DECODER

A decoder has

- n inputs
- 2^n outputs

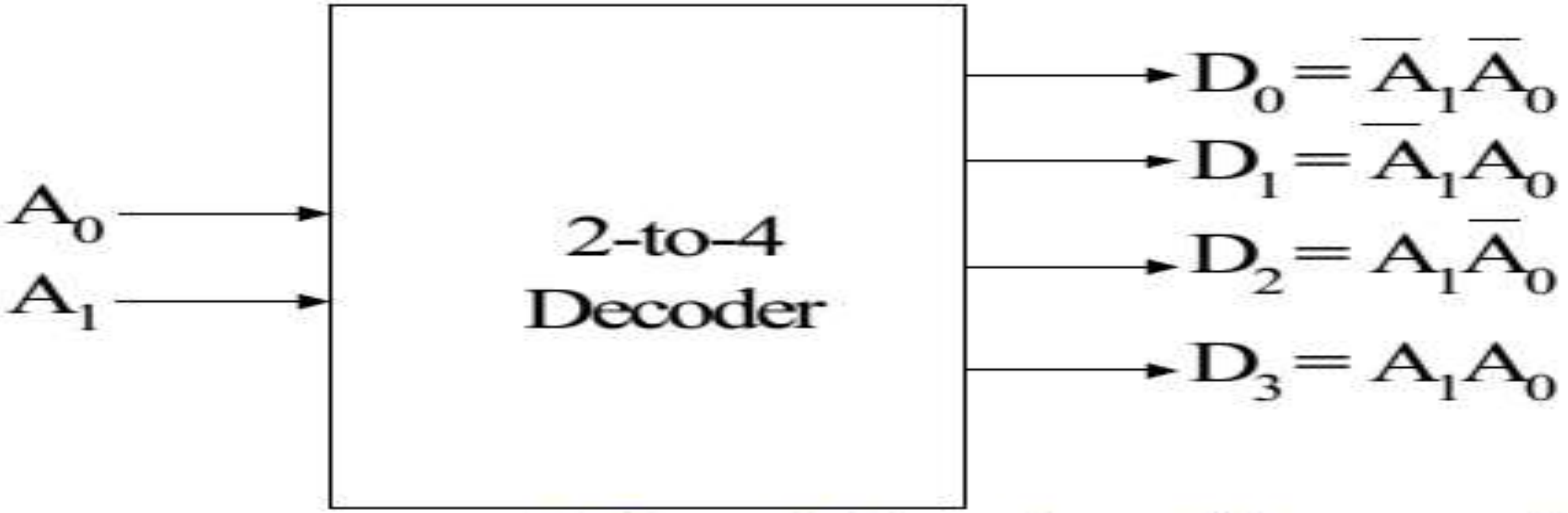
‡A decoder selects one of 2^n outputs by decoding the binary value on the *n* inputs.

‡The decoder generates all of the minterms of the *n* input variables.

- Exactly one output will be active for each combination of the inputs.

What does ³D F W L Y H´ mean?

