Computer Organization

Homework #3 Report

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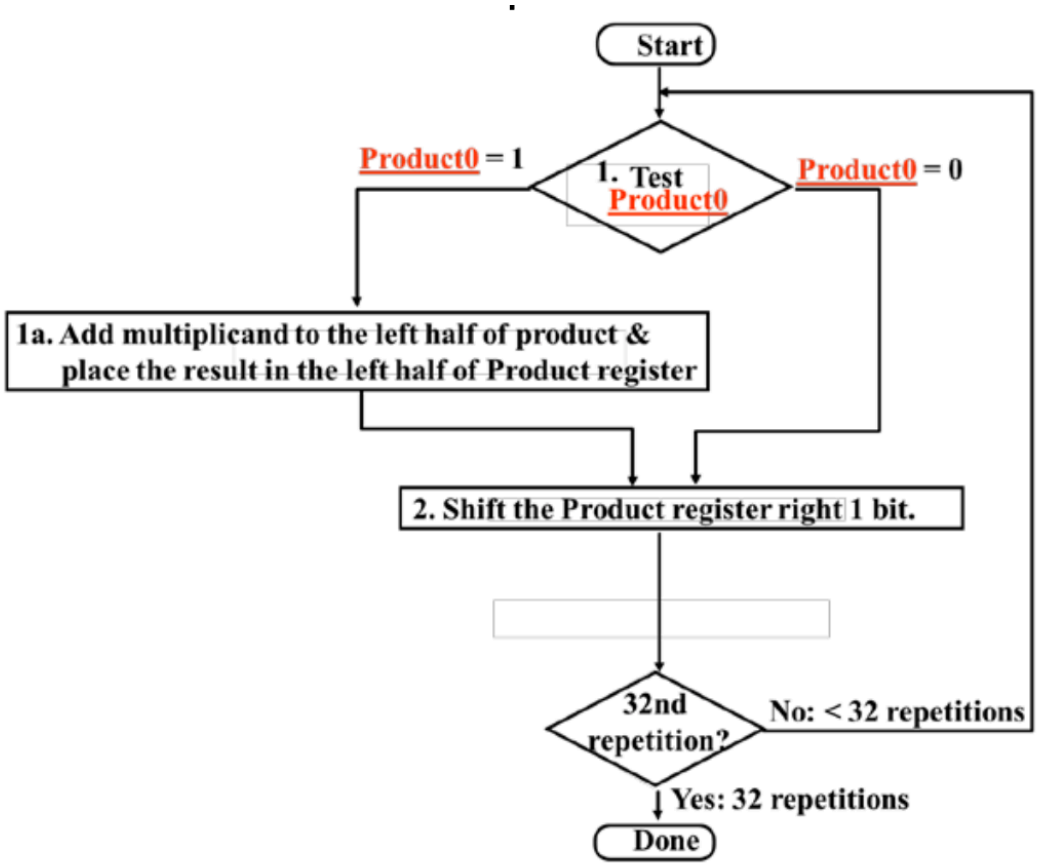
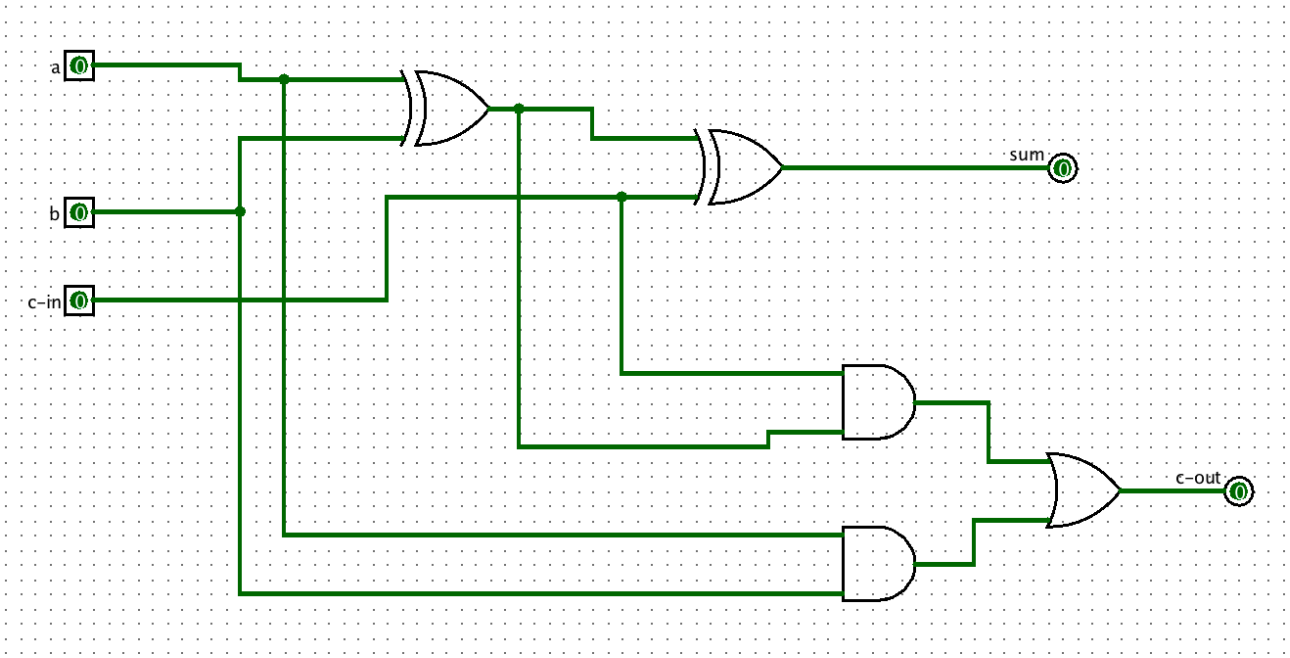
Finite State Machine

