ECE216: Digital Electronics Laboratory

Exp 3: Understanding the combinational logic by implementing the Boolean function using multiplexer

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★ Multiplexer

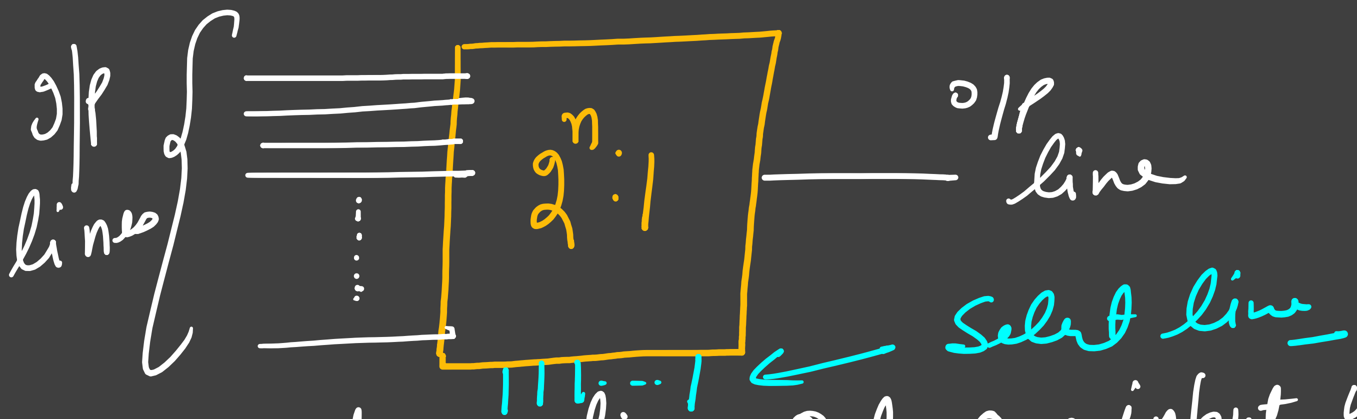
Which can connect many I/Ps to one O/P.

No. of select line

$2^n : 1$

No. of inputs

No. of O/P.



Note: At one time only one input will be connected to the O/P

Q: How to identify which input get connected with the O/P?

Ans: We need select line.

