

Unit 12: Combinational Logic Circuits

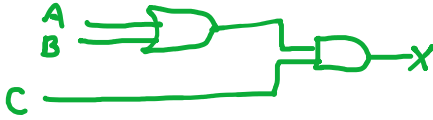
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Combinational Logic circuits

↳ Logic circuits made up of different logic gates

eg.



↳ Very helpful in complex situations

Forms of display

↳ Circuit Diagram

↳ Boolean Expression

↳ Truth tables

Truth tables

↳ No. of rows = 2^n

↳ n = no. of inputs

↳ Deriving Boolean Expression

↳ ① Find rows with output 1

② Write AND expression for them

③ OR all the expressions

eg:

A	B	C	X
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1

→ $\bar{A}\bar{B}\bar{C}$
 $\bar{A}B\bar{C}$
 $\bar{A}BC$

$$\text{SOP} = \bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C} + \bar{A}BC$$

↳ Sum-Of-Product equation

↳ Consists of multiple AND statements OR'd together

↳ Deriving Diagram from SOP

↳ Draw logic for each and

↳ Add inverter for each $\bar{}$

- Connect to AND
- Connect all ANDs to OR
- Connect Output to OR

K-Map

↳ ① Draw empty K-Map

② Fill in K-Map from Truth Table

A \ BC	00	01	11	10
0	X	X	X	X
1	X	X	X	X

Fill Xs from truth table

③ Loop is in the K-Map

- Only in groups of 4, 2, 1
- All 1s need to be looped at least once
- Ends are connected
- Less loops are better.

④ Get Boolean expression from Loop

- AND each term in loop, OR all ANDs. ! Only include Constant !
- Use Boolean Laws to simplify

↳ One Variable → Two Variables

$$\rightarrow \bar{\bar{A}} = A$$

$$\rightarrow A + 0 = A$$

$$\rightarrow A + 1 = 1$$

$$\rightarrow A + A = A$$

$$\rightarrow A + \bar{A} = 1$$

$$\rightarrow A \cdot 0 = 0$$

$$\rightarrow A \cdot 1 = A$$

$$\rightarrow A \cdot A = A$$

$$\rightarrow A \cdot \bar{A} = 0$$

$$\rightarrow A + B = B + A$$

$$A \cdot B = B \cdot A$$

$$A + (B + C) = C + (A + B)$$

$$A \cdot (B \cdot C) = C \cdot (A \cdot B)$$

$$A \cdot (B + C) = AB + AC$$

$$\overline{A + B} = \bar{A} \cdot \bar{B}$$

$$\overline{A \cdot B} = \bar{A} + \bar{B}$$