DECODER



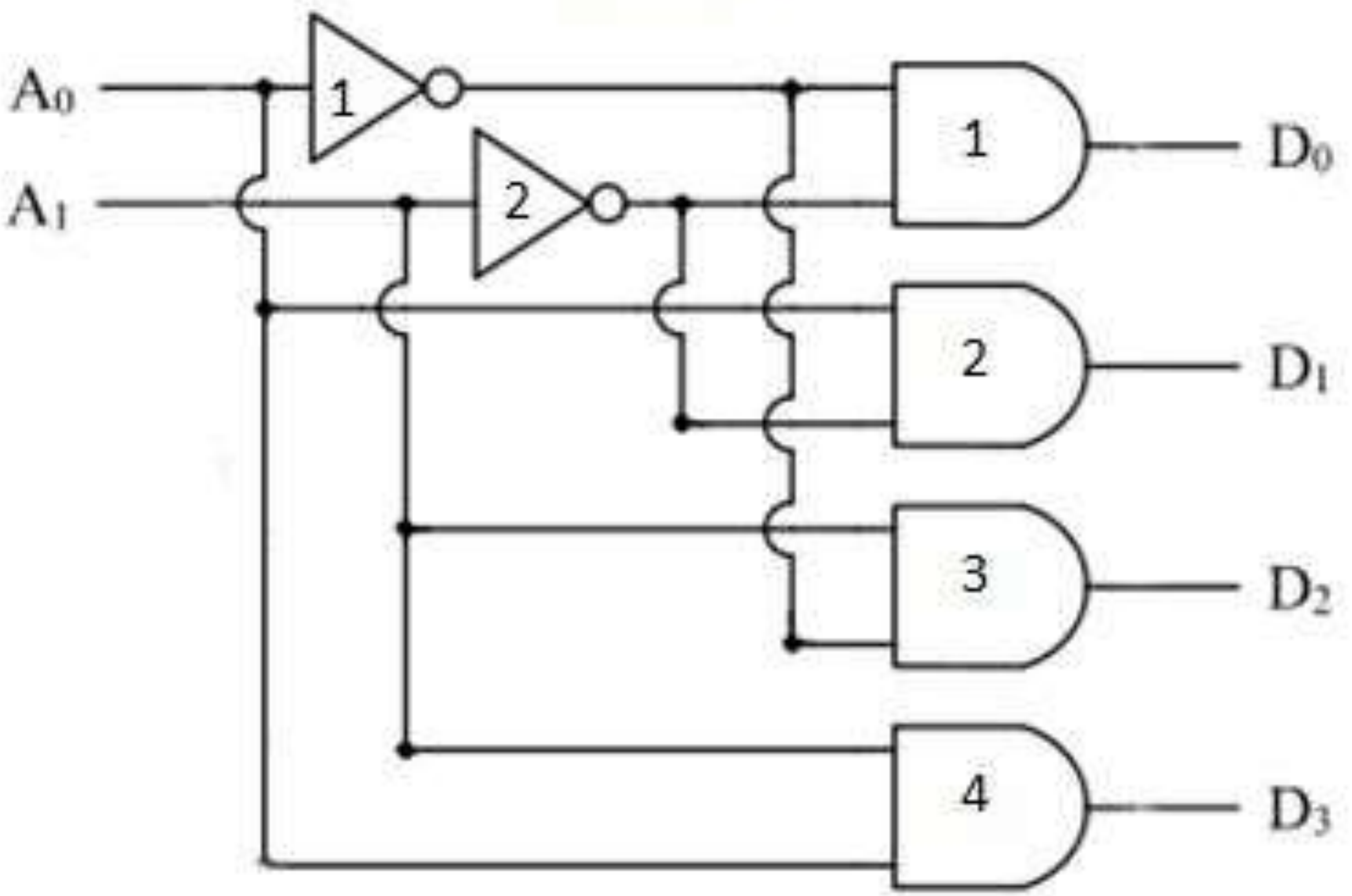
A 2-to-4 decoder without enable

Decimal #	Input		Output			
	A_1	A_0	D_0	D_1	D_2	D_3
0	0	0	1	0	0	0
1	0	1	0	1	0	0
2	1	0	0	0	1	0
3	1	1	0	0	0	1

