Lecture 16
Multiplexer/De-multiplexer

Mux/Demux Vocabulary

MULTIPLEXER (aka DATA SELECTOR)- circuit that can select one of a number of inputs and pass the logic level of that input to the output.

DEMULTIPLEXER (aka DATA DISTRIBUTOR)- circuit that depending on the status of its select inputs will channel its data input to one of several outputs.

SELECT INPUTS (aka ADDRESS LINES)- used by the mux to determine which data inputs will be switched to the output.

$$if\ 2^N\ input\ lines = N\ select\ lines$$

# Example of a Combinatorial Circuit:
A Multiplexer (MUX)

Consider an integer 'm', which is
constrained by the following relation:

$$m = 2^n, \quad \text{where m and n are both}$$
integers.

- **A m-to-1 Multiplexer** has
    - m Inputs: I_0, I_1, I_2, ... $I_{(m-1)}$
    - one Output: Y
    - n Control inputs: S_0, S_1, S_2, ... $S_{(n-1)}$
    - One (or more) Enable input(s)

such that Y may be equal to one of the inputs, depending upon the control inputs.

BASIC TWO-INPUT MULTIPLEXER

$$Z = I_0 \cdot \overline{S} + I_1 \cdot S$$
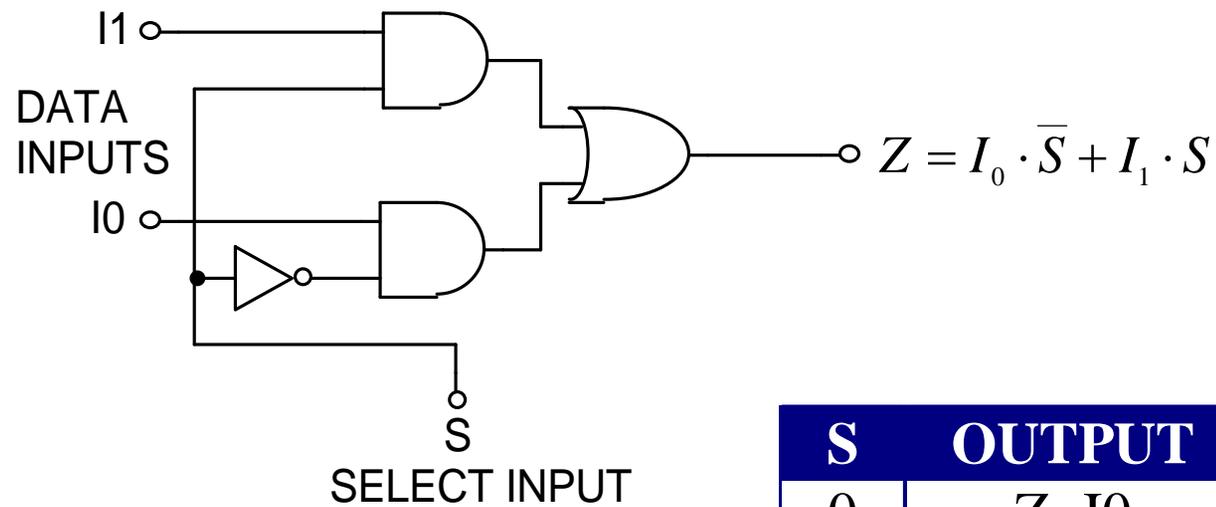
S	OUTPUT
0	Z=I0
1	Z=I1

Example: A 4-to-1 Multiplexer

A 4-to-1 Multiplexer:

2^n inputs

I_0
I_1
I_2
I_3

4:1 MUX

Y

1 output

Enable
(G)

