Ded: 21/1/22

ASSIGNMENT- 6

Encoders, Priority encoder and MUX

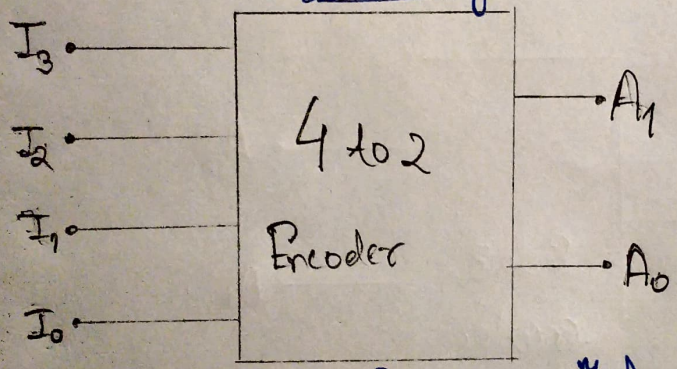
Submitted by-
Anusrthan Saxena
S20210010027

(I) Objective: 4to2, 8to3 and 16 to 4 encoders.

SOFTWARE USED: Logisim.

(A) 4 to 2 encoder –

Block diagram:



4 inputs give max^m of 2 outputs.
Opposite of decoders.

Truth table:

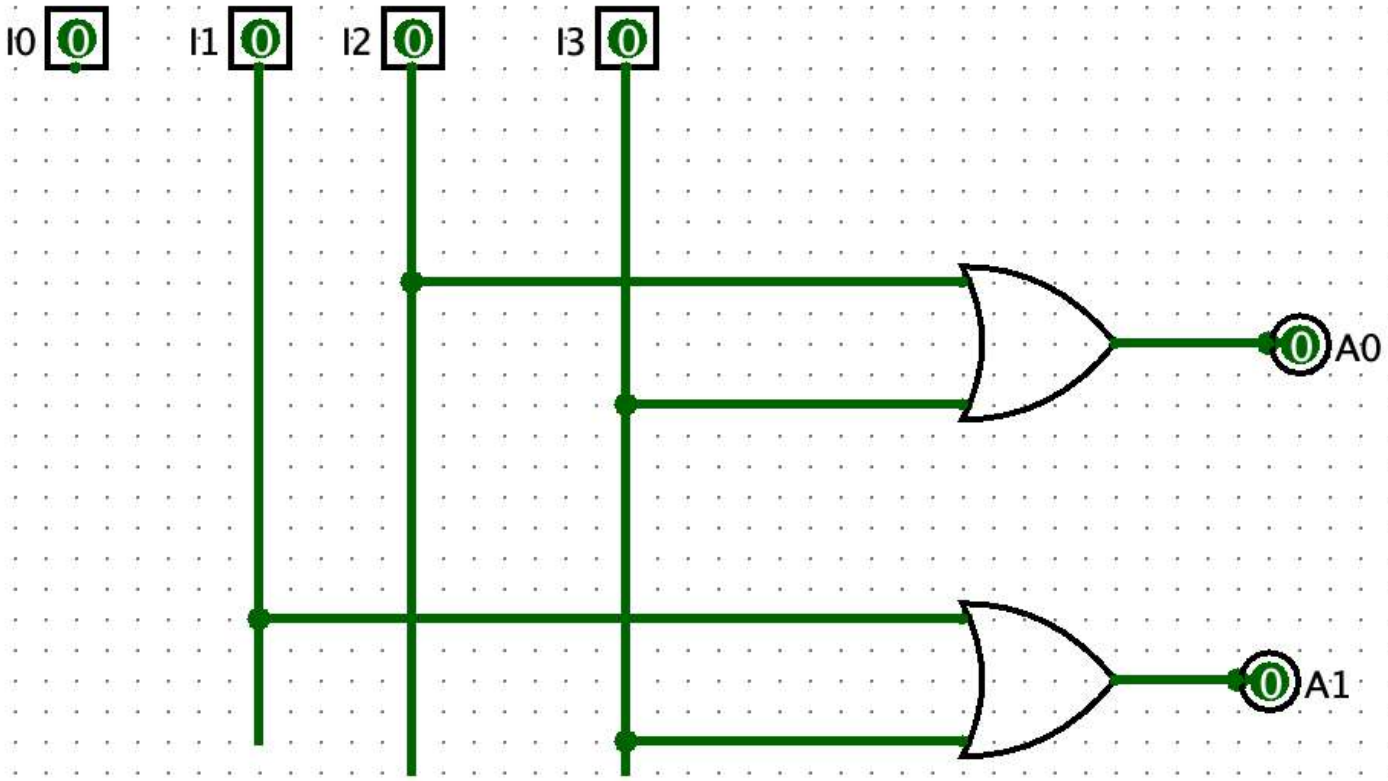
I_0	I_1	I_2	I_3	A_0	A_1
1	0	0	0	0	0
0	1	0	0	0	1
0	0	1	0	1	0
0	0	0	1	1	1

Expression:

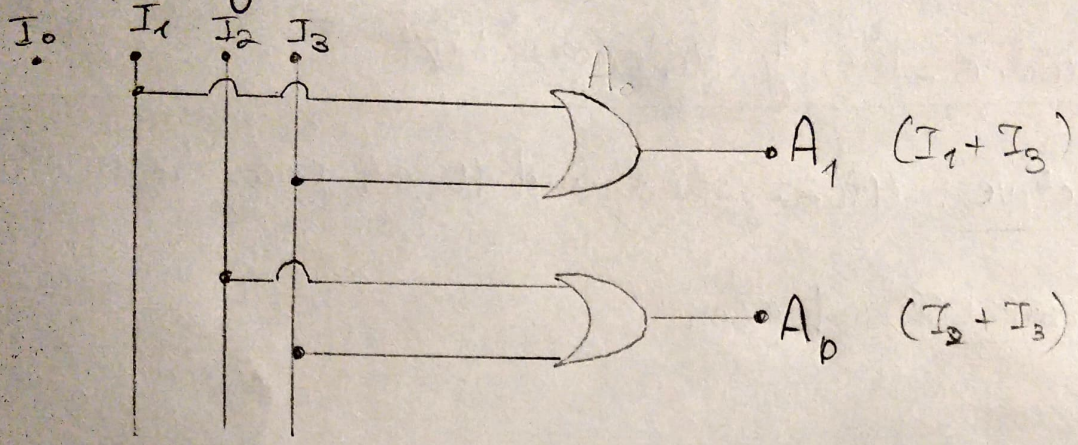
Since A_0 is high when I_2 is high or I_3 is high,

$A_0 = I_2 + I_3$

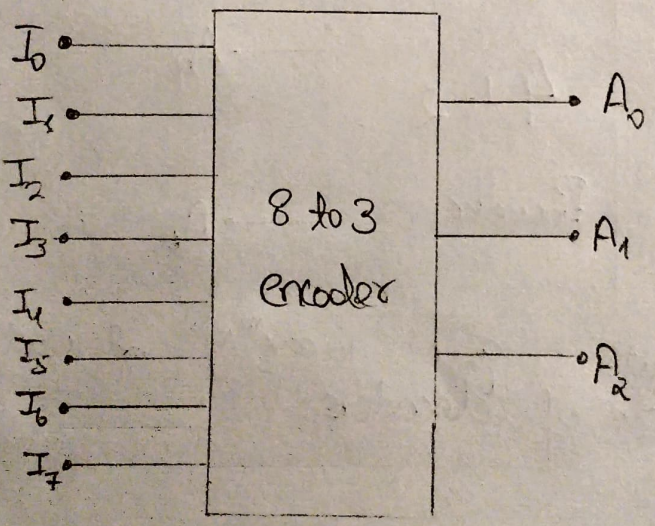
Similarly, $A_1 = I_1 + I_3$


I0
I1
I2
I3
A0
A1

Circuit diagram:



(B) 8 to 3 encoder —



2^3 inputs give 3 outputs.