Truth table for 2-to-4 decoder

DECODER

Logic Diagram



Truth Table

A_1	A_0	D_3	D_2	D_1	D_0
0	0	0	0	0	1
0	1	0	0	1	0
1	0	0	1	0	0
1	1	1	0	0	0

Equations

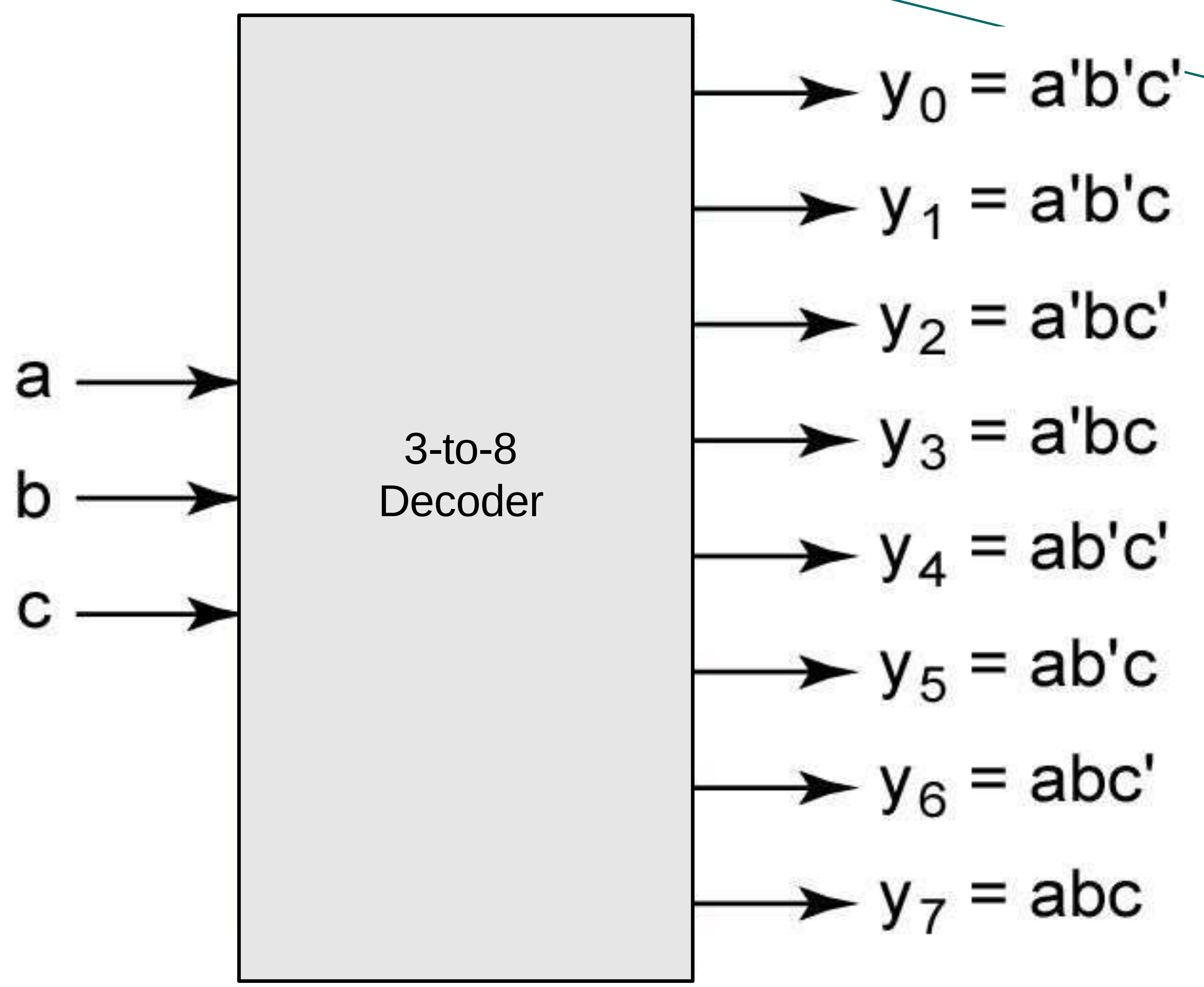
$$D_0 = \overline{A_1} \cdot \overline{A_0}$$