S_0 S_1

n control
inputs
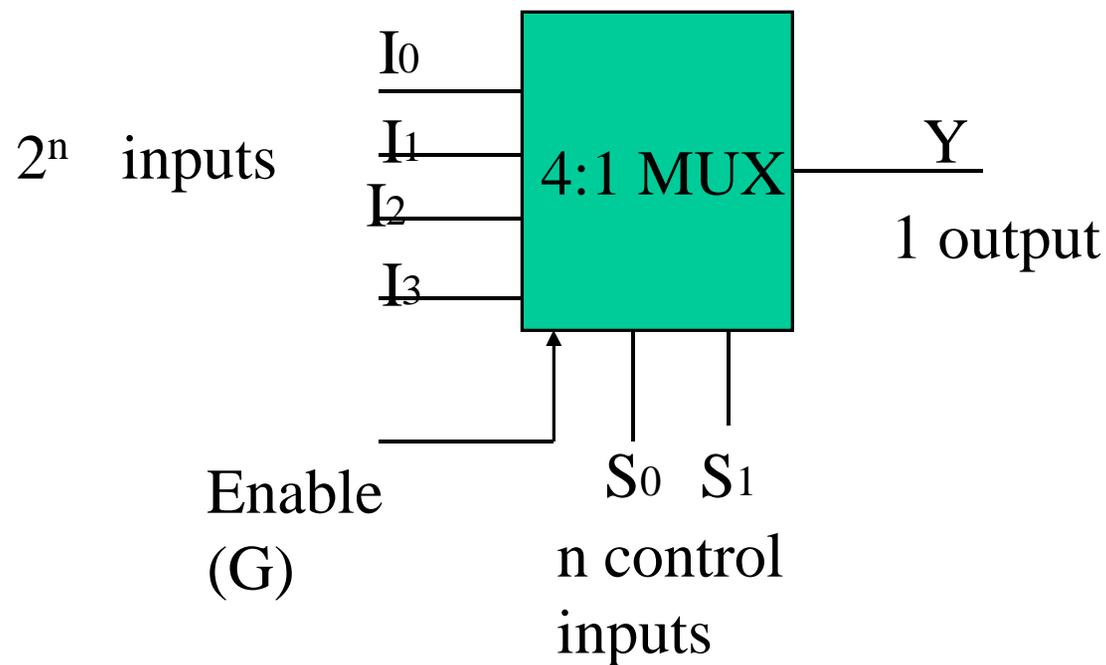
FOUR-INPUT MULTIPLEXER
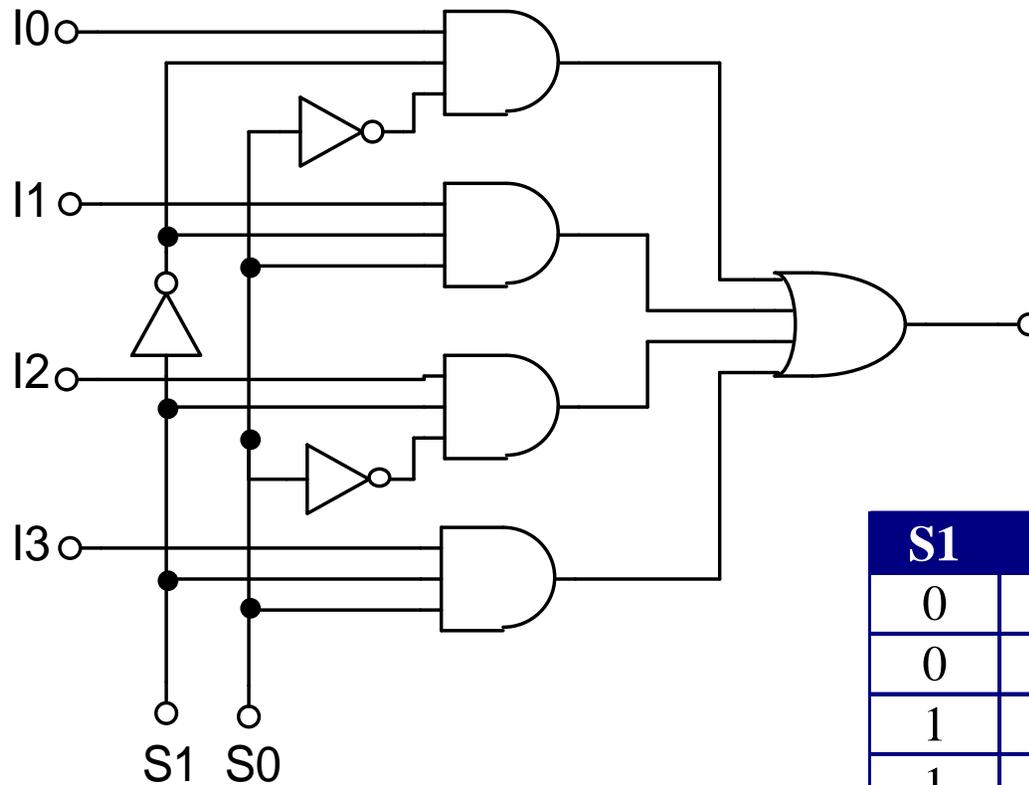
S1	S0	OUTPUT
0	0	Z=I0
0	1	Z=I1
1	0	Z=I2
1	1	Z=I3

