CSE 331/503 COMPUTER ORGANIZATION FALL 2020

HOMEWORK 3 REPORT

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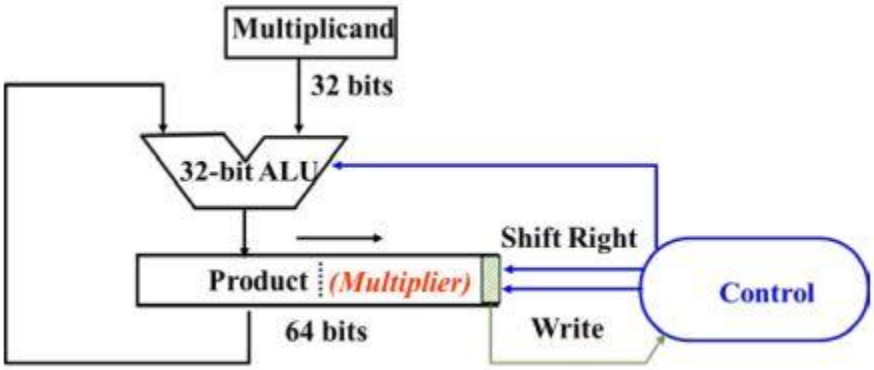
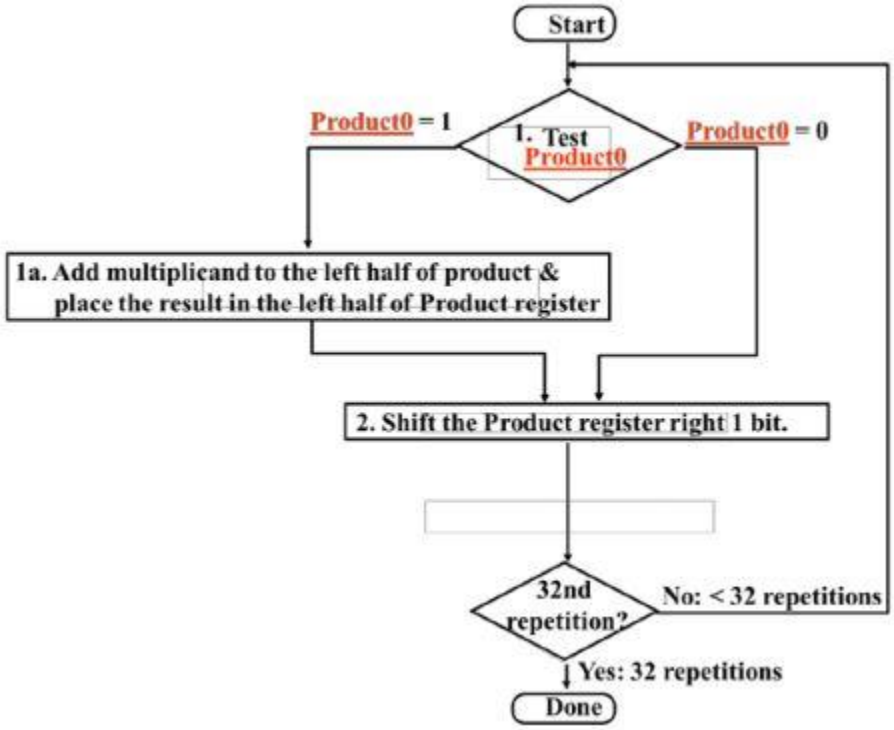
Homework Description:

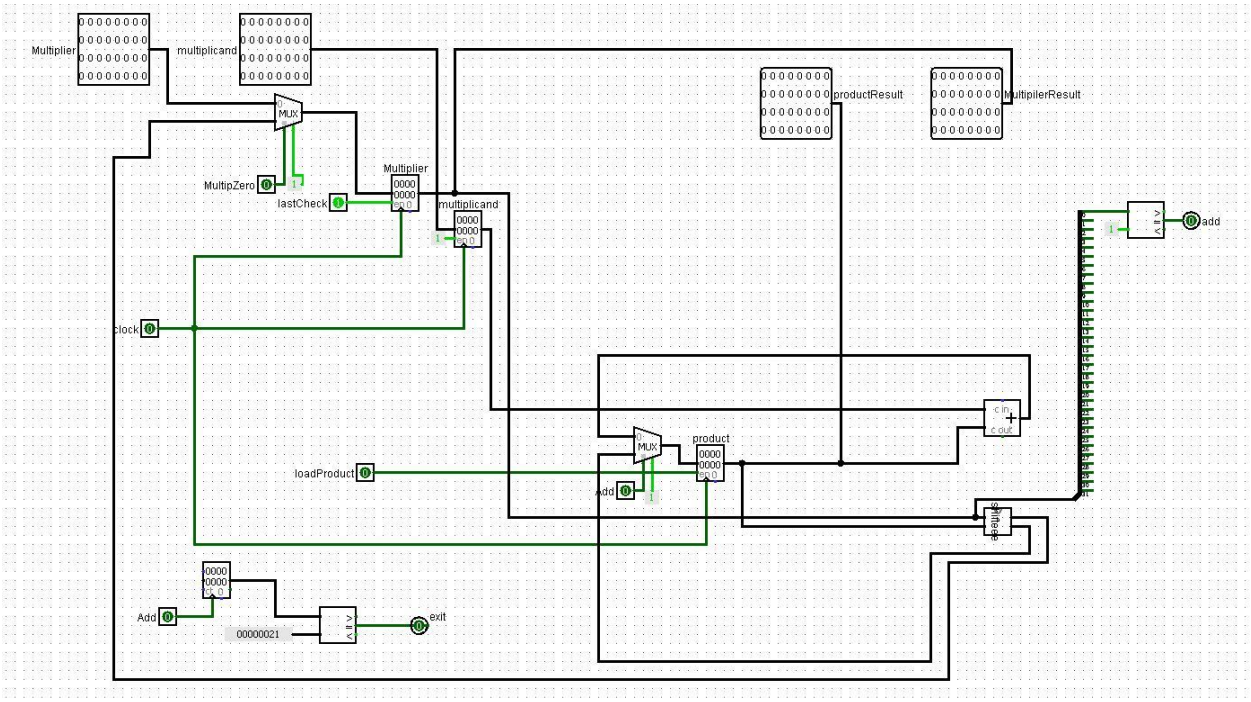
In this assignment you will the bellow Unsigned Number Multiplier using Logisim.



Your Control Unit will implement the below ASM:



Datapath Description:



Datapath takes two 32-bit numbers and multiplies them. There is a control unit that manages the datapath with certain signals in certain state.

Transactions performed in the datapath:

Multiplier and Multiplier 32-bit numbers are placed in registers.

I take the last bit of the multiplier and check it.

Collecting products with Multiplicand. Shifts Product and Multiplier.

According to the control I made at the last bit of the multiplier, I write the multiplier total product result to the product register in the other condition(Shift).

Since it will shift in every cycle under all conditions, I designed my counter to count shifts since the number I have is 32 bits. In this way, when the 32-bit number is shifted 32 times, the multiplication process ends. And it does not write to registers yet.

There are 2 signals from the datapath and they go to the control unit. The first is the add signal by comparing the number from the least significant bit of the Multiplier with my second signal is the exit signal indicating that the multiplication is finished. The exit signal counts the number of times the Circ shifts and compares it with 32. And it generates the exit signal.

There are 5 input signals in my datapath, one of them is a clock. The other 4 are taken from the control unit.