$$D_1 = \overline{A_1} \cdot A_0$$

$$D_2 = A_1 \cdot \overline{A_0}$$

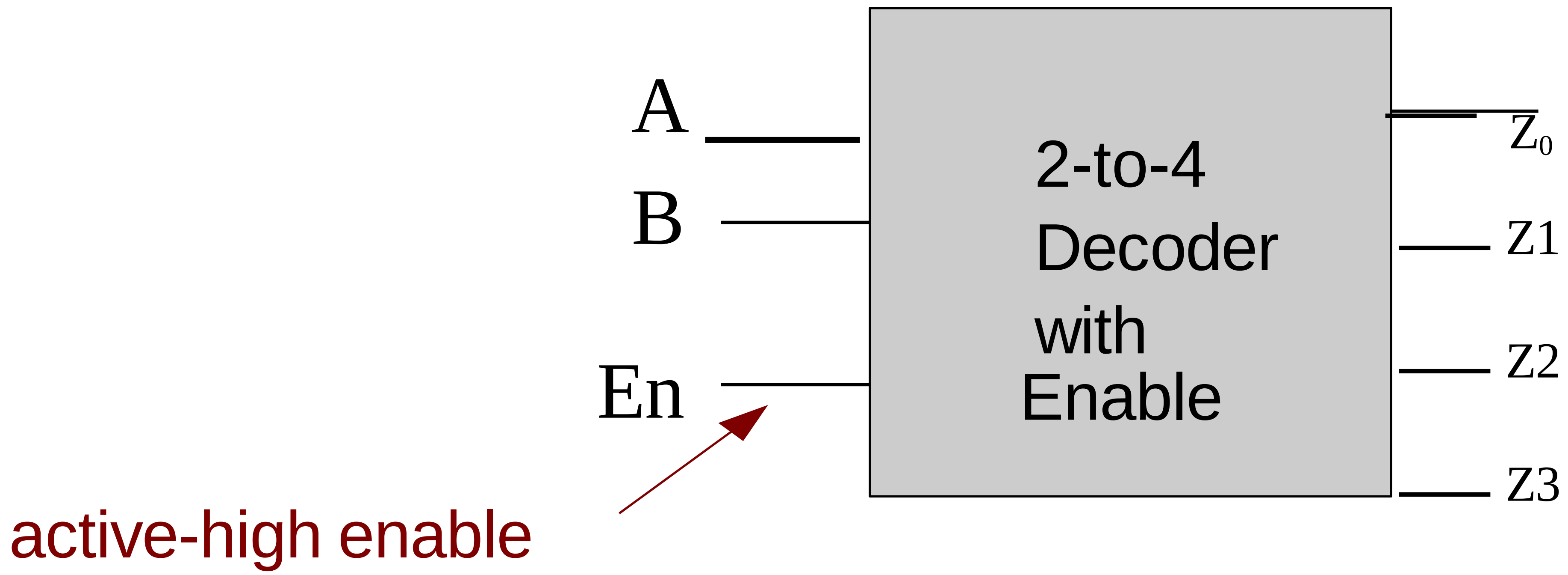
$$D_3 = A_1 \cdot A_0$$

DECODERS



a	b	c	y_0	y_1	y_2	y_3	y_4	y_5	y_6	y_7
0	0	0	1	0	0	0	0	0	0	0
0	0	1	0	1	0	0	0	0	0	0
0	1	0	0	0	1	0	0	0	0	0
0	1	1	0	0	0	1	0	0	0	0
1	0	0	0	0	0	0	1	0	0	0
1	0	1	0	0	0	0	0	1	0	0
1	1	0	0	0	0	0	0	0	1	0
1	1	1	0	0	0	0	0	0	0	1

