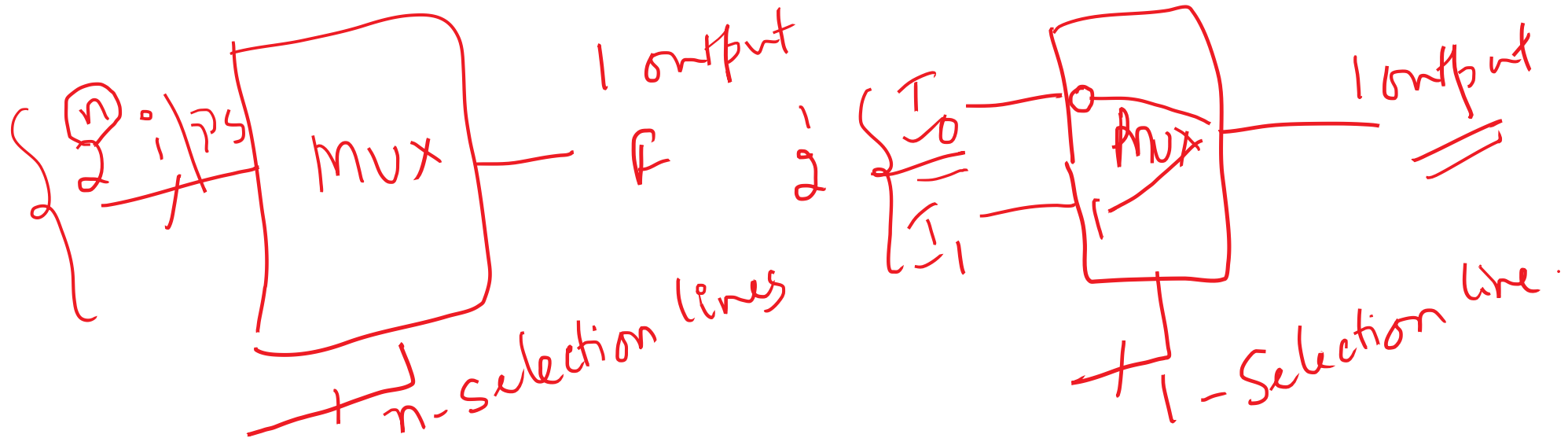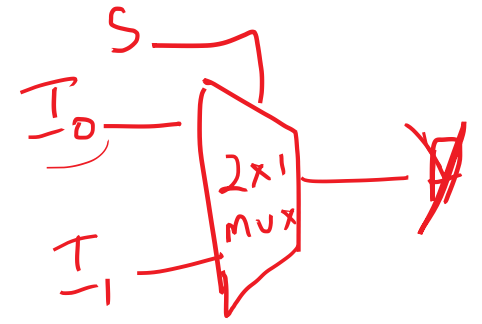# Multiplexers

Multiplexer

- Multiplexer is an useful MSI device and are also called as data selectors.

- Multiplexer selects one of its 2^n input line and directs it to a single output line .

- n-bit select lines decide which input line is to be selected.

- Examples: 2-to-1 line MUX, 4-to-1 line MUX, 8-to-1 line MUX, 16-to-line MUX.

2-to-1 line MUX

$\rightarrow$

① $\rightarrow$ select line

2×1 MUX

- S- selection input, y is the output, I1 and I0 are inputs
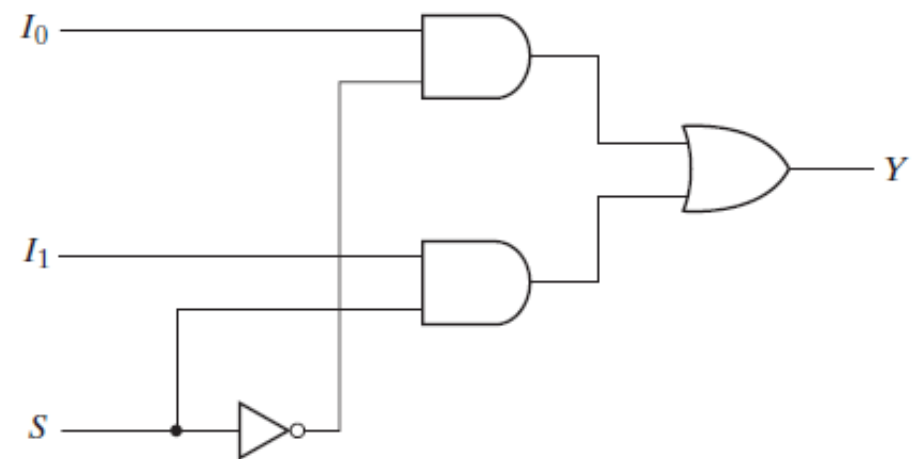- Symbol/block diagram, function table, output expressions and circuit is given :

