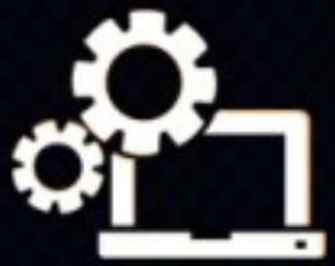
CS & IT ENGINEERING

DIGITAL LOGIC

Combinational Circuit



Lecture No. 2

By- CHANDAN SIR

01 MULTIPLEXER

02 QUESTION PRACTICE

03 DISCUSSION

COMPARATOR

DESIGNING OF COMBINATIONAL CIRCUIT

2. Design a two-Bit comparator?

Step 1.

COMPARATOR

DESIGNING OF COMBINATIONAL CIRCUIT

Step 2. Truth table

	A		B		A>B	A<B	A=B
	A_1	A_0	B_1	B_0	x	y	z
0	0	0	0	0	0	0	1
1	0	0	0	1	0	1	0
2	0	0	1	0	0	1	0
3	0	0	1	1	0	1	0
4	0	1	0	0	1	0	0
5	0	1	0	1	0	0	1
6	0	1	1	0	0	1	0
7	0	1	1	1	0	1	0
8	1	0	0	0	1	0	0
9	1	0	0	1	1	0	0
10	1	0	1	0	0	0	1
11	1	0	1	1	0	1	0
12	1	1	0	0	1	0	0
13	1	1	0	1	1	0	0
14	1	1	1	0	1	0	0
15	1	1	1	1	0	0	1

COMPARATOR

DESIGNING OF COMBINATIONAL CIRCUIT

Step 3. Logical expression

$X(A > B) = \Sigma m(4, 8, 9, 12, 13, 14)$

$Y(A < B) = \Sigma m(1, 2, 3, 6, 7, 11)$

$Z(A = B) = \Sigma m(0, 5, 10, 15)$

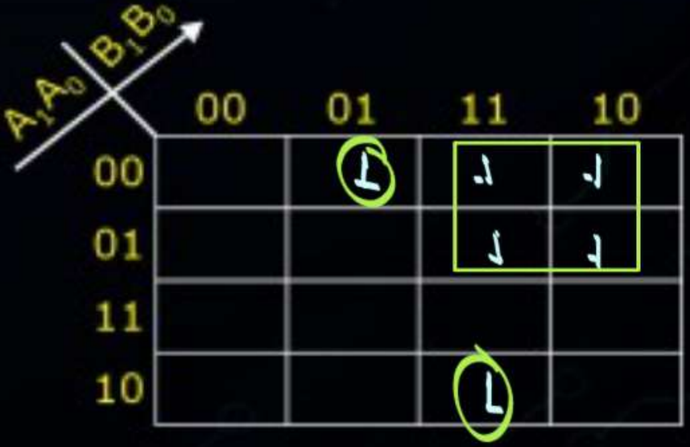
COMPARATOR

DESIGNING OF COMBINATIONAL CIRCUIT

Step 4. Minimization

For X

For Y



Semiminimized

$$X(A>B) = A_1\overline{B}_1 + \overline{A}_1 A_0 \overline{B}_1\overline{B}_0 + A_1 A_0 B_1 \overline{B}_0$$

$$= A_1\overline{B}_1 + (\overline{A}_1\overline{B}_1 + A_1 B_1) A_0 \overline{B}_0$$

$$= A_1\overline{B}_1 + (A_1 \odot B_1) A_0 \overline{B}_0$$

MINIMIZED

$$X(A>B) = A_1\overline{B}_1 + A_0\overline{B}_1\overline{B}_0 + A_1 A_0 \overline{B}_0$$

$$= A_1\overline{B}_1 + (A_1 + \overline{B}_1) A_0 \overline{B}_0$$

Semiminimized Expression

$$Y(A<B) = \overline{A}_1 B_1 + \overline{A}_1 \overline{A}_0 \overline{B}_1 B_0 + A_1 \overline{A}_0 B_1 B_0$$