Decoderwith Enable

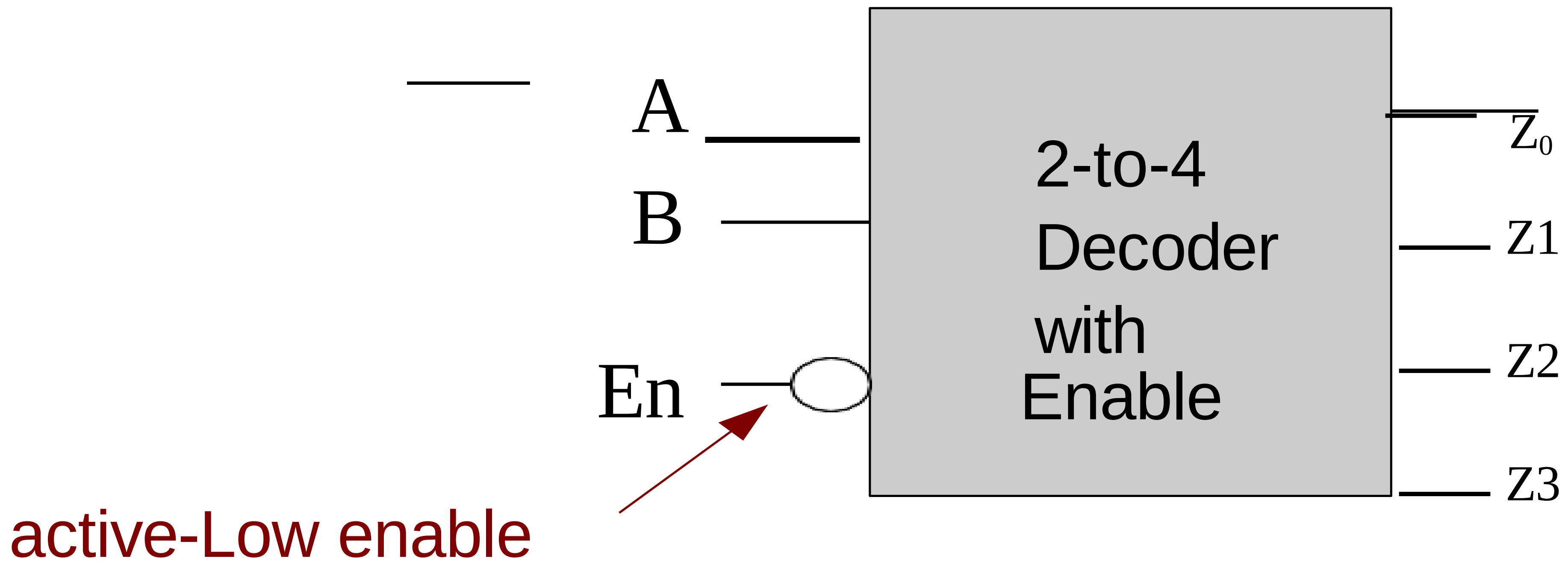


En	A	B	Z_0	Z_1	Z_2	Z_3
1	0	0	1	0	0	0
1	0	1	0	1	0	0
1	1	0	0	0	1	0
1	1	1	0	0	0	1
0	x	x	0	0	0	0

enabled

disabled

Decoderwith Enable



enabled

disabled

En	A	B	Z_0	Z_1	Z_2	Z_3
0	0	0	1	0	0	0
0	0	1	0	1	0	0
0	1	0	0	0	1	0
0	1	1	0	0	0	1
1	x	x	0	0	0	0

WHY ENCODERS?