S	y
0	I_0
1	I_1

$$Y = \bar{S} I_0 + S I_1$$

$$\text{When } S=0 \Big\} \; Y = I_0 \checkmark$$

$$\text{When } S=1 \Big\} \; Y = I_1$$
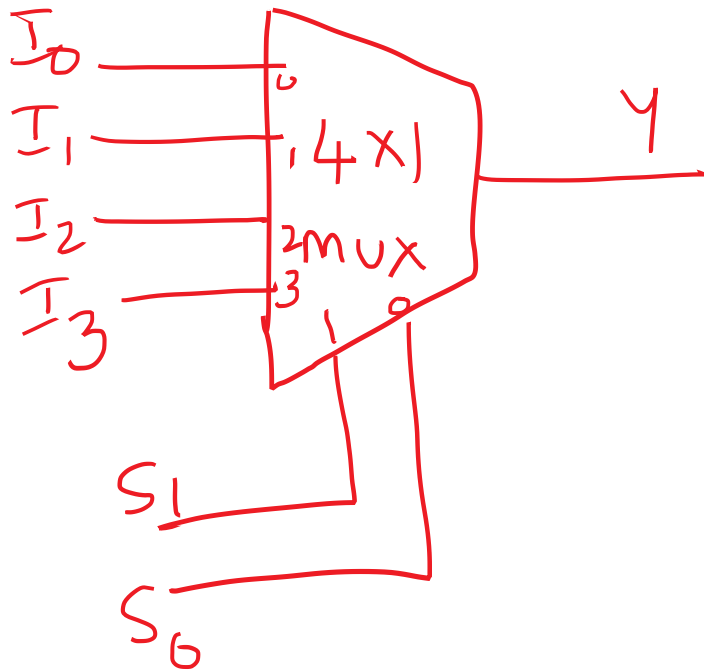
2-to-1 line MUX

(a) Logic diagram
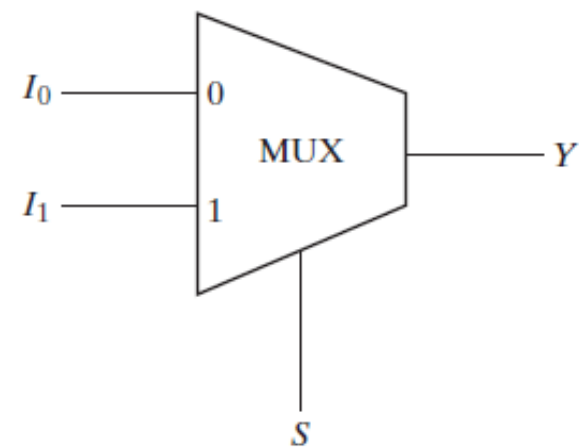
(b) Block diagram

4-to-1 line multiplexer

- Write the Symbol/block diagram, Function table, output expressions and circuit .