MULTIPLEXER LOGIC DIAGRAM

•Takes one of many inputs and funnels it to an output Z.

•Take the selector lines convert to a decimal number and this is the input funneled to the output.

•Strobe is active low enable

D
A
T
A

I
N
P
U
T
S

I_0
I_1
I_2
I_3
I_4
I_5
I_6
I_7

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MUX

E
S_2 S_1 S_0

Z
$\overline{Z}$

SELECT LINES
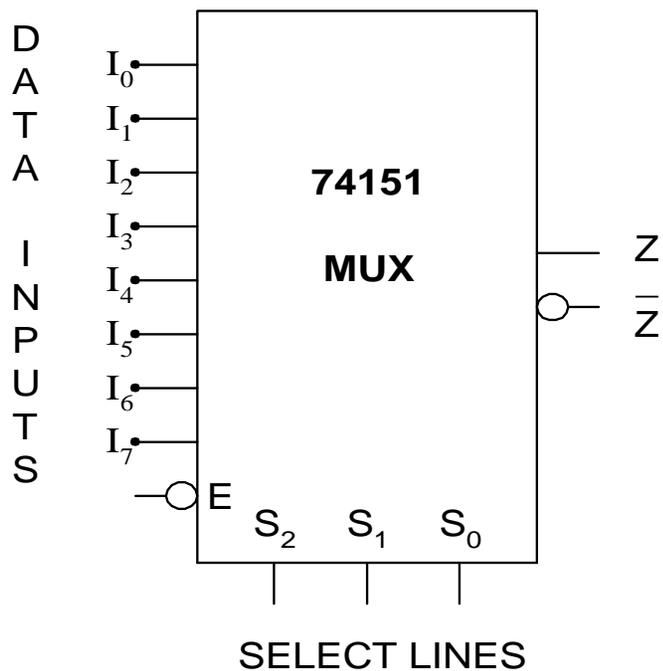
S2	S1	S0	E	Z
0	0	0	0	I0
0	0	1	0	I1
0	1	0	0	I2
0	1	1	0	I3
1	0	0	0	I4
1	0	1	0	I5
1	1	0	0	I6
1	1	1	0	I7