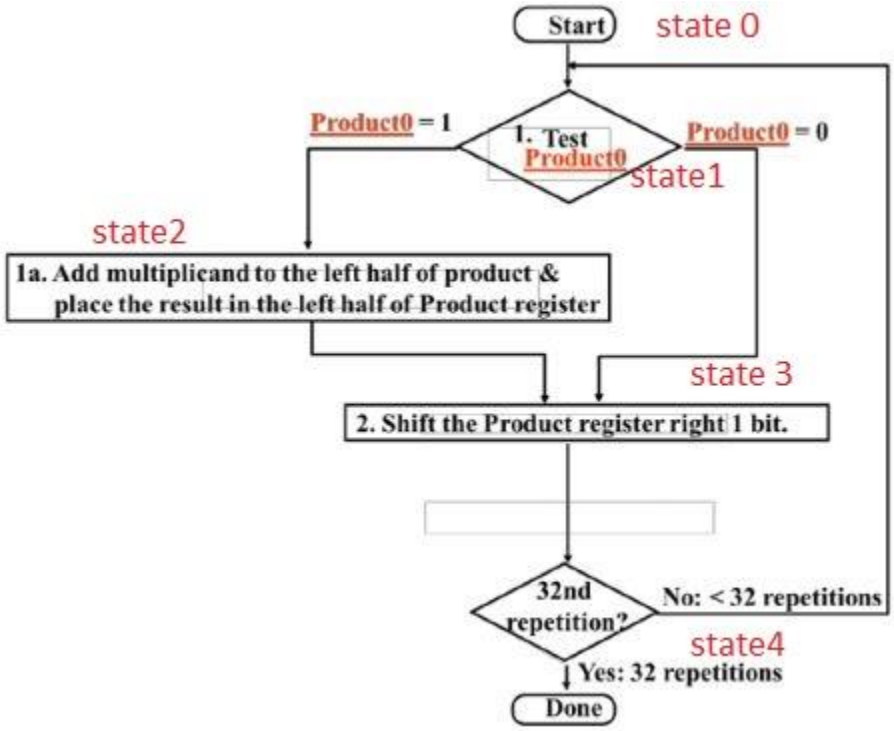
The lastCheck signal is connected to the enable input of the Multiplier register. It controls whether the input to the Multiplier register can be written or not.

The MultipZero signal selects between the result coming from the Multipliera shifter and the input Multiplier. The result of the selection transmits it to the Multiplier register.

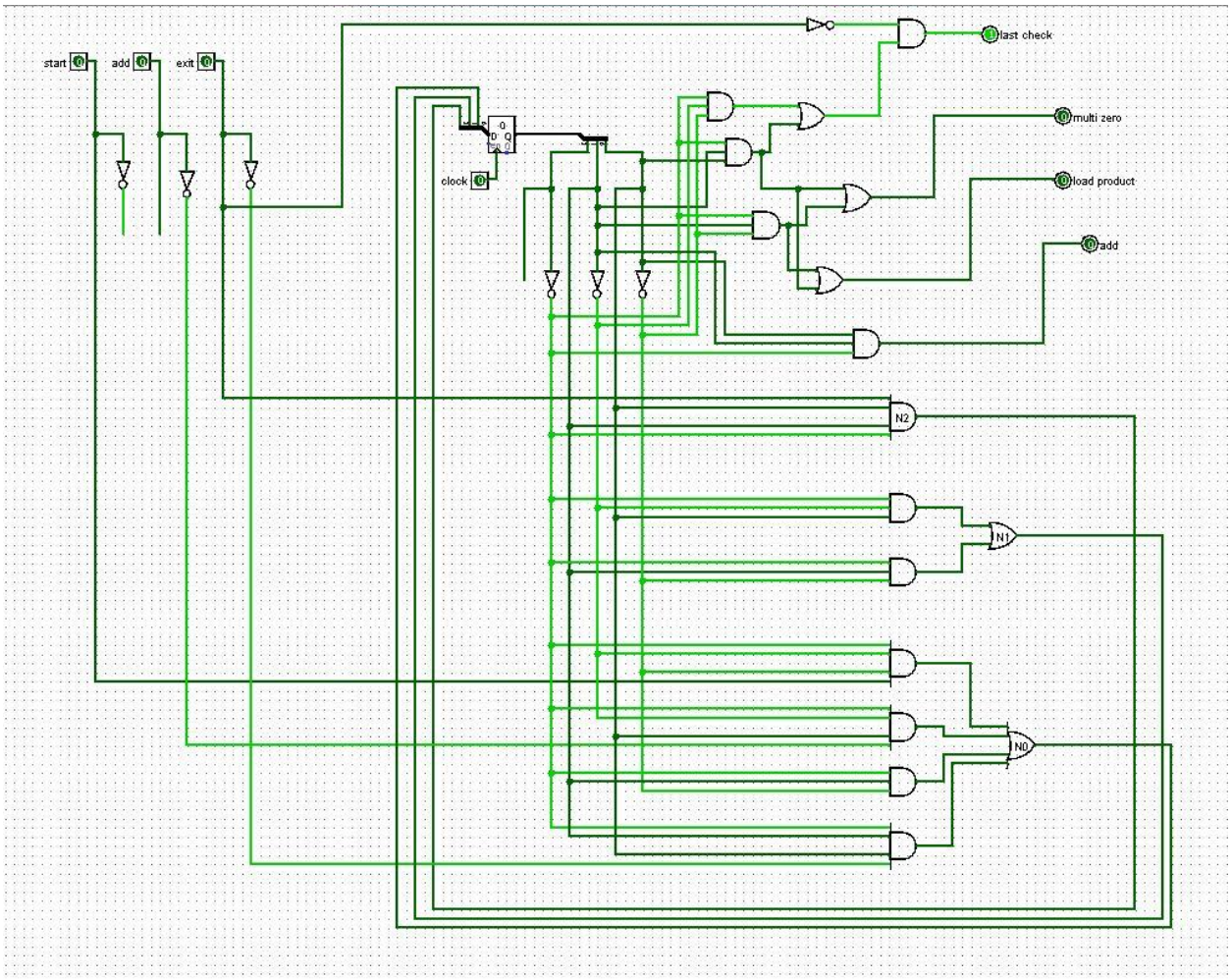
The load product signal is the signal that controls the loading of the product register.