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

$$Y = \overline{S_1}\,\overline{S_0}\,I_0 + \overline{S_1}\,S_0\,I_1$$
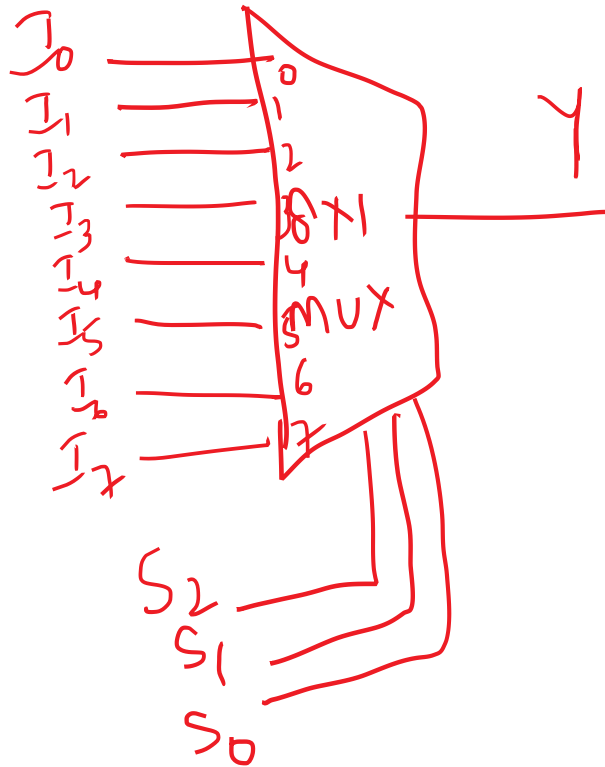$$+ S_1\,\overline{S_0}\,I_2 + S_1\,S_0\,I_3$$

4-to-1 line multiplexer
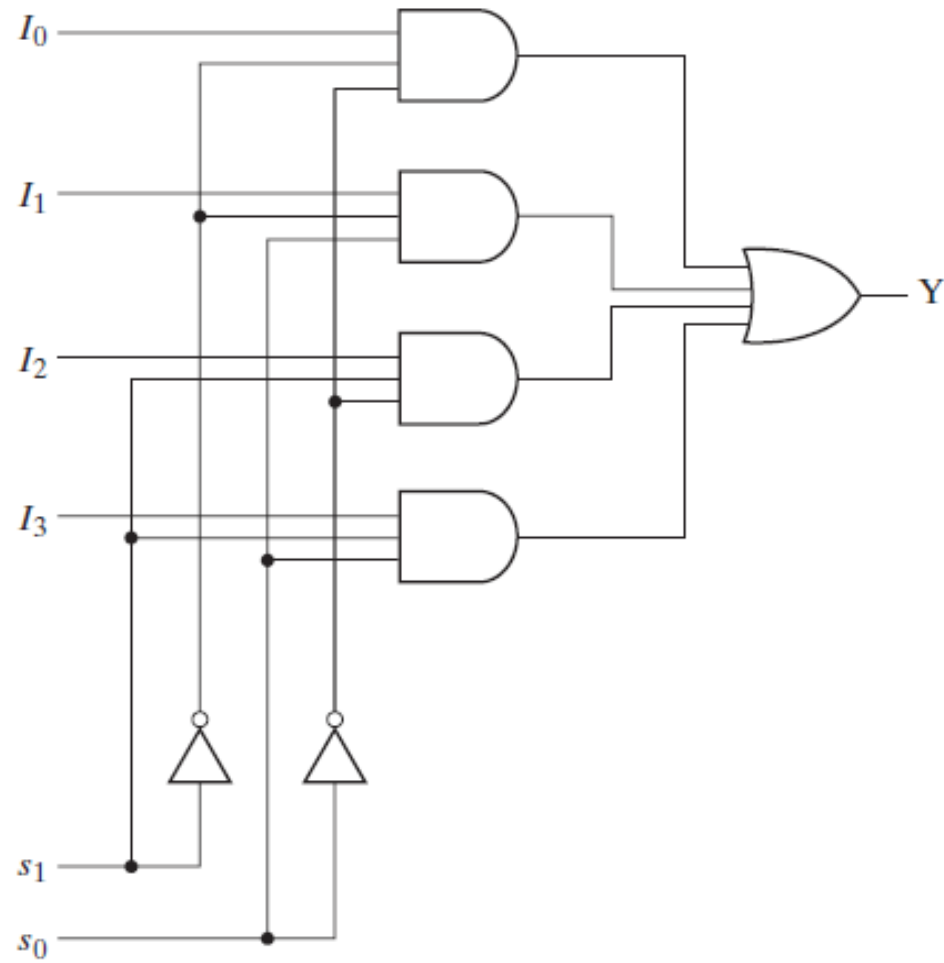
8-to-1 line multiplexer

