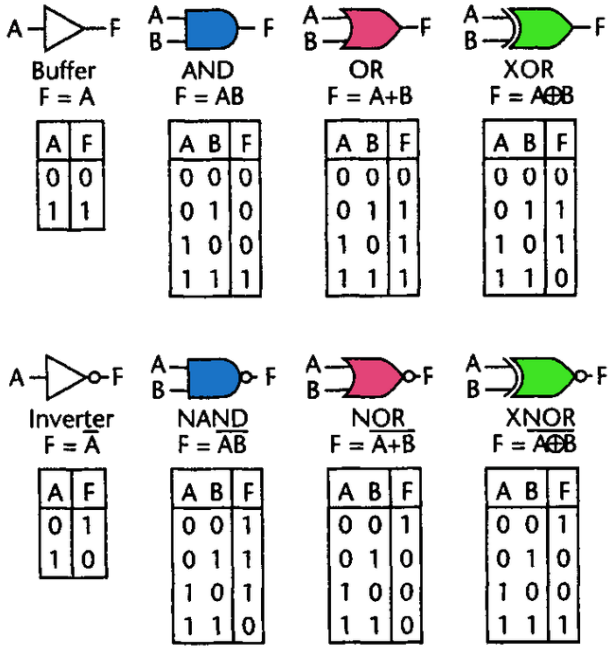
EE2000 Logic Circuit Design

Lecture 1 – Logic Function and Boolean Algebra



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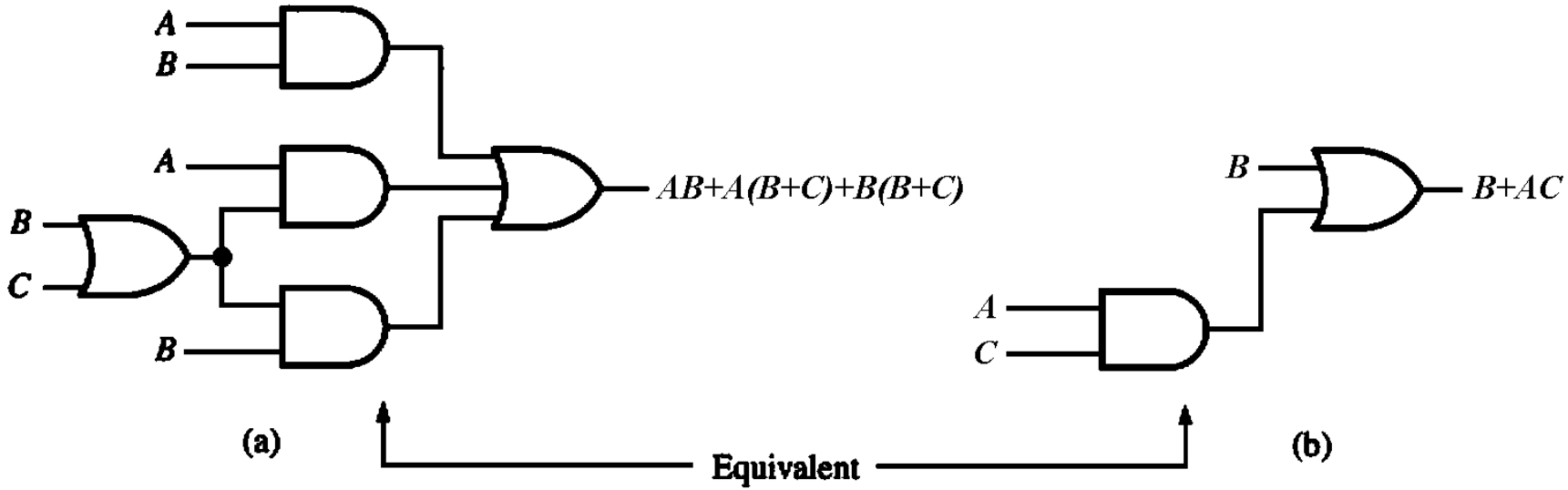
Exercise



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

Simplify the following function.