MULTIPLEXER APPLICATIONS

- DATA ROUTING

- PARALLEL-TO-SERIAL CONVERSION

- OPERATION SEQUENCING

- IMPLEMENT LOGIC FUNCTION OF A TRUTH TABLE

LOGIC FUNCTION GENERATION

+5

$$Z = A\overline{B}\overline{C} + \overline{A}B\overline{C} + ABC$$

I₀ I₁ I₂ I₃ I₄ I₅ I₆ I₇

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MUX

E S₂ S₁ S₀
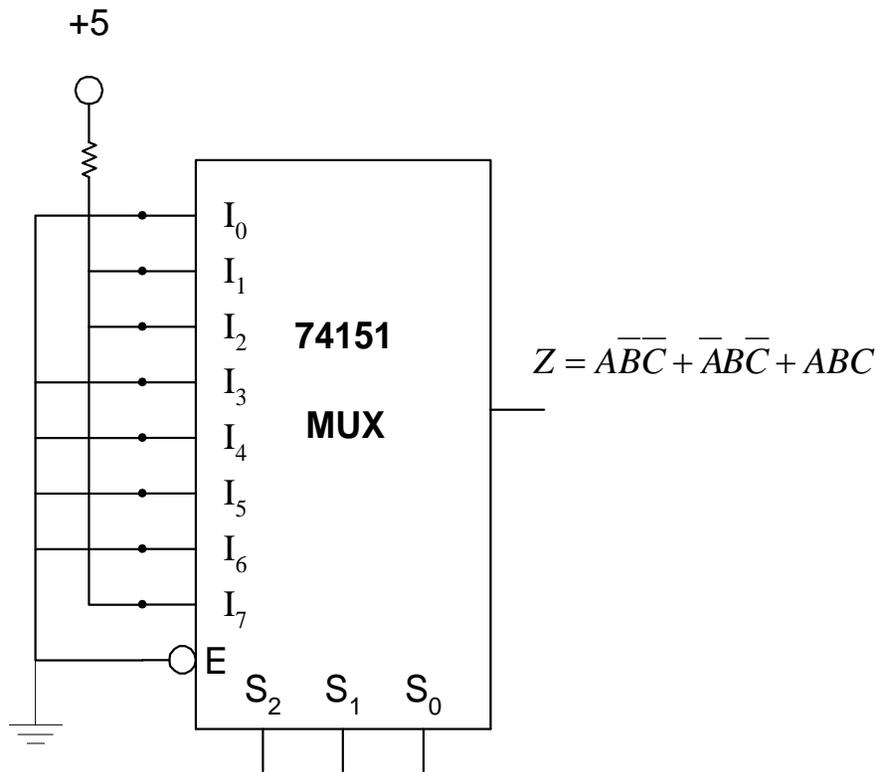
C	B	A	Z
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

Assignment -16

FILL IN THE TABLE
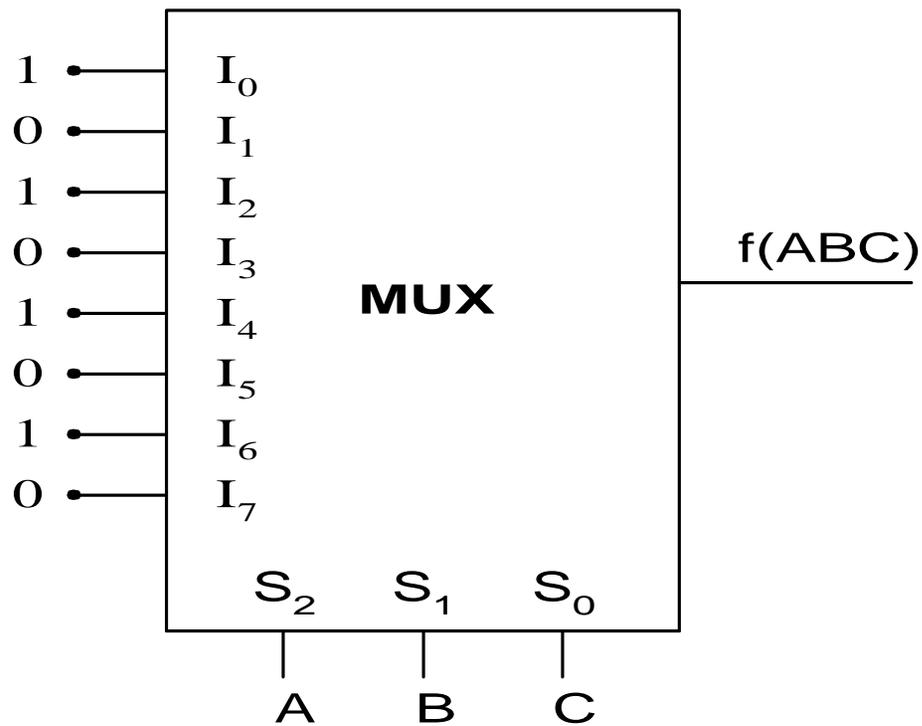
A	B	C	F
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	
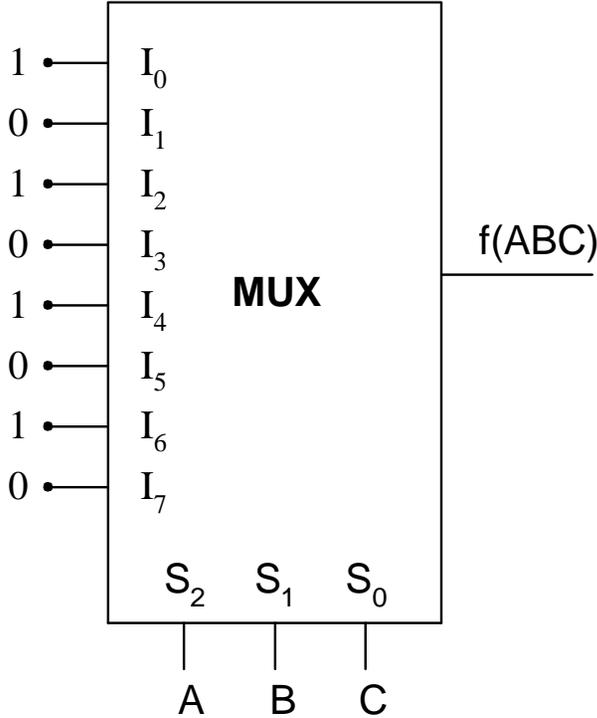
FILL IN THE TABLE

