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)

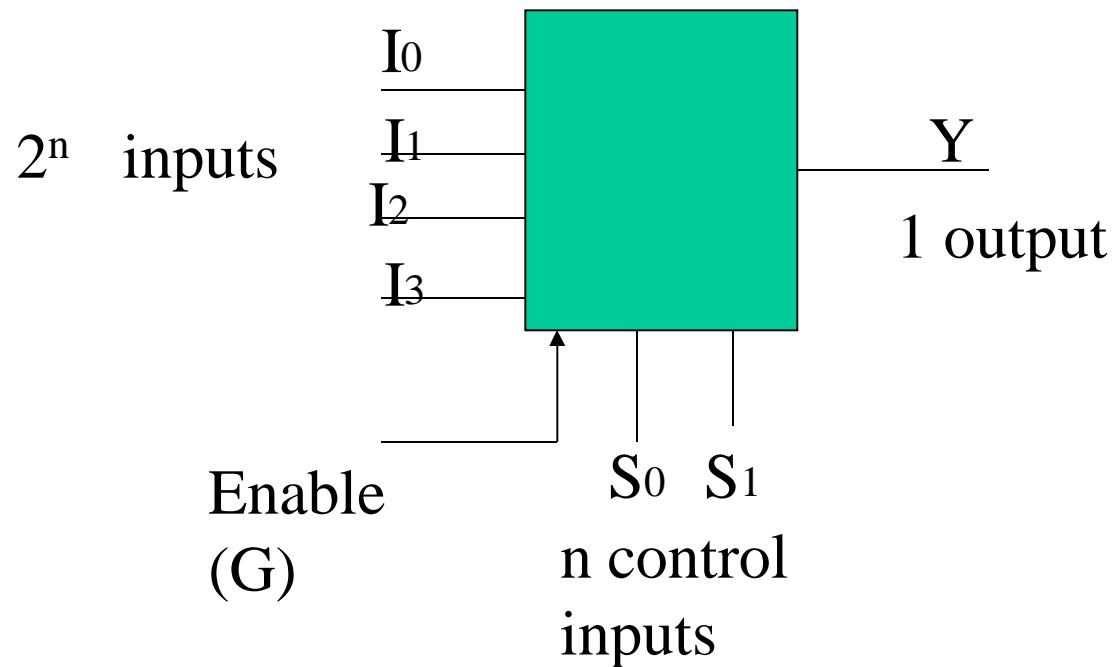such that Y may be equal to one of the inputs, depending upon the control inputs.
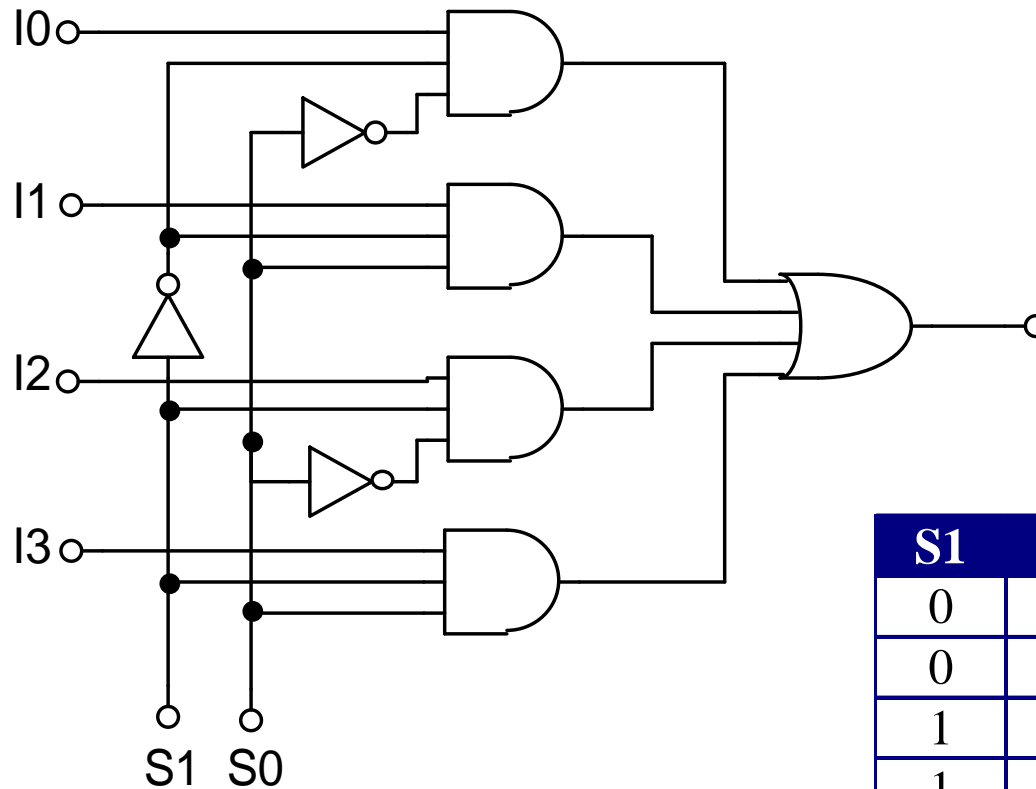
BASIC TWO-INPUT MULTIPLEXER

