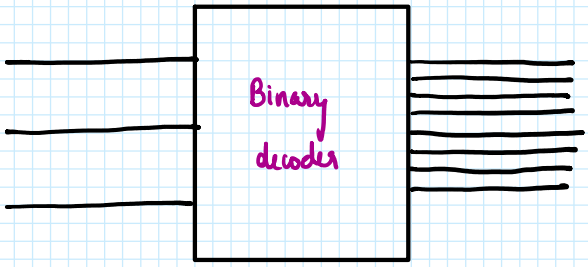
4. Combinational: Decoders, Encoders, Comparators

26 August 2024 08:54

DECODERS

n inputs ⟶ 2^n outputs : no select signal and no demarcation of control & data signal

Data signal itself is the control signal



ENCODERS

Opposite of decoders

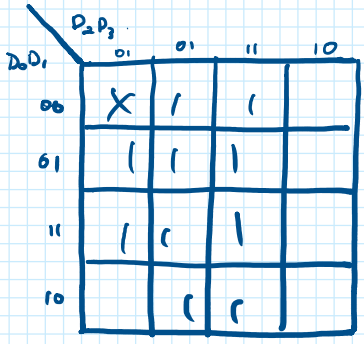
2^n inputs ⟶ n outputs

8:3 ⟶ octal to binary

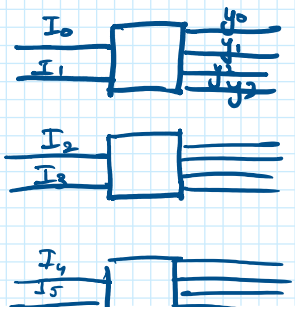
- At any given time, only one input line is at 1

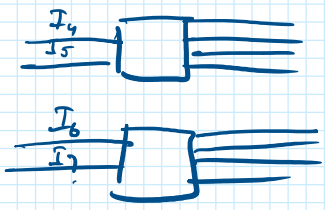
Priority encoder

If more than one input line is high, the higher input is given priority to get output.



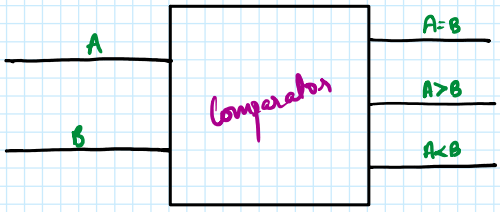
Construct 4:16 line decoder with 5 2:4 line decoders with enable.





4-Bit Magnitude Comparator

Say $A = A_3A_2A_1A_0$
$B = B_3B_2B_1B_0$
} 4 bit binary numbers



$A=B \Rightarrow \overset{x_3}{A_3=B_3}, \overset{x_2}{A_2=B_2}, \overset{x_1}{A_1=B_1}, \overset{x_0}{A_0=B_0}$

$\Rightarrow (\overline{A_3B_3' + A_3'B_3})(---)(--)(--)$

$A>B \Rightarrow A_3 > B_3$

$A_3=B_3,\ A_2>B_2$

$A_3=B_3,\ A_2=B_2,\ A_1>B_1$

$''\quad\quad''\quad\quad A_1=B_1,\ A_0>B_0$

$A>B \Rightarrow A_3B_3' + x_3 \cdot A_2B_2' + x_3x_2A_1B_1' + x_3x_2x_1A_0B_0'$

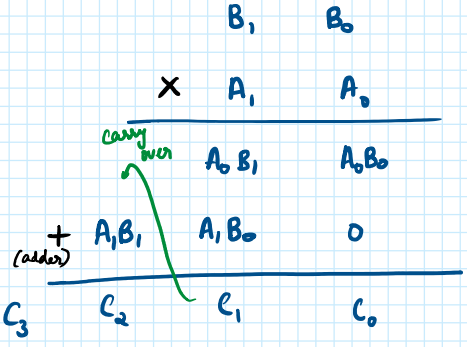
X	Y	XOR	XNOR
0	0	0	1
0	1	1	0
1	0	1	0
1	1	0	1

$X=Y$

XNOR → $\overline{X'Y + XY'}$

2 Bit by 2 Bit Binary Multiplier

Say $A = A_1A_0$
$B = B_1B_0$



4 Bit by 3 Bit Binary Multiplier

Let $A = A_2 A_1 A_0$

$B = B_3 B_2 B_1 B_0$

$$
\begin{array}{cccccccc}
 & & & A_2 & A_1 & A_0 & & \\
\times & & B_3 & B_2 & B_1 & B_0 & & \\
\hline
 & & & A_2B_0 & A_1B_0 & A_0B_0 & & \\
 & & A_2B_1 & A_1B_1 & A_0B_1 & & & \\
 & A_2B_2 & A_1B_2 & A_0B_2 & & & & \\
+ & A_2B_3 & A_1B_3 & A_0B_3 & & & & \\
\hline
C_6 & C_5 & C_4 & C_3 & C_2 & C_1 & C_0 &
\end{array}
$$

Four Bit Adder Substractor (w/ Overflow Detection)

Let $A = A_3 A_2 A_1 A_0$

$B = B_3 B_2 B_1 B_0$

Can perform either $A+B$ or $A-B$ $(A+(-B))$

$-B$ = 2's complement of $B = \overline{B} + 1$

TWOS COMPLEMENT NONSENSE

BCD Adder (Decimal Adder)