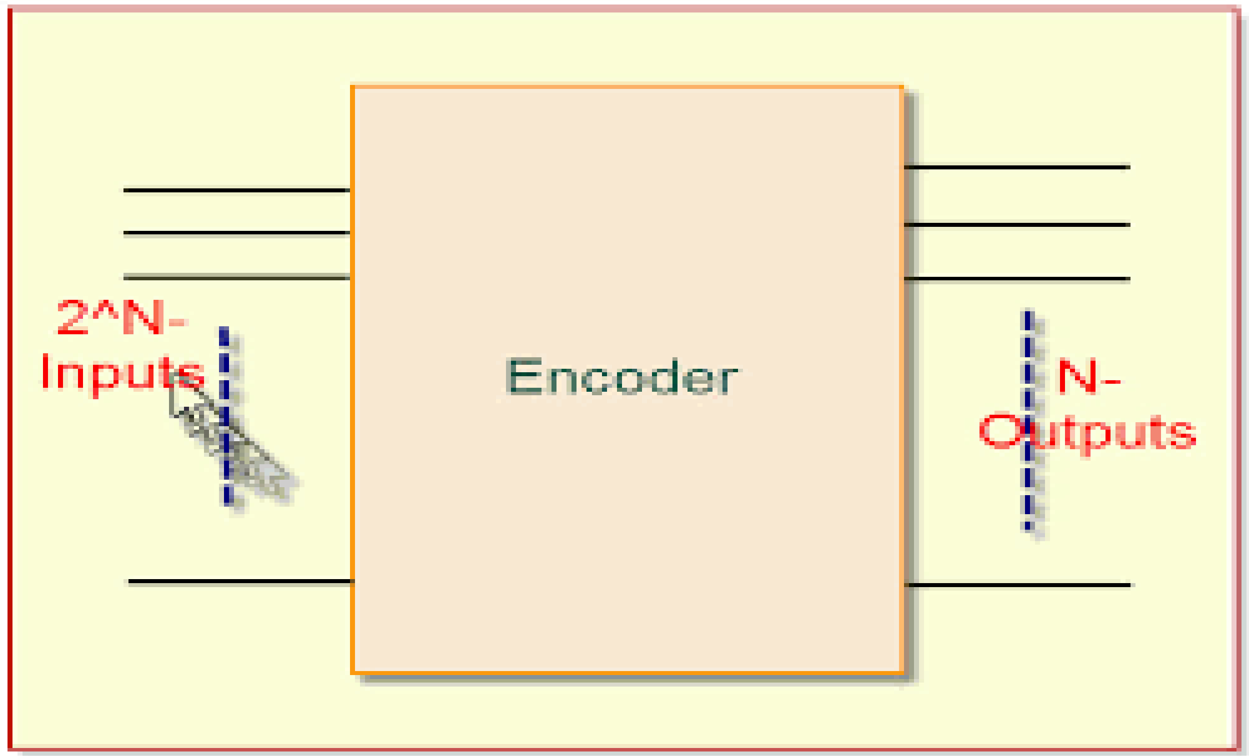
An encoder has

- 2^n inputs
- n outputs

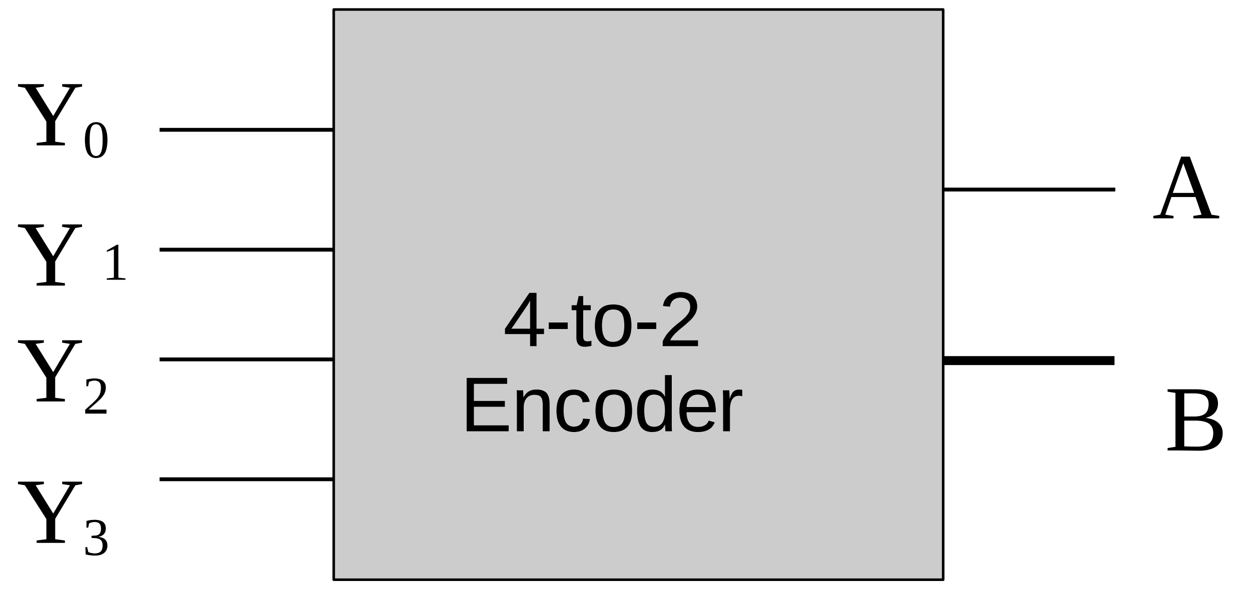
Outputs the binary value of the selected (or active) input.

Performs the inverse operation of a decoder. Issues

- What if more than one input is active?
- What if no inputs are active?

