CSE 232 SPRING 2020

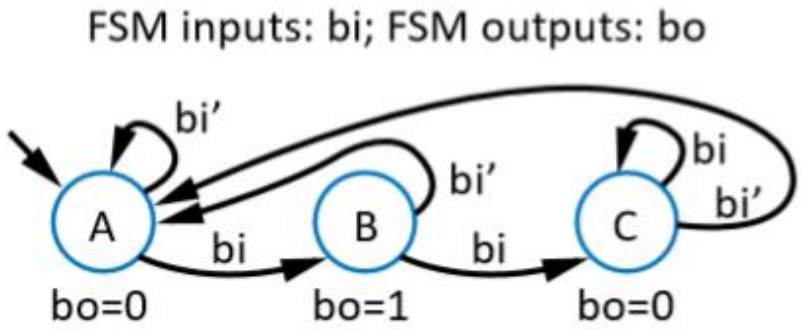
PROJECT 2

Mehmet Avni ÇELİK

1801042630

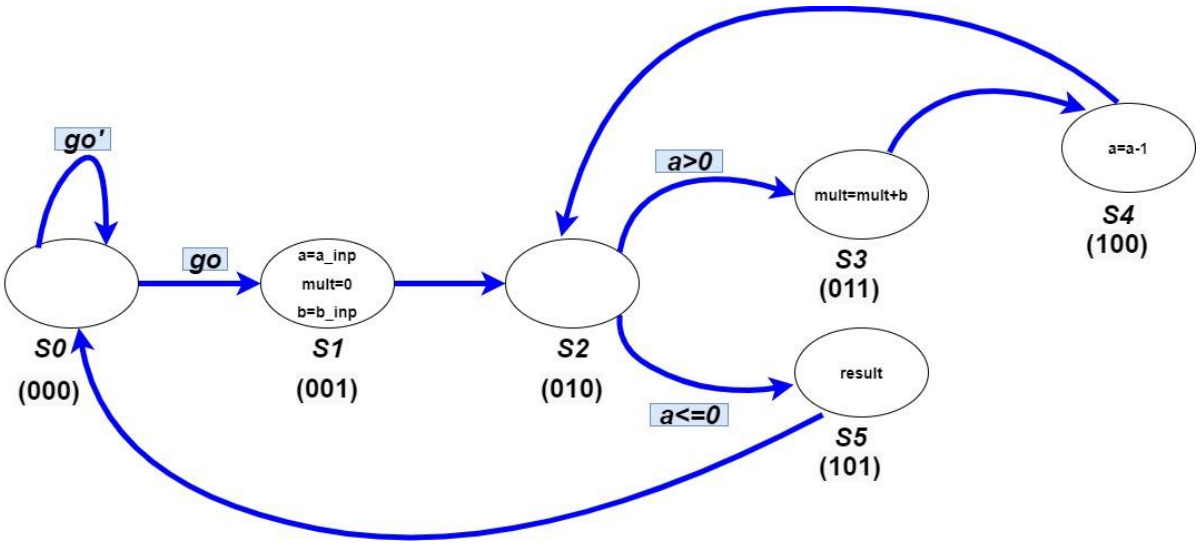
1. ***Decide states and draw the state diagram for your FSM controller.***

State Diagram for Synchronizer:

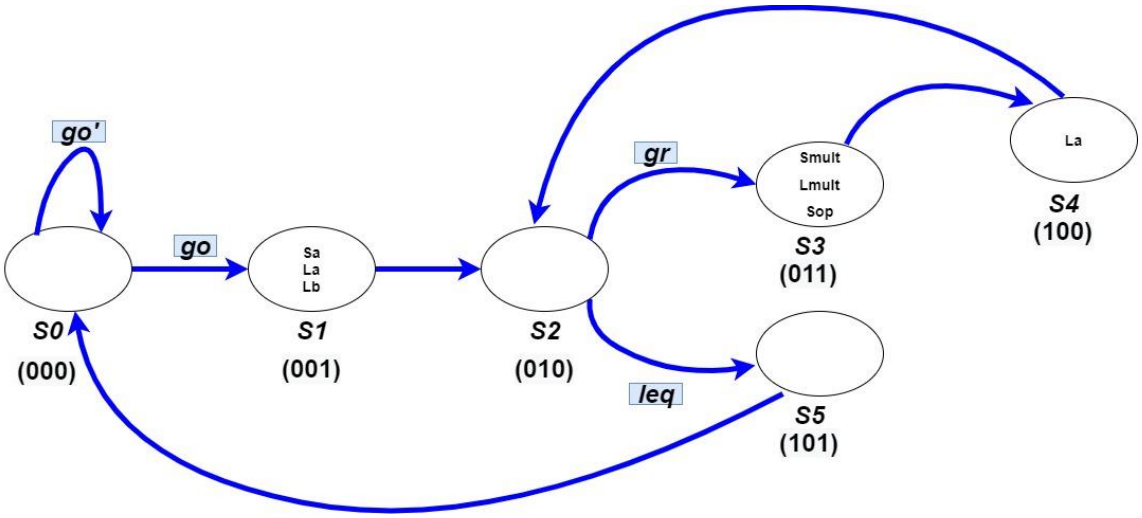


(chapter 3/page47)

