- CSE 331 -

Computer Organization

HW3 Report

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Unsigned Number Multiplier using Logisim :

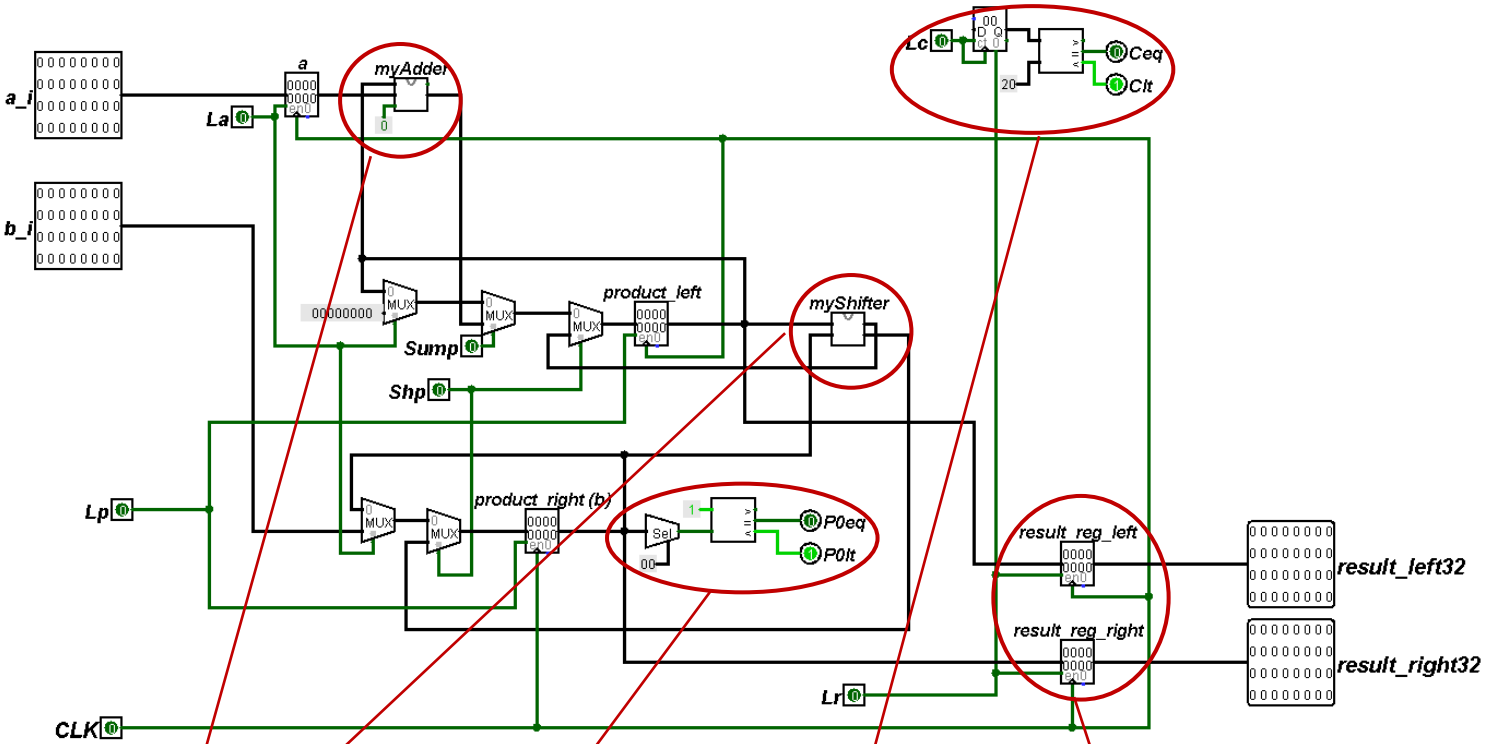
My design has 3 parts:

→Datapath (contains required operations : add, shift etc..)
→Control Unit (implements ASM)
→Mult32 (main)

Also I designed, (inside datapath) (bonus)
→32 bit adder
→64 bit shifter (1-bit logical right shifter)

➢ Datapath Design

La, Lp, Lc, Sump, Shp, Lr are input signals for datapath.