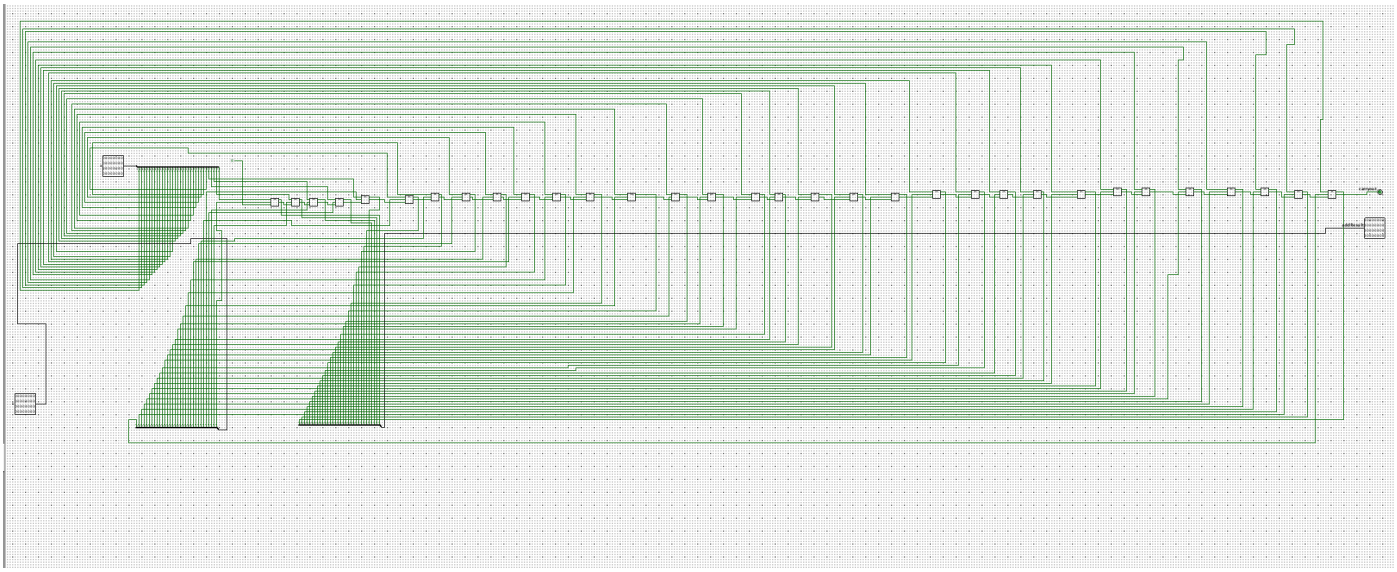


Datapath Organization

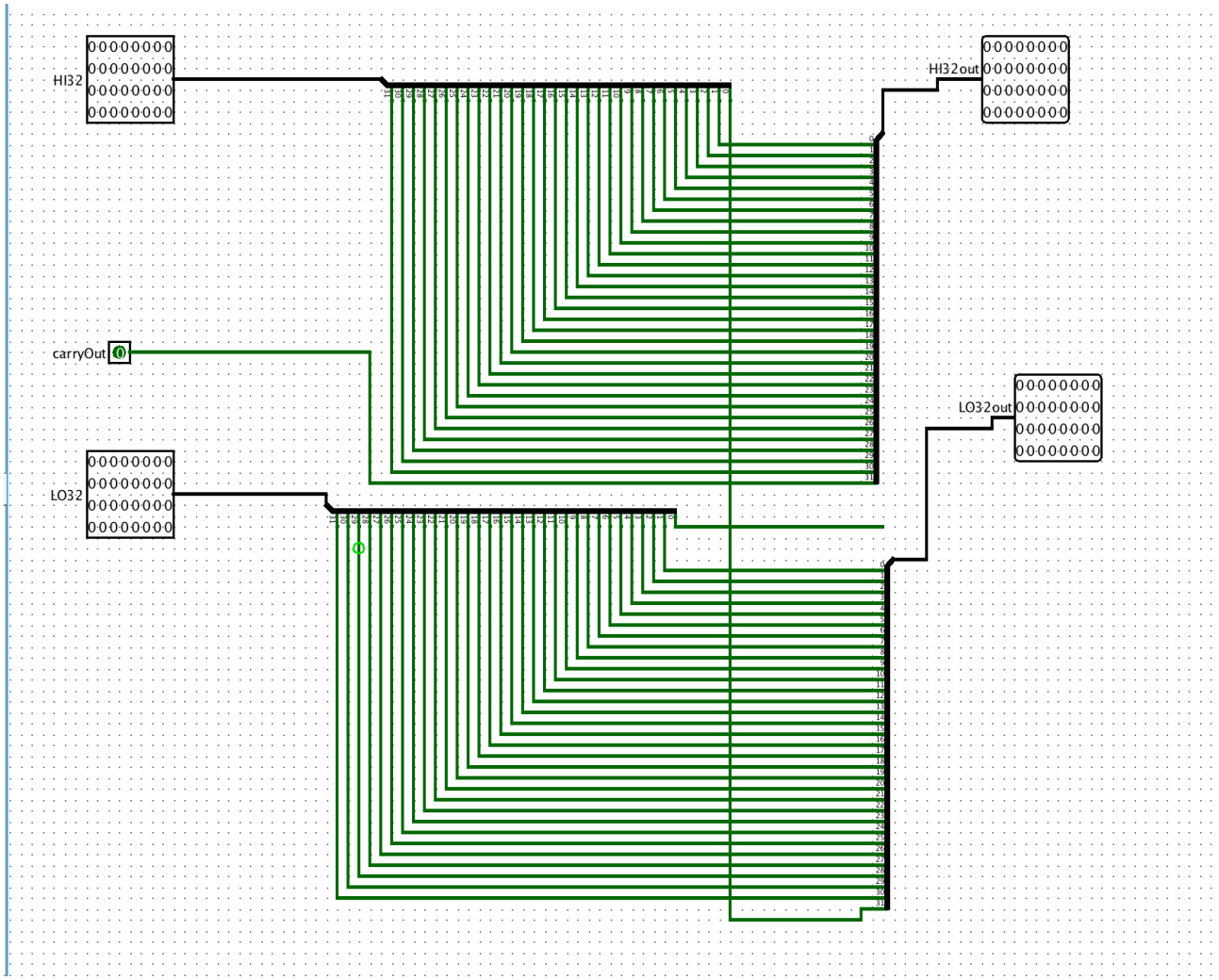
Firstly, I designed a 1 bit adder.



