

Discussion Session on 4/12/19

Po-Ya Hsu

Outline

- Consensus Theorem
- Shannon's Expansion
- Combinational Logic

Consensus Theorem – How To Use

- Sum of Product Form:

$$AB + B'C + AC$$

- Product of Sum Form:

Consensus Theorem – How To Use

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$$AB + B'C + AC$$

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Consensus Theorem – How To Use

- Sum of Product Form:

$$AB + B'C + AC$$

- Product of Sum Form:

$$(A + B) (B' + C) (A + C)$$

Consensus Theorem – How To Use

- Sum of Product Form:

$$AB + B'C + AC$$

- Product of Sum Form:

$$(A + B)(B' + C)(A + C)$$

Consensus Theorem – How To Use

- Sum of Product Form:

$$AB + B'C + AC$$

- Product of Sum Form:

$$(A + B)(B' + C)(A + C)$$

Consensus Theorem – Practice:

Reduce the two expressions

- Sum of Product Form:

$$A'BC + AB'C + ACD + BCD$$

- Product of Sum Form:

$$(A + B' + C) (B' + C + D) (A + C' + D) (A + B' + D)$$

Shannon's Expansion

- Sum of Product Form

- $F(x,y) = x F(1,y) + x'F(0,y)$

- Product of Sum Form

- $F(x,y) = (x + F(0,y)) (x' + F(1,y))$

Shannon's Expansion

- Sum of Product Form

- $f(x, y, z) = xyz + x'y + z'y$

- Product of Sum Form

- $F(x,y) = (x + F(0,y)) (x' + F(1,y))$

Shannon's Expansion

- Sum of Product Form

- $f(x, y, z) = xyz + x'y + z'y$
 $= x(yz + 0 + z'y) + x'(0 + y + z'y)$
 $= xy + x'y$
 $= y$

- Product of Sum Form

- $F(x, y) = (x + F(0, y)) (x' + F(1, y))$

Shannon's Expansion

- Sum of Product Form

- $F(x,y) = x F(1,y) + x'F(0,y)$

- Product of Sum Form

- $$\begin{aligned} f(x, y, z) &= (x + y + z') (x' + y' + z) (z + y) \\ &= (x + (0+y+z'))(1+y'+z)(z+y) (x' + (1+y+z'))(0+y'+z)(z+y)) \\ &= (x+(y+z')(z+y)) (x' + (y'+z)(z+y)) \\ &= (x+y) (x'+z) \end{aligned}$$

Shannon's Expansion - Practice

- Sum of Product Form

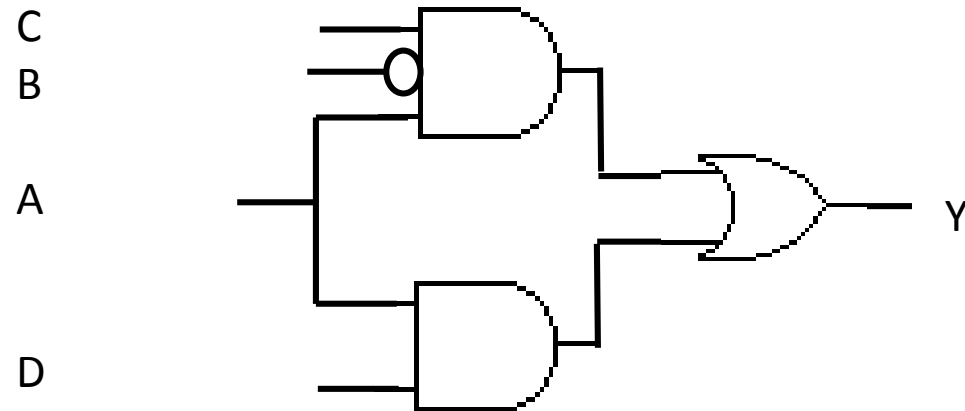
- $f(a, b, c, d) = a'd + bc'd + abc'$

- Product of Sum Form

- $F(a, b, c, d) = (a' + d)(b + c' + d)(a + b + c')$

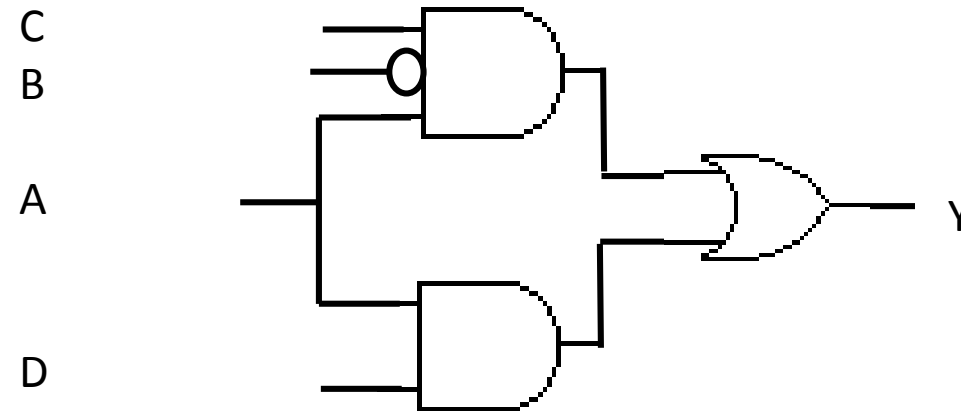
Combinational Circuits

$$Y = AB'C + AD$$



Combinational Circuits

$$Y = AB'C + AD$$



$$\#Variables = 4$$

$$\#literals = 5$$

$$\#operators = 3$$

$$\#net = \#variables + \#operators$$

$$= 4 + 3$$

$$= 7$$

$$\#pin = \#literals + 2 * \#operators - 1$$

$$= 5 + 2 * 3 - 1$$

$$= 10$$