$$Z = I_0 \cdot \overline{S} + I_1 \cdot S$$

S	OUTPUT
0	Z=I0
1	Z=I1

I1

DATA
INPUTS

I0

S
SELECT INPUT
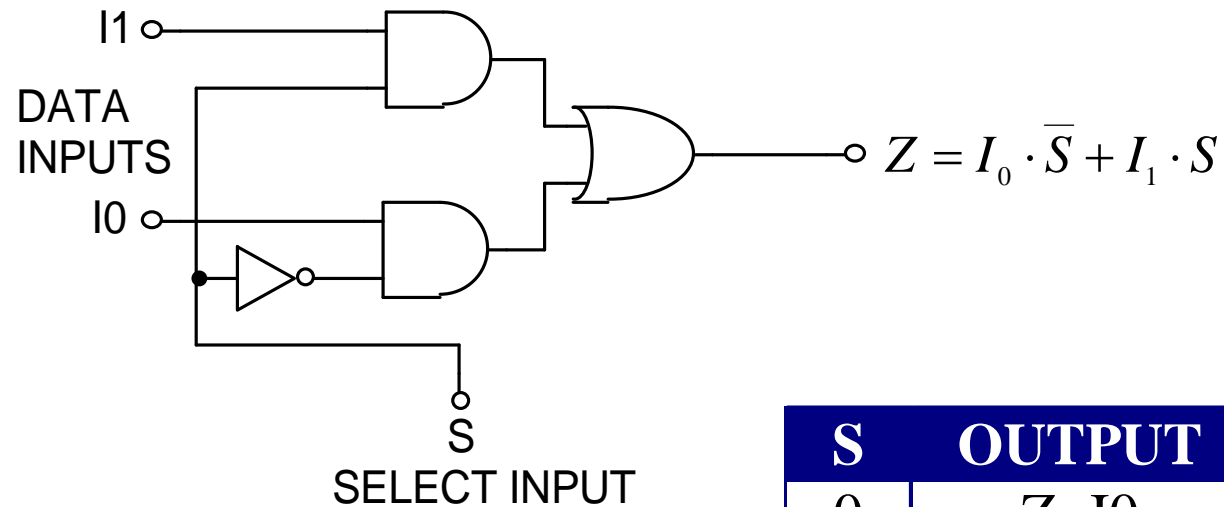
Example: A 4-to-1 Multiplexer

A 4-to-1 Multiplexer:

2^n inputs

I_0

I_1

I_2

I_3

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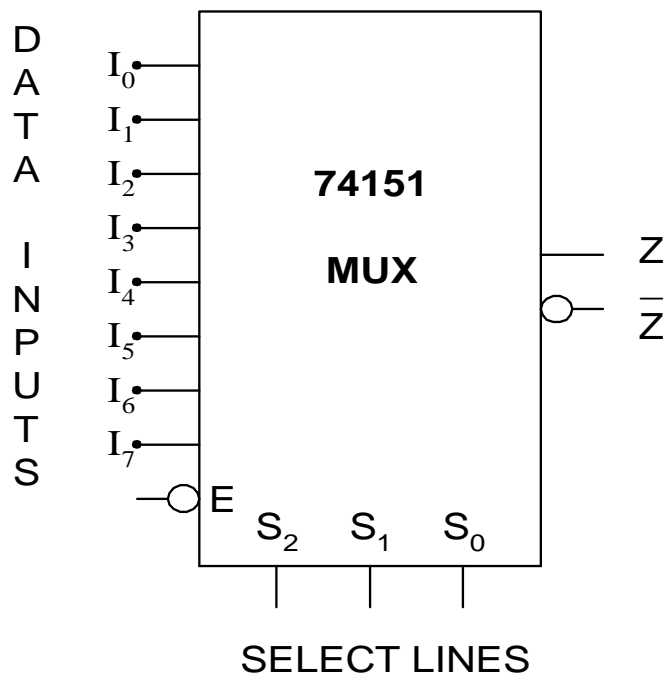
S2	S1	S0	E	Z
0	0	0	0	I0
0	0	1	0	I1
0	1	0	0	I2
0	1	1	0	I3
1	0	0	0	I4
1	0	1	0	I5
1	1	0	0	I6
1	1	1	0	I7