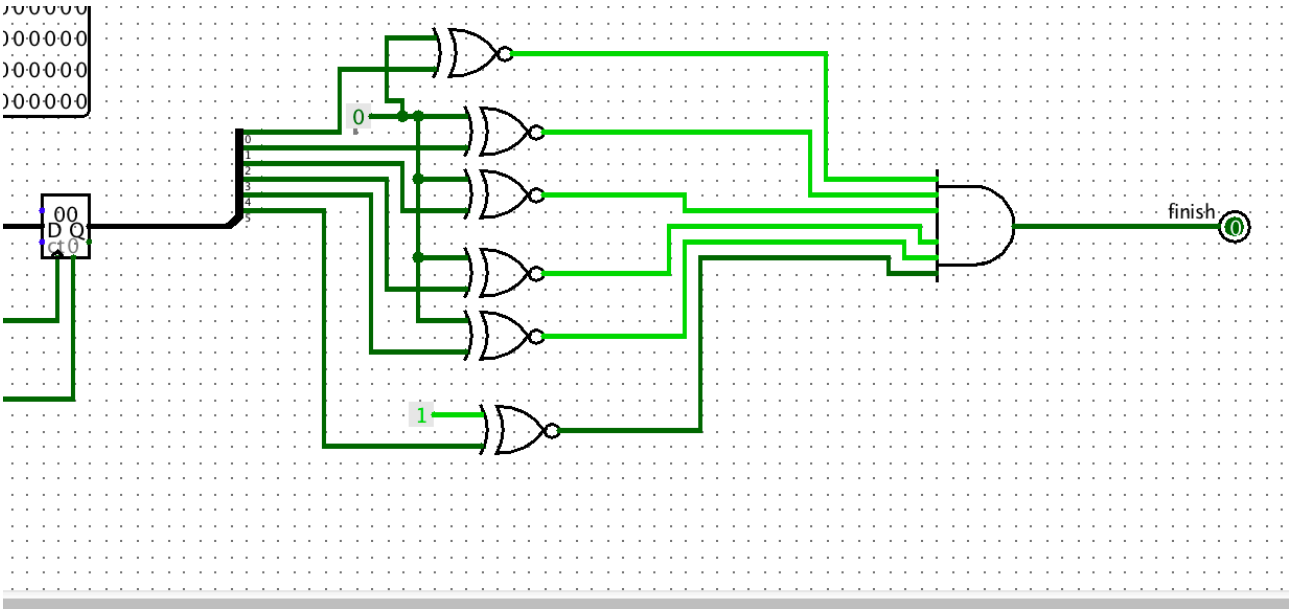
Then I designed a 32 bit adder for my datapath



Then I designed a 1 bit right shifter for 32 bit number for my datapath



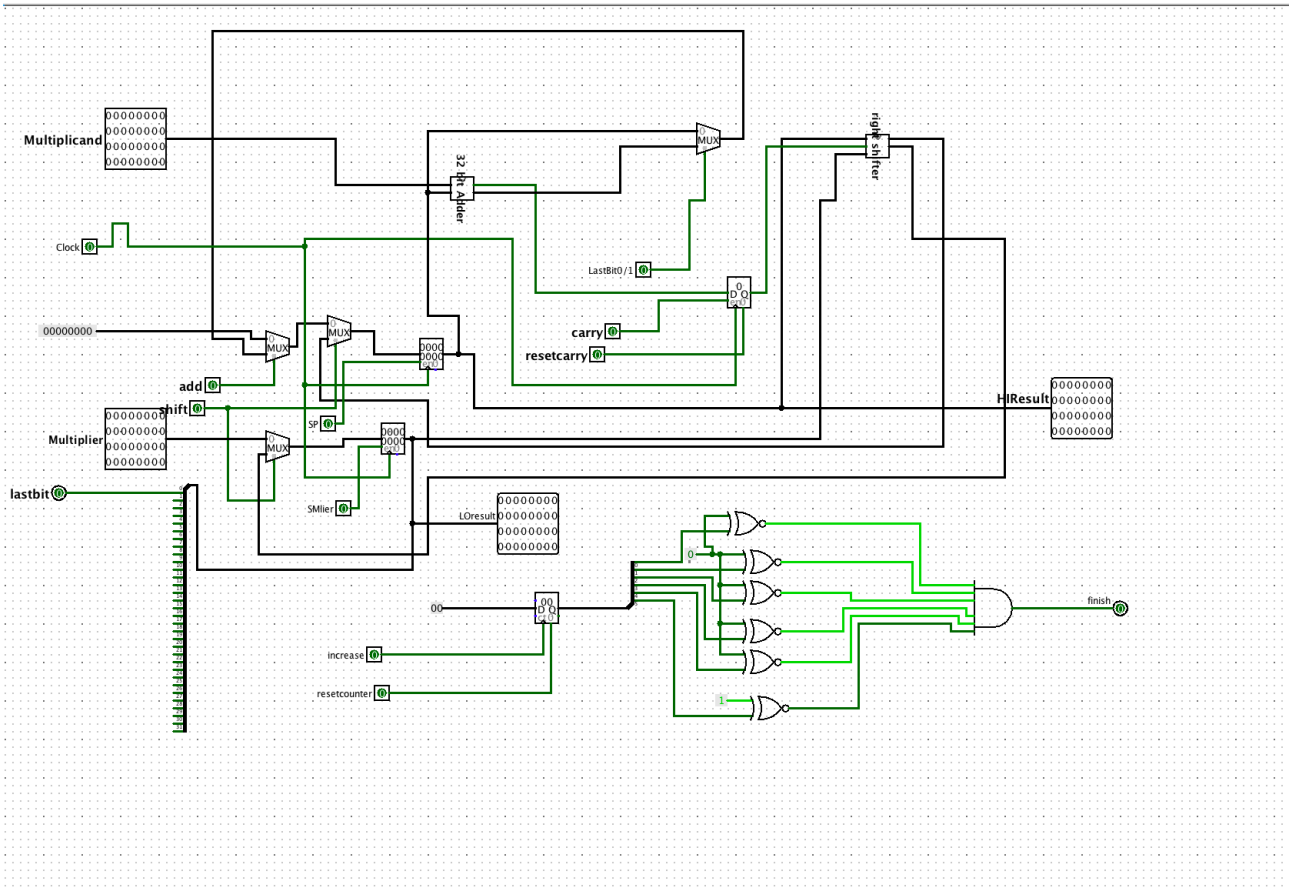
Then I designed a circuit in datapath that checks counter is 32 or not and if it