$$= \overline{A}_1 B_1 + (\overline{A}_1 \overline{B}_1 + A_1 B_1)\overline{A}_0 B_0$$

$$= \overline{A}_1 B_1 + (A_1 \odot B_1)\overline{A}_0 B_0$$

Minimized

$$Y(A<B) = \overline{A}_1 B_1 + (\overline{A}_1 + B_1)\overline{A}_0 B_0$$

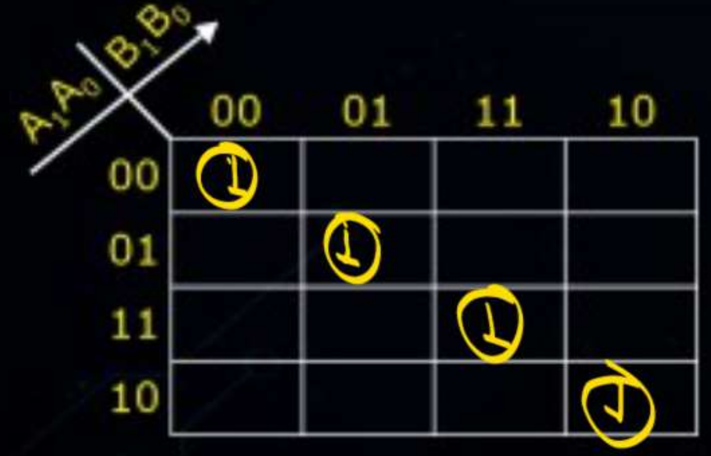
COMPARATOR

DESIGNING OF COMBINATIONAL CIRCUIT

Step 4. Minimization

$$Z(A=B) = (A_1 \odot B_1) \cdot (A_0 \odot B_0)$$

For Z



Step 5 Hardware Implement

COMPARATOR

FOR ONE BIT COMPARATOR

Total condition = 4

Equal condition = 2

Unequal condition = 2

Greater = Less condition = 1

COMPARATOR

FOR TWO BIT COMPARATOR

Total condition = 16 ✓

Equal condition = 4 ✓

Unequal condition = 12 ✓

Greater = Less condition = 6 ✓

COMPARATOR

FOR THREE BIT COMPARATOR

Total condition = 64

Equal condition = 8

Unequal condition = 56

Greater = Less condition = 28

T.C = 2^{2n}

Equal = 2^n

Unequal = $2^{2n} - 2^n$

Greater = Less = $\frac{2^{2n} - 2^n}{2}$

COMPARATOR

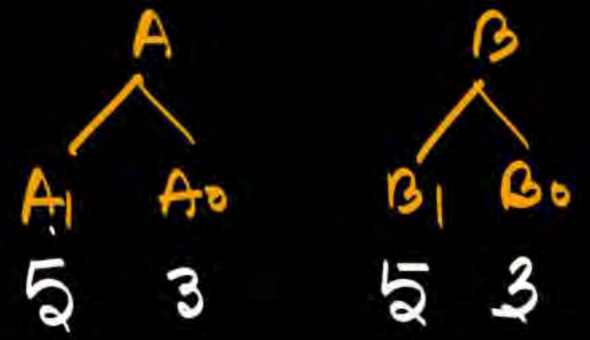
'N' BIT COMPARATOR

Total condition = 2^{2n}

Equal condition = 2^{n}

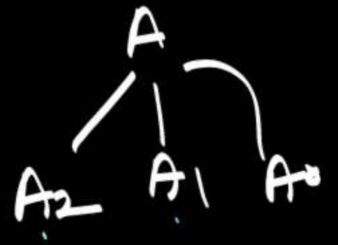
Unequal condition = $2^{2n} - 2^{n}$

Greater = Less condition = $(2^{2n} - 2^{n})/2$



$$
\begin{cases}
X(A>B) = A_1\overline{B_1} + (A_1 \odot B_1)\cdot A_0\overline{B_0} \\
Y(A<B) = \overline{A_1}B_1 + (A_1 \odot B_1)\cdot \overline{A_0}B_0 \\
Z(A=B) = (A_1 \odot B_1)\cdot(A_0 \odot B_0)
\end{cases}
$$

