Boolean Algebra

ELEC 311

Digital Logic and Circuits

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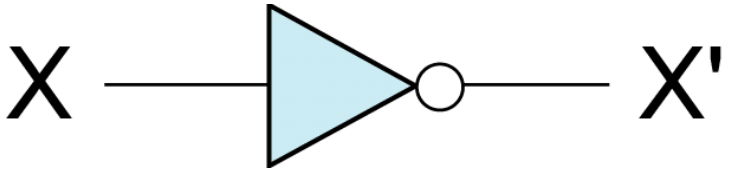
THE CITADEL
DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

Inverter (Not Gate)

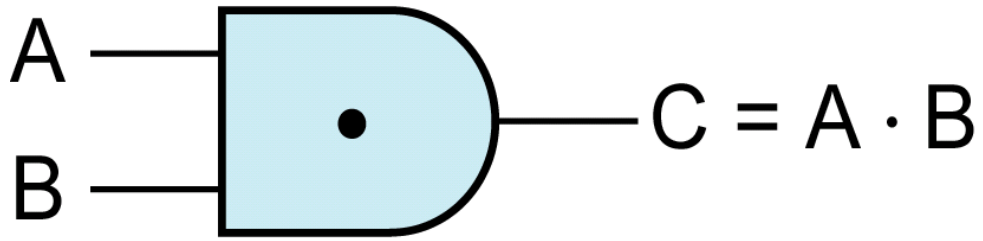
- If X = 0 then X' = 1
- If X = 1 then X' = 0



X	NOT X
0	1
1	0

AND Gate

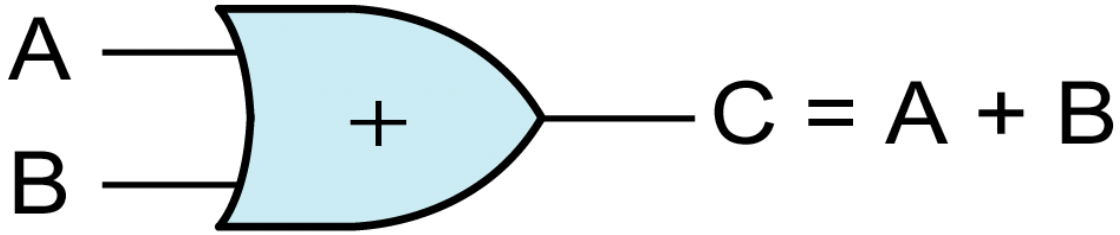
- If A = 1 and B = 1 then C = 1 (else C = 0)



A B	C = A • B
0 0	0
0 1	0
1 0	0
1 1	1

OR Gate

- If A = 1 or B = 1 then C = 1 (else C = 0)