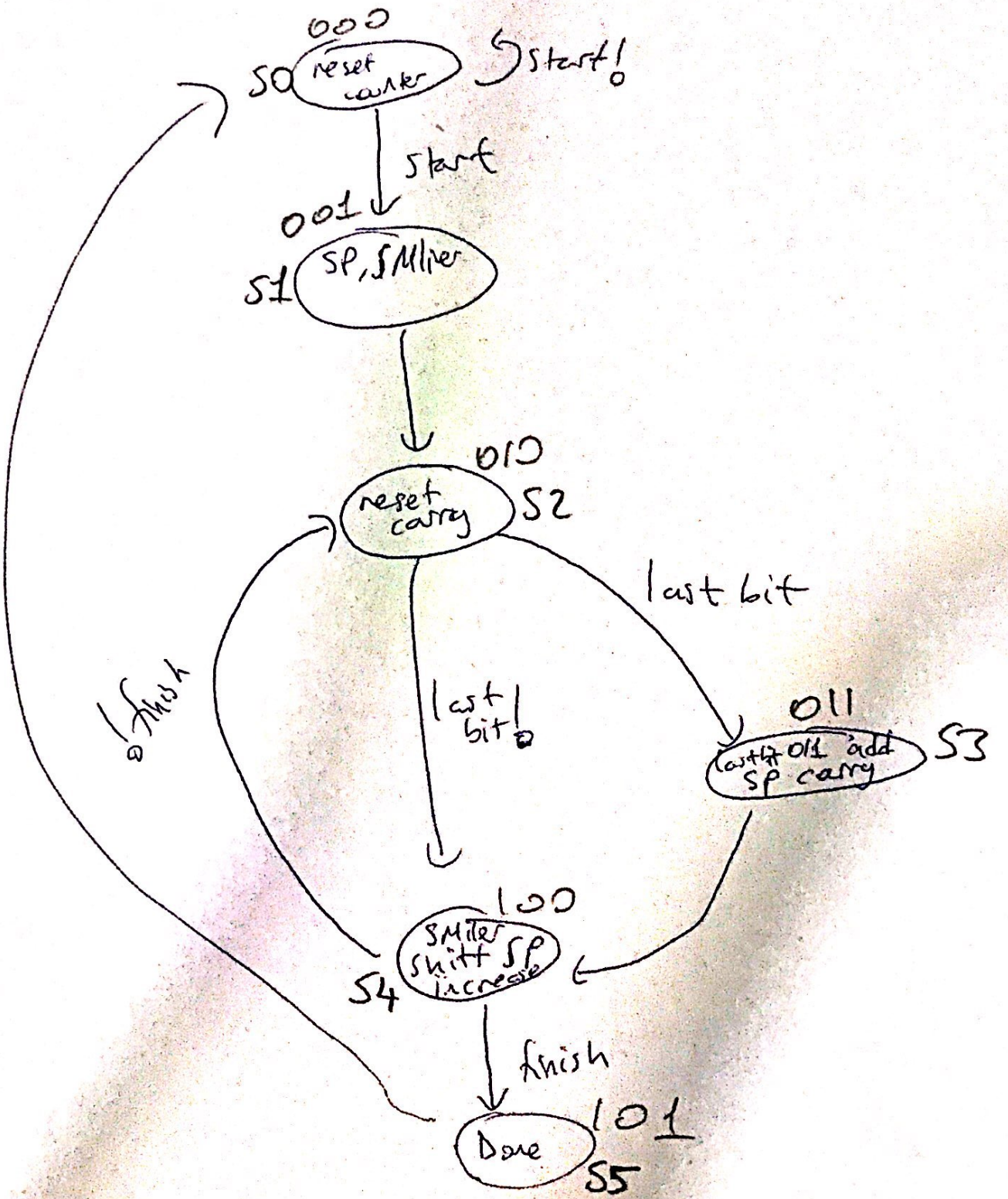
equals to 32 then finish output becomes 1.

After that I put two 32 bit input for multiplicand and multiplier and 32 bit 0 for product register at the first.Then I put registers for them to keep their current values. Before the registers I put MUXes for selecting required number.There is a output that shows the last bit of multiplier register. There is a counter also that counts and if it reaches to 32 then output finish becomes 1.There is also a 32 bit adder and 1 bit right shifter for 32 bit.There is a carry register to keep carry out numbers.Outputs are HI results and LO result that shows 64 bit result.

Datapath


Multiplicand
Clock
00000000
add
shift
Multiplier
lastbit
MUX
32 bit Adder
right shifter
LastBit0/1
carry
resetcarry
HIResult
SP
SMlier
LOresult
00
increase
resetcounter
finish

NEW FINITE STATE MACHINE AFTER DATAPATH



STATE TABLE

inputs						outputs		
S2	S1	S0	start	last-bit	finish	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	—	1	0	0
0	1	0	-	1	-	0	1	1
0	1	1	—	—	—	1	0	0
1	0	0	—	—	0	0	1	0
1	0	0	—	—	1	1	0	1
1	0	1	—	—	—	0	0	0

$N2 = \bar{S2}\,S1\,\bar{S0}\,\overline{last\text{-}bit} + \bar{S2}\,S1\,S0 + S2\,\bar{S1}\,\bar{S0} + S2\,\bar{S1}\,\bar{S0}\,finish$

$N1 = \bar{S2}\,\bar{S1}\,S0 + \bar{S2}\,S1\,\bar{S0}\,last\text{-}bit + S2\,\bar{S1}\,\bar{S0}$

$N0 = \bar{S2}\,\bar{S1}\,\bar{S0}\,start + \bar{S2}\,S1\,\bar{S0}\,last\text{-}bit + S2\,\bar{S1}\,\bar{S0}\,finish$

	inputs			
states	S2	S1	S0	outputs that is 1
S0	0	0	0	reset_counter
S1	0	0	1	SP, SMiler
S2	0	1	0	resetcarry
S3	0	1	1	lastbit0/1, add, SP, carry
S4	1	0	0	SMiler, shift, SP, increase
S5	1	0	1	