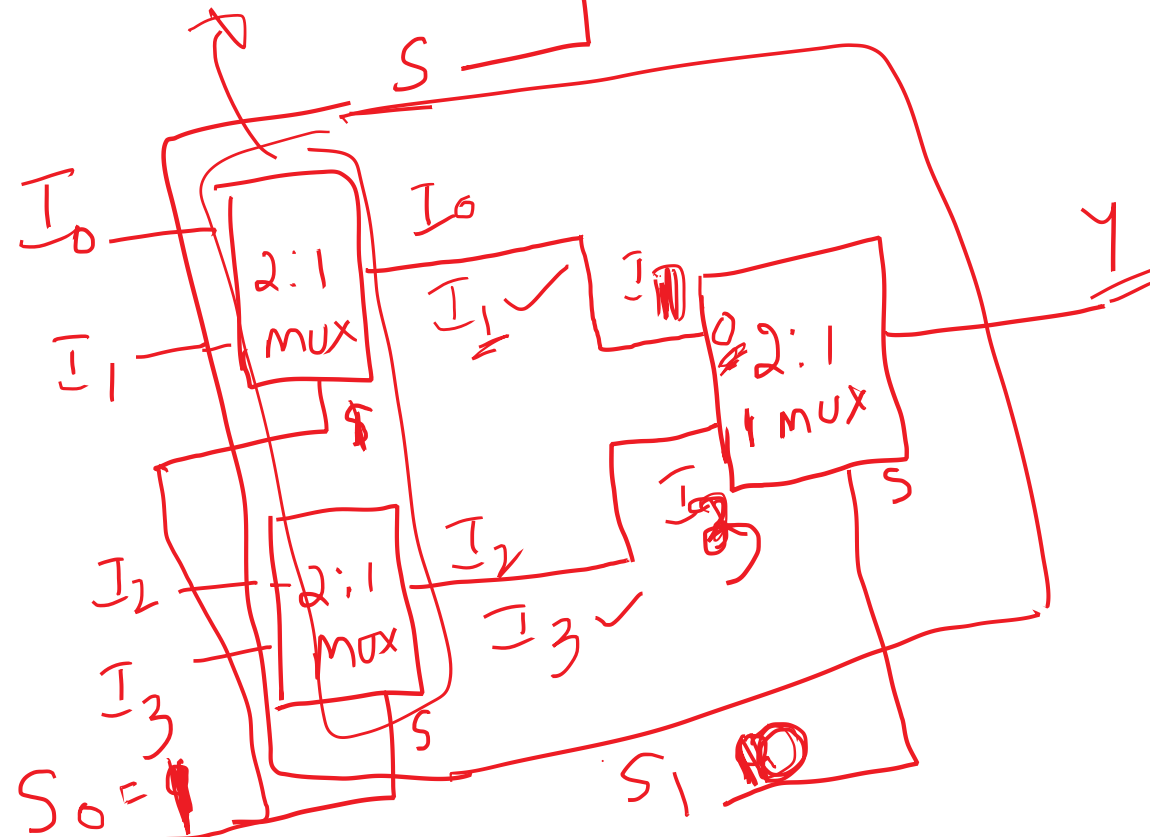- Write the Symbol/block diagram, function table, output expressions and circuit

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

$$Y = \overline{S_2}\,\overline{S_1}\,\overline{S_0}\, I_0 +$$
$$\overline{S_2}\,\overline{S_1}\, S_0\, I_1 +$$
$$\overline{S_2}\, S_1\, \overline{S_0}\, I_2 +$$
$$\overline{S_2}\, S_1\, S_0\, I_3 +$$
$$S_2\, \overline{S_1}\, \overline{S_0}\, I_4 +$$
$$S_2\, \overline{S_1}\, S_0\, I_5 +$$
$$S_2\, S_1\, \overline{S_0}\, I_6 +$$
$$S_2\, S_1\, S_0\, I_7$$

Realize 4:1 using only 2:1 MUXs (Multiplexer tree)

