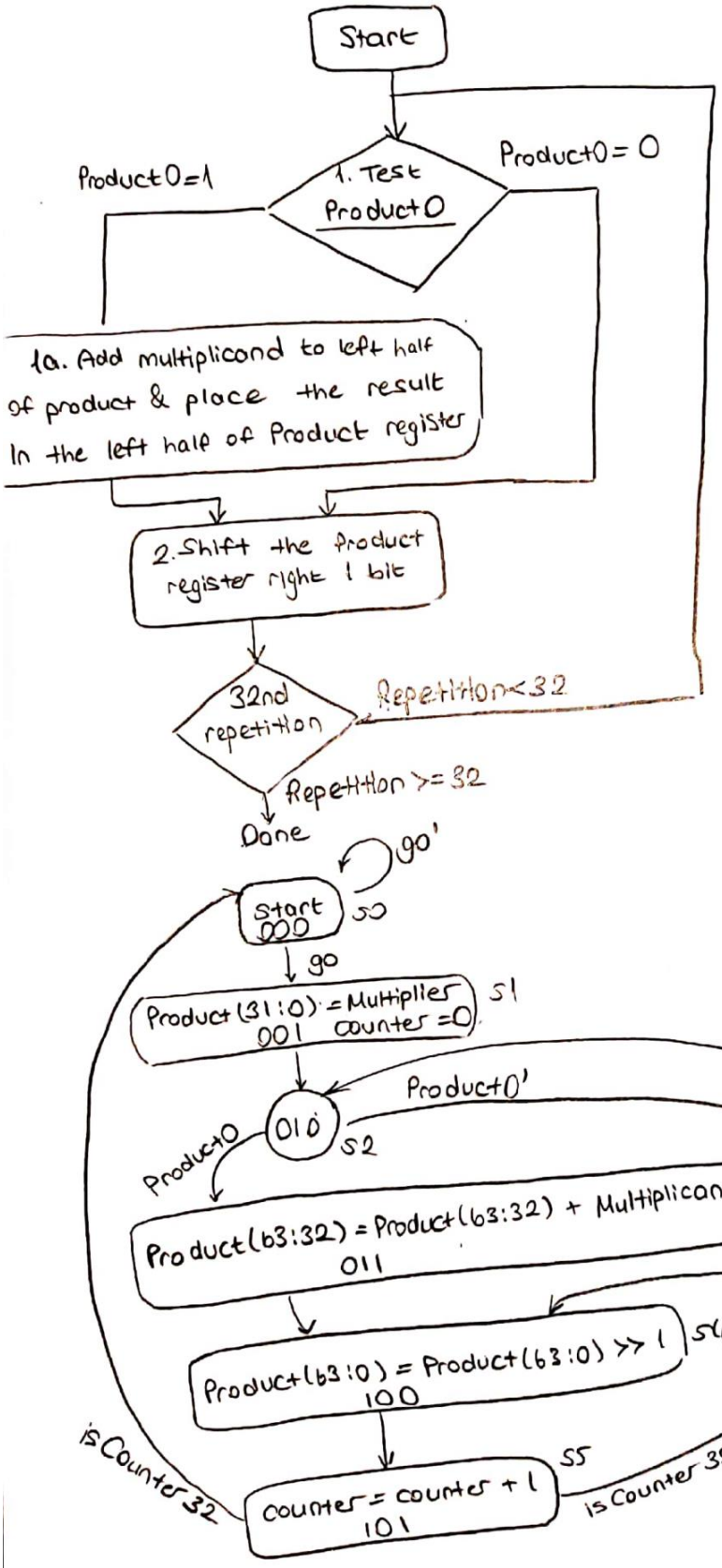
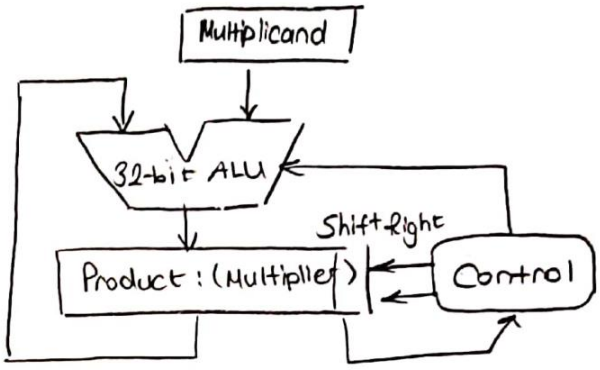
Assignment-3