32 bit adder and

64 bit shifter

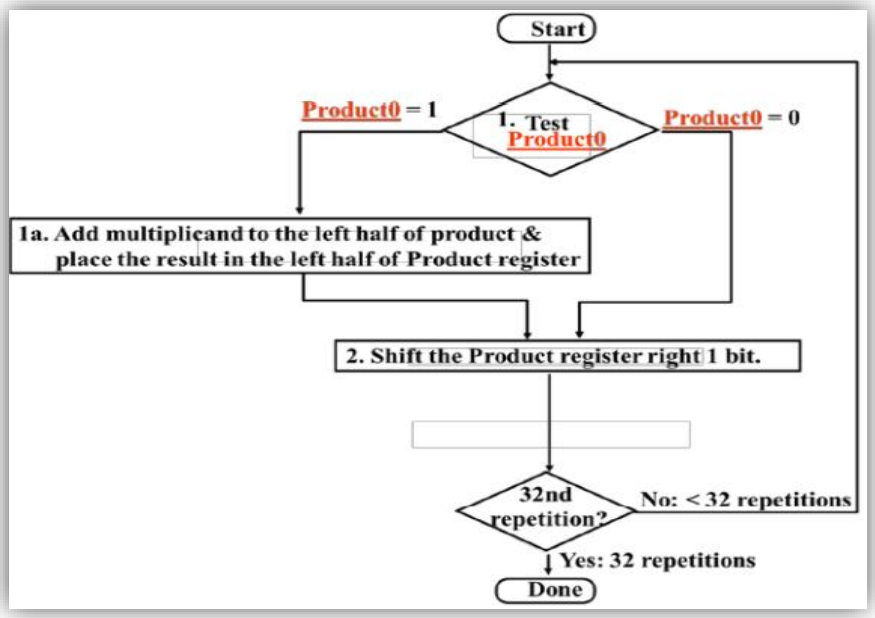
result registers (at the end it goes first state , this is for not loosing the result)

For finding product's 0th bit

For counting 32 repetitions

➢ Control Unit Design

Control Unit will implement the given ASM:



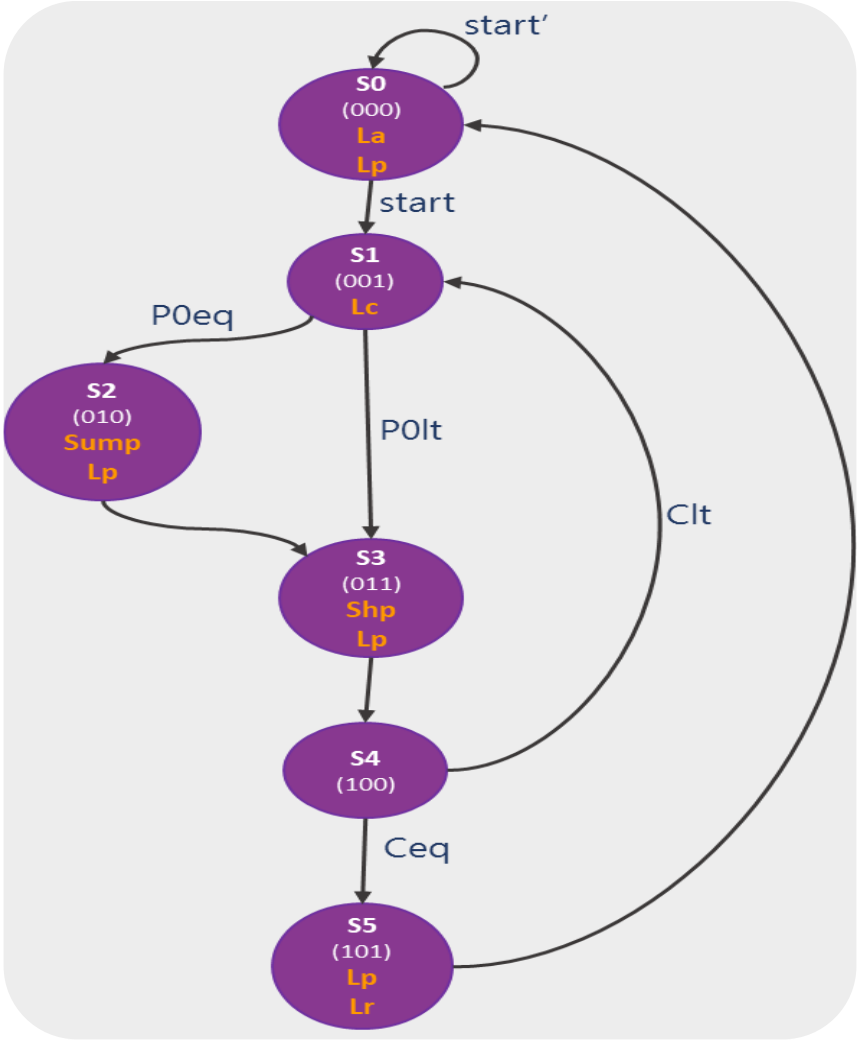
Updated ASM →

States:
S0, S1, S2,
S3, S4, S5

Input signals:
Start, P0eq,
P0lt, Ceq, Clt

Output signals:
(input for datapath)

La, Lp, Lc,
Sump, Shp, Lr



Truth Tables:

Present States (PS)		Inputs					Next States (NS)
	P2 P1 P0	start	P0eq	P0lt	Ceq	Clt	N2 N1 N0
S0	0 0 0	0	-	-	-	-	0 0 0
	0 0 0	1	-	-	-	-	0 0 1
S1	0 0 1	-	1	0	-	-	0 1 0
	0 0 1	-	0	1	-	-	0 1 1
S2	0 1 0	-	-	-	-	-	0 1 1
S3	0 1 1	-	-	-	-	-	1 0 0
S4	1 0 0	-	-	-	0	1	0 0 1
	1 0 0	-	-	-	1	0	1 0 1
S5	1 0 1	-	-	-	-	-	0 0 0

Outputs are just depends on states, so I showed it in separate truth table:

Present States (PS)		La	Lp	Lc	Sump	Shp	Lr
	P2 P1 P0						
S0	0 0 0	1	1	0	0	0	0
S1	0 0 1	0	0	1	0	0	0
S2	0 1 0	0	1	0	1	0	0
S3	0 1 1	0	1	0	0	1	0
S4	1 0 0	0	0	0	0	0	0
S5	1 0 1	0	1	0	0	0	1

Boolean expressions from truth table:

N2 = P2'P1P0 + P2P1'P0'Ceq

N1 = P2'P1'P0P0eq + P2'P1'P0P0lt + P2'P1P0'

