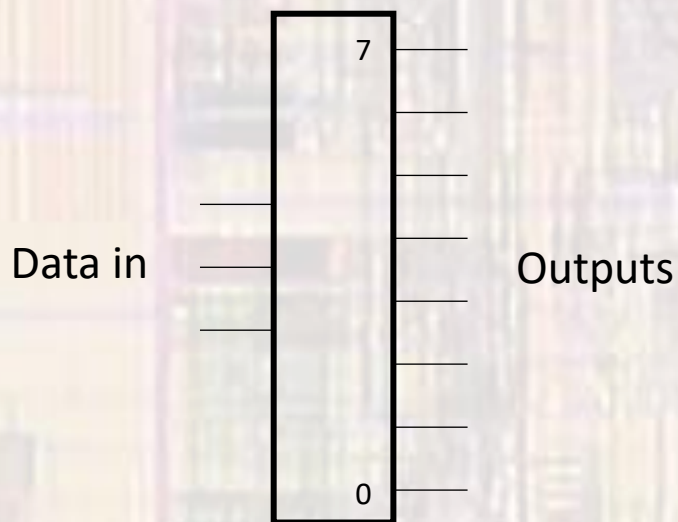# Decoders

Last updated 10/31/24

Decoders

- A decoder sets one of many outputs to 1 based on the inputs
  - N data outputs – typically a power of 2
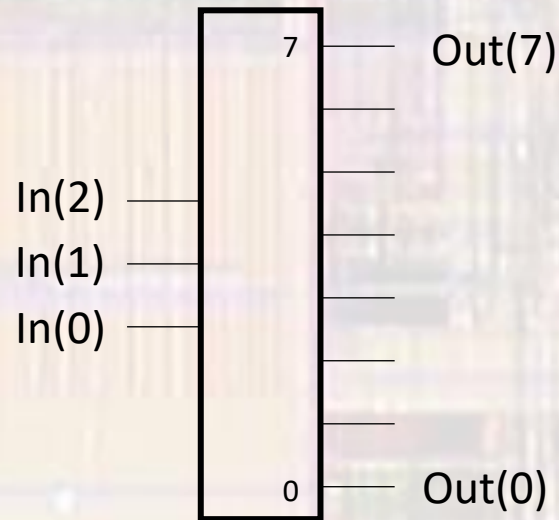 - D data inputs – $\log_2(N)$
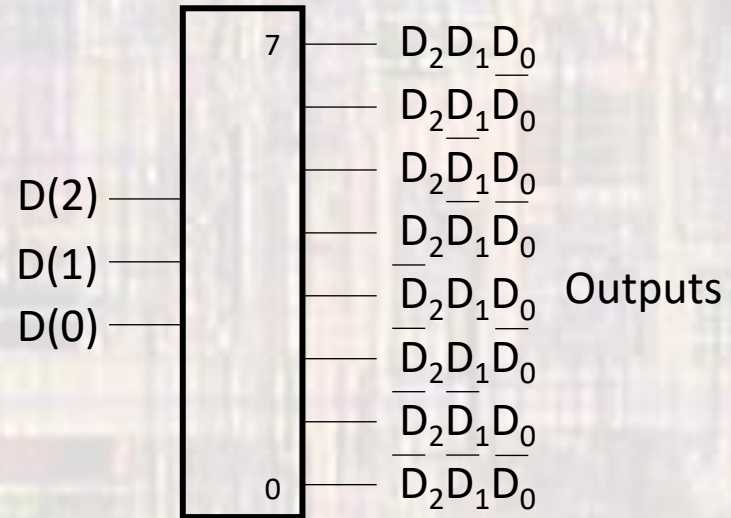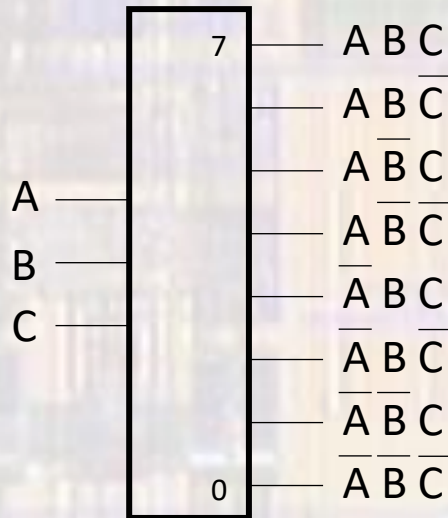 - D:N Decoder

N = 8

D = 3

Data in

7

0

Outputs

Decoders

- A closer look

Decoders

- A closer look

Left decoder (inputs A, B, C), outputs 7 → 0:

$$A\,B\,C$$
$$A\,B\,\overline{C}$$
$$A\,\overline{B}\,C$$
$$A\,\overline{B}\,\overline{C}$$
$$\overline{A}\,B\,C$$
$$\overline{A}\,B\,\overline{C}$$
$$\overline{A}\,\overline{B}\,C$$
$$\overline{A}\,\overline{B}\,\overline{C}$$

Right decoder (inputs D(2), D(1), D(0)), outputs 7 → 0:

$$D_2 D_1 D_0$$
$$D_2 D_1 \overline{D_0}$$
$$D_2 \overline{D_1} D_0$$
$$D_2 \overline{D_1}\,\overline{D_0}$$
$$\overline{D_2} D_1 D_0$$
$$\overline{D_2} D_1 \overline{D_0}$$
$$\overline{D_2}\,\overline{D_1} D_0$$
$$\overline{D_2}\,\overline{D_1}\,\overline{D_0}$$

Outputs

Only one output high

Decoders

- ## Implementation
  - ### Direct Synthesis

$$Out(3) = D1\ D0$$
$$Out(2) = D1\ \overline{D0}$$
$$Out(1) = \overline{D1}\ D0$$
$$Out(0) = \overline{D1}\ \overline{D0}$$

D(1)   D(0)

Out(3)

Out(2)

Out(1)

Out(0)

Only one output high