$2 = 1$
2×1
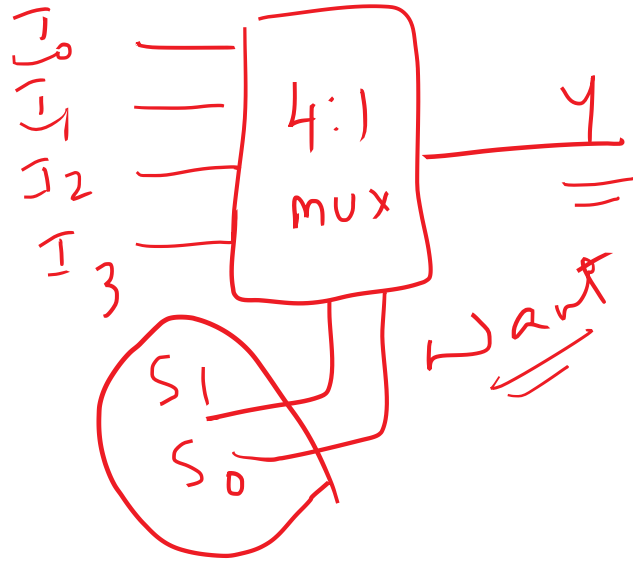
I_0
I_1
I_2
I_3

4:1
mux

Y

Want

S_1
S_0

I_0

2:1
mux

Y

have

S

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

I_0

2:1
mux

I_0

I_1

2:1
mux

I_1

I_2

2:1
mux

I_2

I_3

2:1
mux

Y

$S_0 = $

S

S_1

Realize 8:1 using only 2:1 MUXs (Multiplexer tree)

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
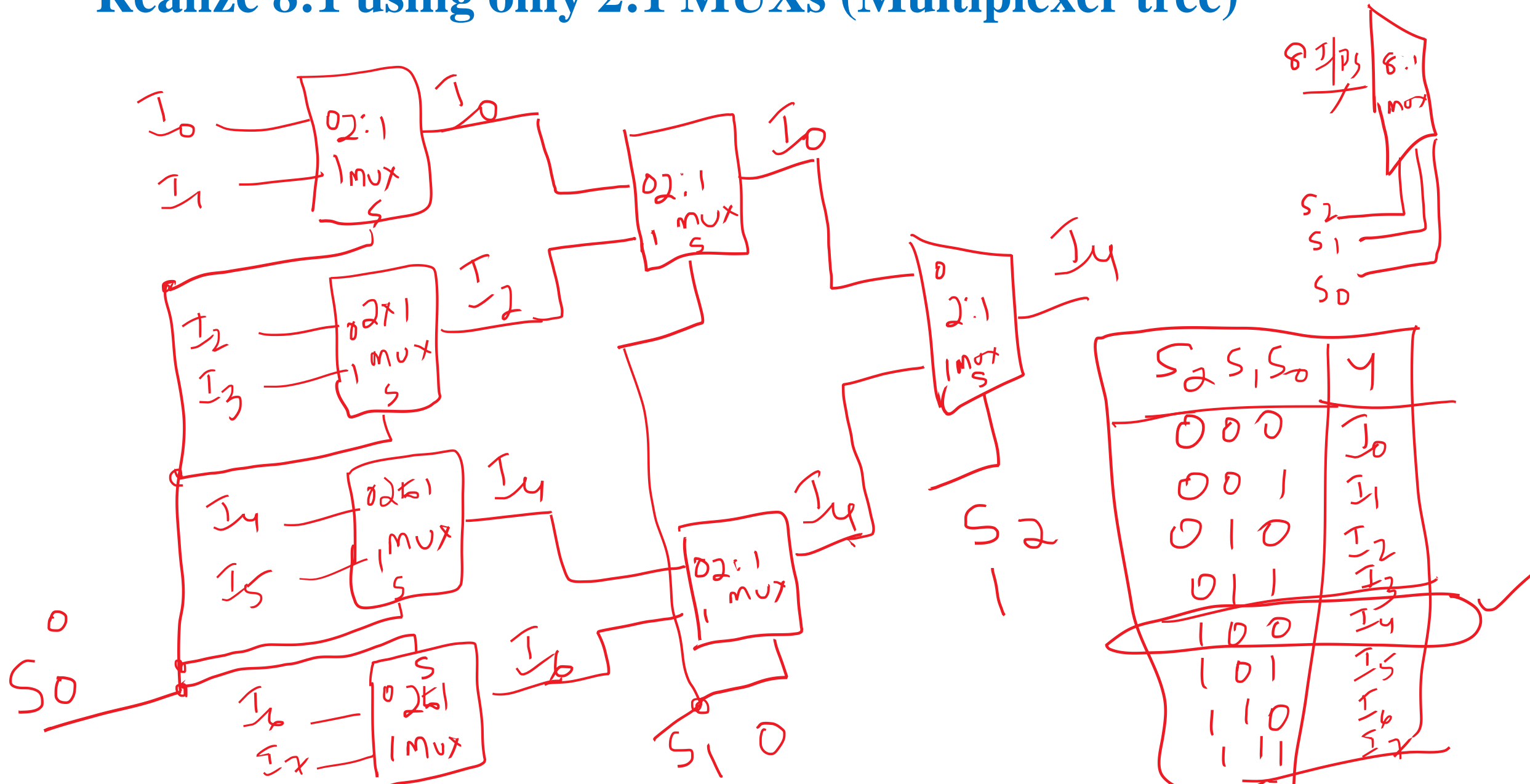
Realize 8:1 using only 4:1 MUXs and 2:1 MUX