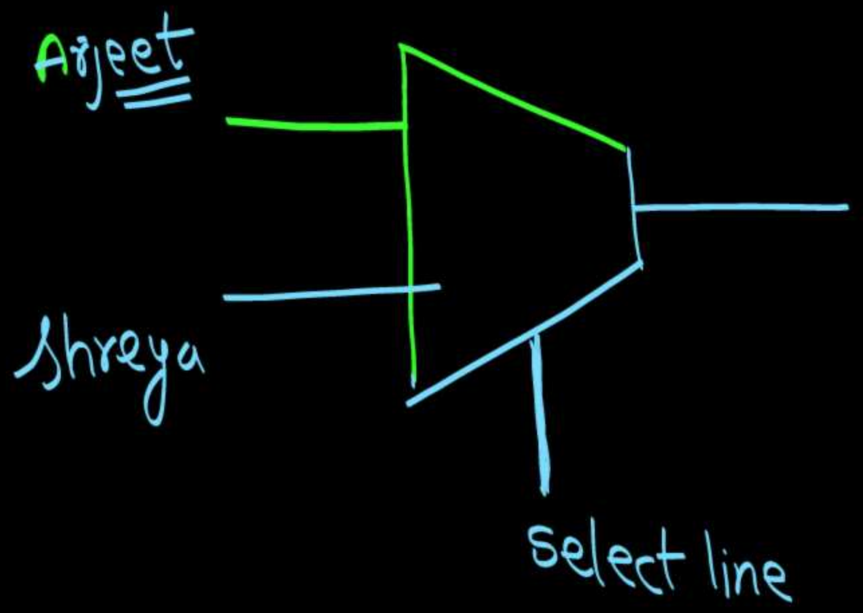
Z10

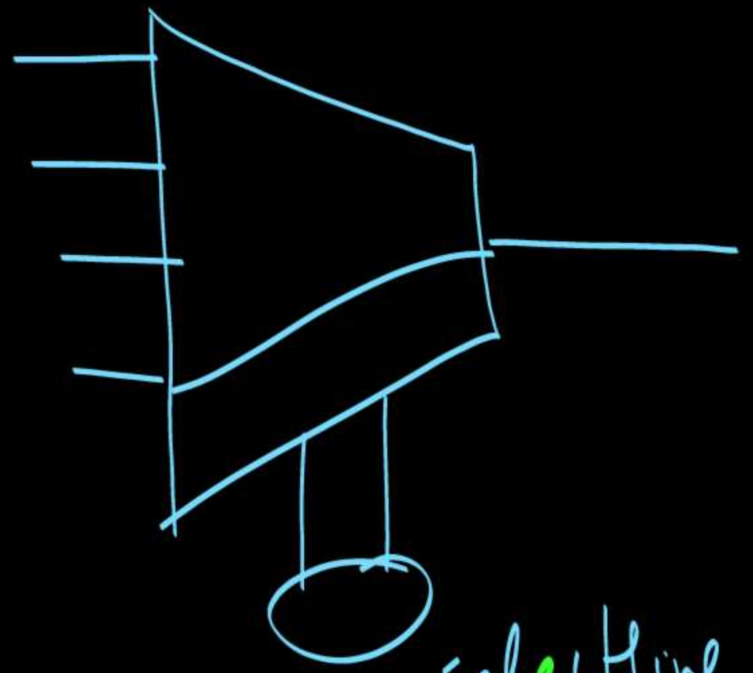


$$X(A>B) = A_2\overline{B_2} + (A_2 \odot B_2)A_1\overline{B_1} + (A_2 \odot B_2)\cdot(A_1 \odot B_1)A_0\overline{B_0}$$

$$Y(A<B) = \overline{A_2}B_2 + (A_2 \odot B_2)\overline{A_1}B_1 + (A_2 \odot B_2)(A_1 \odot B_1)\overline{A_0}B_0$$

