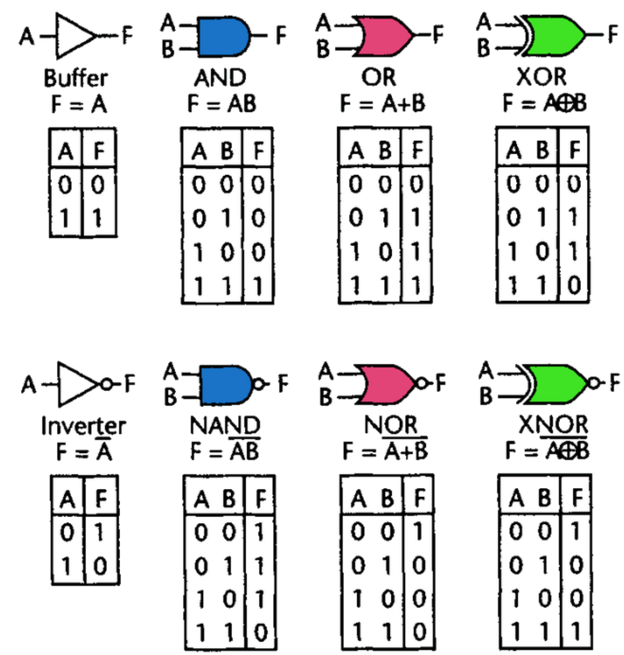
EE2000 Logic Circuit Design

Lecture 1 – Solution for Exercises



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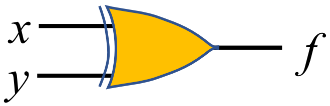
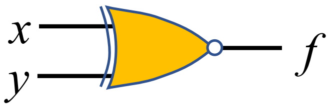
Exercises



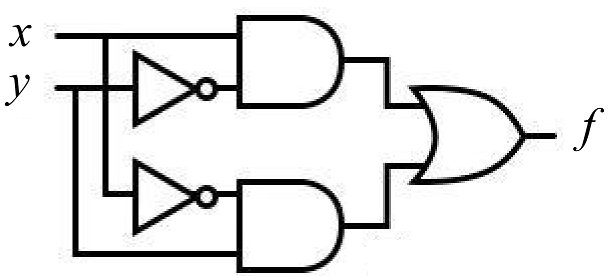


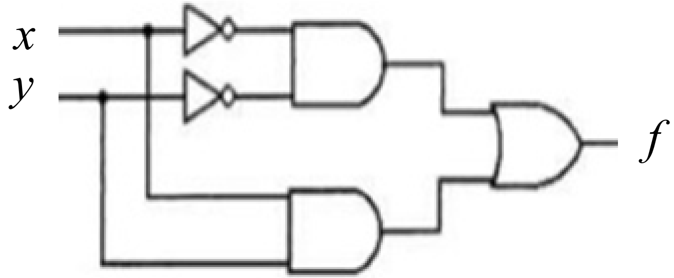
x	y	f
0	0	0
1	0	1
0	1	1
1	1	0

x	y	f
0	0	1
1	0	0
0	1	0
1	1	1

$$f = xy' + x'y$$

$$f = x'y' + xy$$

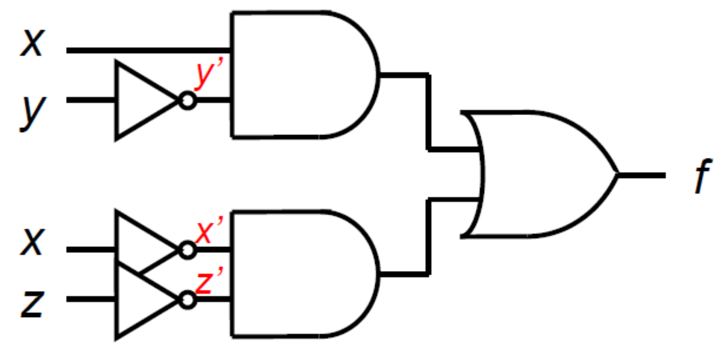




Exercises

Given the Boolean function $f(x, y, z) = xy' + x'z'$, draw the Logic Circuit and work out the truth table.

x	y	z	xy'	$x'z'$	$xy' + x'z'$
0	0	0	0	1	1
0	0	1	0	0	0
0	1	0	0	1	1
0	1	1	0	0	0
1	0	0	1	0	1
1	0	1	1	0	1
1	1	0	0	0	0
1	1	1	0	0	0



Question

- Which of the following has the same function as $x + x'y$?
  - a) $x + xy'$
  - b) $x + y$
  - c) $x' + y$
  - d) y

$$x + x'y = (x + x')(x + y) \quad \text{distributive}$$

$$= 1 \cdot (x + y) \quad \text{complement}$$

$$= x + y \quad \text{identity}$$

Exercise

- Simplify the following expression.