No. of select line for $2^n : 1$ MUX are: n

Ex $\quad 2^n : 1$

if $n=1 \quad 2:1$

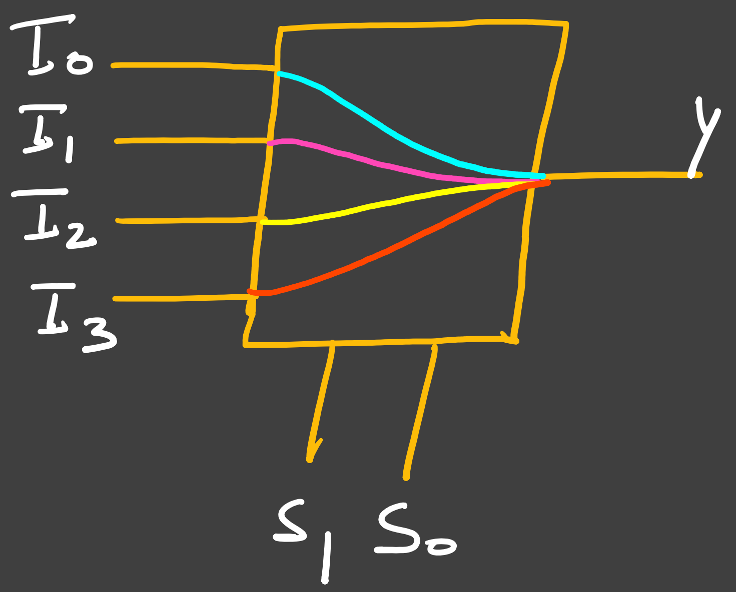
if $n=2 \quad 4:1$

if $n=3 \quad 8:1$

if $n=4 \quad 16:1$

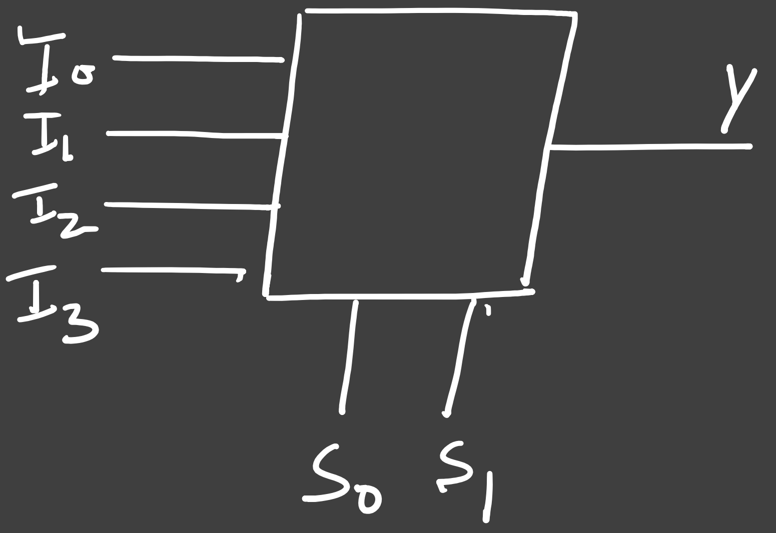
if $n=5 \quad 32:1$

$\vdots \qquad \vdots$



	S_1	S_0	y
0	0	0	I_0
1	0	1	I_1
2	1	0	I_2
3	1	1	I_3

Ex



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

Amisha

LSB $\left\{ S_0 = 0 \right.$
MSB $\left. S_1 = 1 \right\}$ 1 $\quad I_1 = 0$

$Y = 0$

$(10)_2 = 2 \quad I_2 = 1$

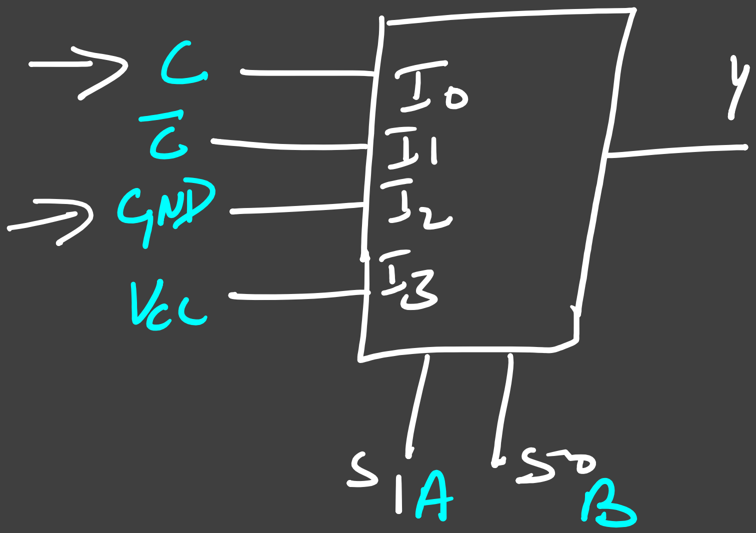
$Y = 1$

LSB $S_0 = 1$
MSB $S_1 = 0$

$(01)_2 = 1 \quad I_1 = 1$

$\boxed{Y = 1}$

Ex



A	B	C	y
0	0	1	1
1	0	1	0

00 → 0

I_0

10 → 2

I_2

Experiment-3

1. Aim: To design a circuit to implement Boolean functions using Multiplexers.

Apparatus required: Multiplexer ICs (dual 4:1 mux 74153),7404, Chords.