A	B	C	F
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

FILL IN THE TABLE
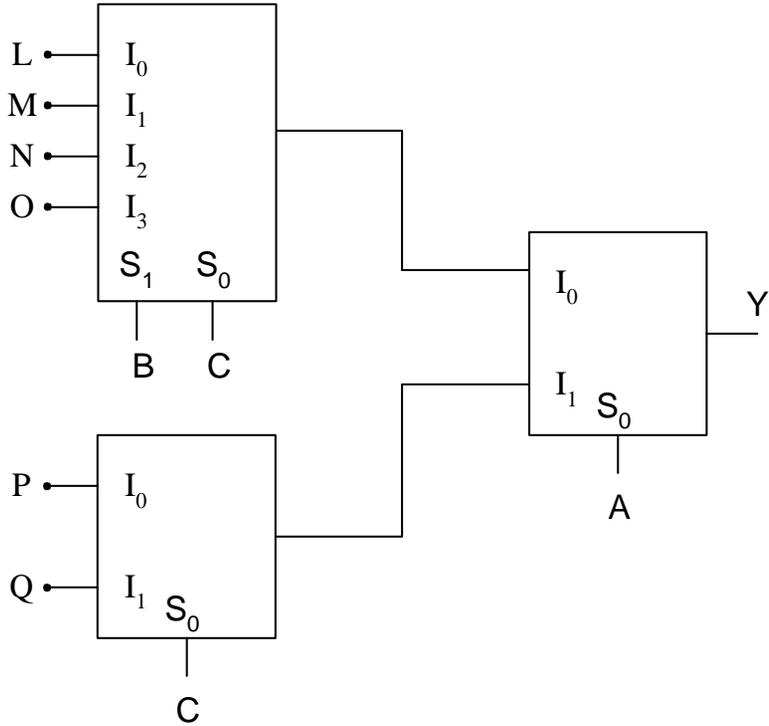
A	B	C	Y
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

FILL IN THE TABLE
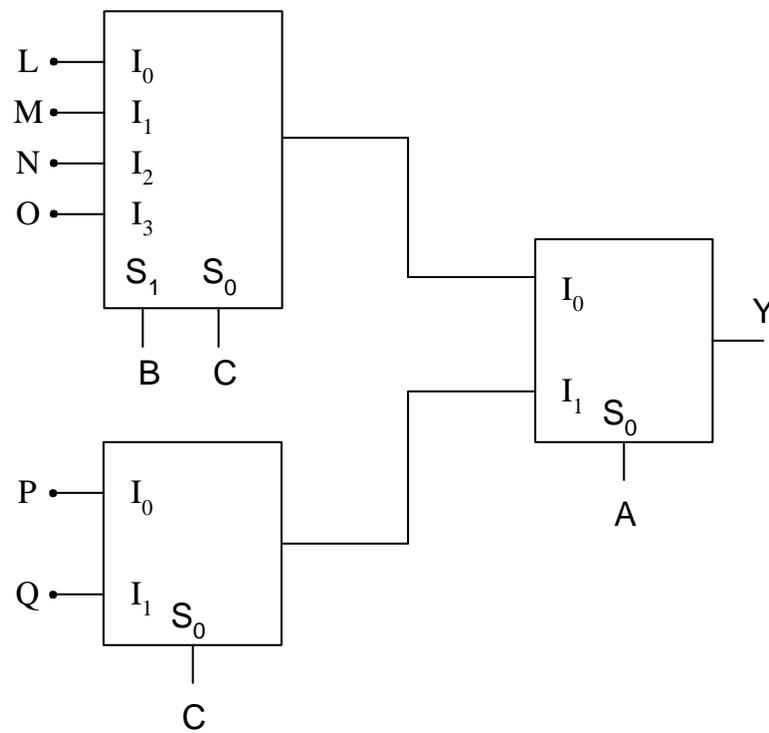
A	B	C	Y
0	0	0	L
0	0	1	M
0	1	0	N
0	1	1	O
1	0	0	P
1	0	1	Q
1	1	0	P
1	1	1	Q