$$xyz' + xyz + xy'z + x'yz + x'y'z + x'y'z'$$

$$= xy(z' + z) + xy'z + x'yz + x'y'(z + z')$$ complement

$$= xy + xy'z + x'yz + x'y'$$

$$= x(y + y'z) + x'(y' + yz)$$ simplification

$$= x(y + z) + x'(y' + z)$$

$$= xy + x'y' + z(x + x')$$ complement

$$= xy + x'y' + z$$

5 literals; 3 terms

Exercise

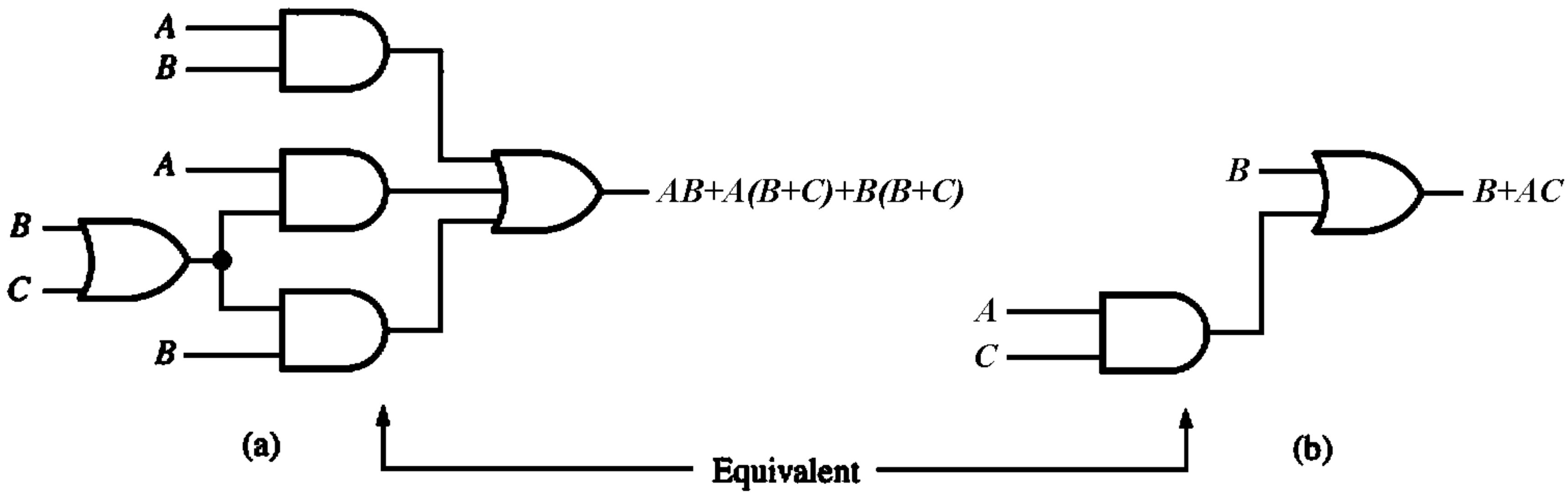
- Simplify the following expression.

$$(x+y+z)(x+y+z')(x+y'+z)(x+y'+z')$$ adjacency

$$= (x+y)(x+y') = x$$

1 literal; 1 term

Exercise



Prove that the above Circuit (a) is equivalent to Circuit (b).

Solution by Boolean Algebra Simplification

$AB + A(B + C) + B(B + C)$		
$AB + AB + AC + BB + BC$		
$AB + AB + AC + B + BC$	$BB=B$	*Idempotent*
$AB + AC + B + BC$	$AB+AB=AB$	*Idempotent*
$AB + AC + B$	$B+BC=B$	*Absorption*
$B + AC$	$AB+B=B$	*Absorption*

Exercise

$$f(w,x,y,z) = wxy' + w'y'z + wx'y' + xy'z + w'z$$

$$= wxy' + wx'y' + xy'z + w'z$$ adsorption

$$= wy' + w'z + xy'z$$ adjacency

Term 1	Term 2	Consensus Term
wy'	$w'z$	$y'z$

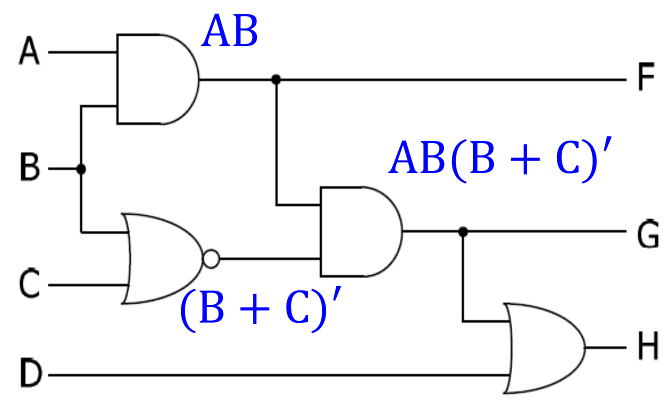
$$= wy' + w'z + xy'z + y'z$$ Add the consensus term

$$= wy' + w'z + y'z$$ adsorption

$$= wy' + w'z$$ Remove the consensus term

Exercise

1. Derive the Boolean functions to describe the operations of the logic circuit as shown.
2. Simplify the functions and draw the circuit.



$$F = AB$$

$$G = AB(B + C)'$$

$$= ABB'C' \quad \text{deMorgan}$$

$$= 0 \quad \text{Complement}$$

$$H = AB(B + C)' + D = D$$