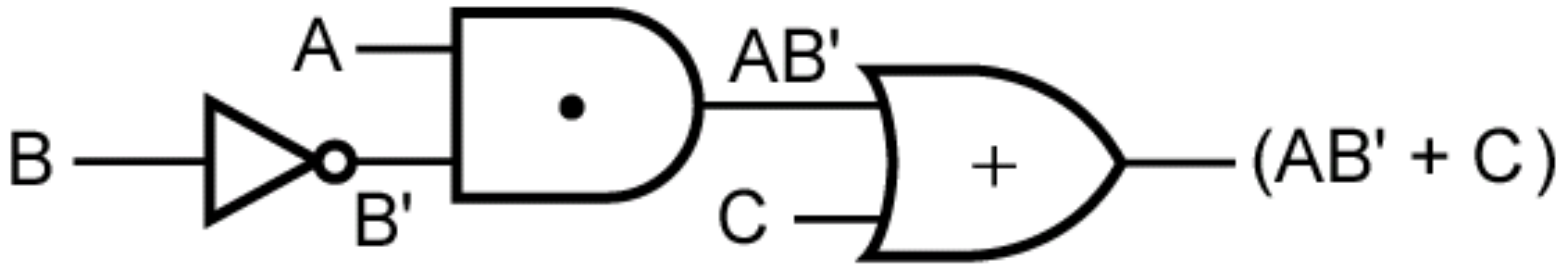
A B	C = A + B
0 0	0
0 1	1
1 0	1
1 1	1

Boolean Algebra

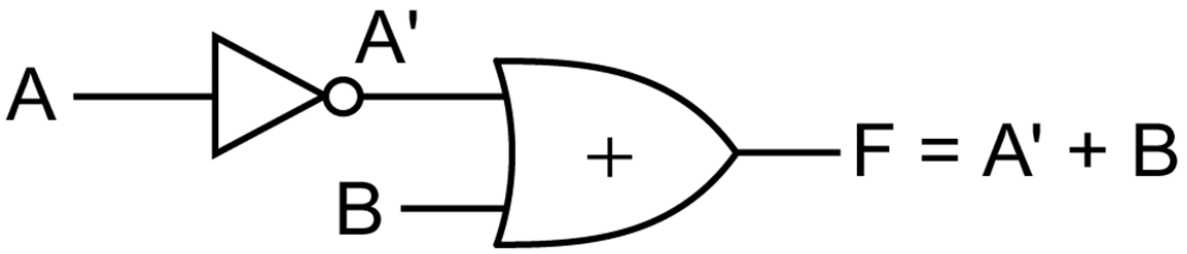
- AND Operation
  - $0 \cdot 0 = 0$
  - $0 \cdot 1 = 0$
  - $1 \cdot 0 = 0$
  - $1 \cdot 1 = 1$
- OR Operation
  - $0 + 0 = 0$
  - $0 + 1 = 1$
  - $1 + 0 = 1$
  - $1 + 1 = 1$
- NOT Operation (Complement)
  - $0' = 1$
  - $1' = 0$

Boolean Expressions

- F = AB' + C



Truth Table



A B	A′	F = A′ + B
0 0	1	1
0 1	1	1
1 0	0	0
1 1	0	1

(b)

Laws and Theorems (p.46)

Operations with 0 and 1:

1. $X + 0 = X$ **1D. $X \cdot 1 = X$**

2. $X + 1 = 1$ **2D. $X \cdot 0 = 0$**

Idempotent laws:

3. $X + X = X$ 3D. $X \cdot X = X$

Involution law:

4. $(X')' = X$

Laws of complements:

5. $X + X' = 1$ **5D. $X \cdot X' = 0$**

Laws and Theorems (p.46)

Commutative laws:

6. $X + Y = Y + X$ 6D. $XY = YX$

Associative laws:

7. $(X + Y) + Z = X + (Y + Z)$ 7D. $(XY)Z = X(YZ) = XYZ$

Distributive laws:

8. $X(Y + Z) = XY + XZ$ 8D. $X + YZ = (X + Y)(X + Z)$

DeMorgan's laws:

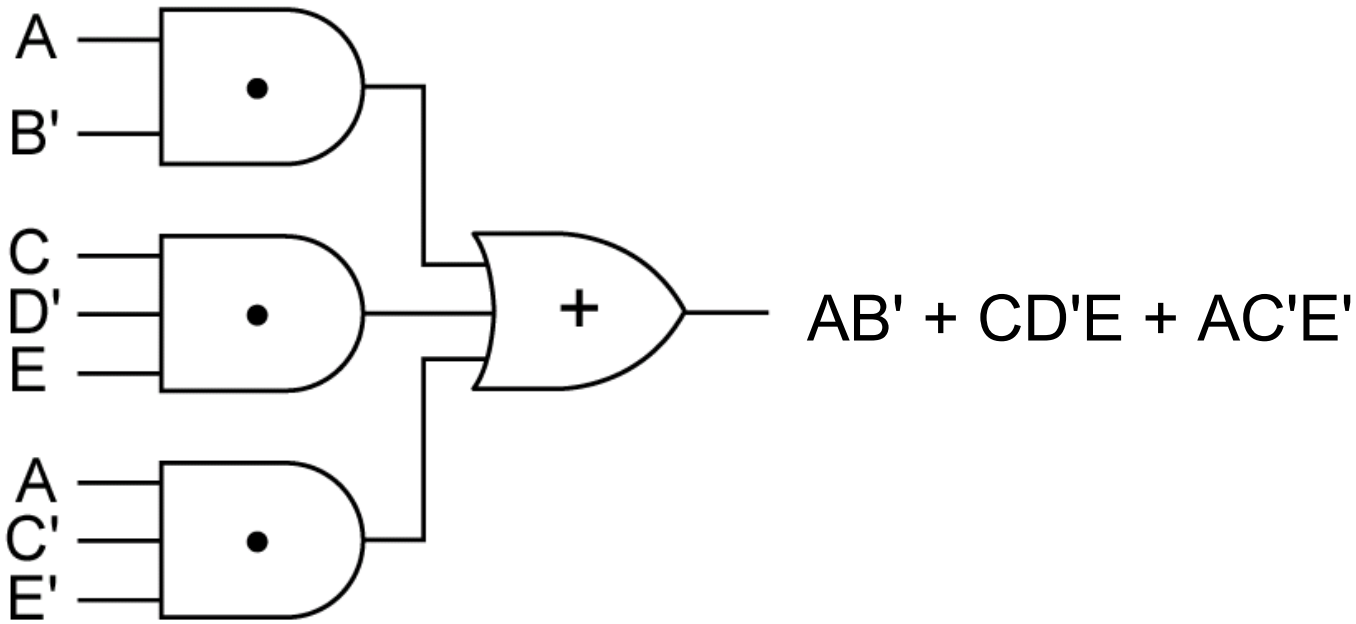
9. $(X + Y)' = X'Y'$ 12D. $(XY)' = X' + Y'$

