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)

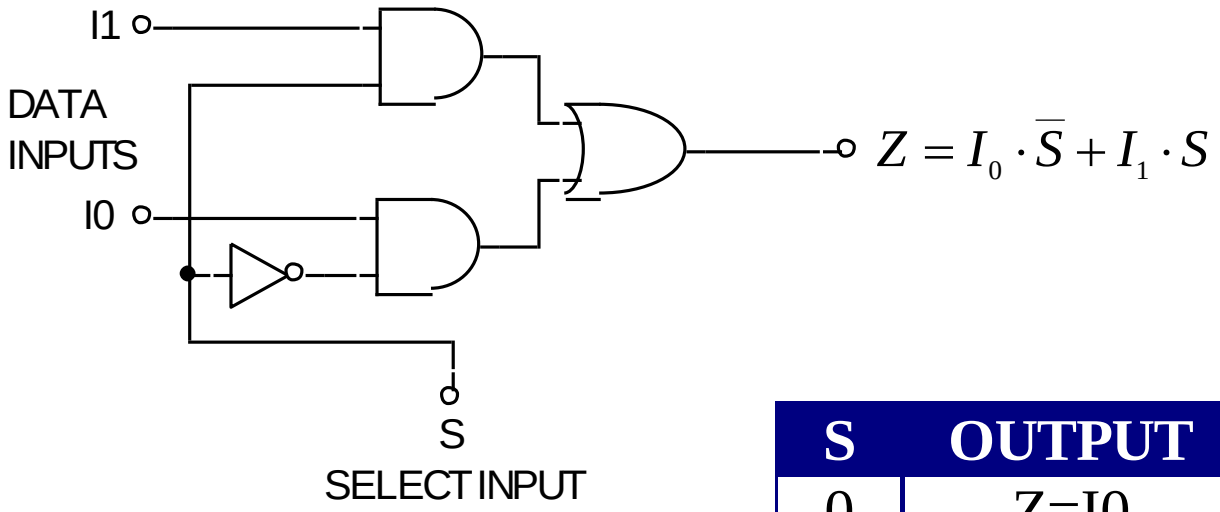
Consider an integer ‘m’, which is constrained by the following relation:

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

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

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

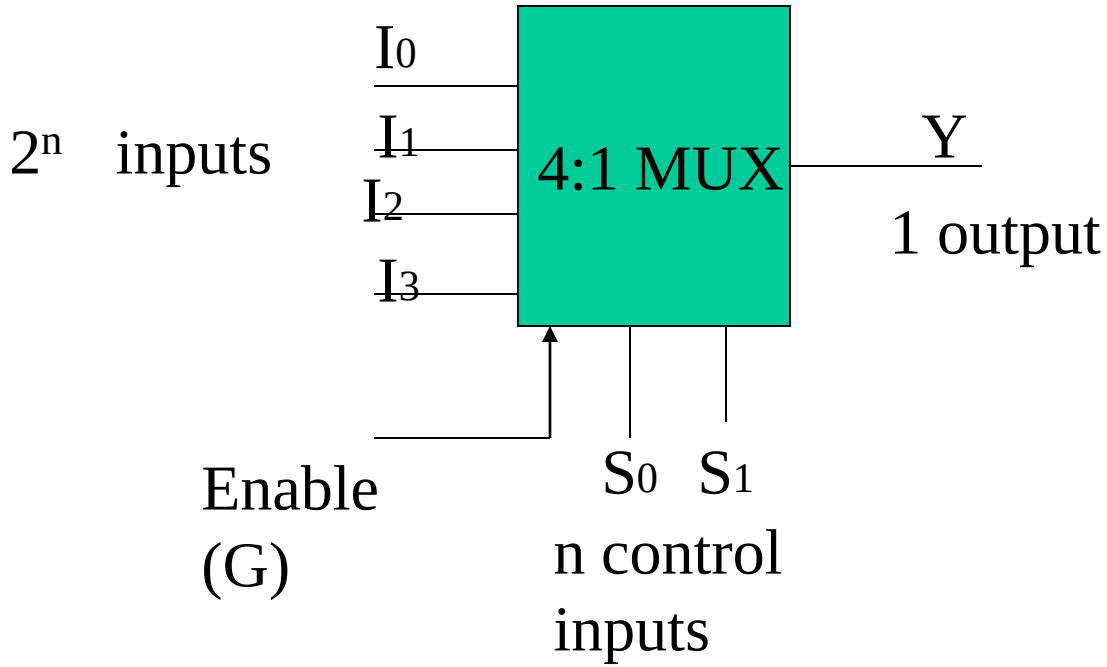
BASIC TWO-INPUT MULTIPLEXER



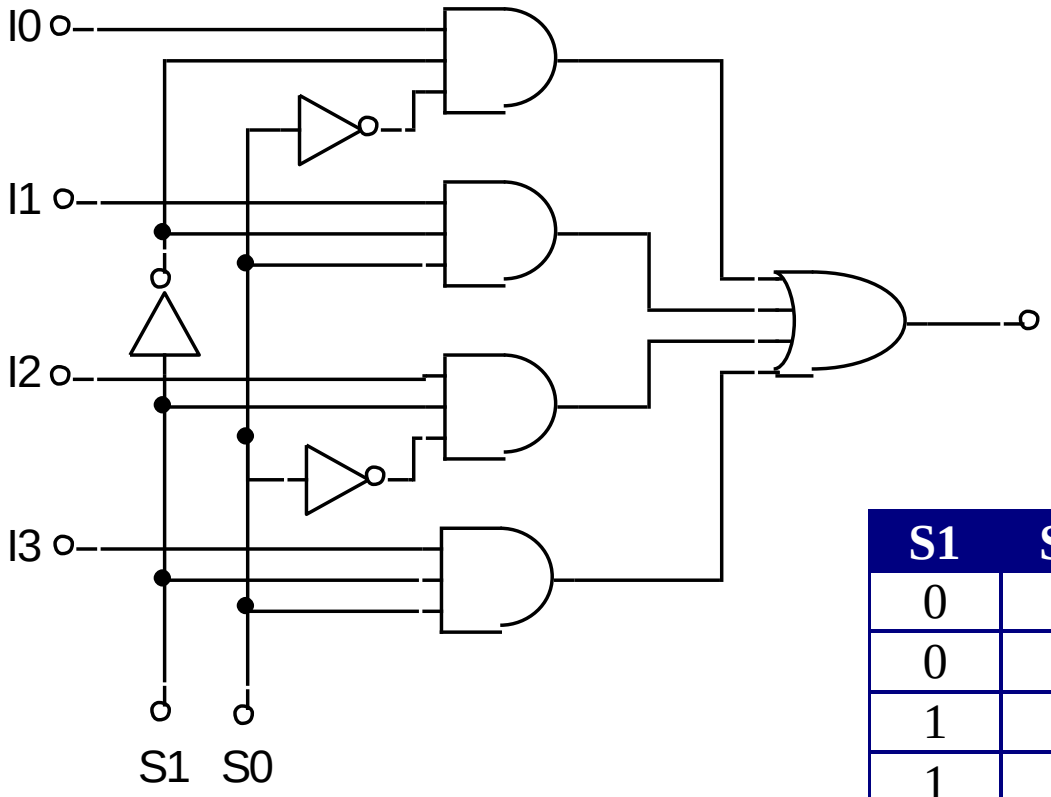
S	OUTPUT
0	Z=I0
1	Z=I1

Example: A 4-to-1 Multiplexer

A 4-to-1 Multiplexer:



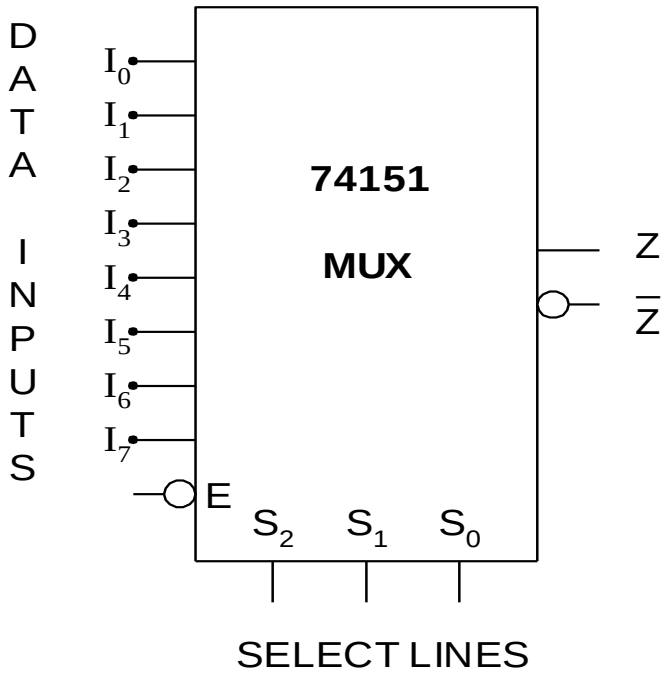
FOUR-INPUT MULTIPLEXER



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

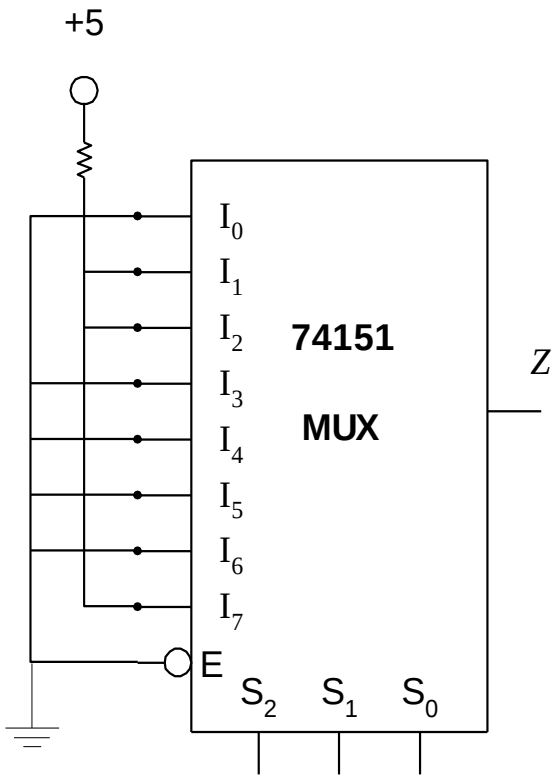


S2	S1	S0	E	Z
0	0	0	0	I0
0	0	1	0	I1
0	1	0	0	I2
0	1	1	0	I3
1	0	0	0	I4
1	0	1	0	I5
1	1	0	0	I6
1	1	1	0	I7

MULTIPLEXER APPLICATIONS

- DATA ROUTING
- PARALLEL-TO-SERIAL CONVERSION
- OPERATION SEQUENCING
- IMPLEMENT LOGIC FUNCTION OF A TRUTH TABLE