- Multiplier must be stored at start state
- 64-bit Product register needed
- 5-bit counter register needed

s2	s1	s0	go	Product0	isCounter32	n2	n1	n0
0	0	0	0	-	-	0	0	0
0	0	0	1	-	-	0	0	1
0	0	1	-	-	-	0	1	0
0	1	0	-	0	-	0	1	1
0	1	0	-	1	-	1	0	0
0	1	1	-	-	-	1	0	0
1	0	0	-	-	-	1	0	1
1	0	1	-	-	0	0	1	0
1	0	1	-	-	1	0	0	0

$n2 = s2's1s0'Product0' + s2s1's0' + s2's1s0$
$s2's1s0'Product0' + s2 \text{ xor } (s1's0')$

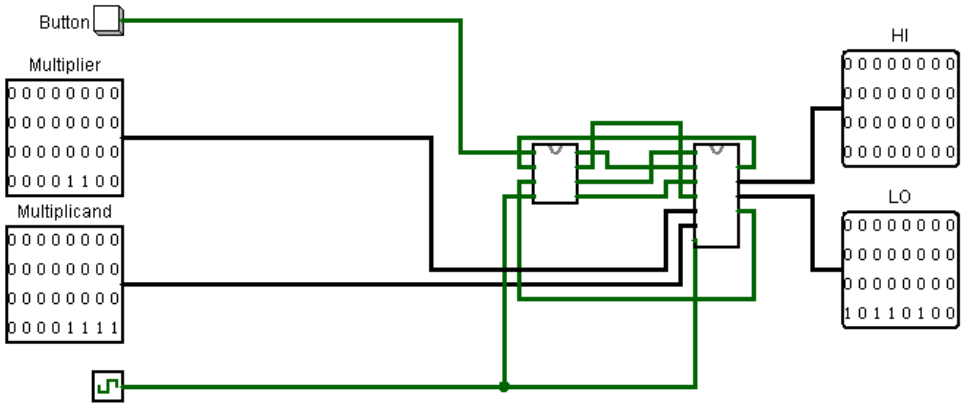
$n1 = s2's1's0 + s2's1s0'Product0 - s2s1's0isCounter32'$

$n0 = s2's1's0'go + s2's1s0'Product0' + s2s1's0'$

s2	s1	s0	Op_select	Load_Multiplicand	Increment_Counter	Reset_Counter	Select_Load	Load_Product
0	0	0	s0	x	0	0	0	0
0	0	1	s1	x	1	1	1	1
0	1	0	s2	x	0	0	0	0
0	1	1	s3	1	0	0	0	1
1	0	0	s4	0	0	0	0	1
1	0	1	s5	x	0	0	0	0

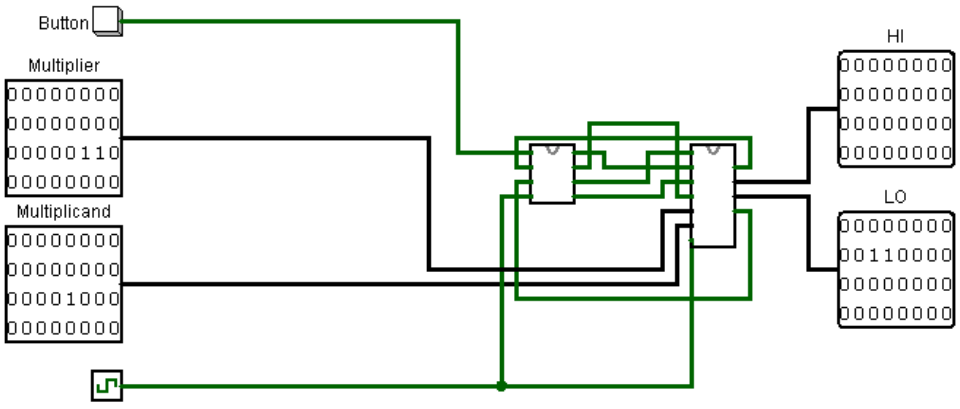
Test Cases:

1-



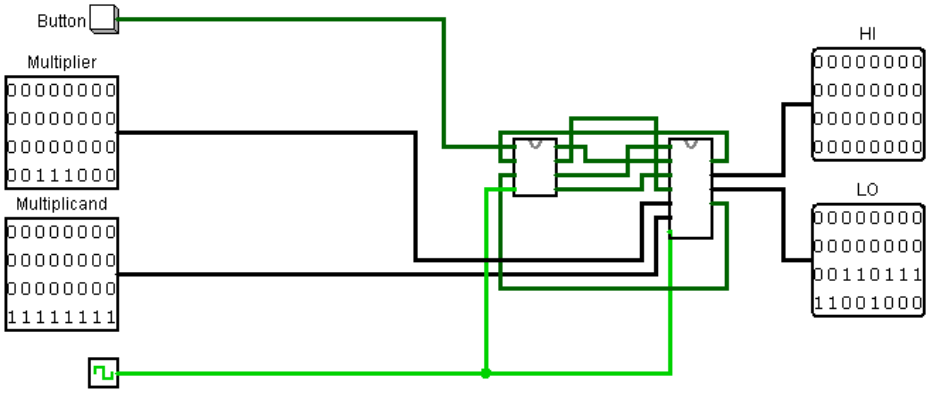
12 * 15 = 180

2-



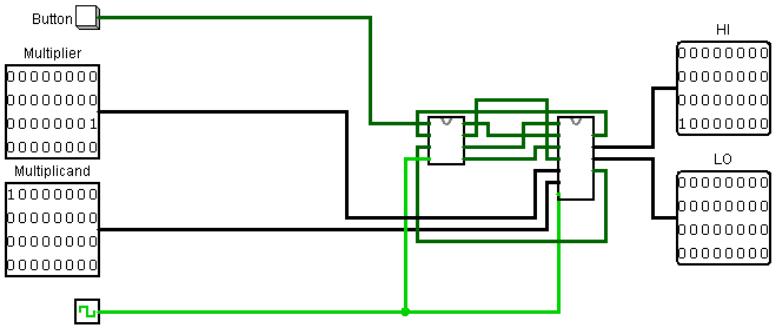
2048 * 1536 = 3145728

3-



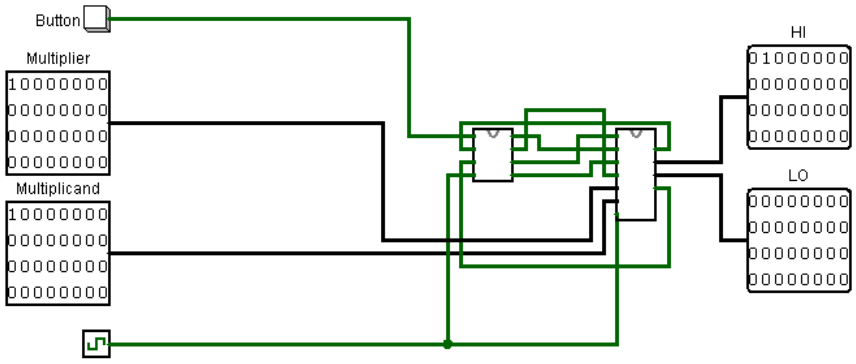
255 *56 = 14280

4-



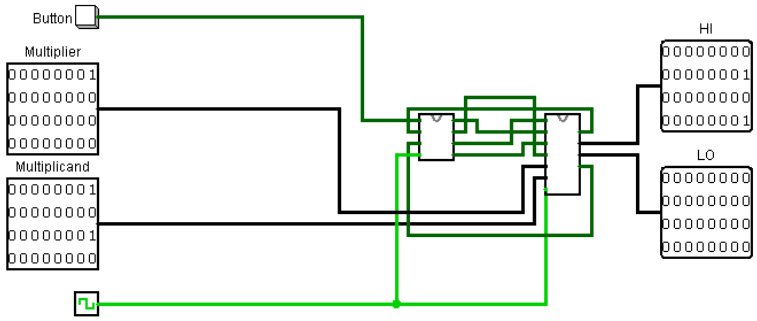
2^31 * 2 ^ 8 = 2^39

5-



$$2^{31} * 2^{31} = 2^{62}$$

6-



$$2^{24} * (2^{24} + 2^{8}) = 2^{48} + 2^{32}$$