WRITE A BOOLEAN EXPRESSION FOR THE CIRCUIT

WRITE A BOOLEAN EXPRESSION FOR THE CIRCUIT

1 — I_0

0 — I_1

1 — I_2 — f(AB)

1 — I_3

S_1 S_0

A   B
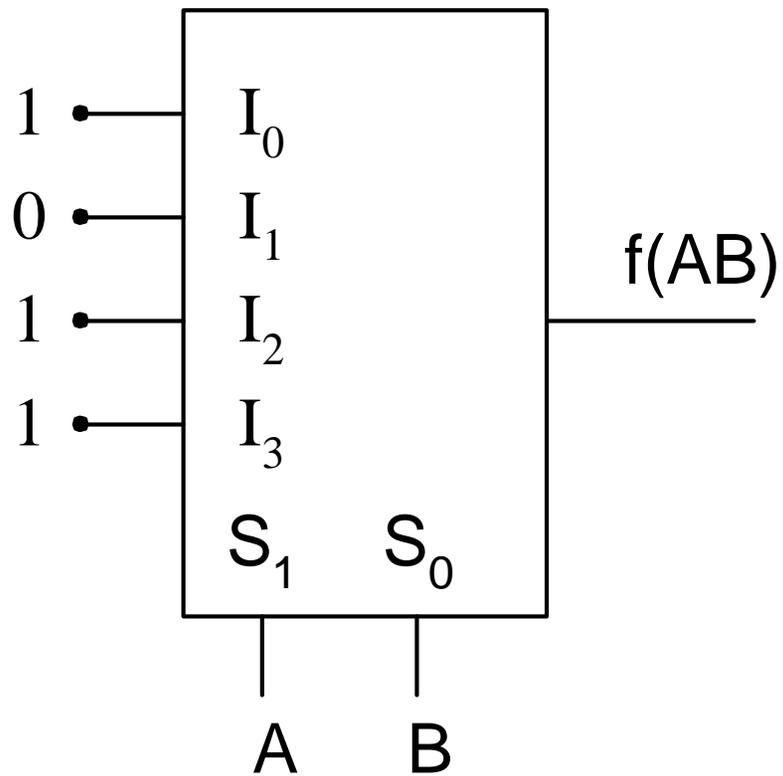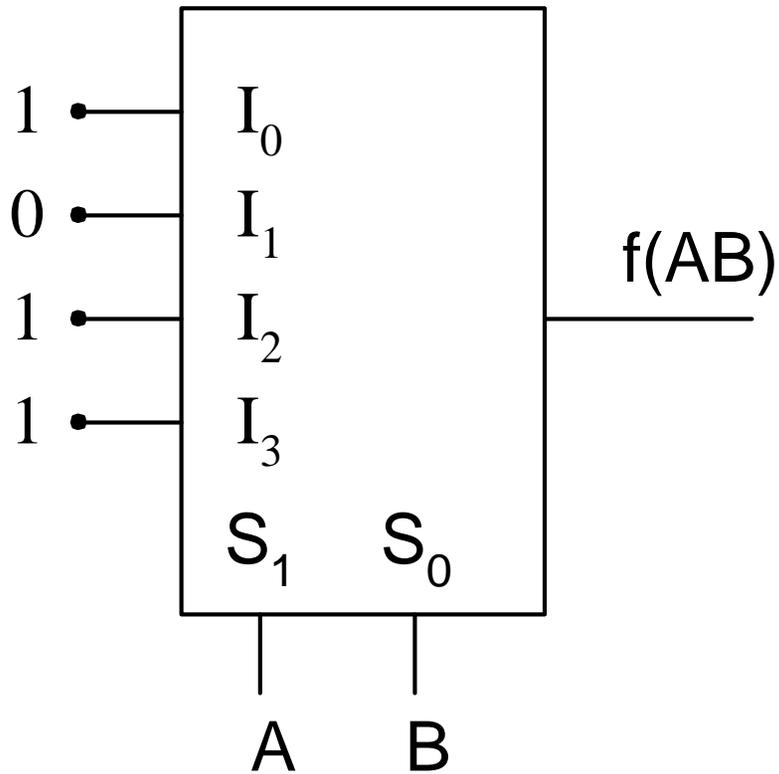
$$\overline{A}\,\overline{B} + A\overline{B} + AB$$