LOGIC FUNCTION GENERATION

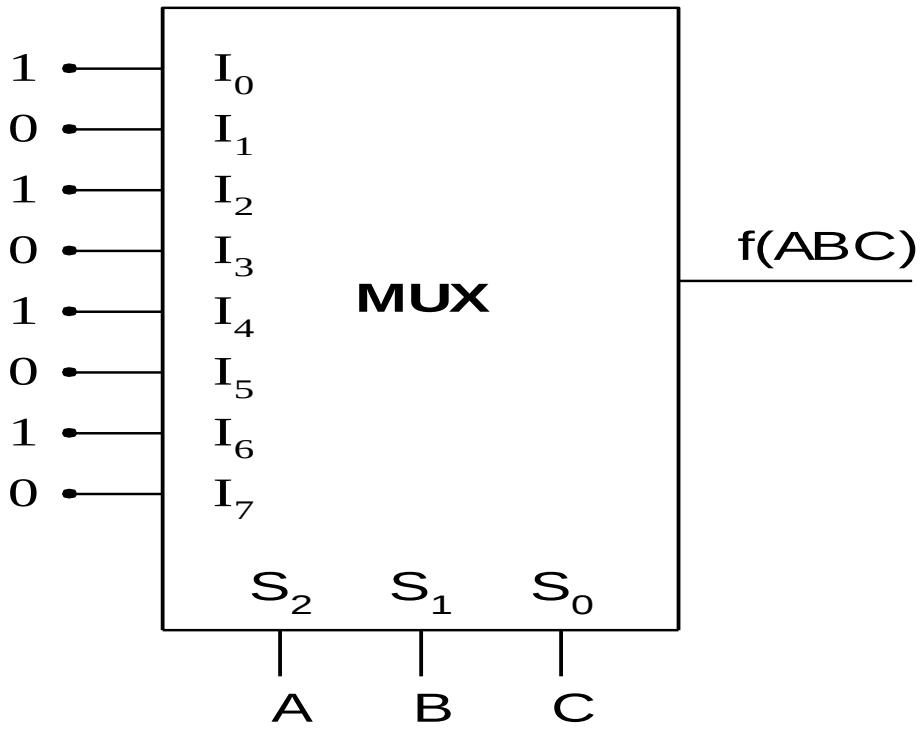


$$Z = A\overline{B}\overline{C} + \overline{A}B\overline{C} + ABC$$

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

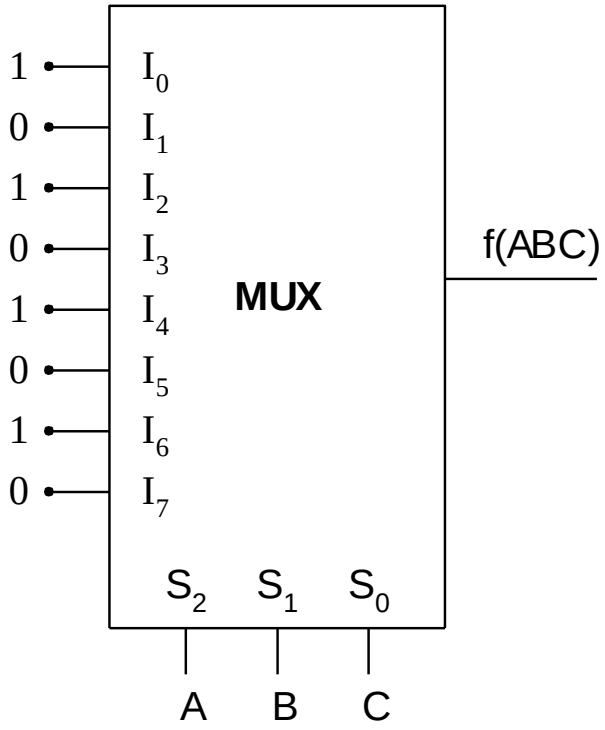
Assignment -16

FILL IN THE TABLE



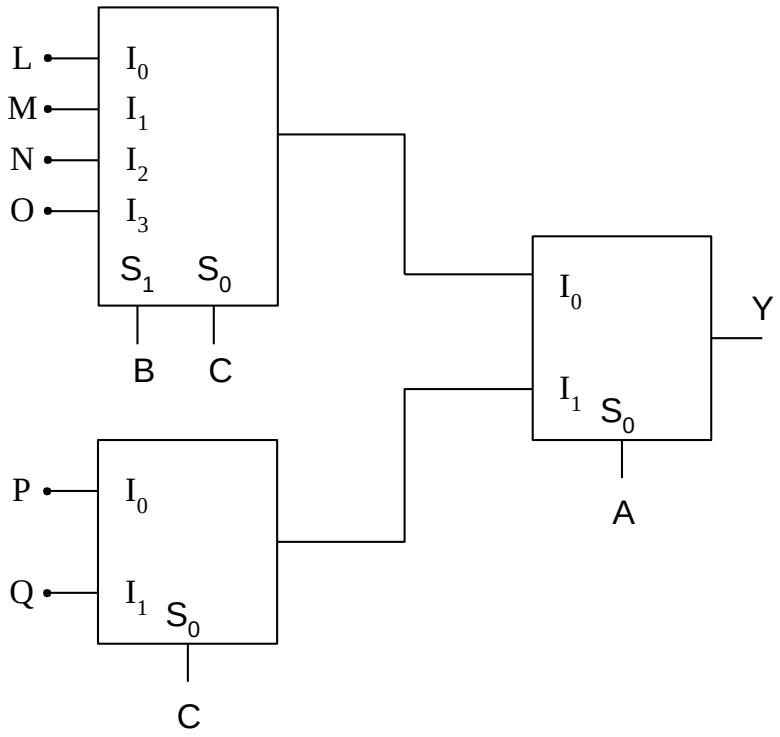
A	B	C	F
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