→ 3 S lines

?   ?   =

$S_2 S_1 S_0$

I_0 — 0

4:1

I_1 — 1

I_2 — 2   MUX

I_3 — 3

S_1

S_0

I_4 — 0   4:1

I_5 — 1

I_6 — 2   MUX

I_7 — 3

S_1

S_0

0   2:1
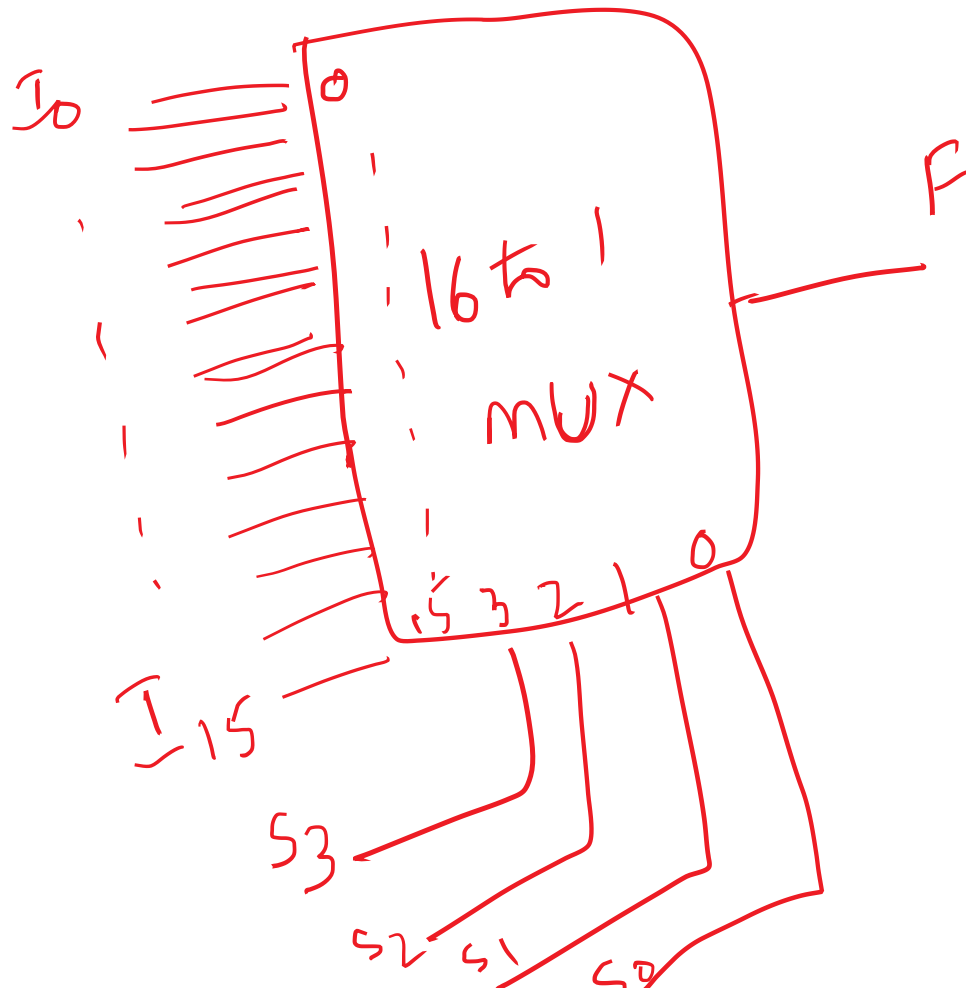
1   MUX

S

Y

S_2