Implementing Digital Functions : by using a Multiplexer

Implementation of $F(A,B,C,D)=\sum (m(1,3,5,7,8,10,12,13,14), d(4,6,15))$

By using a 16-to-1 multiplexer:
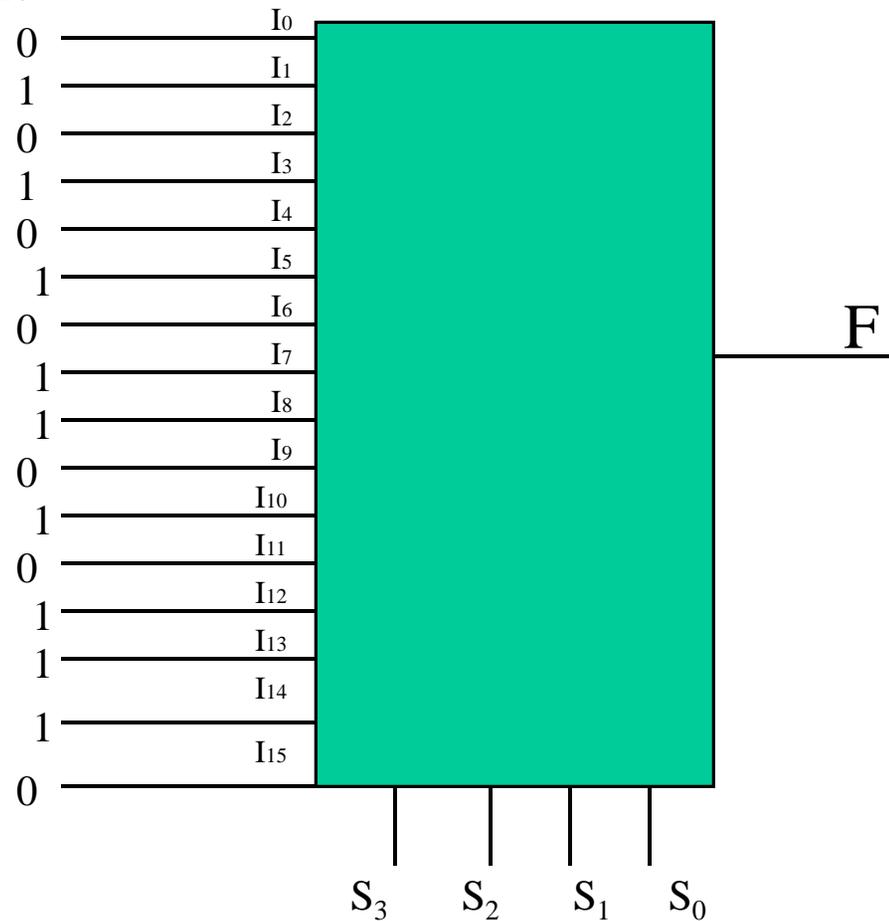
NOTE: 4,6 and 15 MAY BE
CONNECTED to either 0 or 1

I_0
I_1
I_2
I_3
I_4
I_5
I_6
I_{m-2}
I_{m-1}

m:1 Mux

Y

S_{n-1} S_2 S_1 S_0

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