The add signal selects between product and multipicandi sum or shifted states of the product to snap to the product register.

State Diagram:



Control Unit Description:



Control unit is the circuit that manages the datapath with the signals it sends. There are 4 inputs, these are start, add, clock and exit signals. There are 4 output signals, these are last check, multi zero, load product and exit. I designed the control unit using the tables I defined below.

Truth Tables Statement and Output:

Present State			Inputs			Next State		
P2	P1	P0	Start	Add	Exit	N2	N1	N0
0	0	0	0	X	X	0	0	0
0	0	0	1	X	X	0	0	1
0	0	1	X	0	X	0	1	1
0	0	1	X	1	X	0	1	0
0	1	0	X	X	X	0	1	1
0	1	1	X	X	0	0	0	1
0	1	1	X	X	1	1	0	0

State			LastCheck	MultiZero	Loadproduct	Add
P2	P1	P0				
0	0	0	1	0	0	0
0	0	1	0	0	0	0
0	1	0	0	1	1	0
0	1	1	1	1	1	1

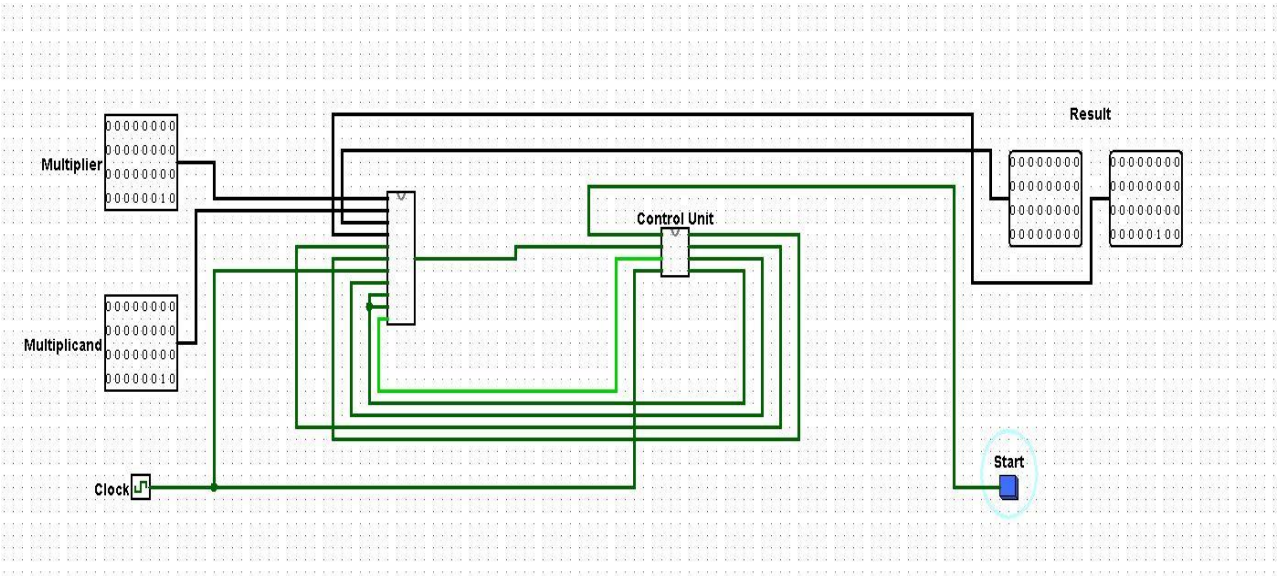
N2: P2’P1P0E

N1: P2’P1’P0 + P2’P1P0’