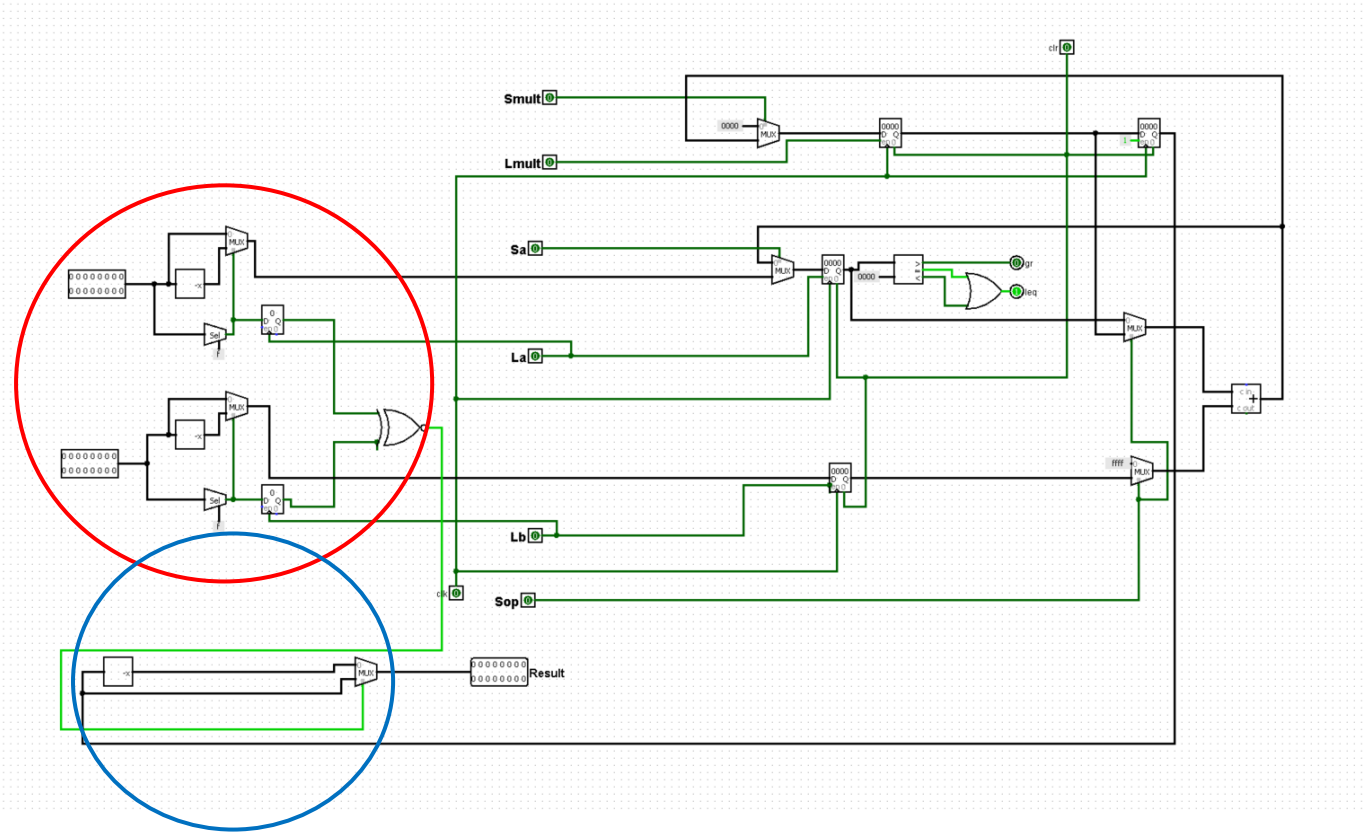
State Diagram for The Calculator(with commands):



This diagram becomes the following figure(with outputs):



2. ***Draw datapath.***



Red Circle is for taking the absolute value of negative numbers and evaluate them as positive numbers. At the end of the calculation, in blue circle, they will be considered by their original signs.