resetcounter = S0

SP = S1 + S3 + S4

SMiler = S1 + S4

resetcarry = S2

lastbit 0/1 = S3

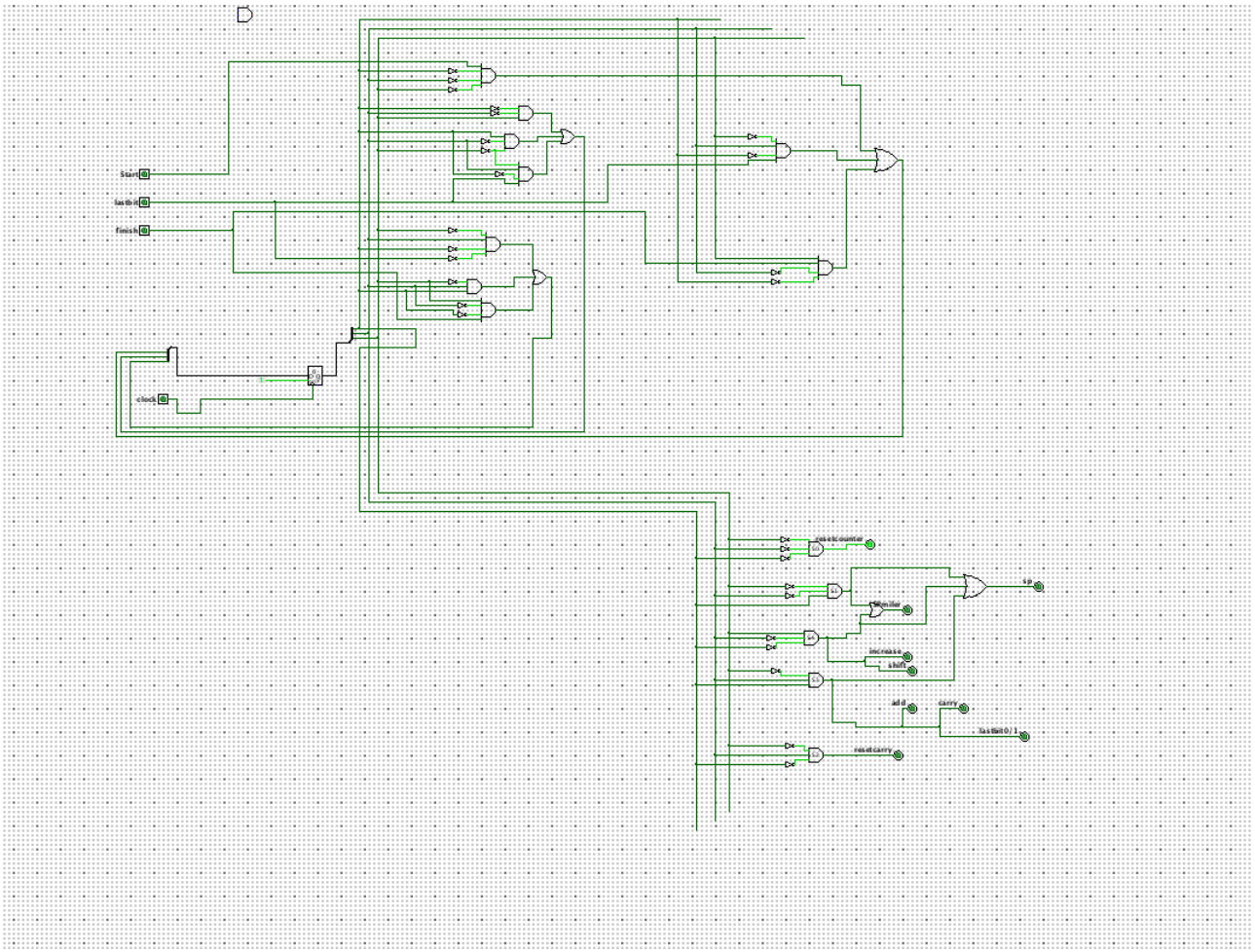
add = S3

carry = S3

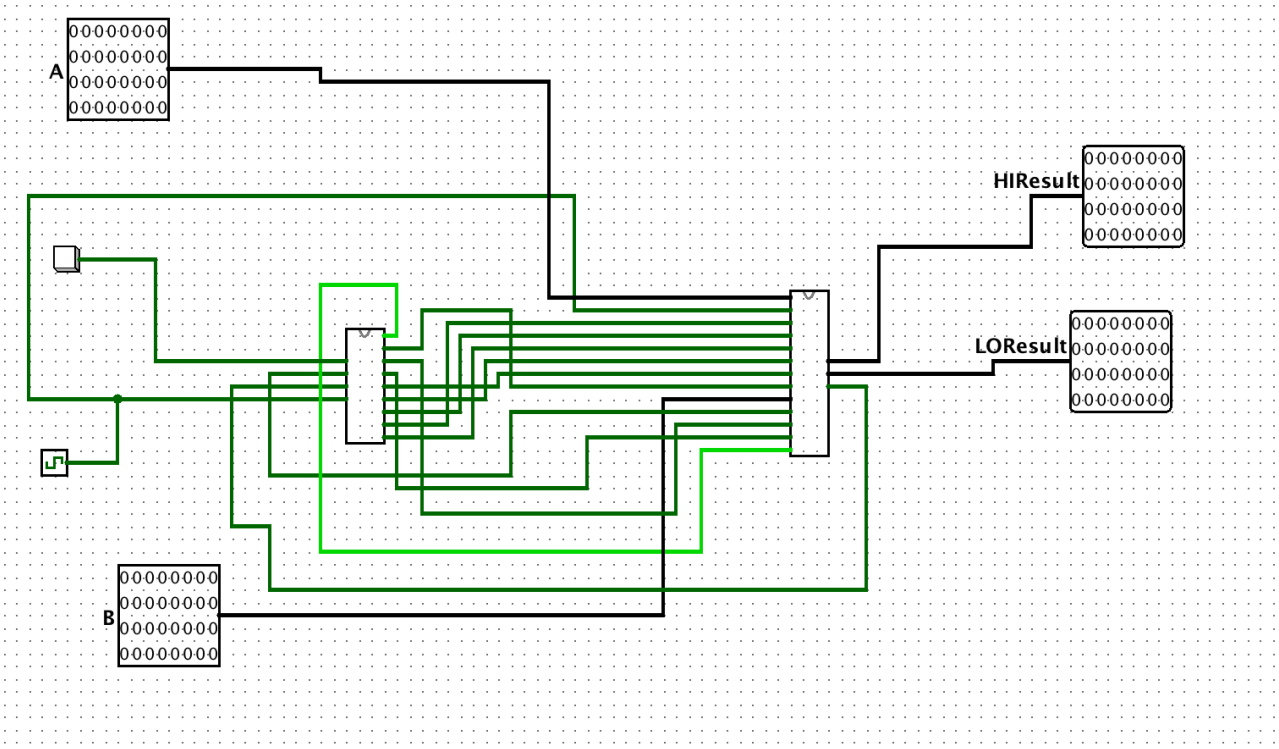
shift = S4