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

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'	$w'z$	$y'z$

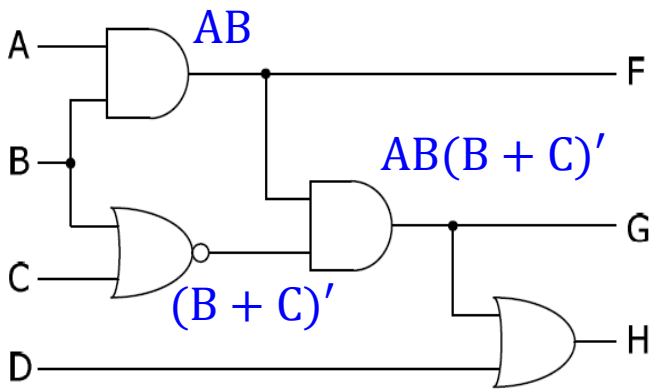
$$= wy' + w'z + xy'z + y'z$$ Add the consensus term

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



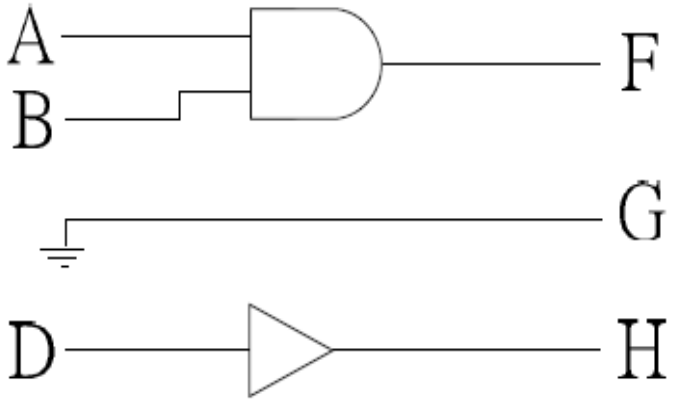
$$F = AB$$

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

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

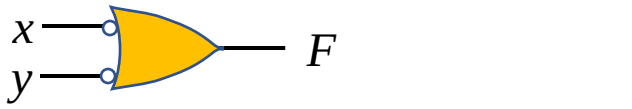
$$= 0 \quad \text{Complement}$$

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

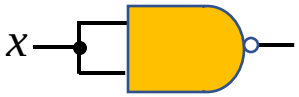


Exercise

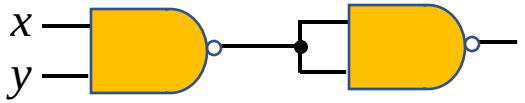
Work out the Boolean functions of the following circuits. Which standard logic gate does each of them represent?



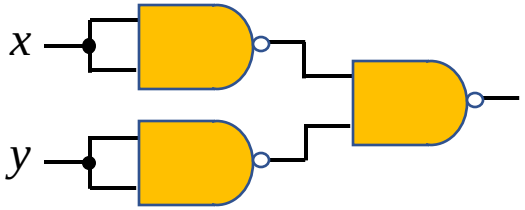
$$F = x' + y' = (xy)'$$



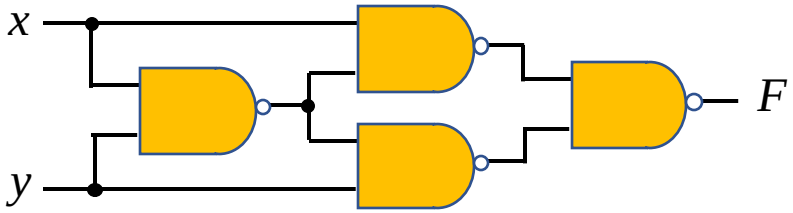
$$F = (xx)' = x'$$



$$F = [(xy)']' = xy$$



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



$$\begin{aligned} F &= \{[x(xy)']'[y(xy)']'\}' \\ &= [x(xy)']'' + [y(xy)']'' \\ &= x(xy)' + y(xy)' \\ &= x(x' + y') + y(x' + y') \\ &= xy' + yx' = x \oplus y \end{aligned}$$

Exercise

Inputs			*Output*
x	*y*	*z*	*f*(*x*, *y*, *z*)
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

$$f(x,y,z) = \sum m(1,3,6,7) = \prod M(0,2,4,5)$$

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