N0 = P2'P1'P0'start + P2'P1'P0P0lt + P2'P1P0' +
P2P1'P0'Clt + P2P1'P0'Ceq

La = S0

Lp = S0 + S2 + S3 + S5

Lc = S1

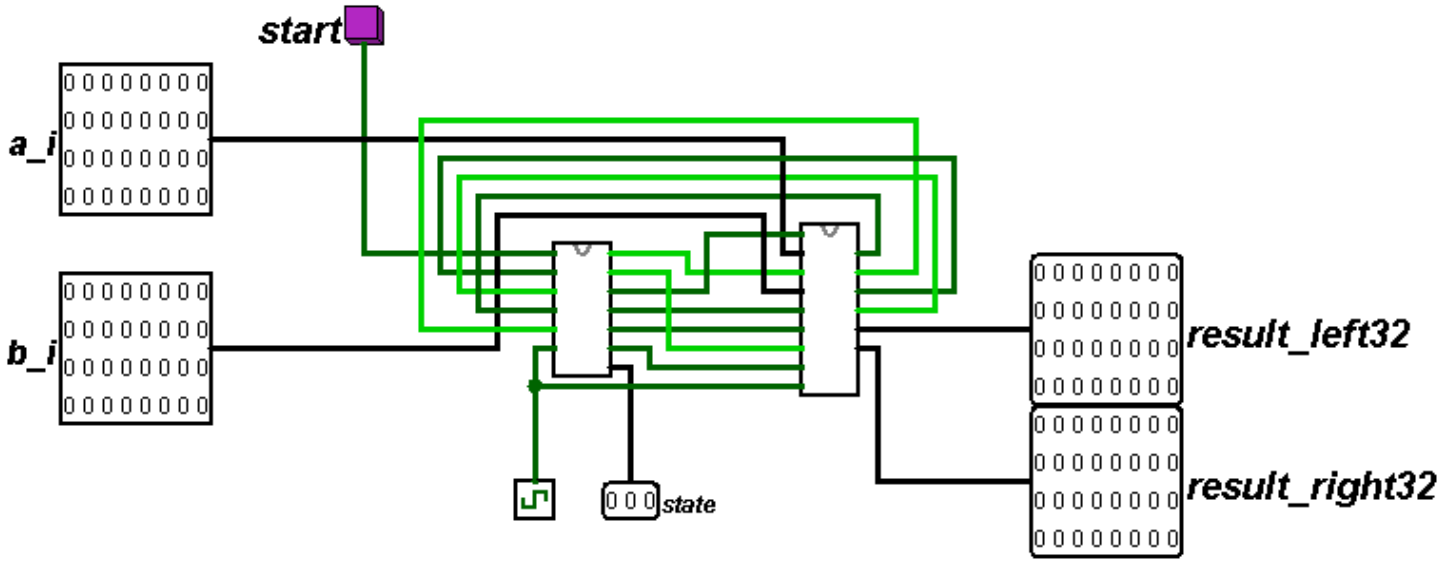
Sump = S2

Shp = S3

Lr = S5

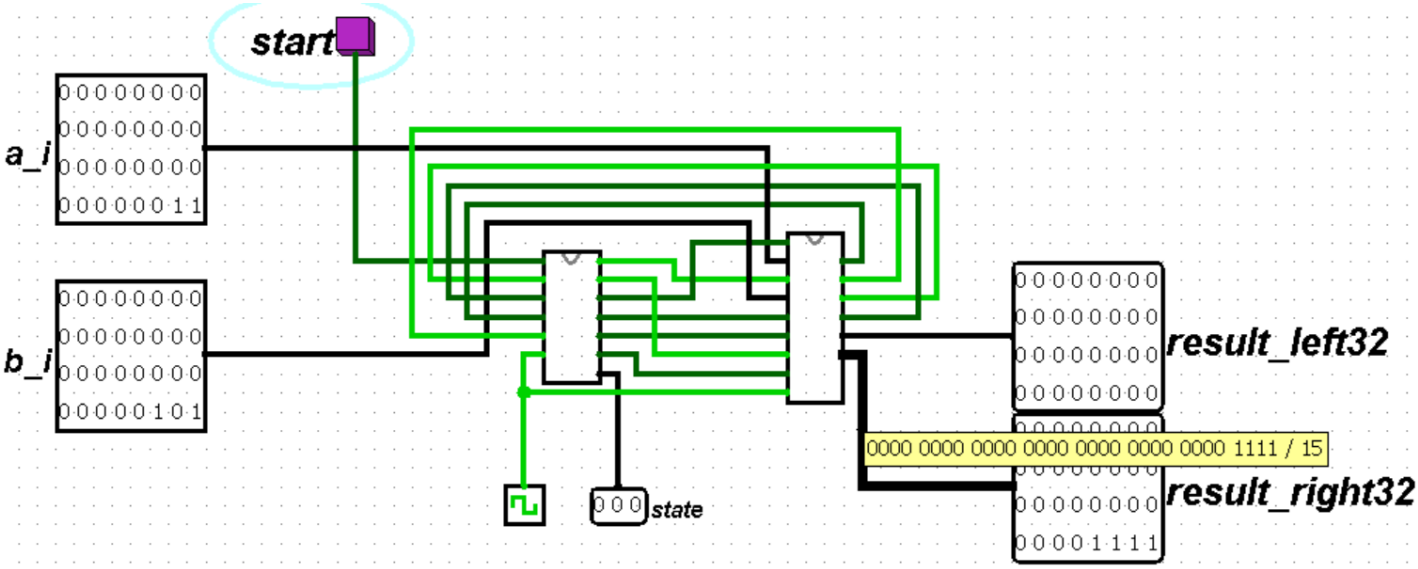
➢ Mult32

Mult32: main file which combines datapath and control unit.