increase = S4

Control Unit



Mult32

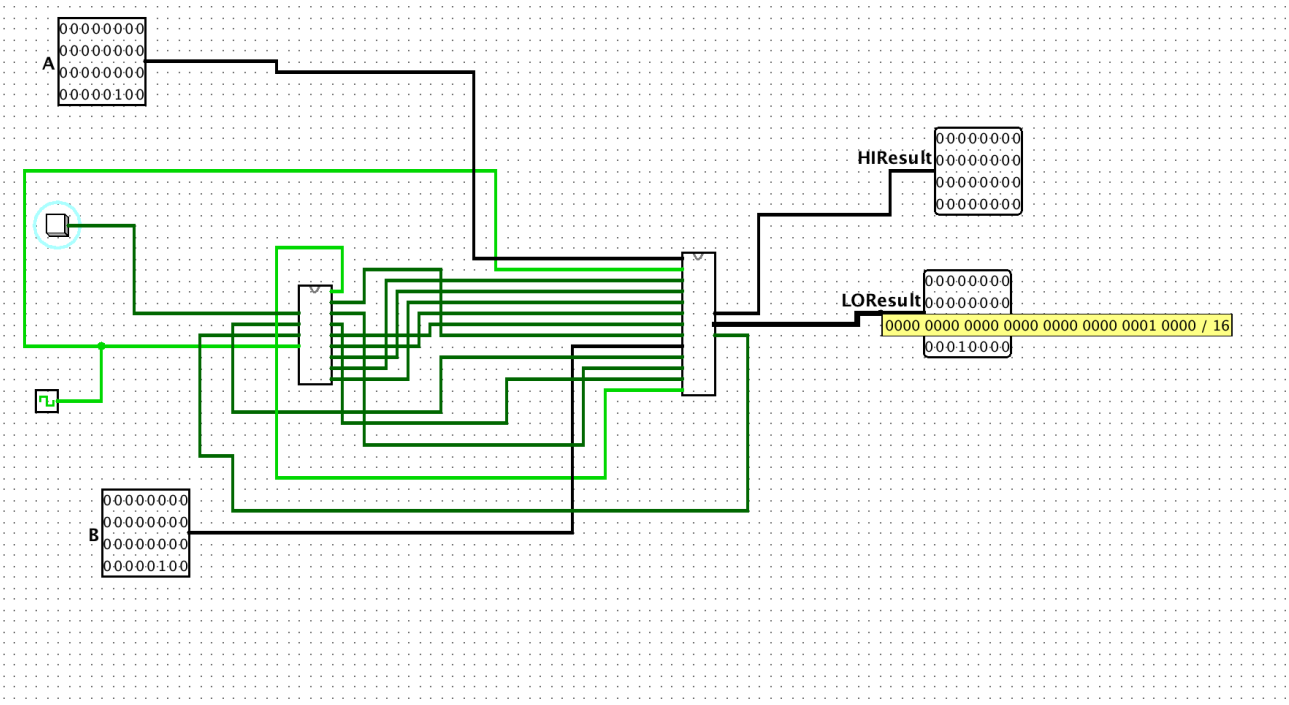


Outputs

When We put numbers in 32 bit pin A and B then push start button , results seems

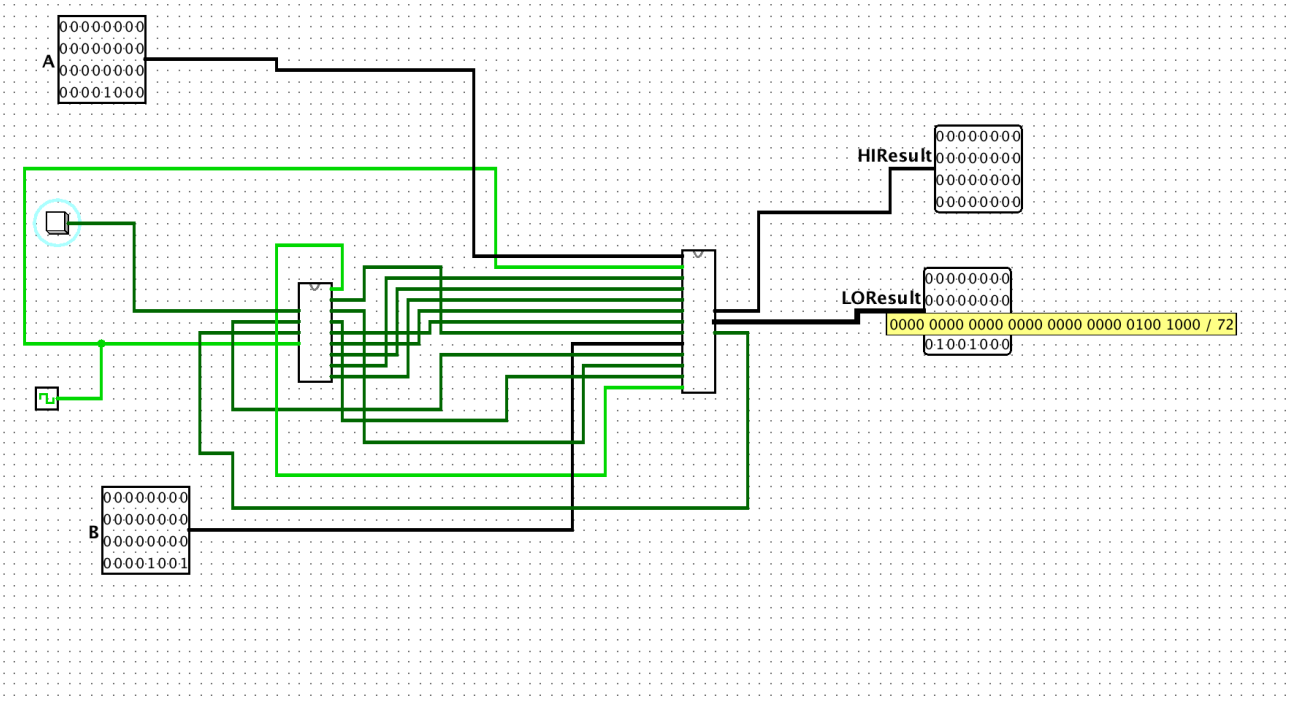
1)