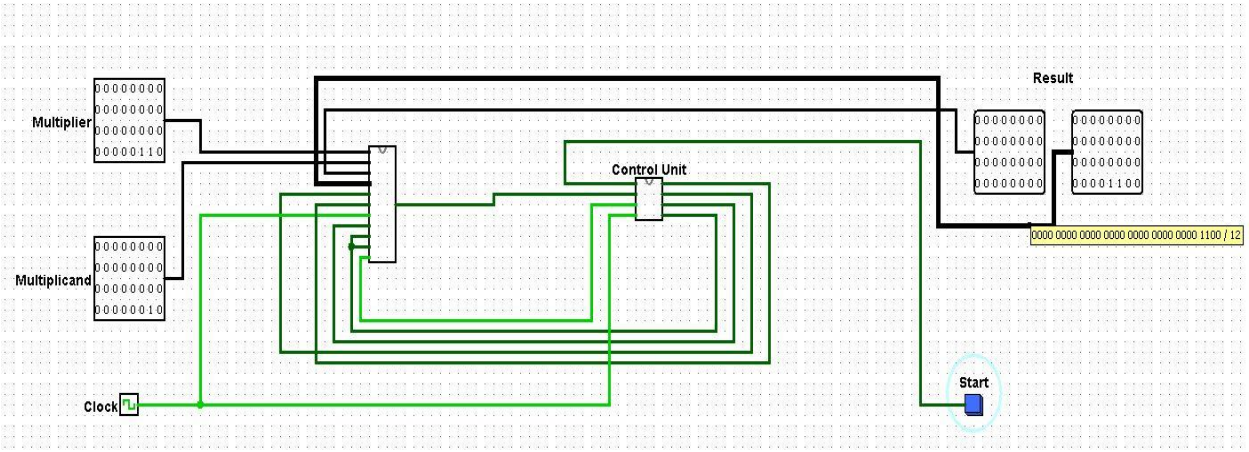
N0: P2’P1’P0’S + P2’P1’P0A’ + P2’P1P0’ + P2’P1P0E’

Test Case:

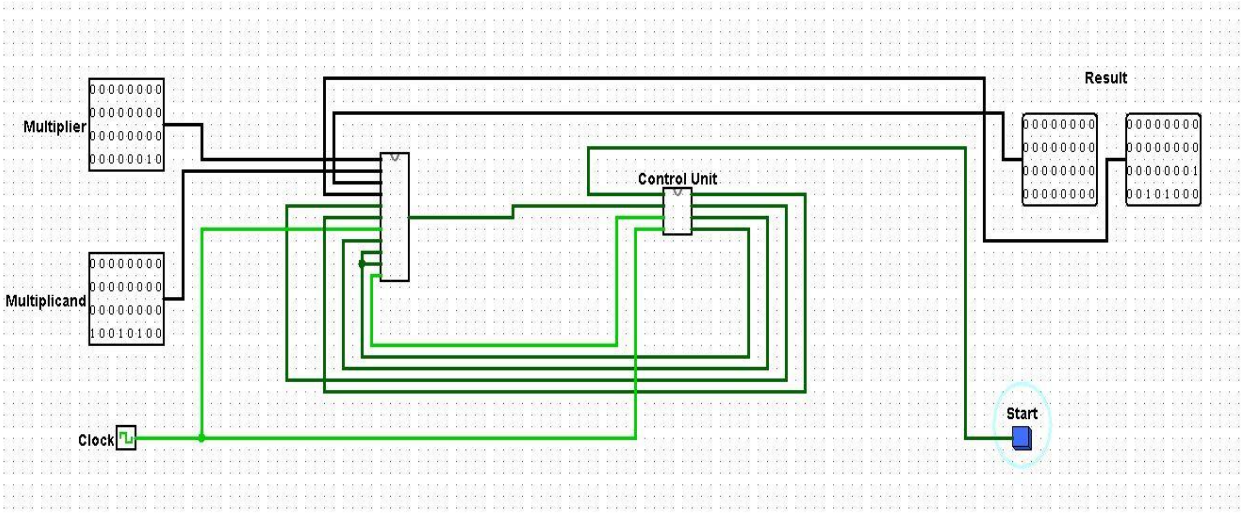
1) **2** x **2 = 4**



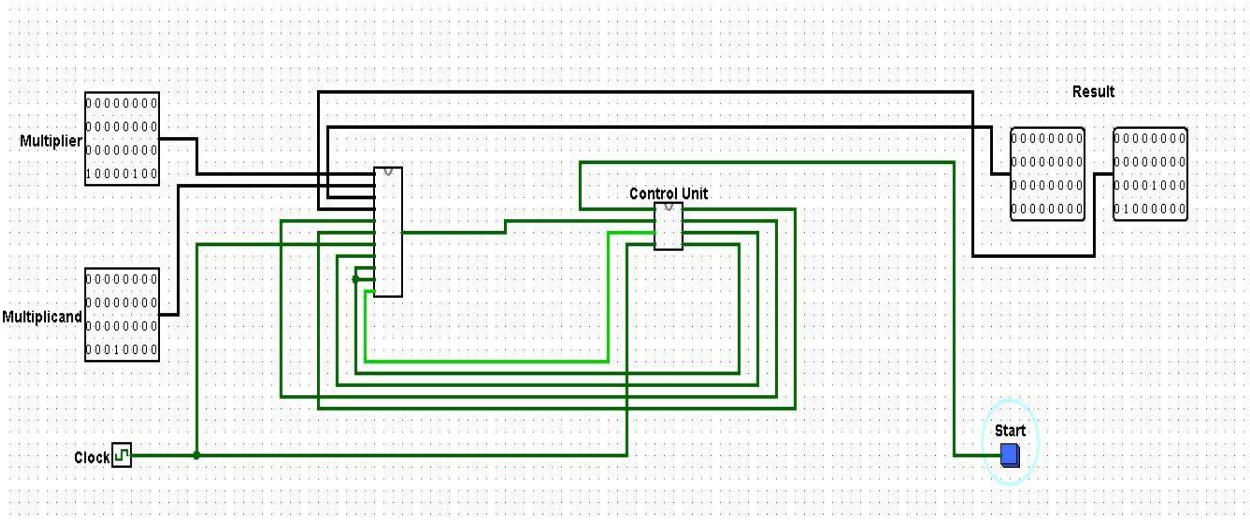
2) 6 x 2 = 12



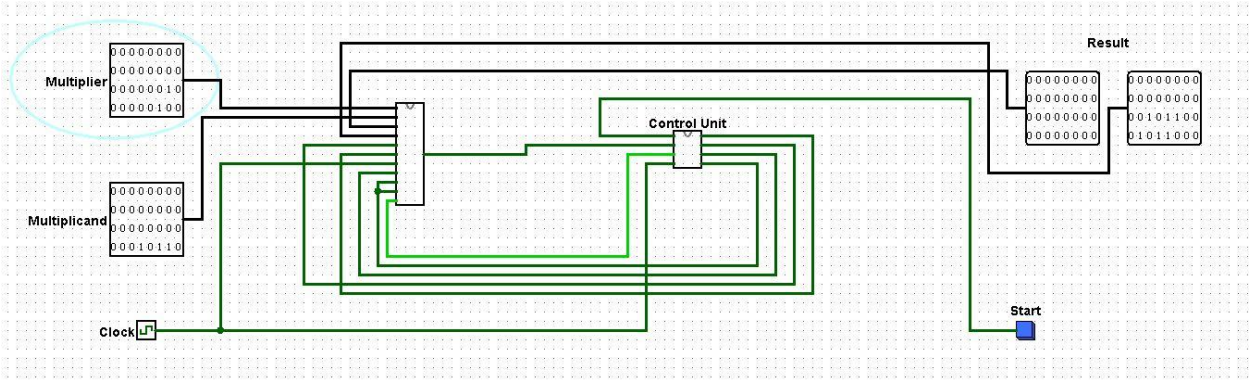
3) 2 x 148 = 296



4) 132 x 16 = 2112



5) 516 x 22 = 11352



6) 10 x 36 = 360