FILL IN THE TABLE



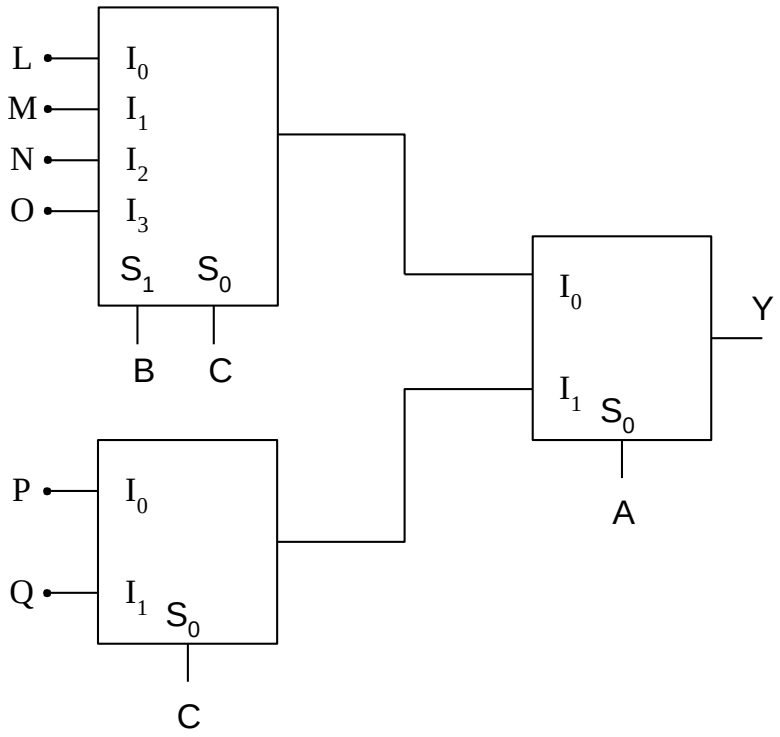
A	B	C	F
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

FILL IN THE TABLE



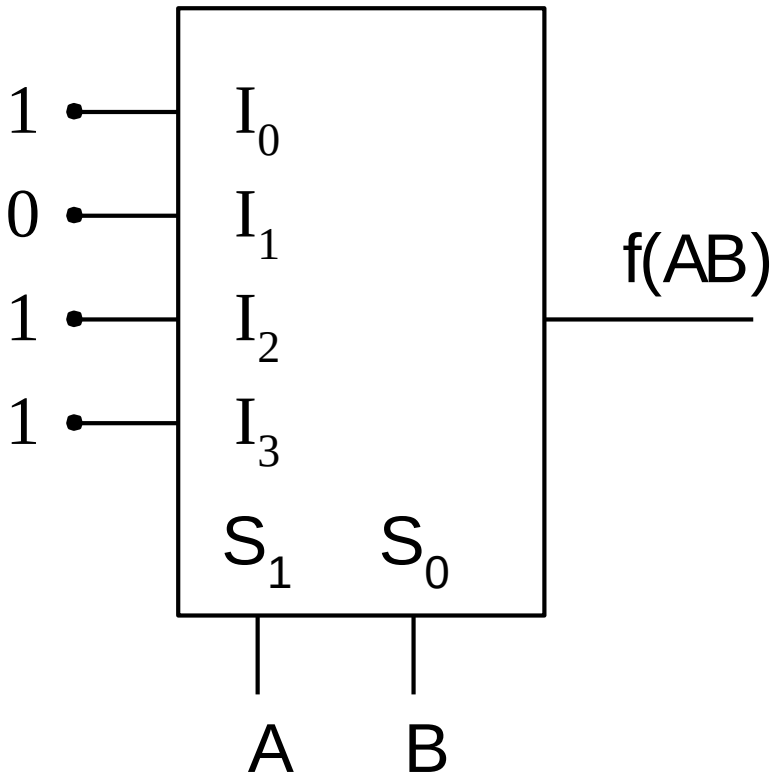
A	B	C	Y
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