4 * 4 = 16



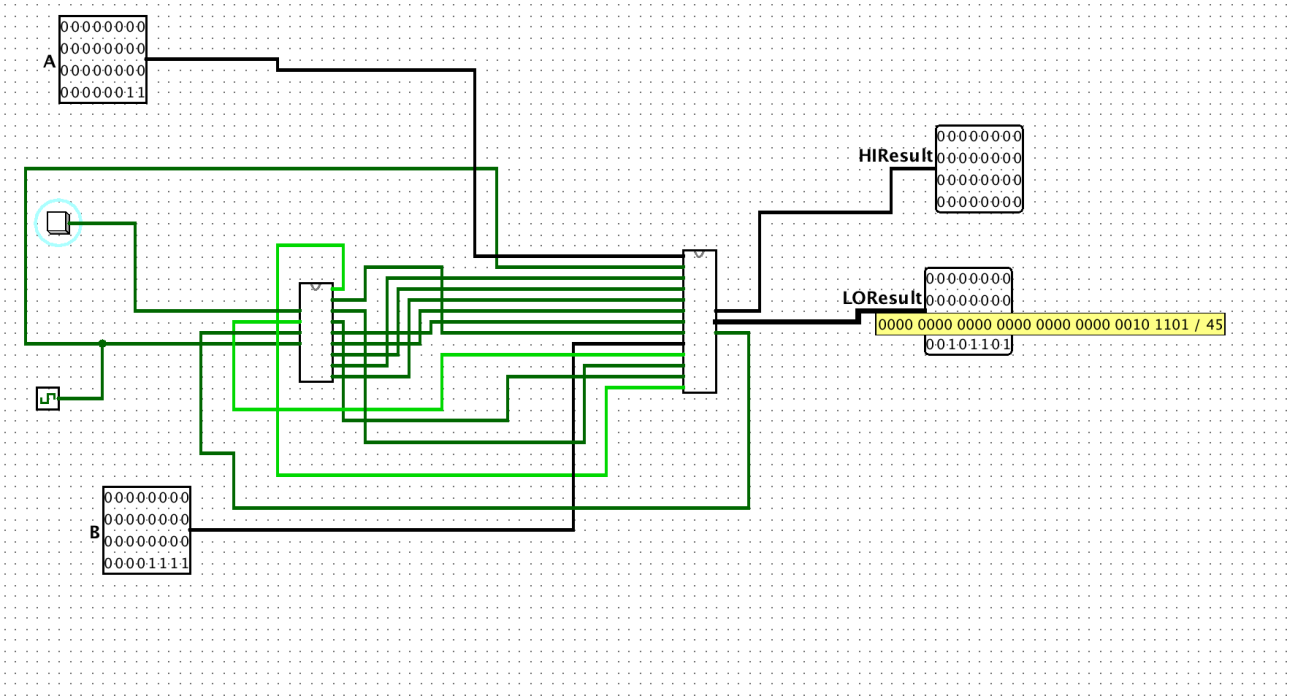
2)

8 * 9 = 72



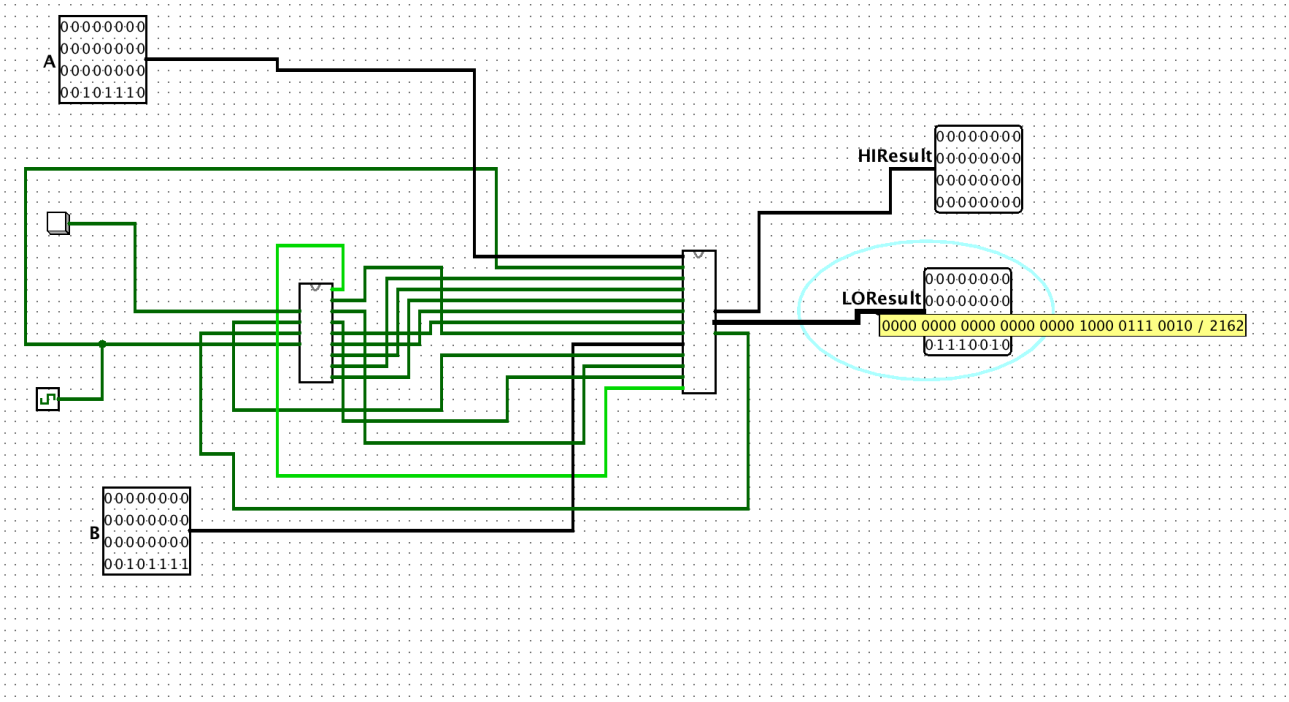
3)