3. ***Draw truth table.***

Current States			Inputs			Next States		
S2	***S1***	***S0***	***go***	***gr***	***leq***	***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	x	x	0	1	0
0	1	0	x	1	0	0	1	1
0	1	1	x	x	x	1	0	0
1	0	0	x	x	x	0	1	0
0	1	0	x	0	1	1	0	1
1	0	1	x	x	x	0	0	0

State Bits			State No	Outputs					
S2	***S1***	***S0***	***S***	***Smult***	***Lmult***	***Sa***	***La***	***Lb***	***Sop***
0	0	0	**S0 ->**	0	0	0	0	0	0
0	0	1	**S1 ->**	0	0	1	1	1	0
0	1	0	**S2 ->**	0	0	0	0	0	0
0	1	1	**S3 ->**	1	1	0	0	0	1
1	0	0	**S4 ->**	0	0	0	1	0	0
1	0	1	**S5 ->**	0	0	0	0	0	0

4. ***Derive Boolean expressions from the truth table.***

N2= $S_2'.S_1.S_0 + S_2'.S_1.S_0.gr'.leq$

N1= $S_2'.S_1'.S_0 + S_2'.S_1.S_0'.gr.leq' + S_2.S_1'.S_0'$

N0= $S_2'.S_1'.S_0'.go + S_2'.S_1.S_0'.gr.leq' + S_2'.S_1.S_0'.gr'.leq$

Smult=S_3 (011)

Lmult=S_3 (011)

Sa= S_1 (001)

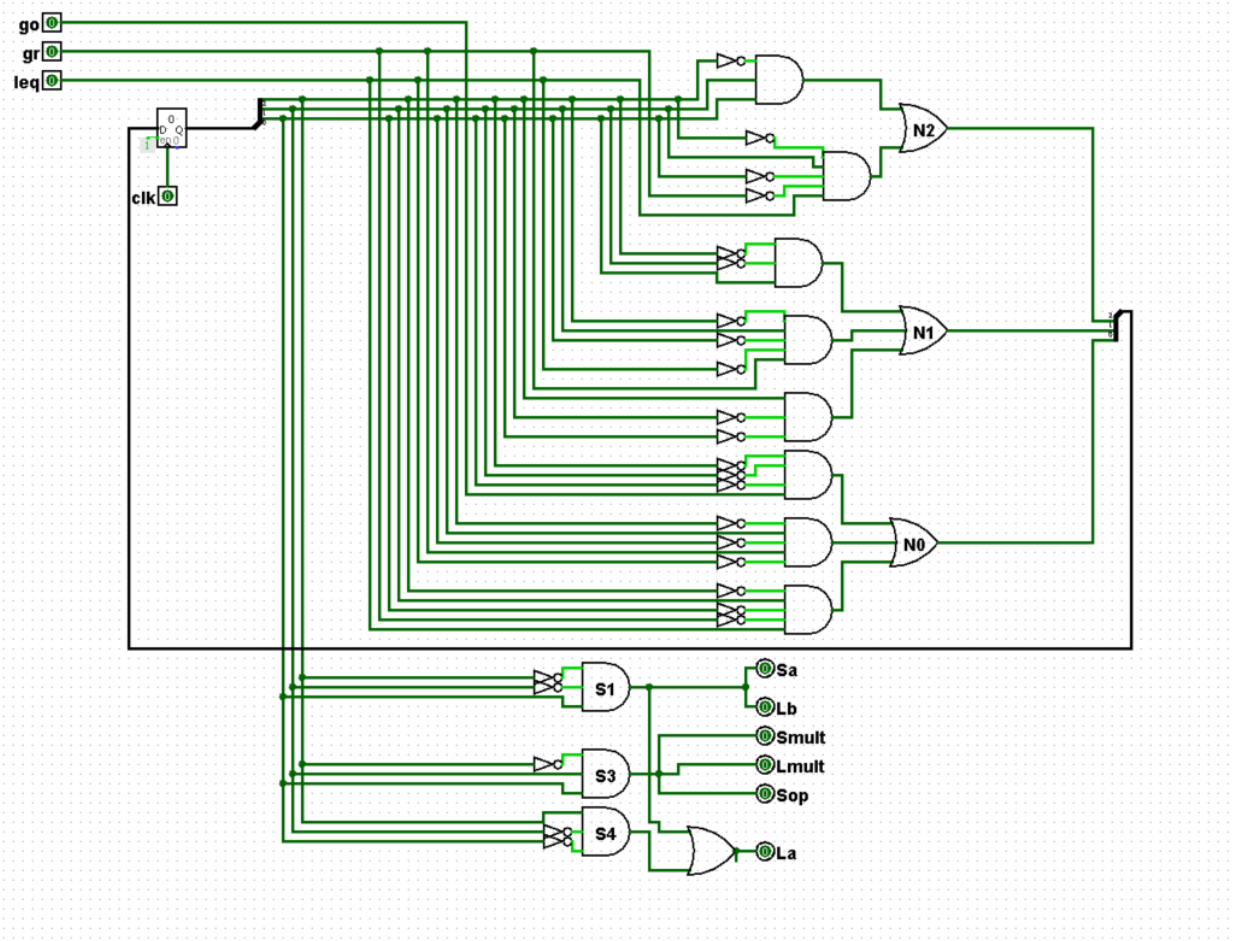
La= S_1+S_4 (001)+(100)