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



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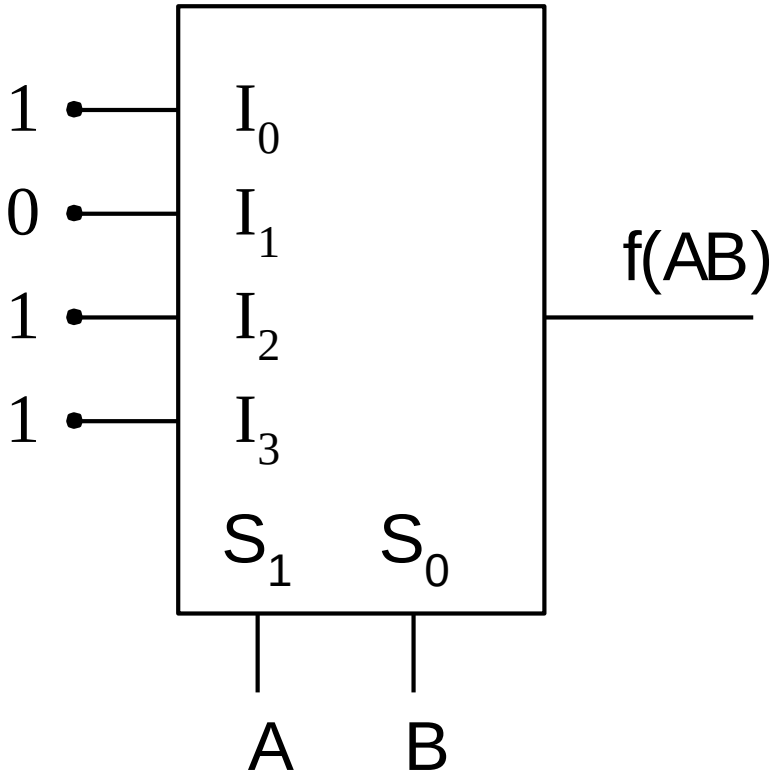
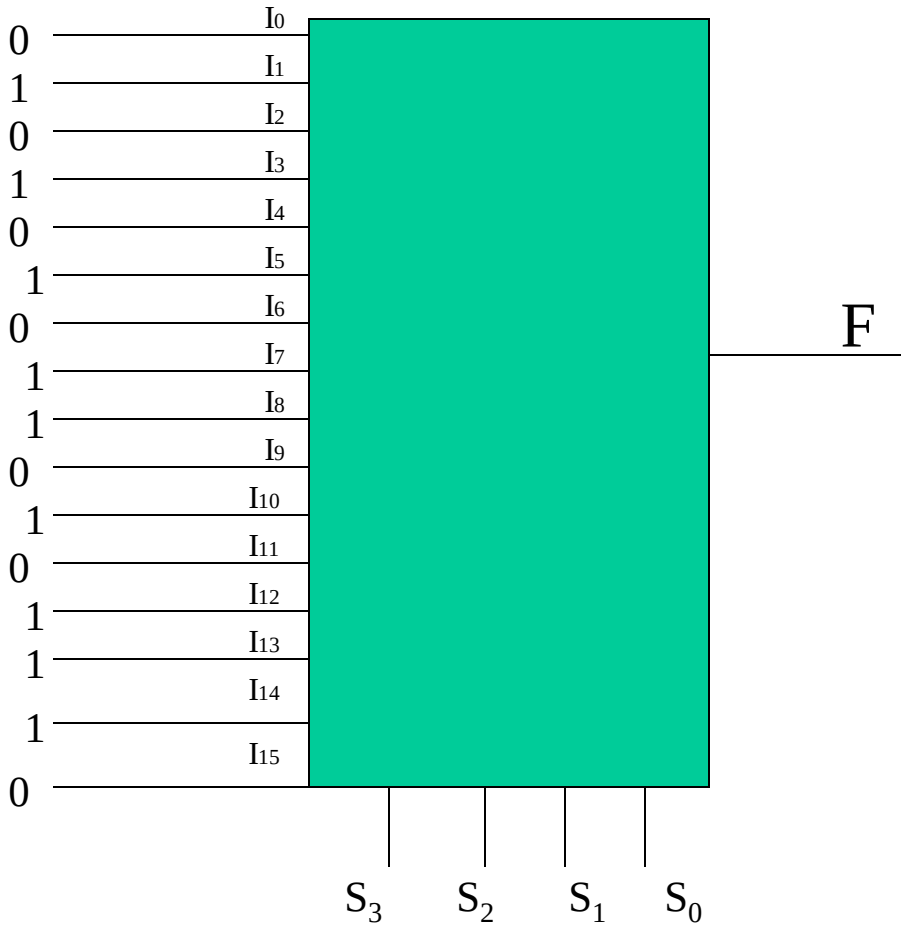