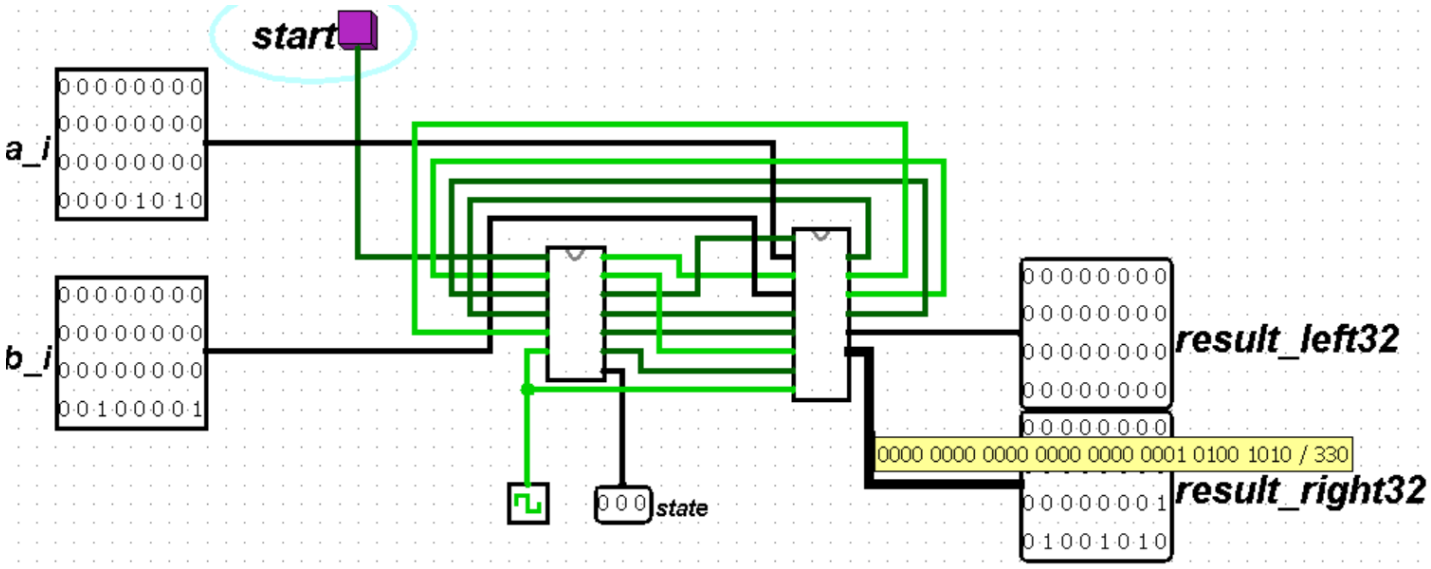


➢ Test Cases

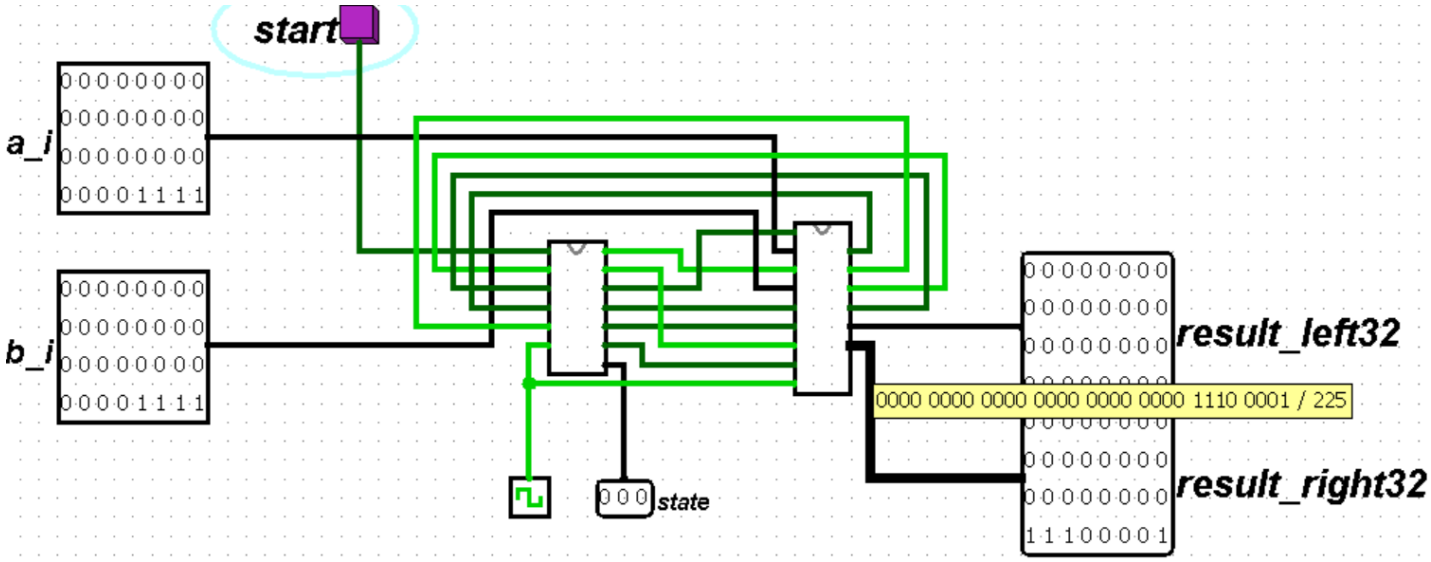
- **Test1 → 3 x 5 = 15**