Lb= S_1 (001)

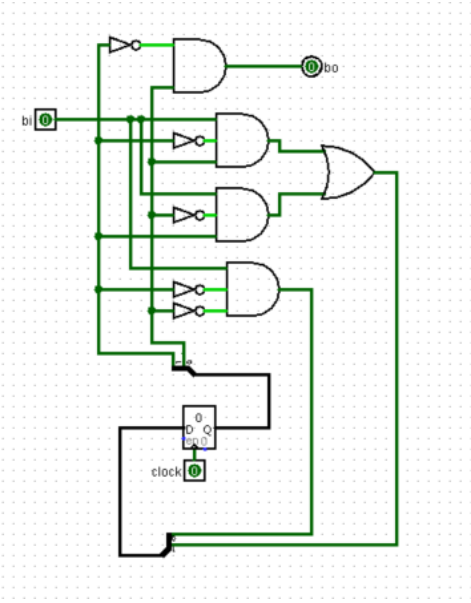
Sop= S_3 (011)

5. ***Draw the circuit on Logisim.***

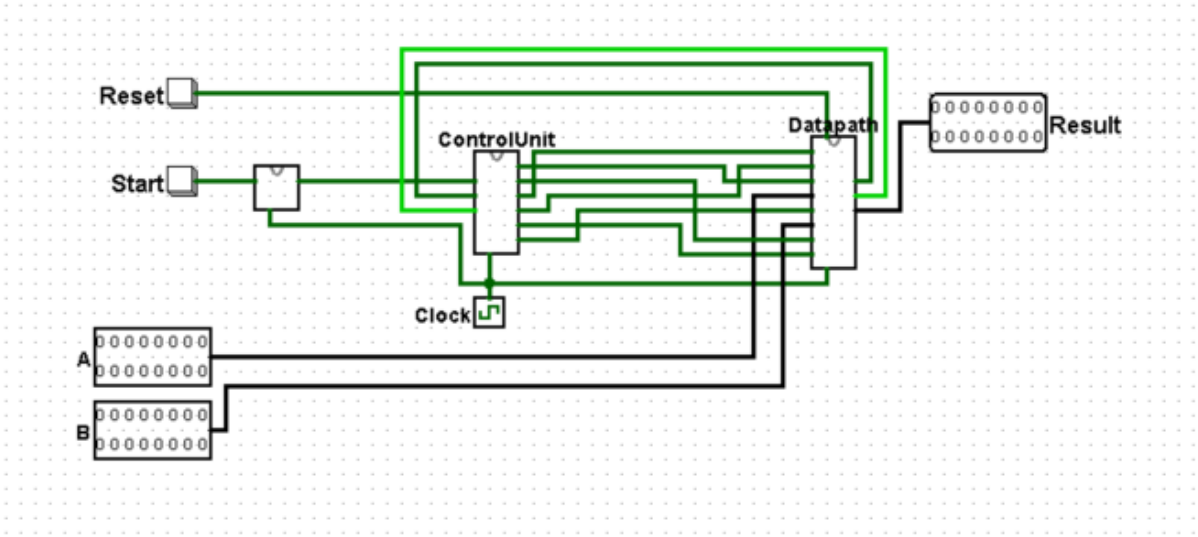
Control Unit of the Calculator:



Synchronizer of the Calculator:



All components of the calculator:



- ## How Does It Work?

  The multipliers should be written in A and B inputs. **It doesn't matter whether the numbers are positive or not.** Either way, the result of multiplication will be correct.

  After a calculation is done, reset button must be pressed. Otherwise, previous result and current result will be added.

  Synchronizer prevents to make more calculations caused by a long push to start button.

  To get the best result, make sure that the tick frequence(clock) is larger than 32 Hz.

  No glitch/error is observed in the designed circuit.