Truth table:

I_0	I_1	I_2	I_3	I_4	I_5	I_6	I_7	A_0	A_1	A_2
1	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	1
0	0	1	0	0	0	0	0	0	1	0
0	0	0	1	0	0	0	0	0	1	1
0	0	0	0	1	0	0	0	1	0	0
0	0	0	0	0	1	0	0	1	0	1
0	0	0	0	0	0	1	0	1	1	0
0	0	0	0	0	0	0	1	1	1	1

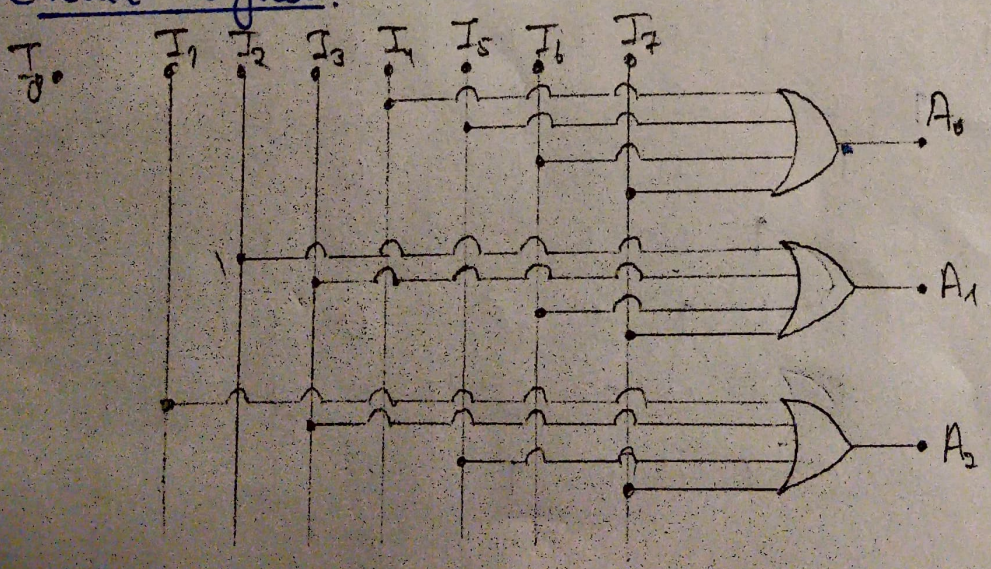
Expression:

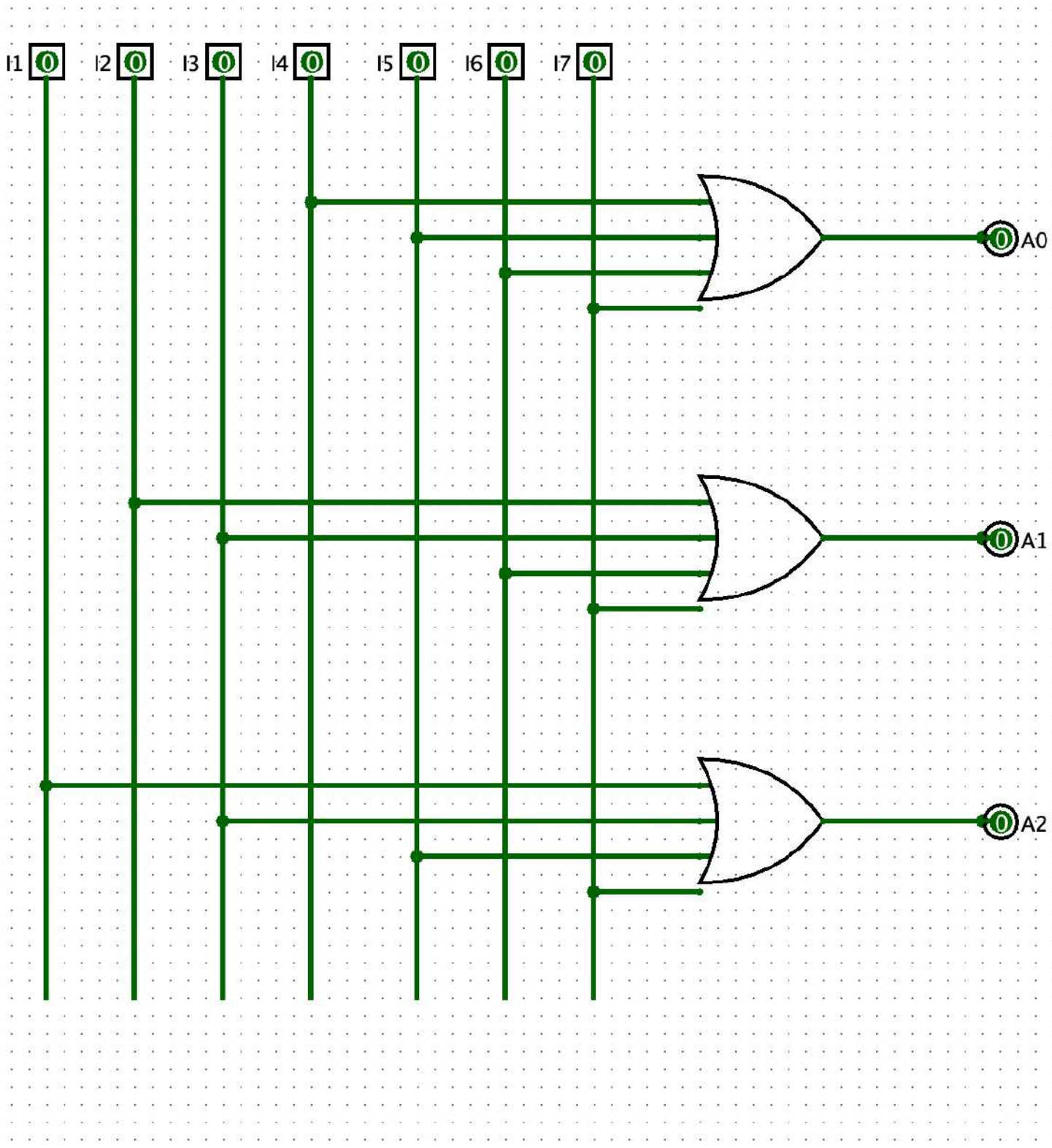
$$A_0 = I_4 + I_5 + I_6 + I_7$$

$$A_1 = I_2 + I_3 + I_6 + I_7$$

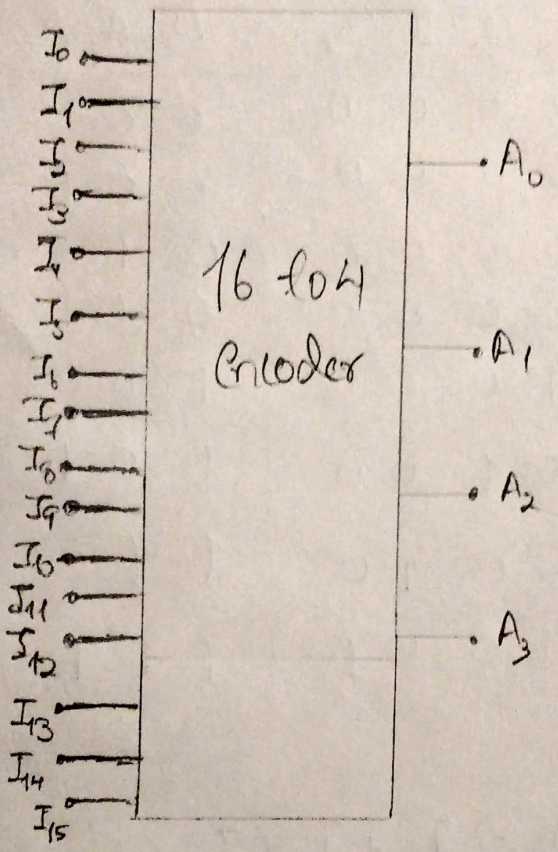
$$A_2 = I_1 + I_3 + I_5 + I_7$$

Circuit diagram:




I1
I2
I3
I4
I5
I6
I7
A0
A1
A2

(c) 16 to 4 encoder —



Truth table:

1st half:

I_0	I_1	I_2	I_3	I_4	I_5	I_6	I_7	A_0	A_1	A_2	A_3
1	0	0	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	0	1
0	0	1	0	0	0	0	0	0	0	1	0
0	0	0	1	0	0	0	0	0	0	1	1
0	0	0	0	1	0	0	0	0	1	0	0
0	0	0	0	0	1	0	0	0	1	0	1
0	0	0	0	0	0	1	0	0	1	1	0
0	0	0	0	0	0	0	1	0	1	1	1

2nd half:

I_8	I_9	I_{10}	I_{11}	I_{12}	I_{13}	I_{14}	I_{15}	A_0	A_1	A_2	A_3
1	0	0	0	0	0	0	0	1	0	0	0
0	1	0	0	0	0	0	0	1	0	0	1
0	0	1	0	0	0	0	0	1	0	1	0
0	0	0	1	0	0	0	0	1	0	1	1
0	0	0	0	1	0	0	0	1	1	0	0
0	0	0	0	0	1	0	0	1	1	0	1
0	0	0	0	0	0	1	0	1	1	1	0
0	0	0	0	0	0	0	1	1	1	1	1

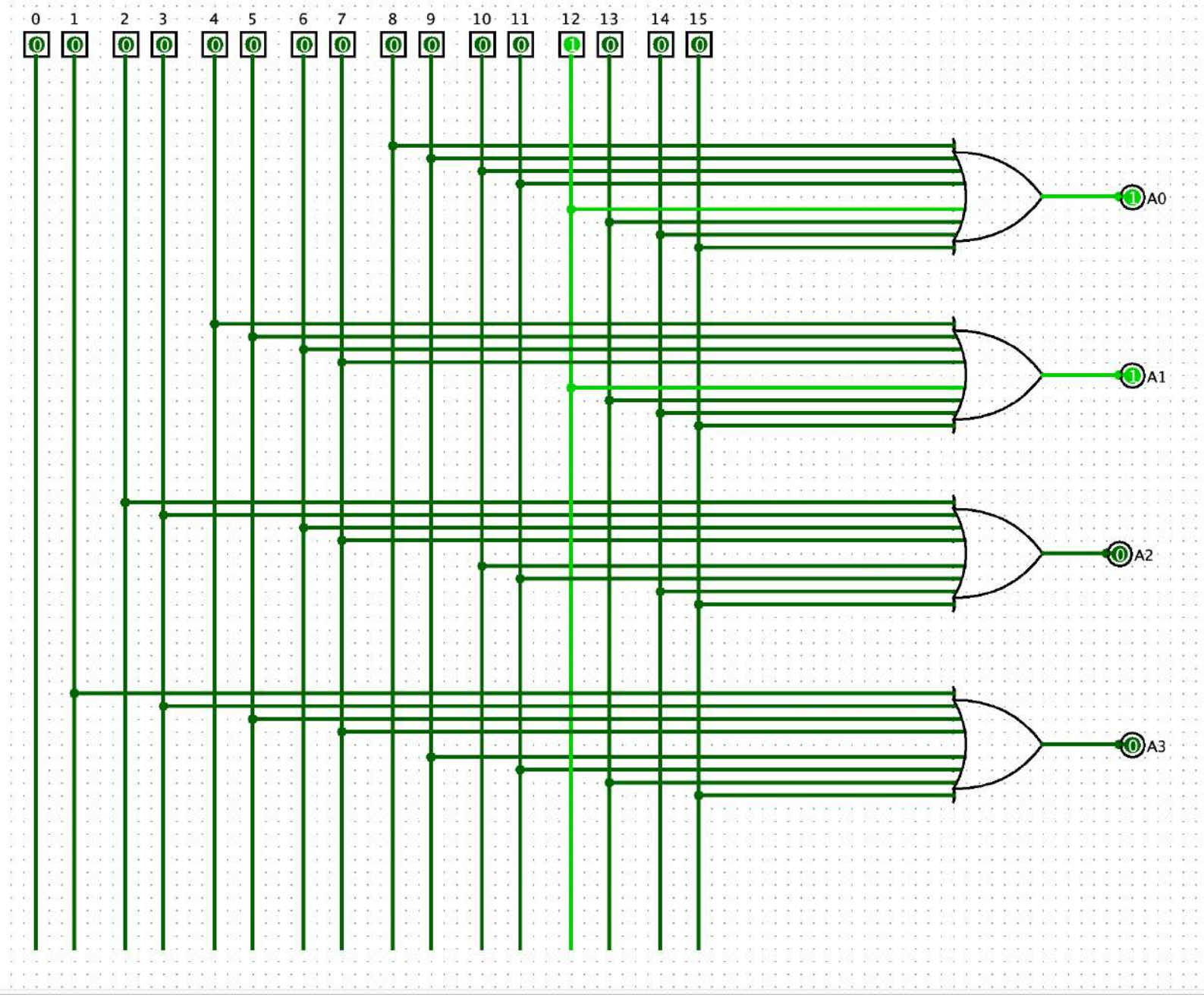
Expressions:

$$A_0 = I_8 + I_9 + I_{10} + I_{11} + I_{12} + I_{13} + I_{14} + I_{15}$$

$$A_1 = I_4 + I_5 + I_6 + I_7 + I_{12} + I_{13} + I_{14} + I_{15}$$

$$A_2 = I_2 + I_3 + I_6 + I_7 + I_{10} + I_{11} + I_{14} + I_{15}$$

$$A_3 = I_1 + I_3 + I_5 + I_7 + I_9 + I_{11} + I_{13} + I_{15}$$

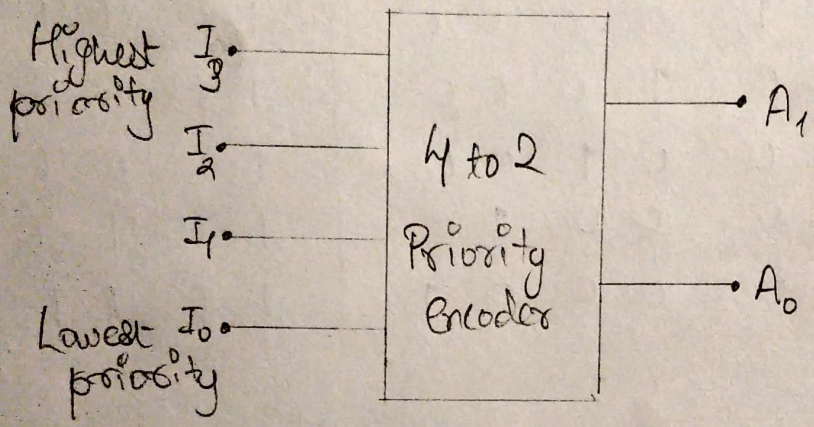

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
A0
A1
A2
A3

(II) Objective: 4 to 2 priority encoder

Software Used: Logisim

Theory:

Block ~~Circuit~~ diagram-



Truth table:

I_0	I_1	I_2	I_3	A_0	A_1
1	0	0	0	0	0
x	1	0	0	0	1
x	x	1	0	1	0
x	x	x	1	1	1

	I_0	I_1	I_2	I_3	A_0	A_1	
	0	0	0	0	x	x	(Undefined)
	1	0	0	0	0	0	
x	0	1	0	0	0	1	
x	1	1	0	0	0	1	
	0	0	1	0	1	0	
xx	0	1	1	0	1	0	
xx	1	0	1	0	1	0	
xx	1	1	1	0	1	0	
	0	0	0	1	1	1	
	0	0	1	1	1	1	
	0	1	0	1	1	1	
	0	1	1	1	1	1	
xxx	1	0	0	1	1	1	
xxx	1	0	1	1	1	1	
xxx	1	1	0	1	1	1	
xxx	1	1	1	1	1	1	

K-Map:

A_0

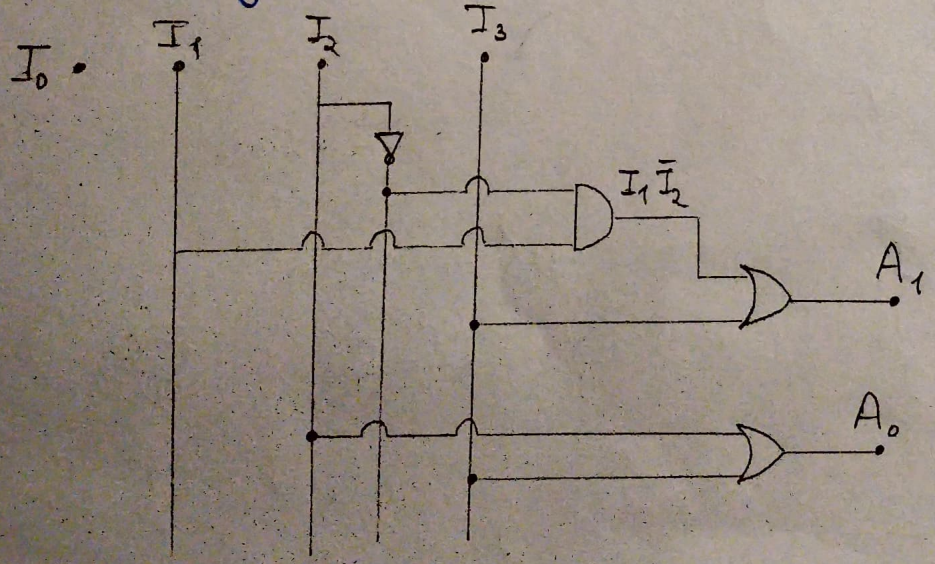
I_0I_1 \ I_2I_3	00	01	11	10
00	x	1	1	1
01		1	1	1
11		1	1	1
10		1	1	1