2. Learning objectives:

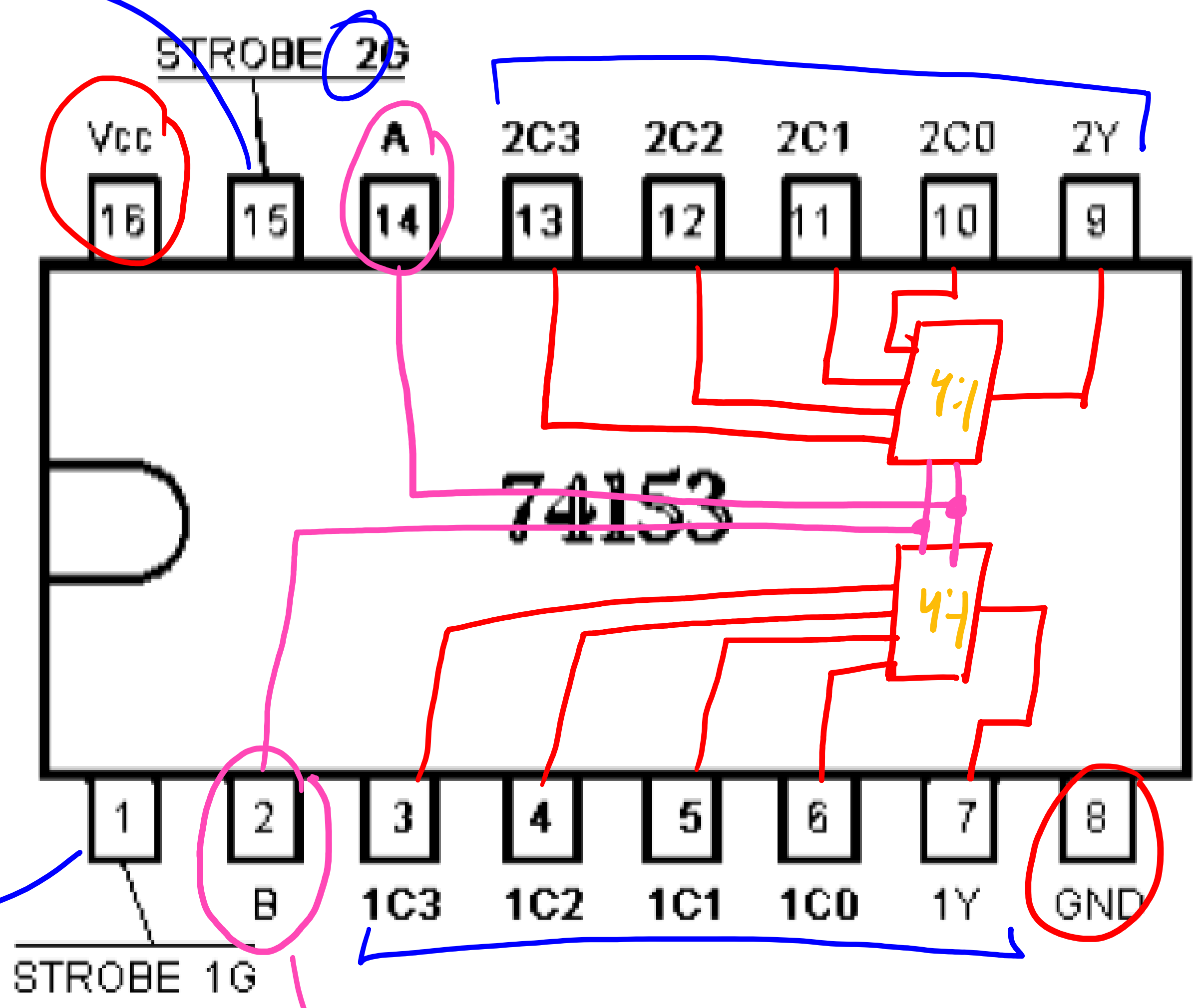
a) How to realize functionality of Dual 4 Line to 1 Line Multiplexer using 74153 IC.

b) How Dual 4 Line to 1 Line Multiplexer select the particular input to be sent to the output.

3. Theory:

It quite often happens, in the design of large-scale digital systems, that a single line is required to carry two or more different digital signals. Of course, only one signal at a time can be placed on the one line. What is required is a device that will allow us to select, at different instants, the signal we wish to place on this common line. Such a circuit is referred to as a Multiplexer. A multiplexer performs the function of selecting the input on any one of 'n' input lines and feeding this input to one output line.

Multiplexers are used as one method of reducing the number of integrated circuit packages



Enable Pins

Active low with GND.

Select lines

A - 14 - LSB

B - 2 - MSB

Understanding the combinational logic by implementing the Boolean function using multiplexer