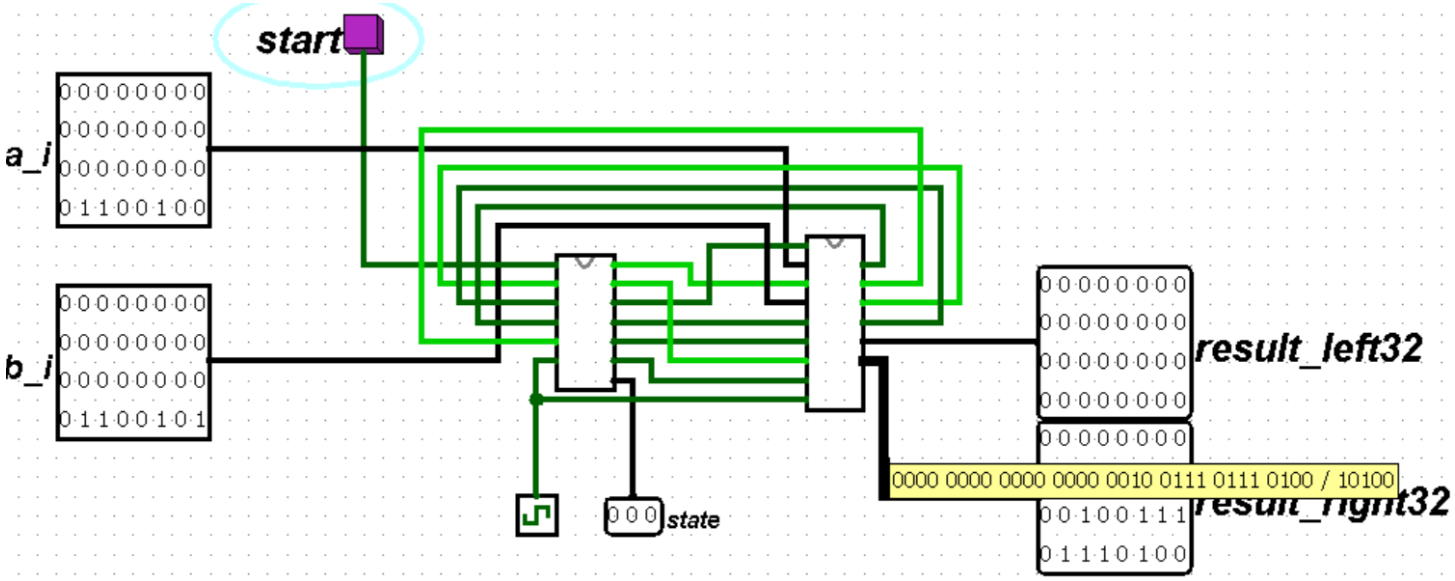
- **Test2 → 10 x 33 = 330**



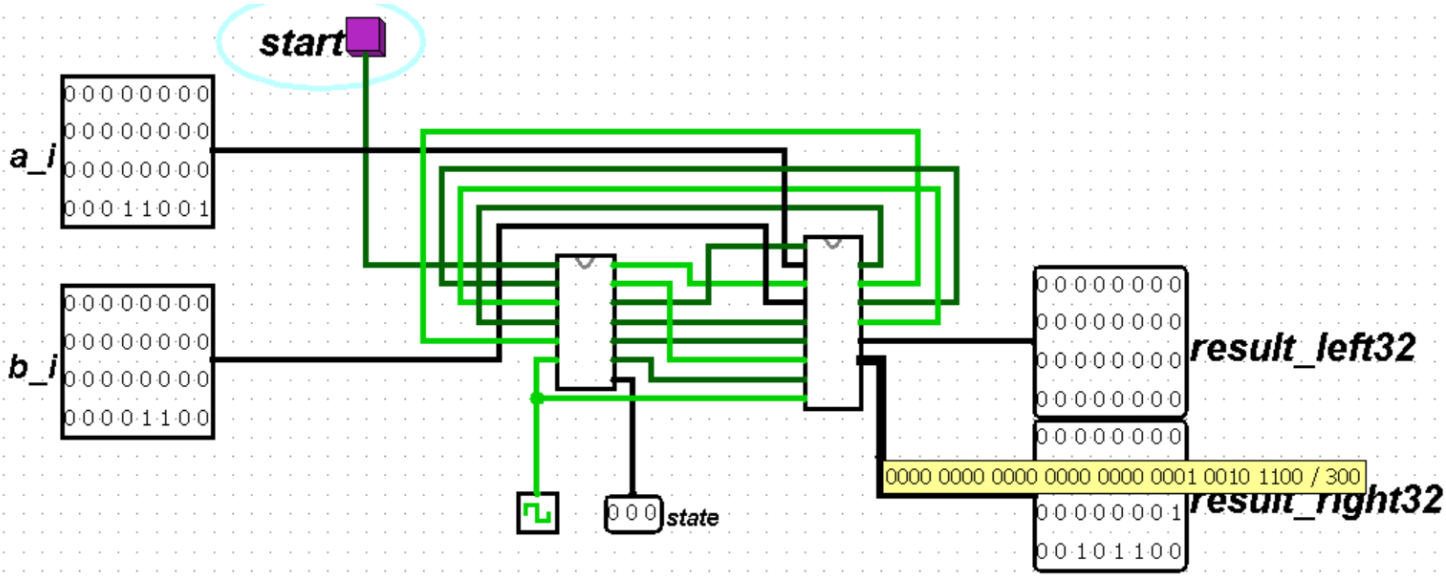
- **Test3 → 15 x 15 = 225**



- **Test4 → 100 x 101 = 10100**



- **Test5 → 25 x 12 = 300**



- **Test6 → 1500 x 1450 = 2175000**