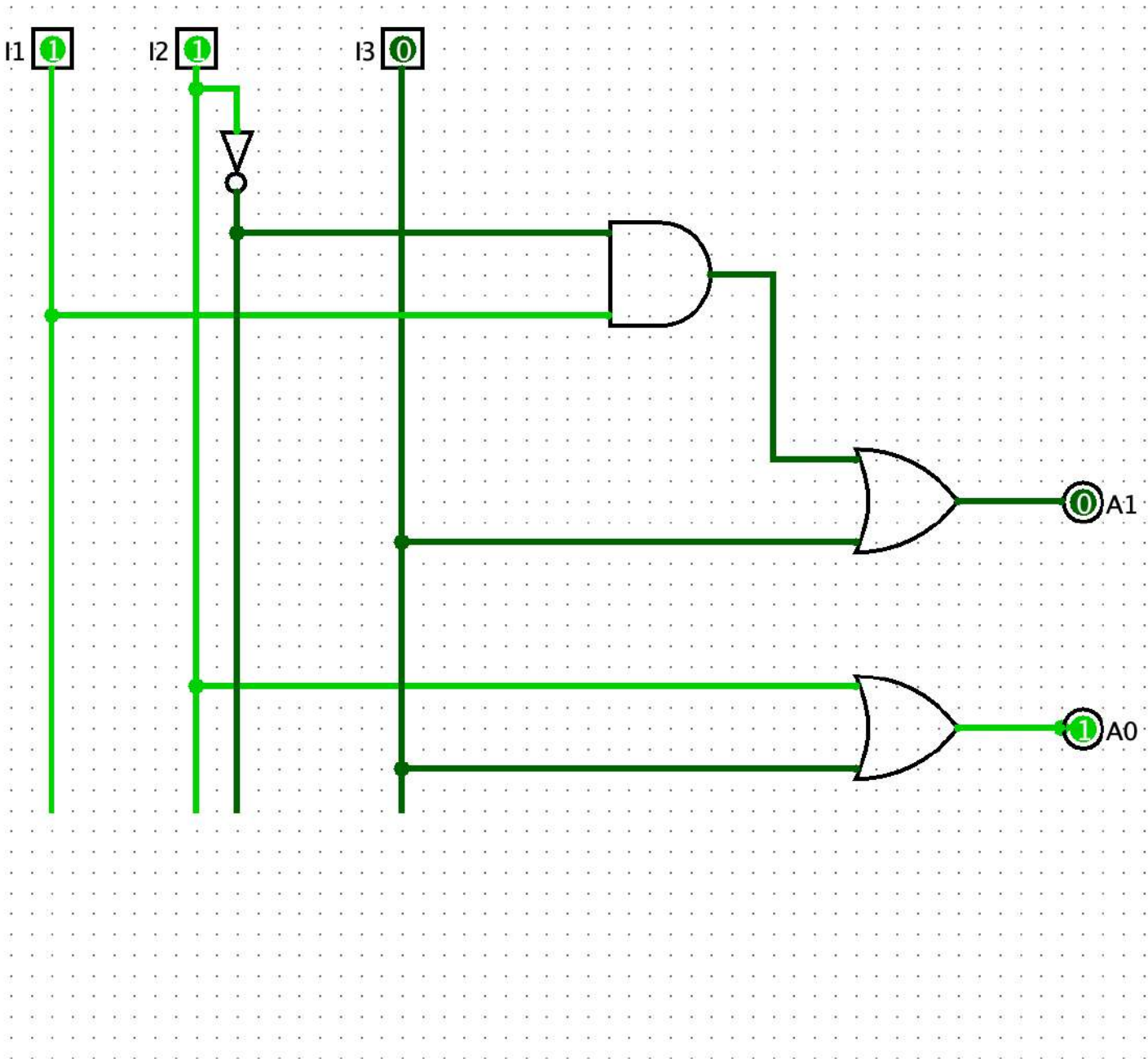
$$A_0 = I_3 + I_2$$

I_0I_1 \ I_2I_3	00	01	11	10
00	x	1	1	
01	1	1	1	
11	1	1	1	
10		1	1	

$$A_1 = I_1 I_2' + I_3$$

Circuit diagram:



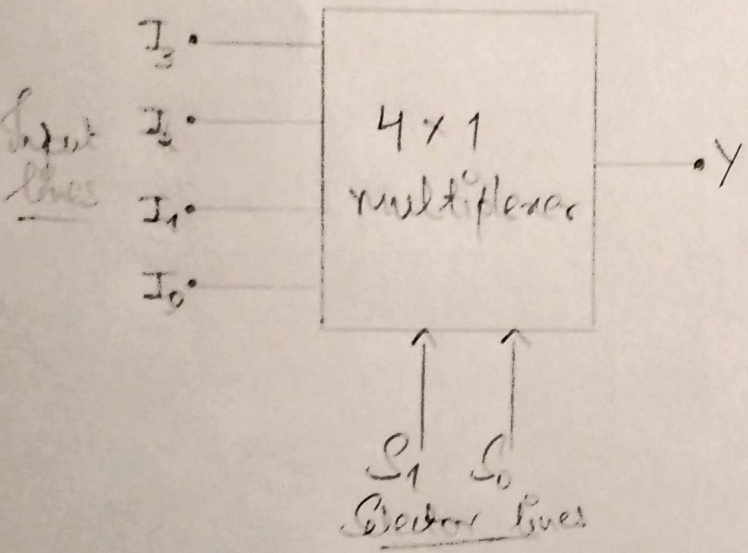

I1
1
I2
1
I3
0
0
A1
1
A0

(III) Objective: 4×1, 8×1 and 16×1 multiplexers.

Software used: Logisim

(A) 4×1 multiplexer:

Block diagram:

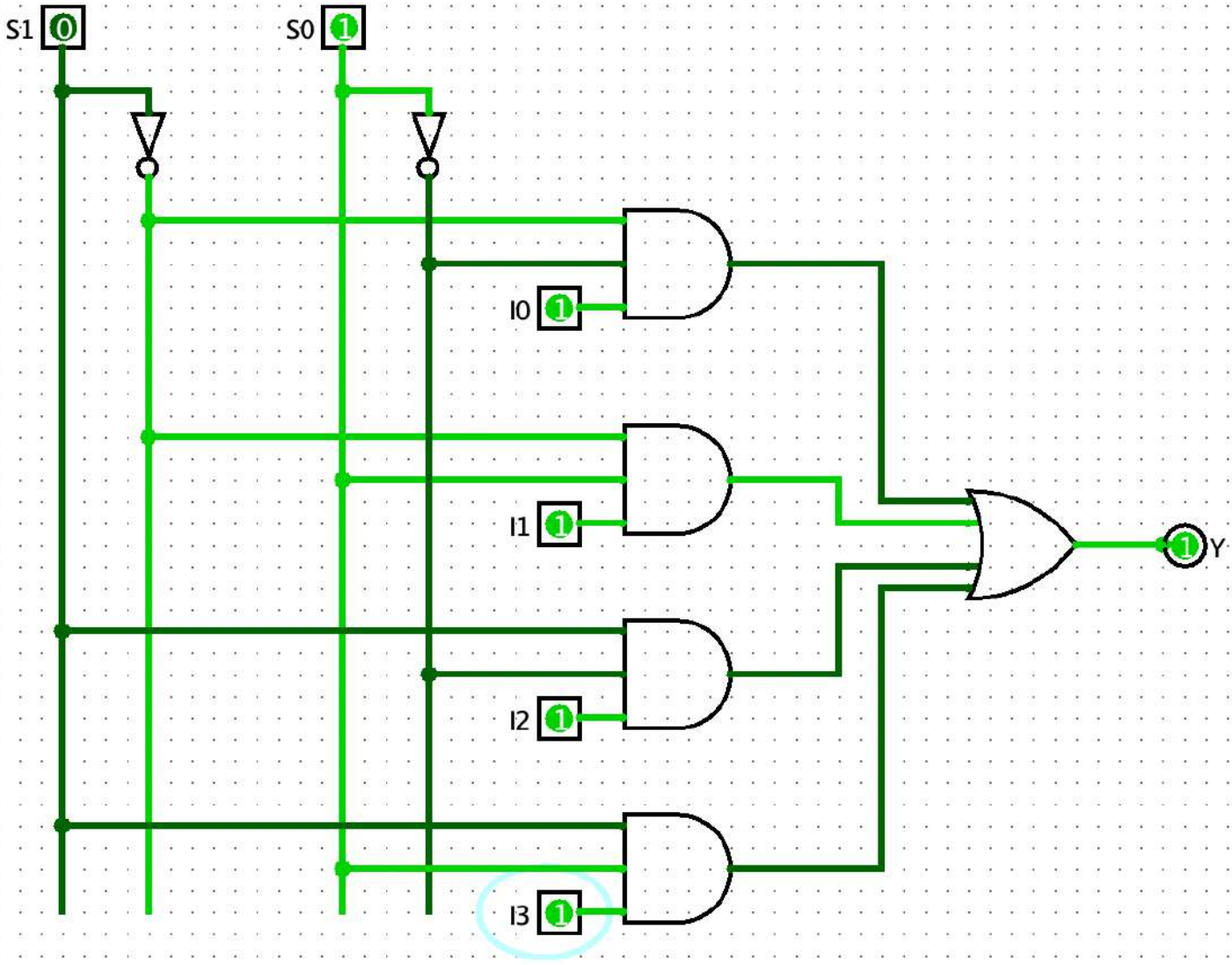


Truth table:

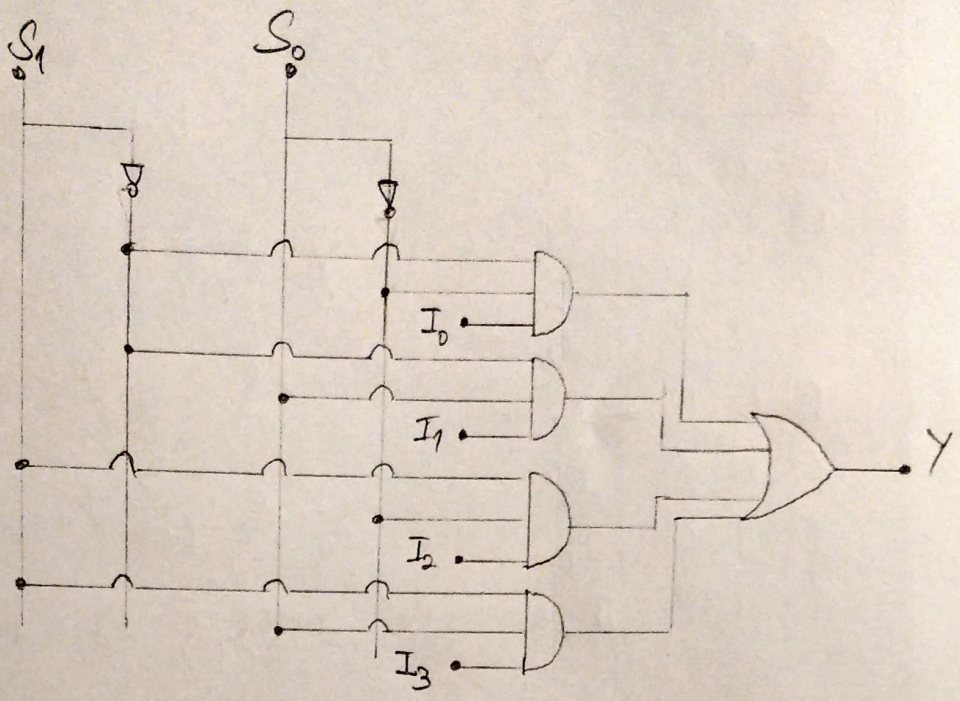
S_1	S_0	Y
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_3

Expression:

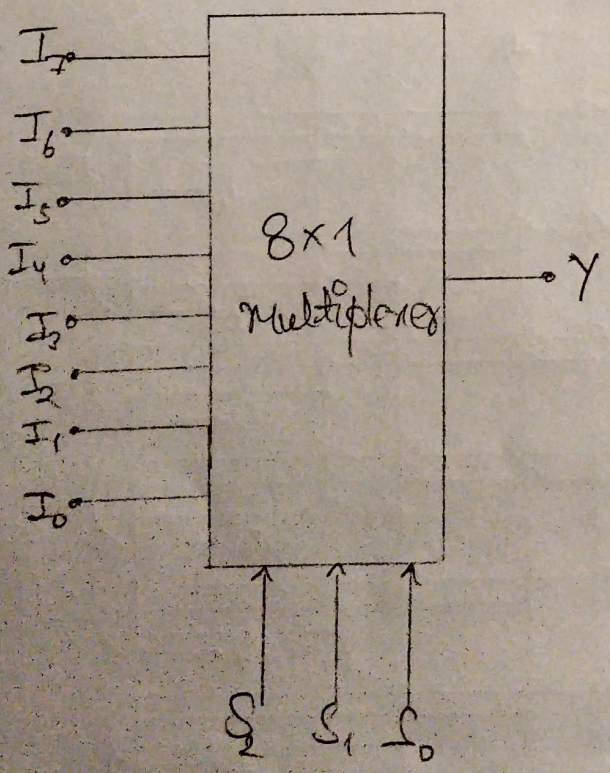
$$Y = \bar{S_1}\bar{S_0}I_0 + \bar{S_1}S_0I_1 + S_1\bar{S_0}I_2 + S_1S_0I_3$$


S1
0
S0
1
I0
1
I1
1
I2
1
I3
1
Y
1

Circuit diagram :



(B) 8×1 multiplexer :



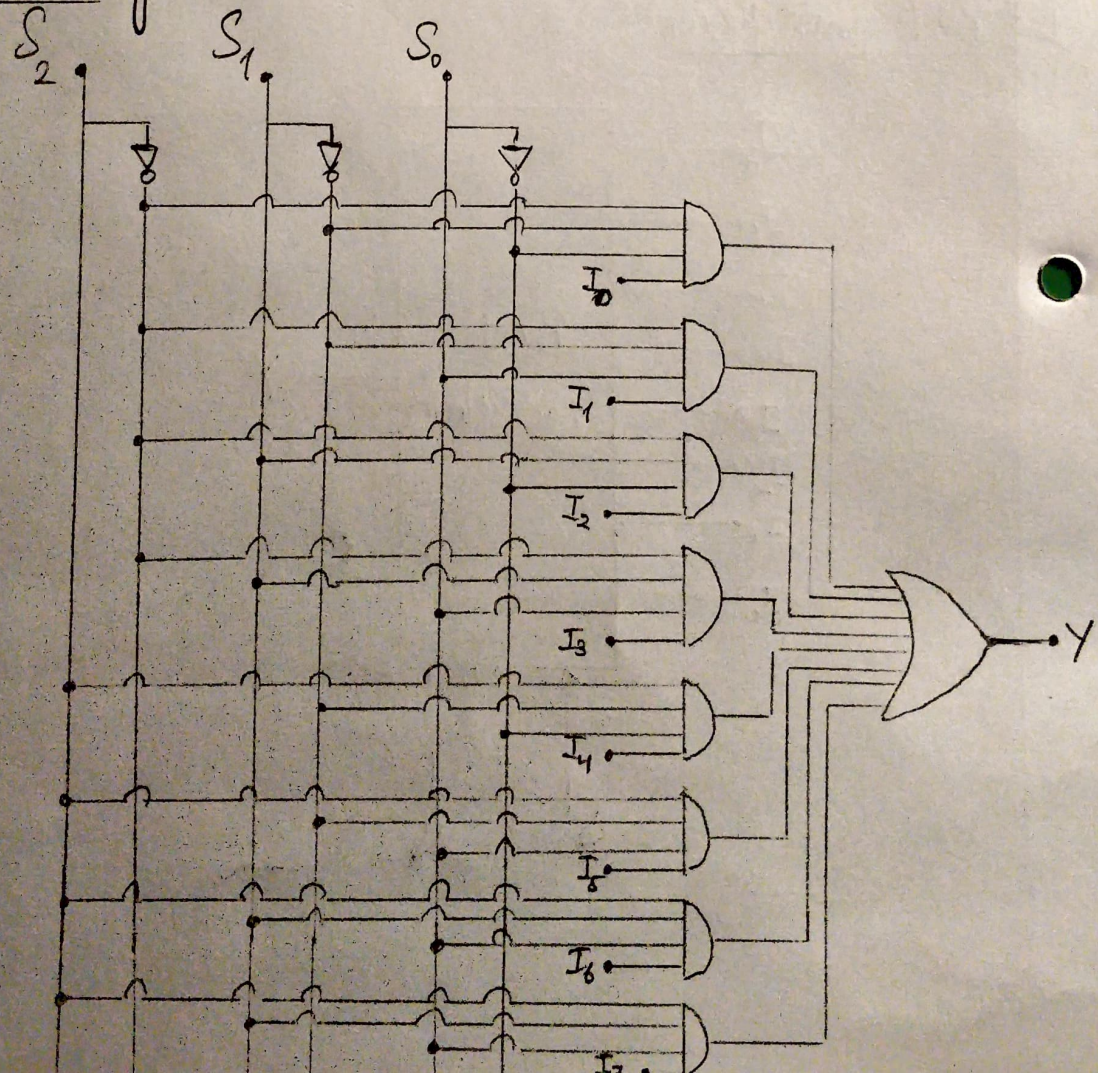
Truth table:

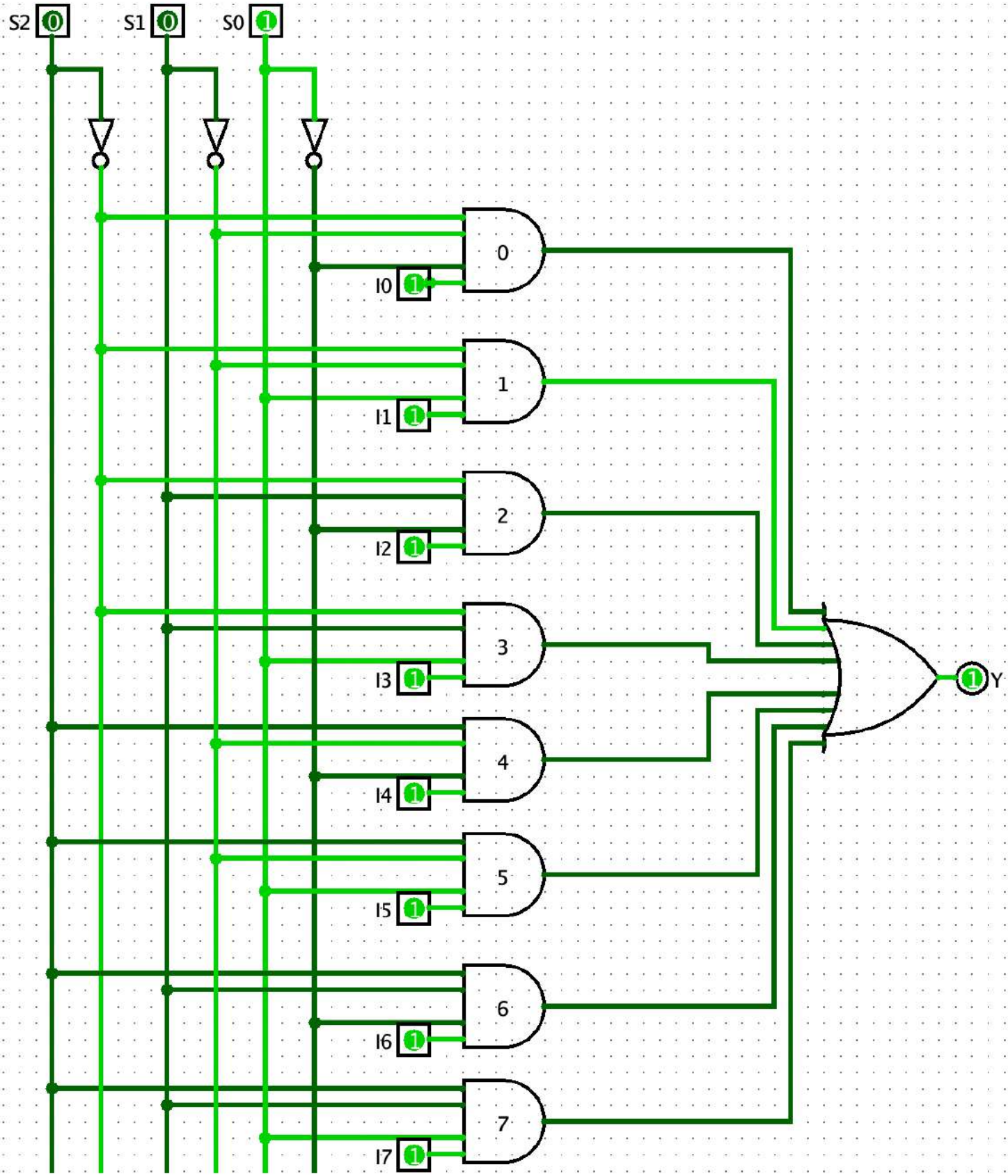
S_2	S_1	S_0	Y
0	0	0	I_0
0	0	1	I_1
0	1	0	I_2
0	1	1	I_3
1	0	0	I_4
1	0	1	I_5
1	1	0	I_6
1	1	1	I_7

Expression:

$$Y = \bar{S}_2 \bar{S}_1 \bar{S}_0 I_0 + \bar{S}_2 \bar{S}_1 S_0 I_1 + \bar{S}_2 S_1 \bar{S}_0 I_2 + \bar{S}_2 S_1 S_0 I_3 + S_2 \bar{S}_1 \bar{S}_0 I_4 + S_2 \bar{S}_1 S_0 I_5 + S_2 S_1 \bar{S}_0 I_6 + S_2 S_1 S_0 I_7$$

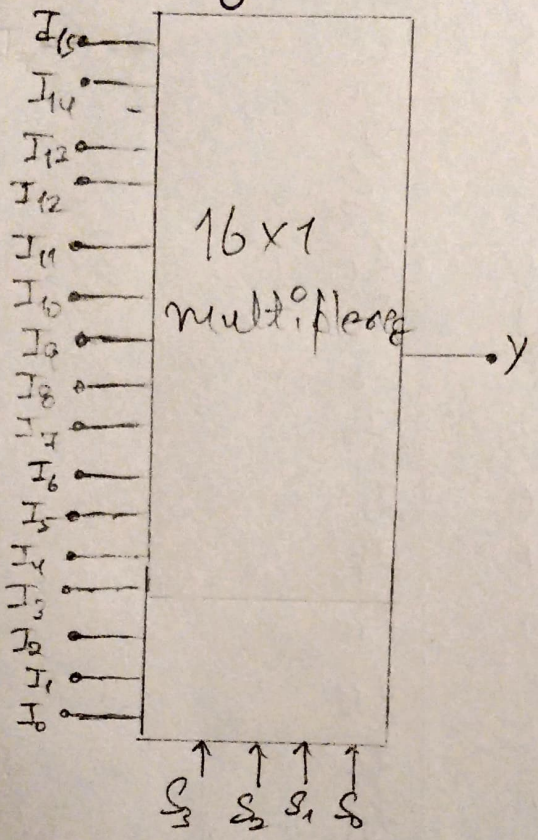
Circuit diagram:




S2
0
S1
0
S0
1
0
I0
1
1
I1
1
2
I2
1
3
I3
1
4
I4
1
5
I5
1
6
I6
1
7
I7
1
1
Y

(Q) 16×1 multiplexer :

Block diagram:



Truth table:

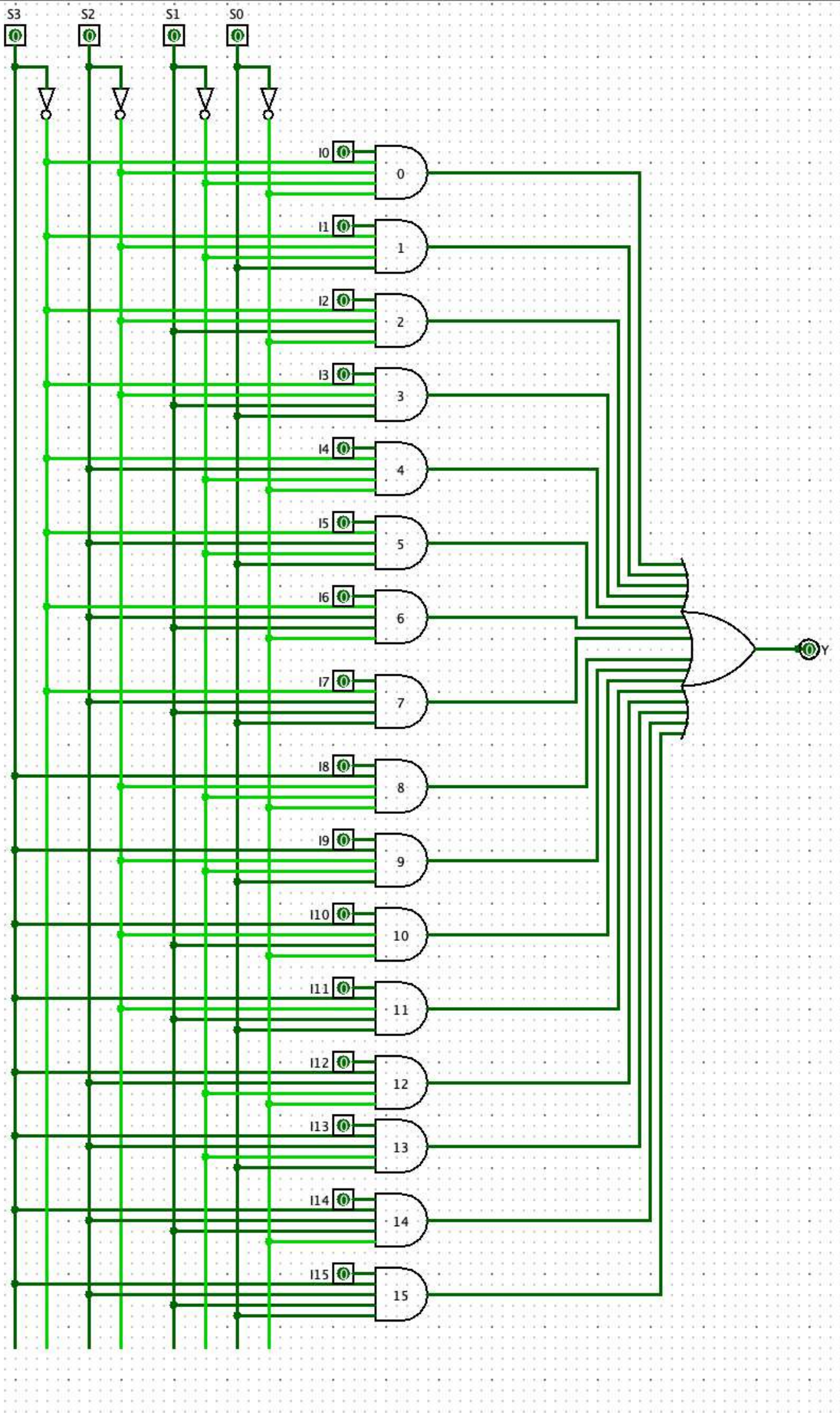
S_3	S_2	S_1	S_0	Y
0	0	0	0	I_0
0	0	0	1	I_1
0	0	1	0	I_2
0	0	1	1	I_3
0	1	0	0	I_4
0	1	0	1	I_5
0	1	1	0	I_6
0	1	1	1	I_7
1	0	0	0	I_8
1	0	0	1	I_9
1	0	1	0	I_{10}
1	0	1	1	I_{11}
1	1	0	0	I_{12}
1	1	0	1	I_{13}

Truth table:

S_3	S_2	S_1	S_0	Y
0	0	0	0	I_0
0	0	0	1	I_1
0	0	1	0	I_2
0	0	1	1	I_3
0	1	0	0	I_4
0	1	0	1	I_5
0	1	1	0	I_6
0	1	1	1	I_7
1	0	0	0	I_8
1	0	0	1	I_9
1	0	1	0	I_{10}
1	0	1	1	I_{11}
1	1	0	0	I_{12}
1	1	0	1	I_{13}
1	1	1	0	I_{14}
1	1	1	1	I_{15}

Expression:

$$Y = \bar{S}_3\bar{S}_2\bar{S}_1\bar{S}_0 I_0 + \bar{S}_3\bar{S}_2\bar{S}_1 S_0 I_1 + \bar{S}_3\bar{S}_2 S_1\bar{S}_0 I_2 + \bar{S}_3\bar{S}_2 S_1 S_0 I_3$$
$$+ \bar{S}_3 S_2\bar{S}_1\bar{S}_0 I_4 + \bar{S}_3 S_2\bar{S}_1 S_0 I_5 + \bar{S}_3 S_2 S_1\bar{S}_0 I_6 + \bar{S}_3 S_2 S_1 S_0 I_7$$
$$+ S_3\bar{S}_2\bar{S}_1\bar{S}_0 I_8 + S_3\bar{S}_2\bar{S}_1 S_0 I_9 + S_3\bar{S}_2 S_1\bar{S}_0 I_{10} + S_3\bar{S}_2 S_1 S_0 I_{11}$$
$$+ S_3 S_2\bar{S}_1\bar{S}_0 I_{12} + S_3 S_2\bar{S}_1 S_0 I_{13} + S_3 S_2 S_1\bar{S}_0 I_{14} + S_3 S_2 S_1 S_0 I_{15}$$


S3
S2
S1
S0
I0
I1
I2
I3
I4
I5
I6
I7
I8
I9
I10
I11
I12
I13
I14
I15
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Y