DATA INPUTS

I_0
I_1
I_2
I_3
I_4
I_5
I_6
I_7

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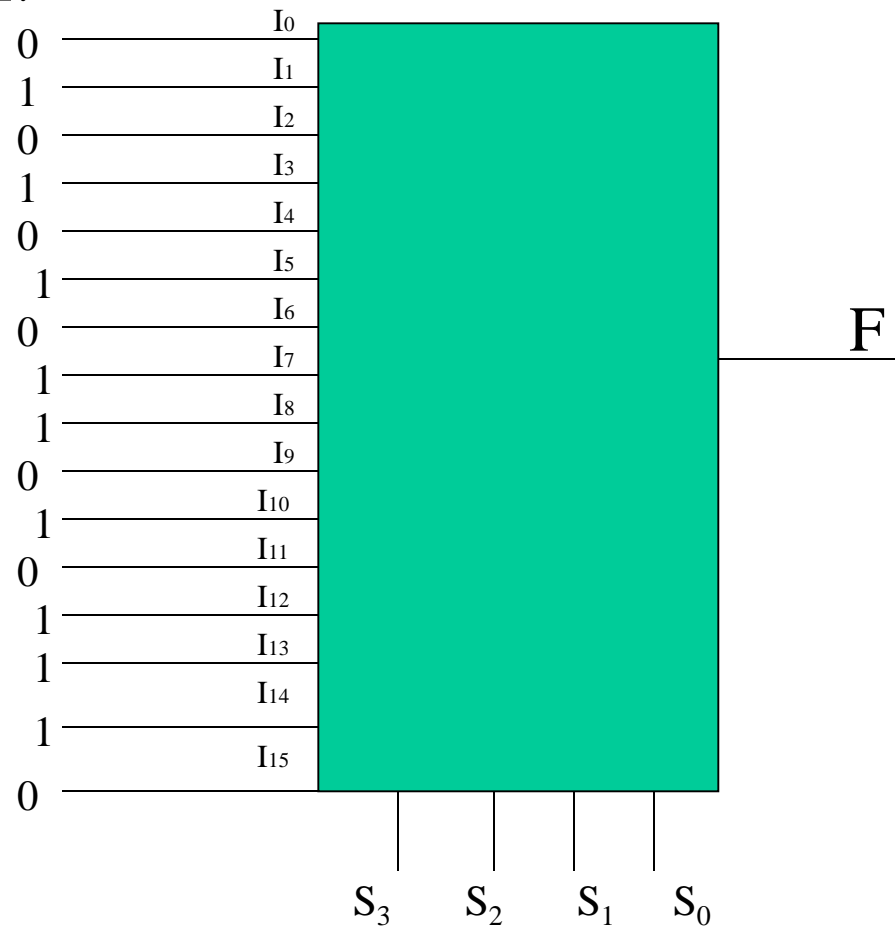
MUX

Z

$\bar{Z}$

E

S_2 S_1 S_0

SELECT LINES

MULTIPLEXER APPLICATIONS

- DATA ROUTING

- PARALLEL-TO-SERIAL CONVERSION

- OPERATION SEQUENCING

- IMPLEMENT LOGIC FUNCTION OF A TRUTH TABLE

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:

Input	Value
I_0	0
I_1	1
I_2	0
I_3	1
I_4	0
I_5	1
I_6	0
I_7	1
I_8	1
I_9	0
I_{10}	1
I_{11}	0
I_{12}	1
I_{13}	1
I_{14}	1
I_{15}	0

F

S_3 S_2 S_1 S_0

NOTE: 4,6 and 15 MAY BE CONNECTED to either 0 or 1