Ex: Sum of full adder

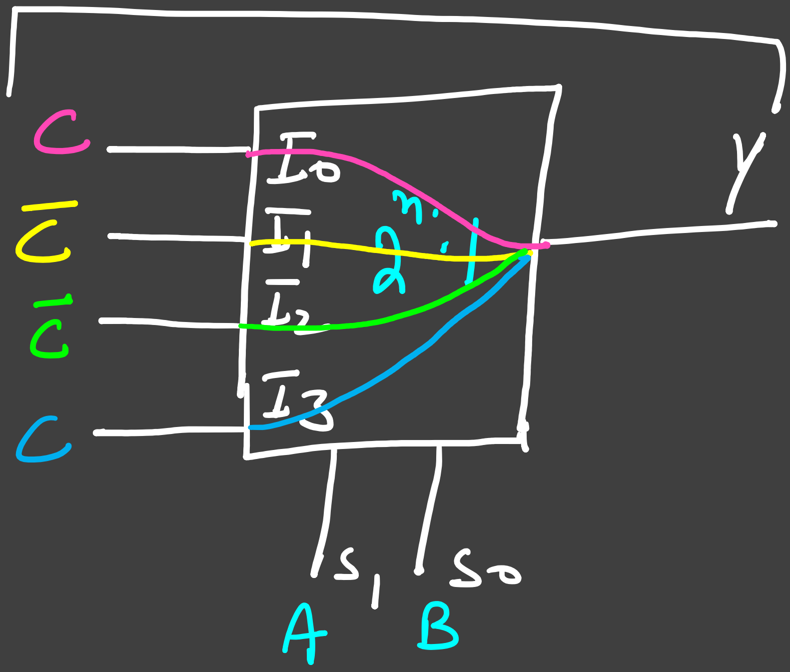
$S = A \oplus B \oplus C$

MSB, LSB

A	B	C	S	
0	0	0	0	C
0	0	1	1	
0	1	0	1	$\bar{C}$
0	1	1	0	
1	0	0	1	$\bar{C}$
1	0	1	0	
1	1	0	0	C
1	1	1	1	

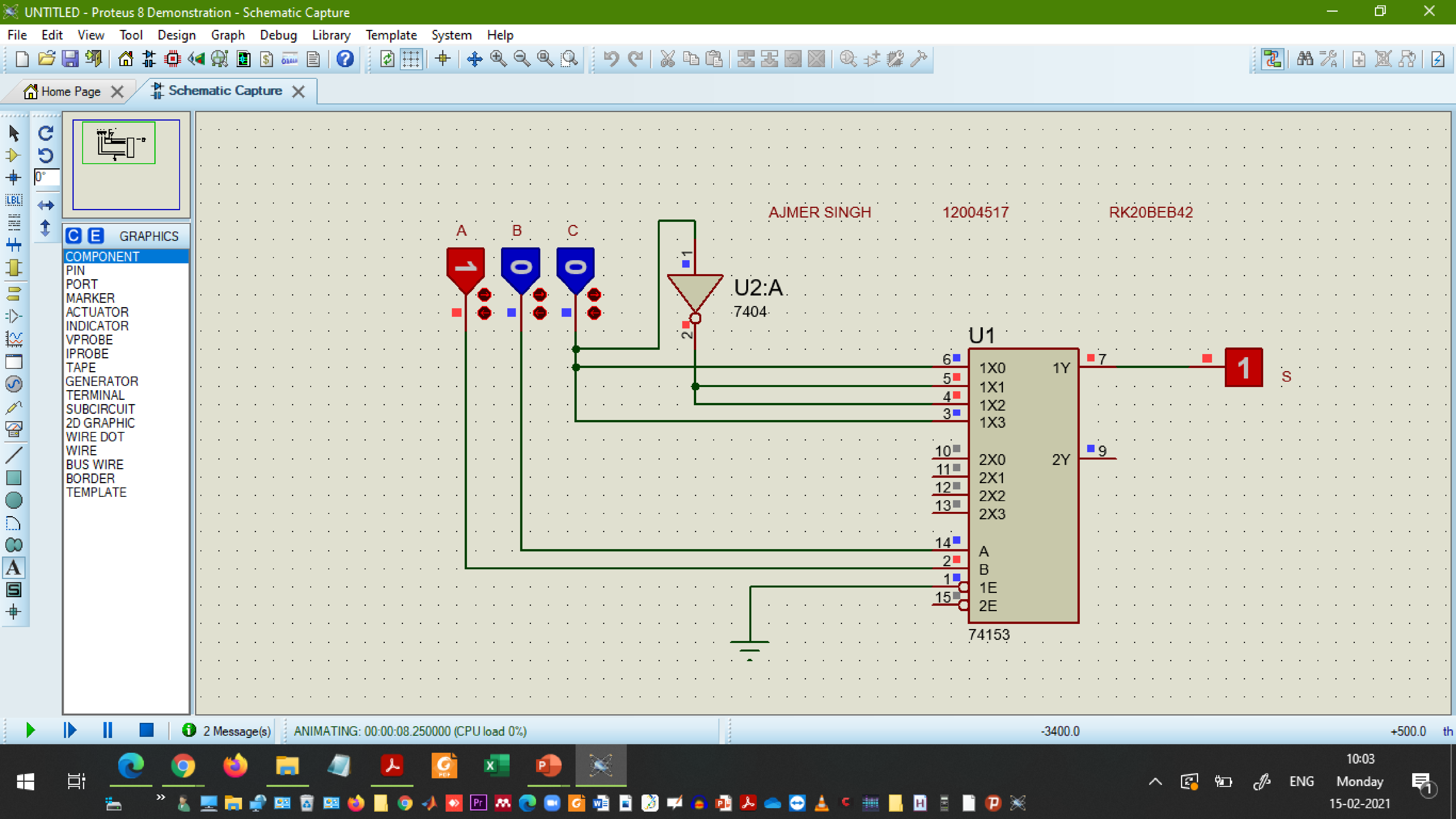
* Always consider the MSB Bits for select lines.