3 * 15 = 45



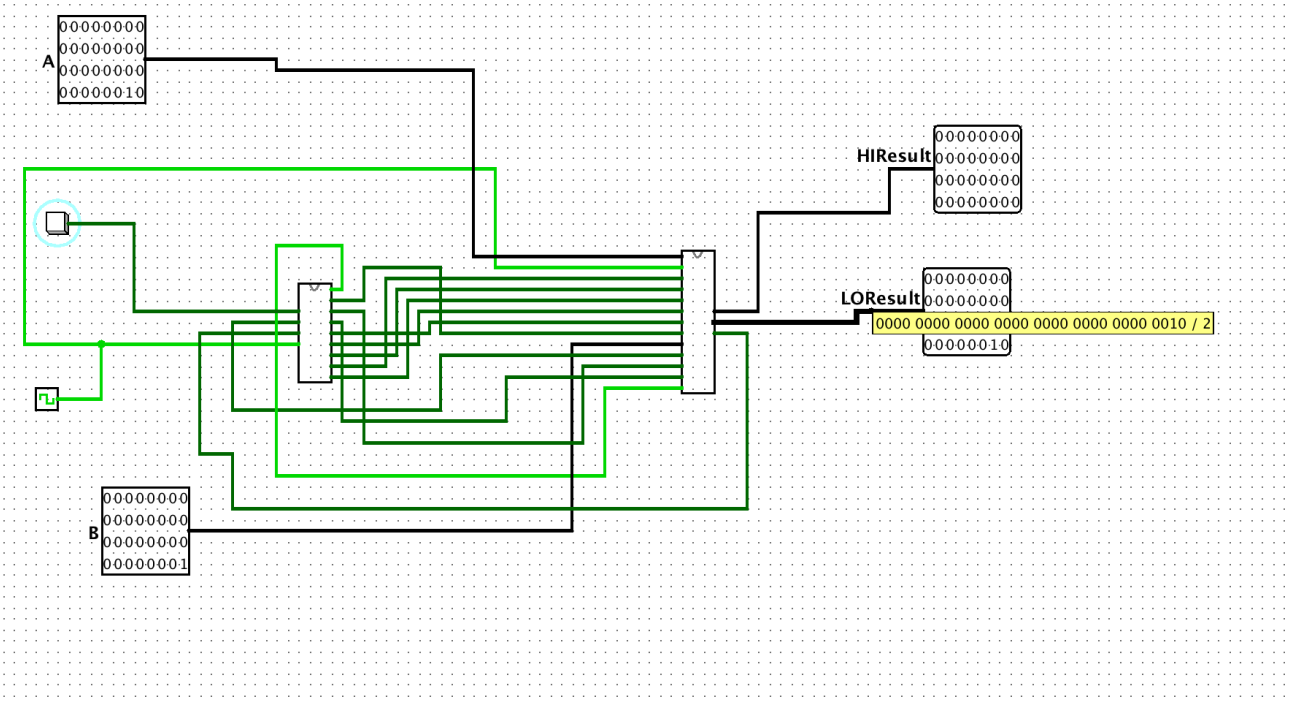
4)

46 * 47 = 2162



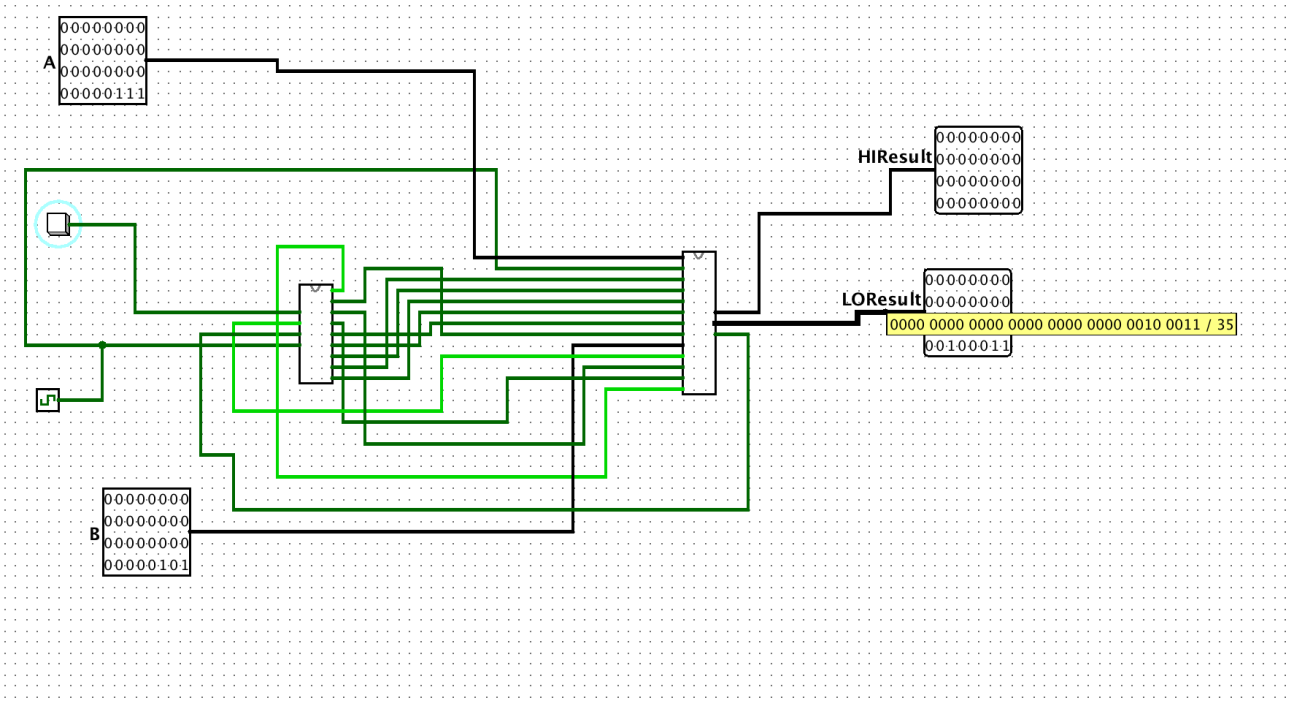
5)

2 * 1= 2


A
00000000
00000000
00000000
00000010
HIResult
00000000
00000000
00000000
00000000
LOResult
00000000
00000000
0000 0000 0000 0000 0000 0000 0000 0010 / 2
00000010
B
00000000
00000000
00000000
00000001

6)

7 * 5 = 35


A
00000000
00000000
00000000
00000111
HIResult
00000000
00000000
00000000
00000000
LOResult
00000000
00000000
0000 0000 0000 0000 0000 0000 0010 0011 / 35
00100011
B
00000000
00000000
00000000
00000101