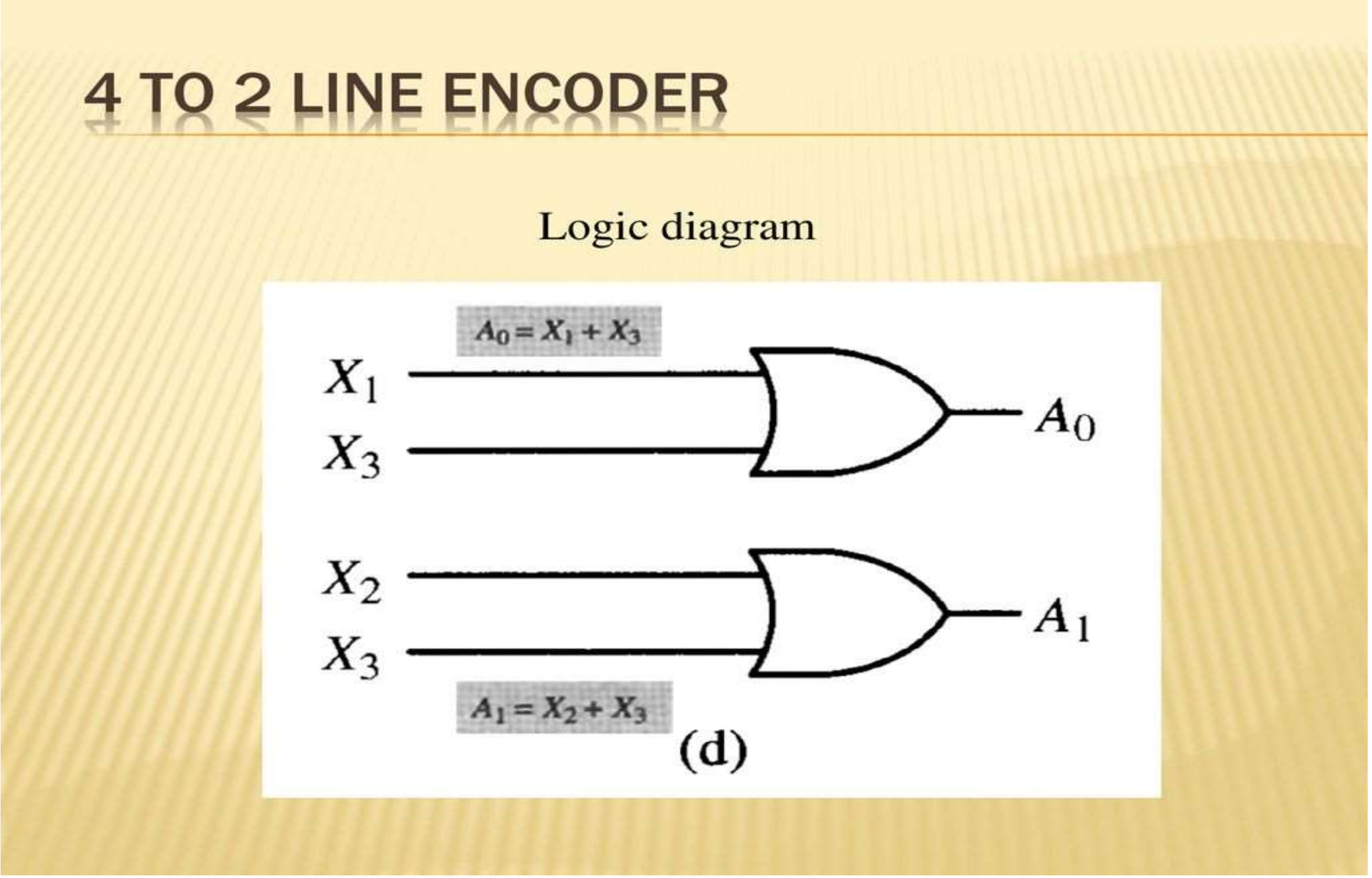


Encoders



Y_0	Y_1	Y_2	Y_3	A	B
1	0	0 10	0	0	0
0	1	0	0	0	1
0	0	1	0	1	0
0	0	0	1	1	1

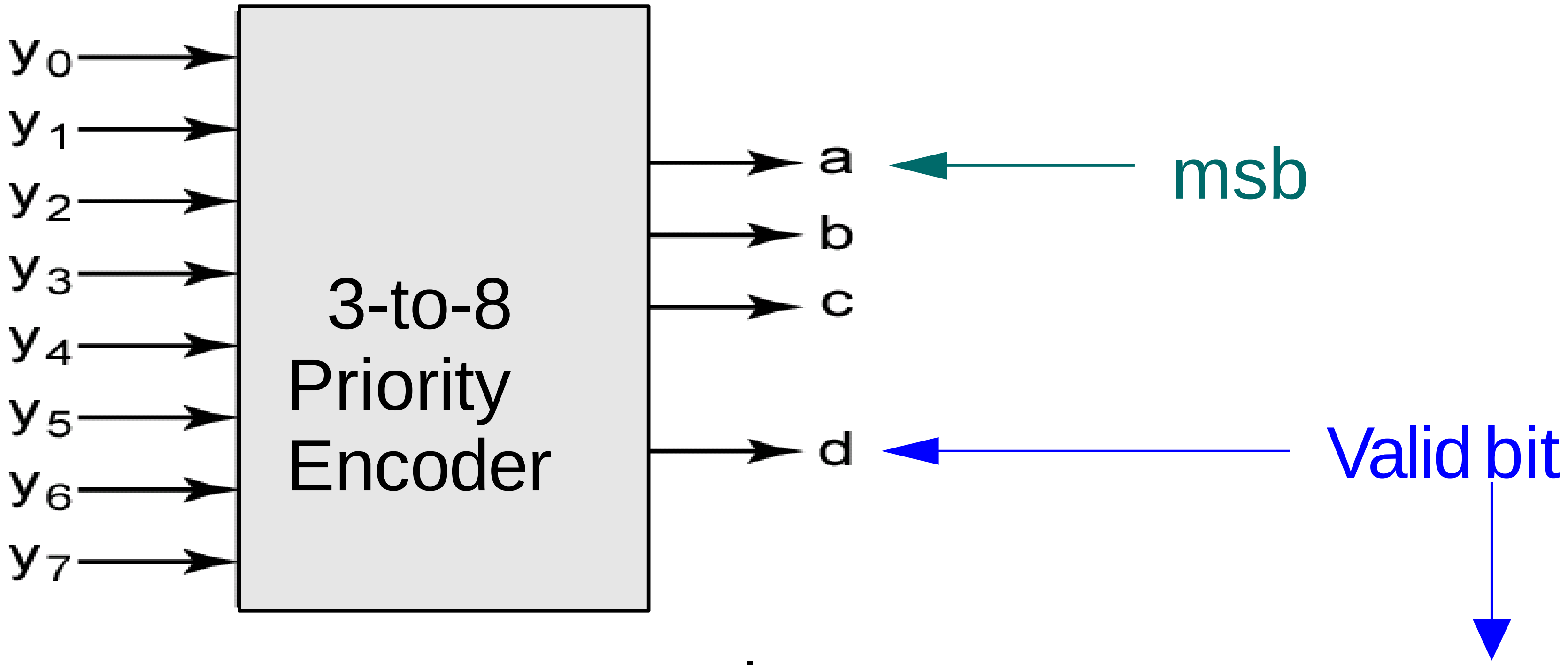
Encoders


4 TO 2 LINE ENCODER
Logic diagram
$A_0 = X_1 + X_3$
X_1
X_3
A_0
X_2
X_3
A_1
$A_1 = X_2 + X_3$
(d)

Priority Encoders

- If more than one input is active, the higher-order input has priority over the lower-order input.
  - The higher value is encoded on the output
- A valid indicator, d, is included to indicate whether or not the output is valid.
  - Output is invalid when no inputs are active
    - $d = 0$
  - Output is valid when at least one input is active
    - $d = 1$

PriorityEncoders



y_0	y_1	y_2	y_3	y_4	y_5	y_6	y_7	a	b	c	d
0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	1
X	1	0	0	0	0	0	0	0	0	1	1
X	X	1	0	0	0	0	0	0	1	0	1
X	X	X	1	0	0	0	0	0	1	1	1
X	X	X	X	1	0	0	0	1	0	0	1
X	X	X	X	X	1	0	0	1	0	1	1
X	X	X	X	X	X	1	0	1	1	0	1
X	X	X	X	X	X	X	1	1	1	1	1

Using an m-output Decoder

- Use an *n*-output decoder to realize a logic circuit for a function with *n* minterms.
- Each minterm of the function can be mapped to an output of the decoder.
- For each row in the truth table, for the function, where the output is 1, sum (or ò ó the corresponding outputs of the decoder.

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2

- That is, for each minterm in the minterm expansion of the function, OR the corresponding outputs of the decoder.

Leave remaining outputs of the decoder unconnected.

Using an m-output Decoder

Example

- Using a 3-to-8 decoder, design a logic circuit to realize the following Boolean function

- $F(A,B,C) = \Sigma m(2, 3, 5, 6, 7)$

Using an m-output Decoder

Example

‡ Using a 2-to-2 decoder, design a logic circuit to realize the following Boolean function

$$F(A,B,C) = \Sigma m(0, 1, 4, 6, 7)$$

ASSESSMENT

1. What is a Encoder?
2. Device which converts an input device state into a binary representation of ones or zeros is termed as
   1. **Encoder**
   2. Decoder
   3. Multiplexer
   4. Data selector
3. A decoder converts n inputs to __________ outputs.(2^n)
4. ------------------are building blocks of encoders.(Ans- OR gate)
5. Draw the block diagram of 2x4 decoder.

THANK YOU