In this case $\boxed{n=2}$



Q: How many variable function can be implement using one $2^n:1$ Mux

A: $n+1$ Variables.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1X1
1X2
1X3
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2Y
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1E
2E
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ENG

Ex Carry of full adder

$C_{out} = (A \oplus B)C + AB$

S_1 S_0

	A	B	C	Cout	
0 I_0	0	0	0	0	GND
1	0	0	1	0	
2 I_1	0	1	0	0	C
3	0	1	1	1	
4 I_2	1	0	0	0	C
5	1	0	1	1	
6 I_3	1	1	0	1	Vcc
7	1	1	1	1	

★ Minterm Representation

$$\boxed{C_{out} = \sum m(3,5,6,7)}$$

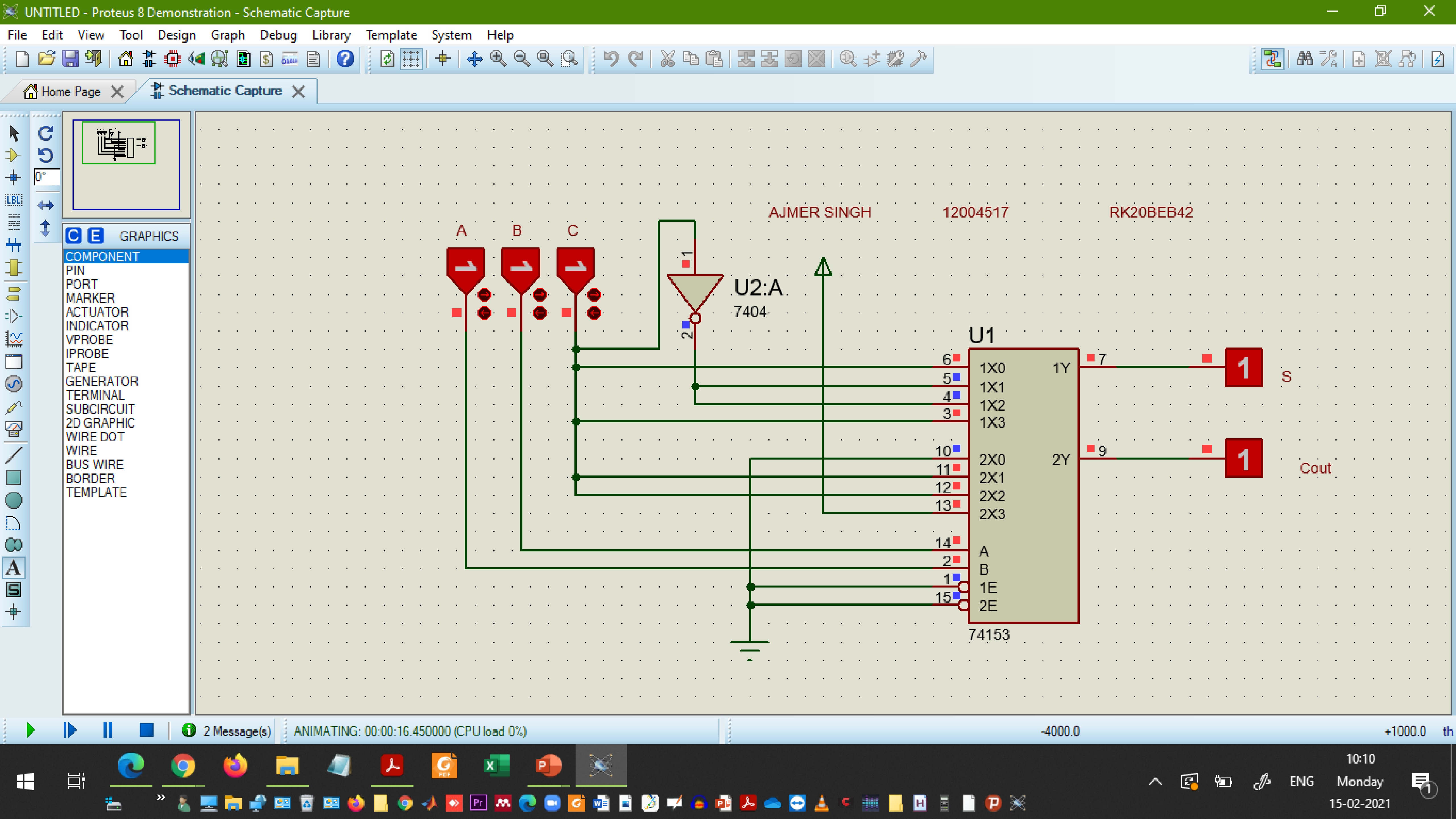
other the o/p is zero

SOP

★ Maxterm Representation

$$\boxed{C_{out} = \prod M(0,1,2,4)}$$

other the o/p is one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2E
1Y
2Y
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Cout
2 Message(s)
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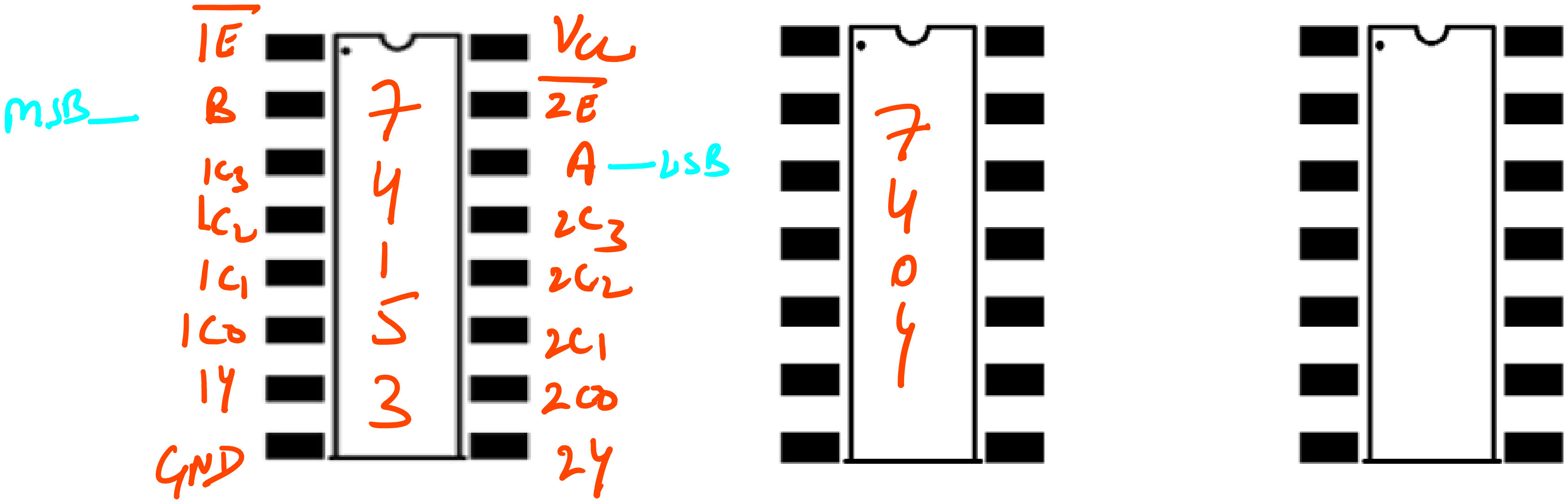
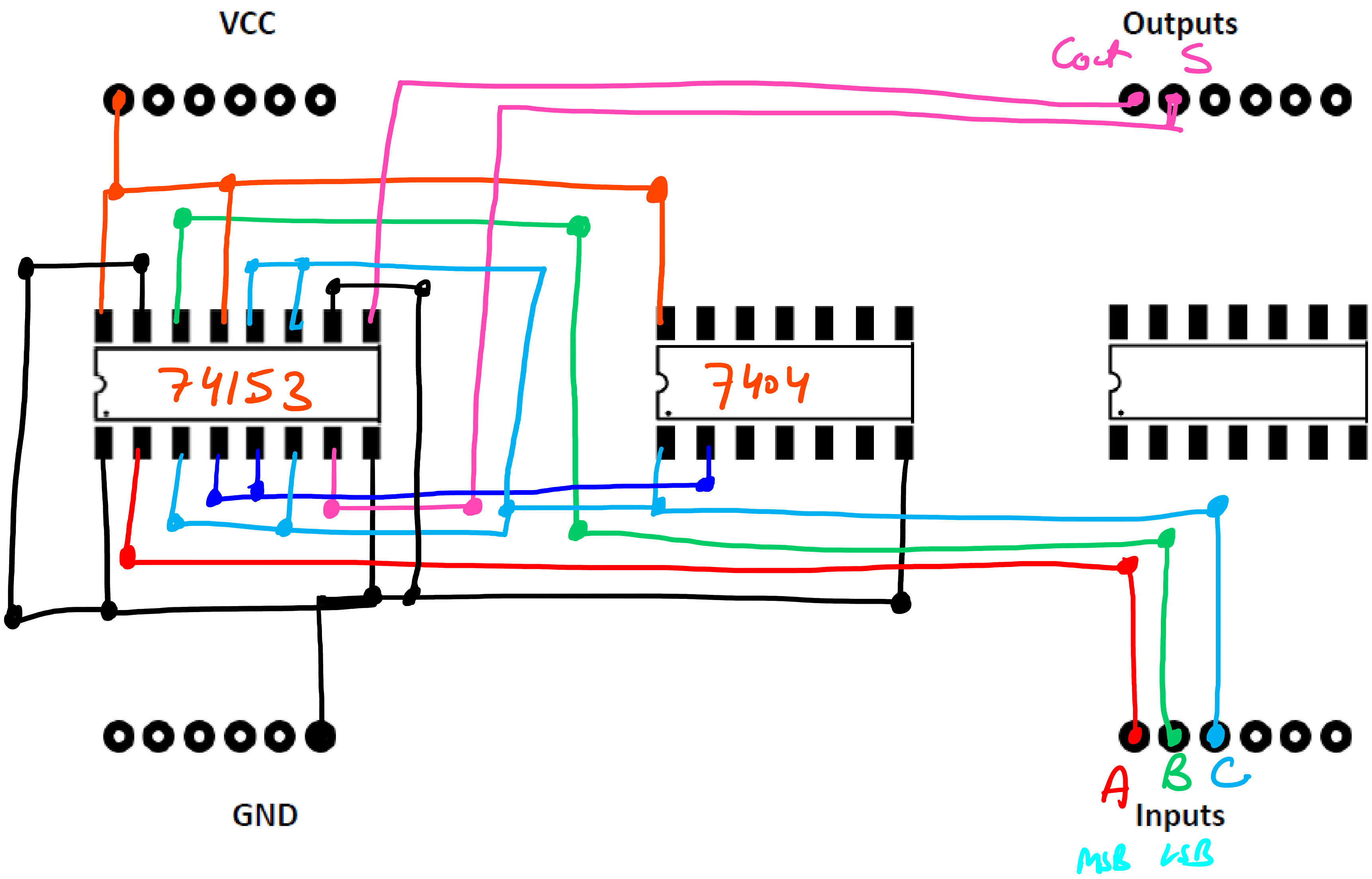
Pin configuration of ICs:



Draw Bread Board Connection diagram: Full adder using mux

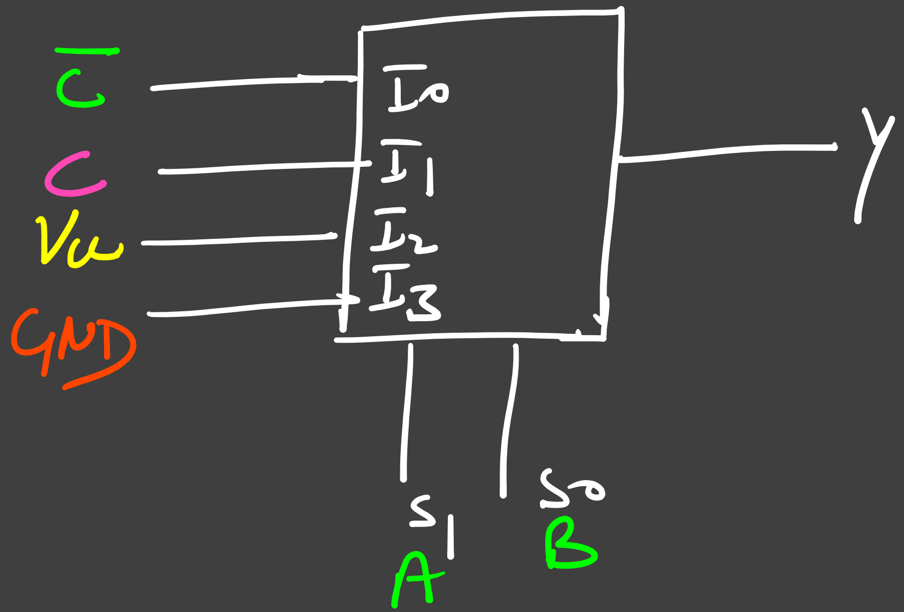


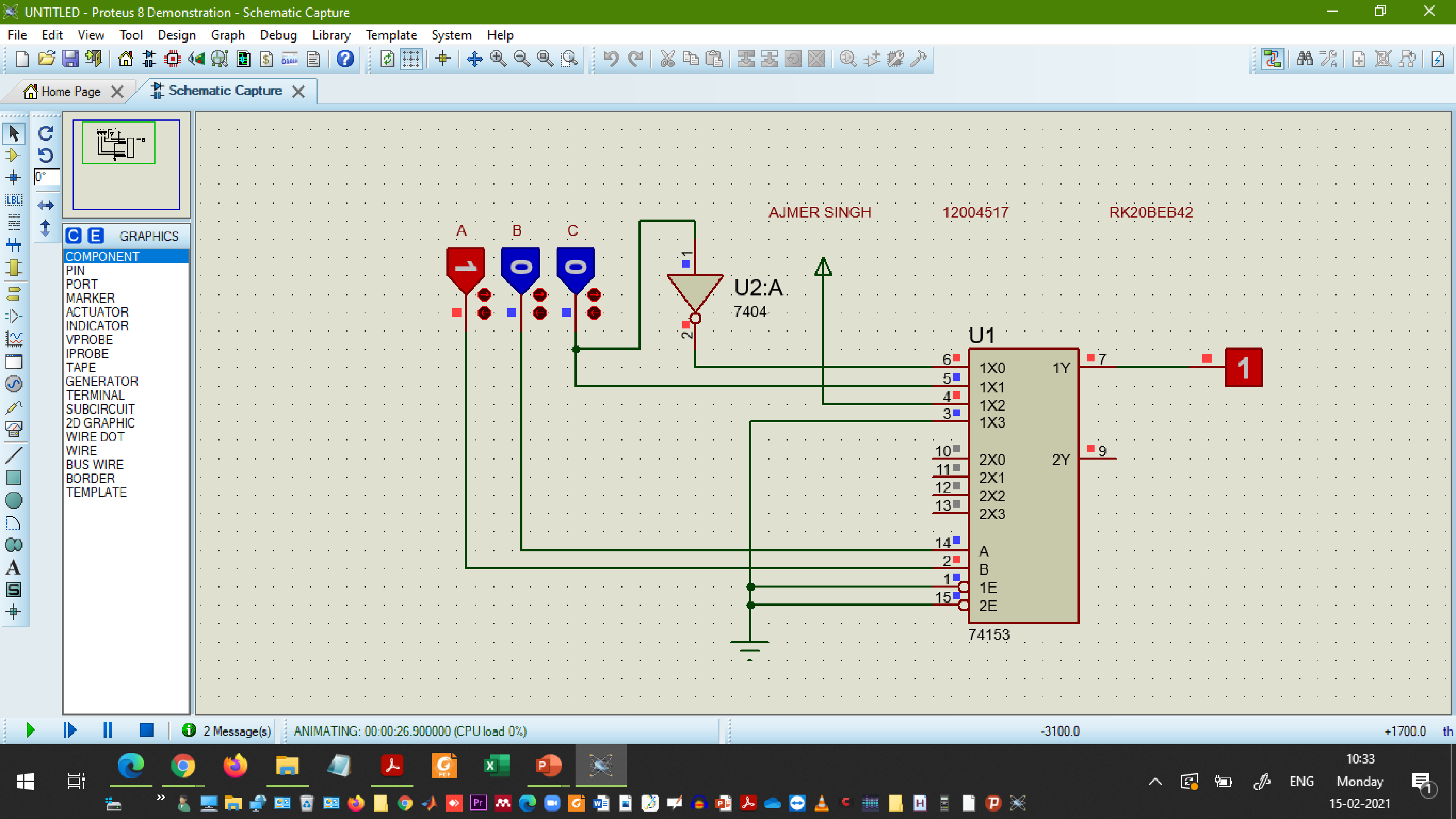
Ex Implement the following Boolean fun. using Mux

$$Y(A, B, C) = \sum m(0, 3, 4, 5)$$

MSB (A) LSB (C)

	S_1	S_0			
	A	B	C	Y	
I_0	0	0	0	1	$\bar{C}$
	0	0	1	0	
I_1	0	1	0	0	C
	0	1	1	1	
I_2	1	0	0	1	Vcc
	1	0	1	1	
I_3	1	1	0	0	GND
	1	1	1	0	

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2E
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2 Message(s)
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15-02-2021

Ex Implement the following boolean function using Mux

(i) $Y_1 = \sum m(0, 1, 5, 6)$

(ii) $Y_2 = \prod M(0, 1, 3, 4)$

A	B	C	Y_1	Y_2
0	0	0	1	0
0	0	1	1	0
0	1	0	0	1
0	1	1	0	0
1	0	0	0	0
1	0	1	1	1
1	1	0	1	1
1	1	1	0	1

Y_1	Y_2
Vcc	GND
GND	$\bar{C}$
C	C
$\bar{C}$	Vcc