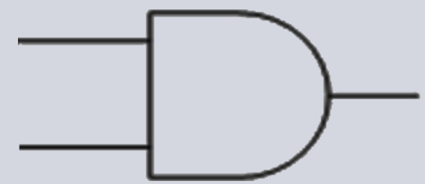
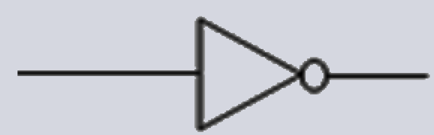
LOGIC CIRCUITS

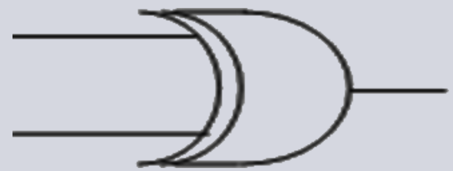
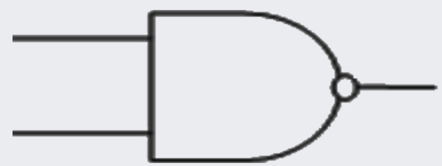
Individual homework – Cîrstea Andrei Daniel

THEORY ASPECTS

Basic Gates

Gate	Symbol
AND	
OR	
NOT	

Derived Gates

Gate	Symbol	Boolean Function
XOR		$A \oplus B = \bar{A}B \vee A\bar{B}$
NAND		$A \uparrow B = \overline{AB} = \bar{A} \vee \bar{B}$
NOR		$A \downarrow B = \overline{A \vee B} = \bar{A}\ \bar{B}$
NXOR		$A \otimes B = \overline{AB} \vee AB$ $= (\bar{A} \vee B)(\bar{B} \vee A)$

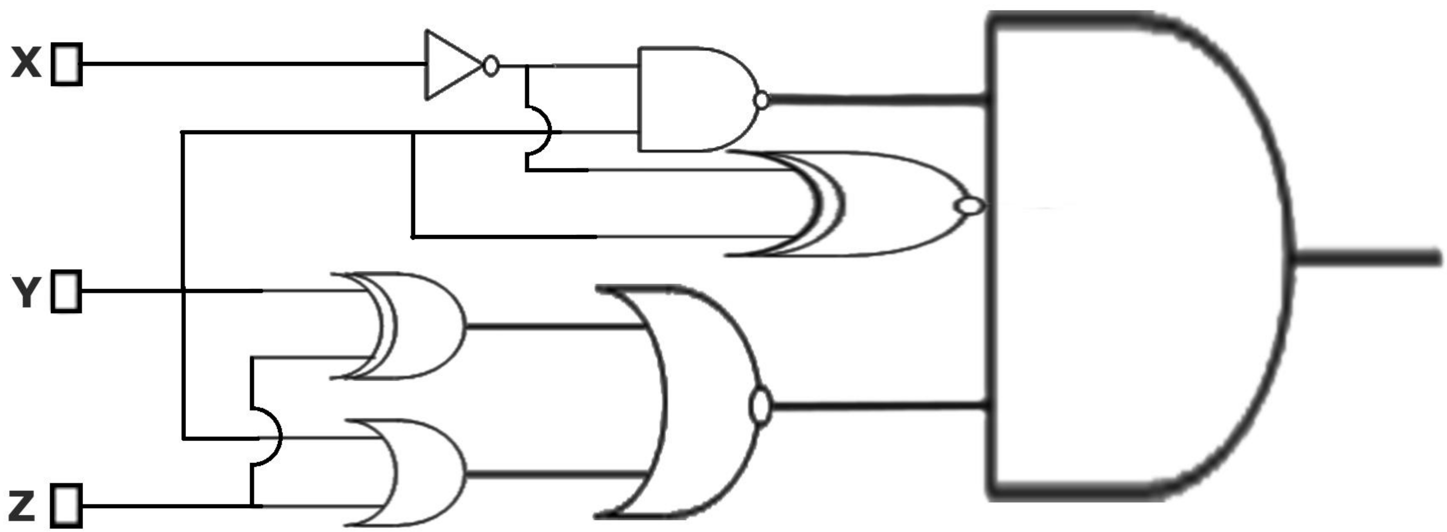
Solution

Problem statement

Exercise 3.

Draw a logic circuit having 3 input wires and containing all basic and derived gates. Write the corresponding Boolean function, simplify it and then draw a simplified circuit equivalent to the initial one.

Chosen Circuit



Corresponding Boolean formula

$$f(x,y,z) = \left(\bar{x} \uparrow y\right) \wedge (\bar{x} \otimes y) \wedge \left[(y \oplus z) \downarrow (y \vee z)\right]$$

Simplification

$$f(x,y,z) = (\bar{x}\uparrow y) \wedge (\bar{x} \otimes y) \wedge [(y \oplus z) \downarrow (y \vee z)] =$$

$= (x \vee \bar{y}) \wedge (\bar{x} \vee \bar{y}) \wedge (x \vee y) \wedge [((\bar{y} \wedge z) \vee (y \wedge \bar{z})) \downarrow (y \ \vee \ z)]$
$= (x \vee \bar{y}) \wedge (\bar{x} \vee \bar{y}) \wedge (x \vee y) \wedge (y \vee \bar{z}) \wedge (\bar{y} \vee z) \wedge \bar{y} \wedge \bar{z}$

$= (\text{absorption laws for } \bar{y} \ and \ \bar{z}) =$

$= (x \vee y) \wedge \bar{y} \wedge \bar{z} = (x \vee y) \wedge (\bar{y} \wedge \bar{z}) = (x \wedge \bar{y} \wedge \bar{z}) \vee (y \wedge \bar{y} \wedge \bar{z})$ (the last parenthesis is always false because of y $\wedge$ $\neg$y)
$= x \wedge \bar{y} \wedge \bar{z}$

So, $f(x,y,z) = x \wedge \bar{y} \wedge \bar{z}$

Simplified circuit