$$Z(A=B) = (A_2 \odot B_2)\cdot(A_1 \odot B_1)\cdot(A_0 \odot B_0)$$

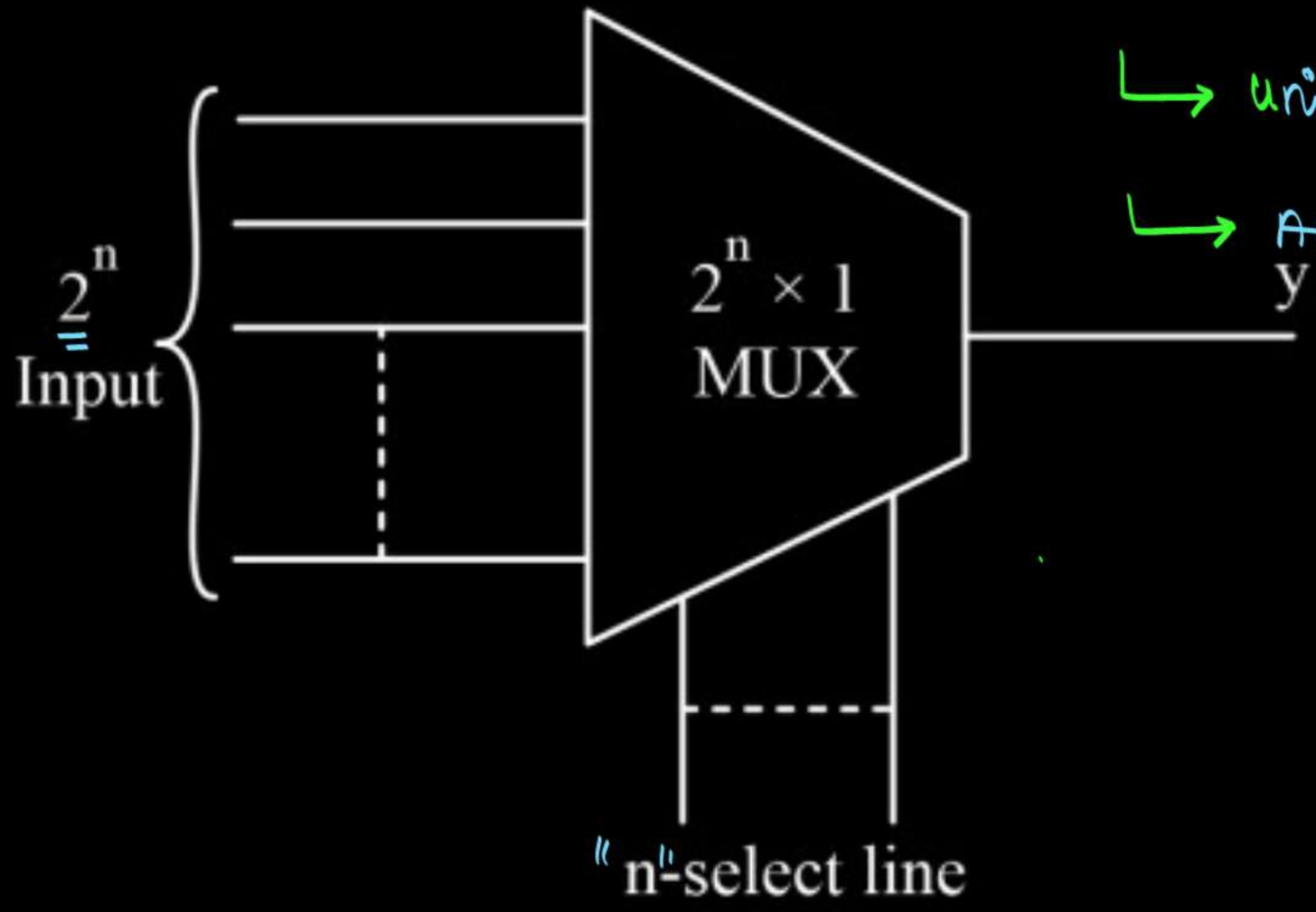

Arjeet
Shreya
select line


selecting

MULTIPLEXER

200%

- 2^n to 1 Converter
- universal Logic
- AND-OR Logic




THANK YOU GW
SOLDIERS !