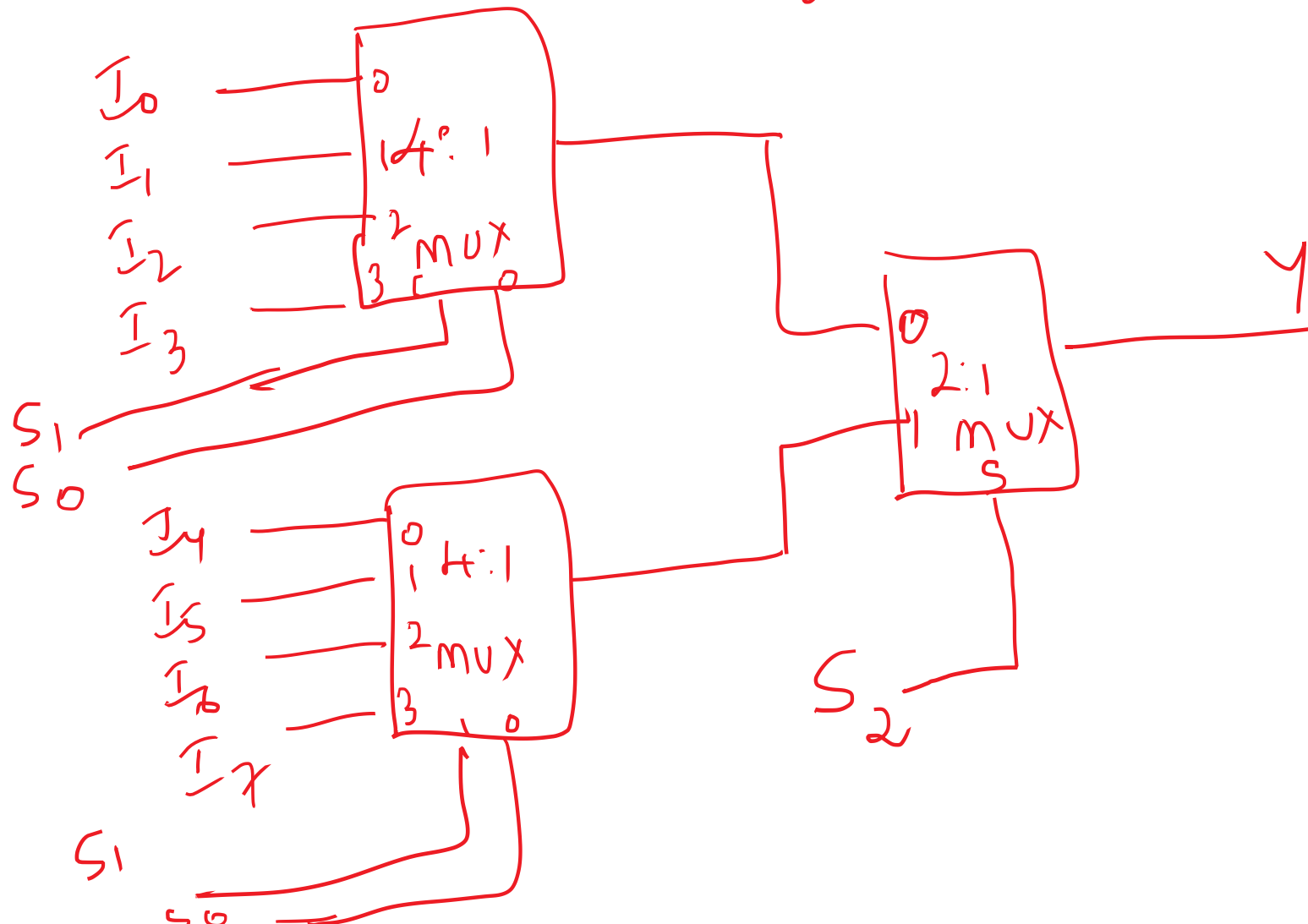
16-to-1 line multiplexer----Exercise for you

- Write the Symbol/block diagram, function table, output expressions and circuit

I_0

16 to 1
mux

S_3 S_2 S_1 S_0

I_{15}

F

$$F = 16 - terms$$

Question?