Simplification theorems:

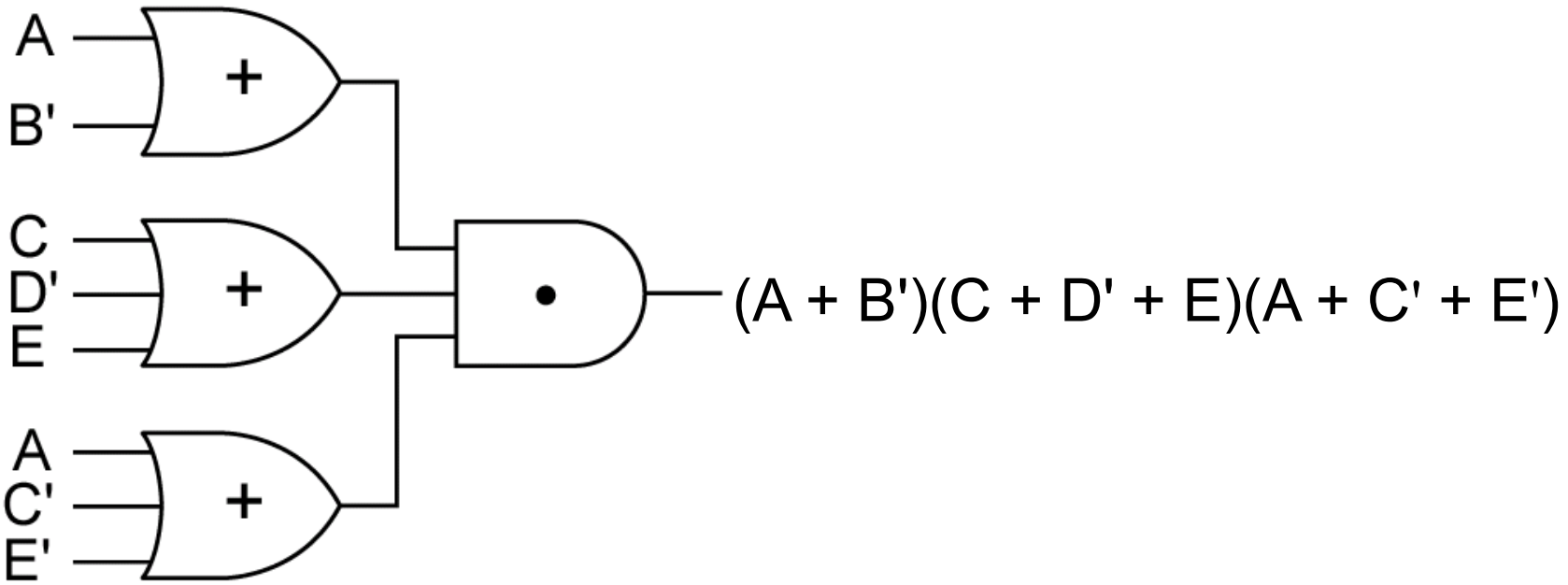
10. $XY + XY' = X$ (Adjacency Theorem)

11. $X + XY = X$

Sum of Products (SOP)



Product of Sums (POS)



Summary

- Logic Gates
- Boolean Algebra
- Truth Tables
- Laws and Theorems