$$\overline{A}\overline{B} + A\overline{B} + AB$$

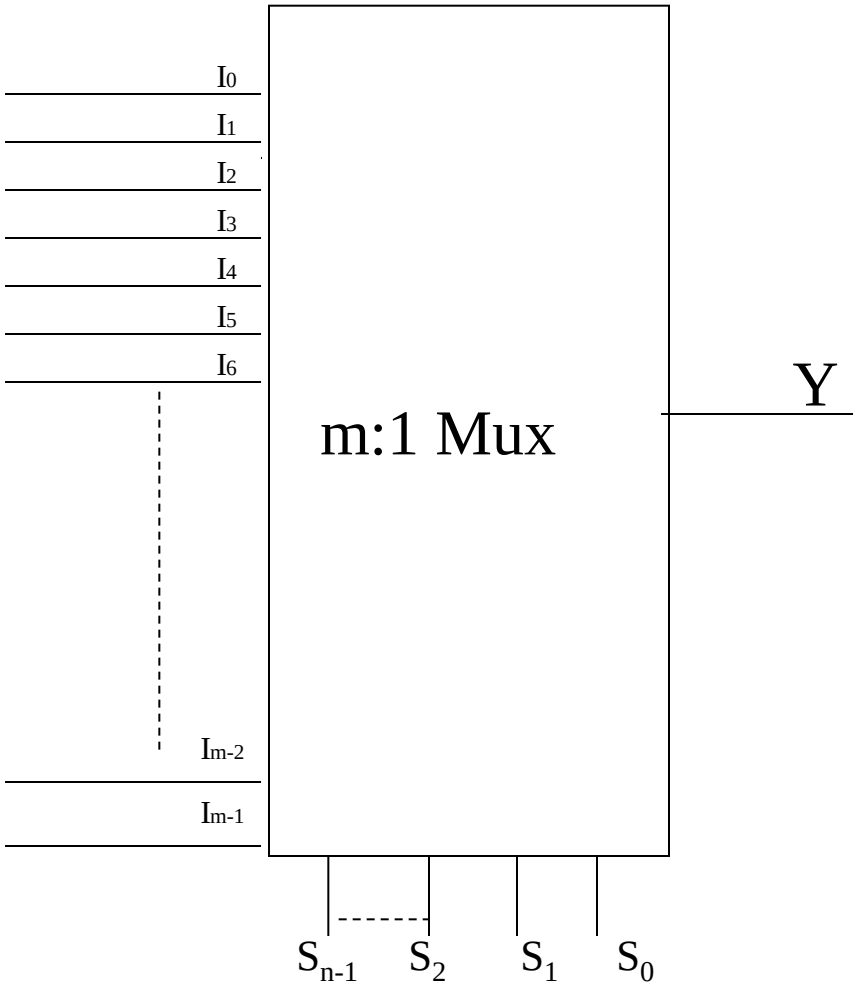
Implementing Digital Functions : by using a Multiplexer

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


I0
I1
I2
I3
I4
I5
I6
Im-2
Im-1
m:1 Mux
Y
Sn-1
S2
S1
S0