Functional Notation

Addendum to Chapter 4

Logic Notation Systems

- We have seen three different, but equally powerful, notational methods for describing the behavior of gates and circuits:
  - Boolean expressions
  - logic diagrams
  - truth tables

Recall that…

- **Boolean expressions** are expressions in Boolean algebra, a mathematical notation for expressing two-valued logic.

  This algebraic notation is an elegant and powerful way to demonstrate the activity of electrical circuits.

Recall further that…

- **Logic diagram** A graphical representation of a circuit

  Each type of gate is represented by a specific graphical symbol.

- **Truth table** A table showing all possible input value and the associated output values.

A Fourth System

In addition to these three, there is another widely used system of notation for logic.

Functional Notation

Functional Notation

- Uses a function name followed by a list of arguments in place of the operators used in Boolean Notation.
- For example:

A′ becomes NOT(A)

Functional Equivalents

Boolean Notation	Functional Notation
X=A’	X=NOT(A)
X=A + B	X=OR(A,B)
X=A • B	X=AND(A,B)
X=(A + B)’	X=NOT(OR(A,B))
X=(A • B)’	X=NOT(AND(A,B))

XOR

If/when the XOR function is not available, it must be defined in terms of the 3 logic primitives: AND, OR, and NOT

Recall its explanation:

"one or the other but not both"

In Boolean Notation this becomes:

$$X=(A + B) \bullet (A \bullet B)'$$

In Functional Notation:

$$X=AND(OR(A,B),NOT(AND(A,B)))$$

XOR

The truth table for XOR reveals a hint for simplifying or expression.

Note that XOR is false (0) when A and B are the same, and true (1) when they are different.

A	B	XOR
0	0	0
0	1	1
1	0	1
1	1	0

XOR

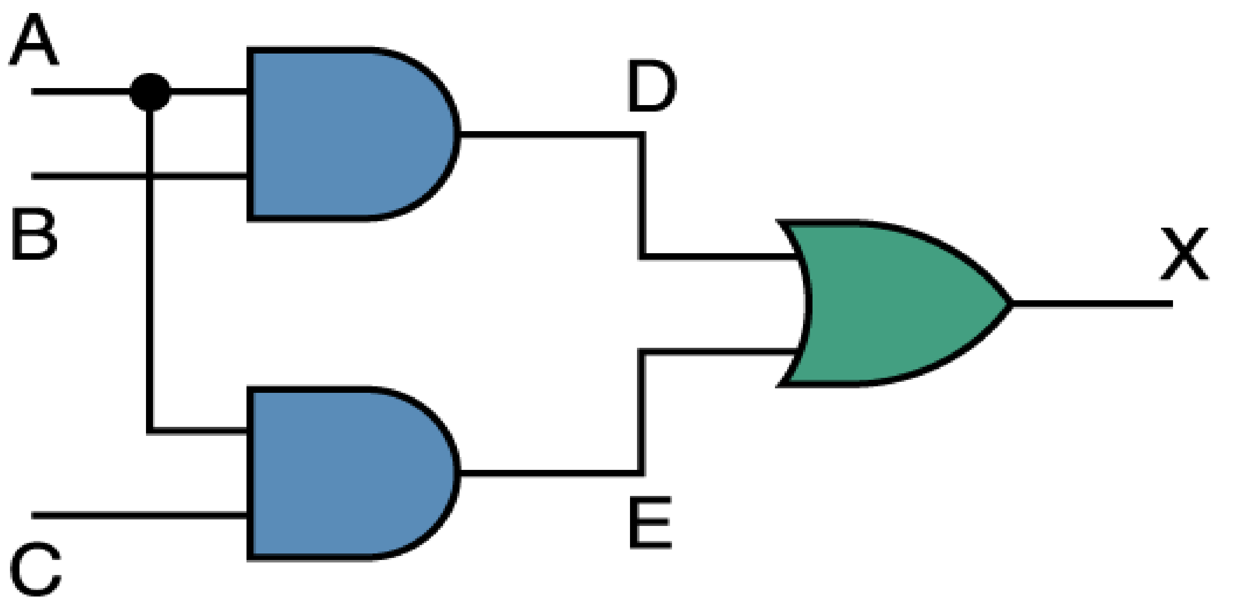
So XOR can be expressed very simply as:

$$X=NOT(A=B)$$

or

$$X=A<>B$$

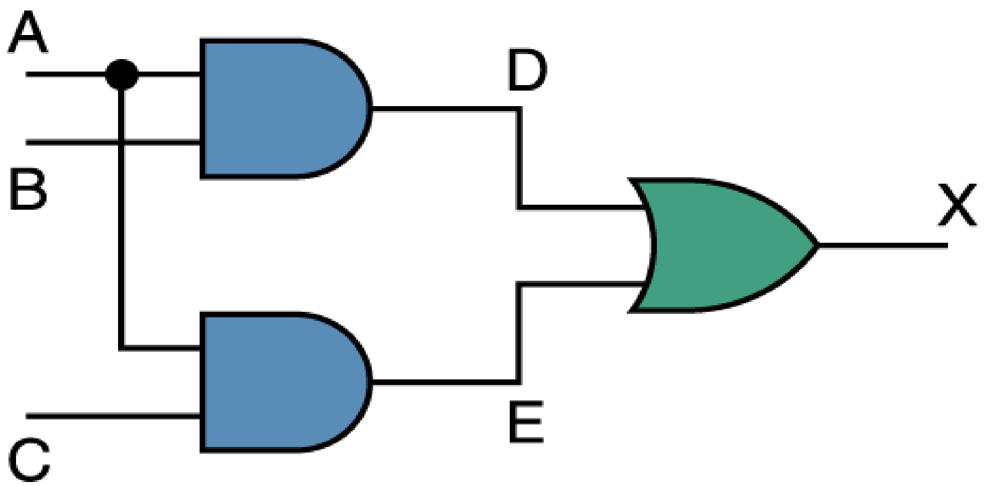
Consider this familiar circuit



X=(AB + AC)

How will this expression look in functional notation?

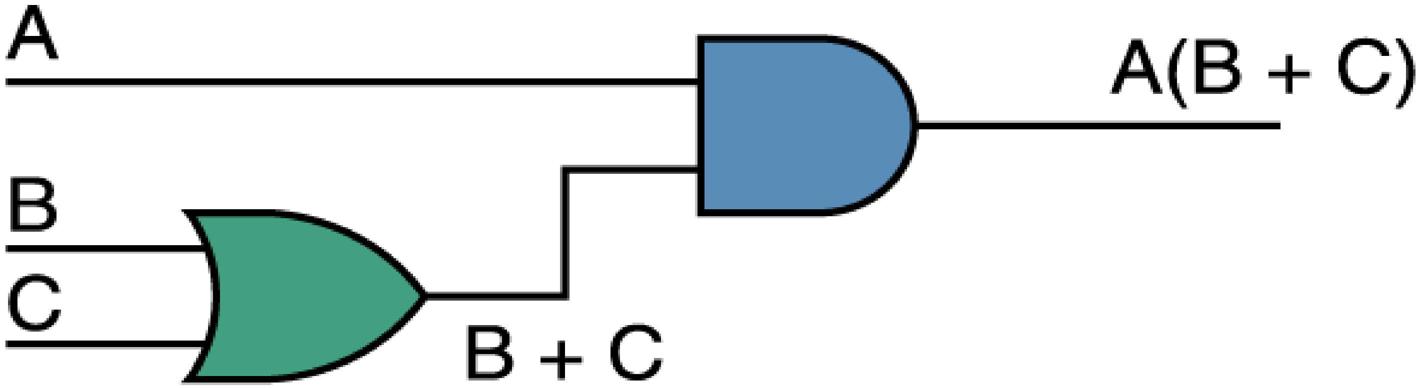
Equivalent expressions



X=(AB + AC)

X=OR(AND(A,B), AND(A,C))

The equivalent circuit



$$X = A\,(B + C)$$

$$X = AND(A,\ OR(B,C))$$