1:3 Definitions Assignment

Definition of "Boolean algebra":

Introduction:
In this assignment, I will provide a parenthetical, sentence and expanded definition for the term "Boolean algebra", a relatively complex term used in the Computer Science field. My intended audience are first year computer science students, with high school mathematics knowledge, who are interested in computer hardware and solving logic problems. The purpose of this definition to simplify a complex and important term which can be later be applied in advanced Computer Science courses and future technology related careers.

Parenthetical Definition:
Boolean algebra (the study of true/false representation) is used in logic problems and used to build circuits.

Sentence Definition:
Boolean algebra is the type of algebra where the values of variables can only be represented by 1's and 0's.

Expanded Definition:

How did the name "Boolean algebra" originate?
The name Boolean algebra was named after George Boole, an English mathematician who introduced this branch of algebra.

What is the history of Boolean algebra?

- In 1847, George Boole wrote a book called "The Mathematical Analysis of Logic", where he first introduced the term Boolean algebra.
- In 1854, he wrote another book called "An Investigation of the Laws of Thought, on Which are Founded the Mathematical Theories of Logic and Probabilities", and in this book he introduced a practical system of logic in algebraic form and also the rules of the logical connectors and variable assignments in Boolean algebra.
- Later in 1937, Claude E. Shannon introduced the use of Boolean algebra in building circuits and how the rules of logical connectors and variable assignment mapped to logic gates and switches in circuits.

How is Boolean algebra used/applied?
In Boolean algebra, variables, which are also known as propositions, can only be assigned either 1 or 0. 1 represents true and 0 represents false.

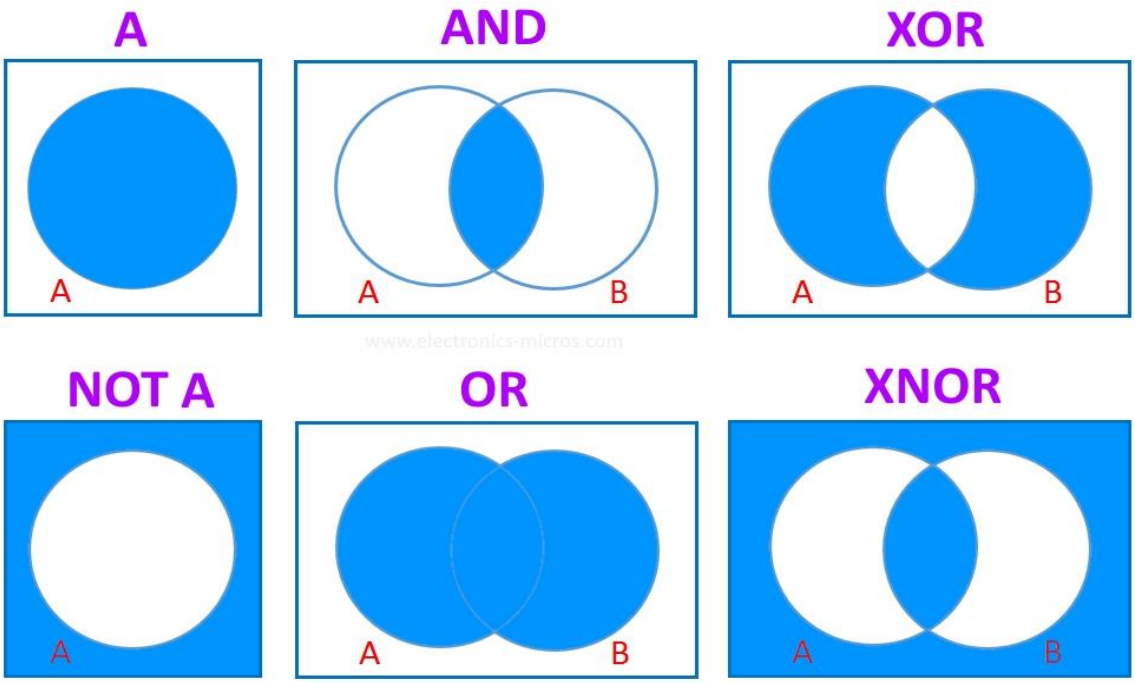

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Figure 1: Venn Diagrams showing the behavior of logical connectors. The blue color in the Venn Diagrams show the result produced by each logical connector.

These propositions are joined by logical connectors like NOT, AND, OR, XOR, XNOR and Figure 1 shows the behavior of each logical connector.

For example, if we have two propositions, A and B, they must each have a value of either 0 or 1. Say we assign A = 1 and B = 0 and that A and B are joined by the OR logical connector. We will have the expression “A OR B” and we want to find the value of this expression. To find this value, we look at the behavior for the OR logical connector and see that only one of A and B need to be 1 in order for the whole expression to evaluate to 1. So, since A = 1, A OR B evaluates to 1.

Boolean algebra is used often in building circuits. Each logical connector is called a gate and each proposition will work as a light switch, where 1 means the switch is on and 0 means the switch is off.

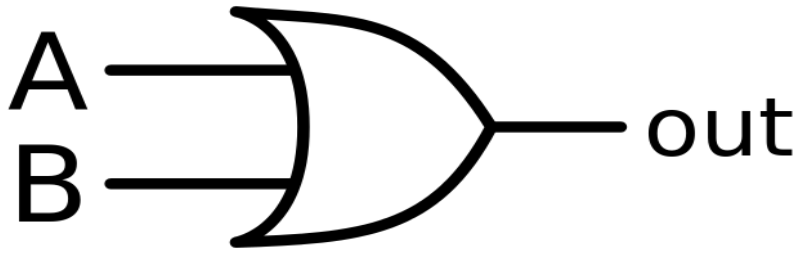

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Figure 2: A circuit using an OR gate

Consider this simple circuit in Figure 2. Here we use an OR gate to connect the switches A and B. If switch A is turned on and switch B is turned off, the output wire will still carry the light provided by the switches since A is 1, B is 0 and A OR B returns 1.

How does Boolean algebra compare to mathematical algebra?

Mathematical algebra and Boolean algebra both contain variables that are connected by a specific operator to make an expression. However, they have different rules in terms of the domain of the values assigned to variables and different behaviors of the connecting operators in the expressions.

- In mathematical algebra, variables can have a value which can be, for simplicity, any real number. Variables are connected by arithmetic operators, like addition, subtraction, multiplication and division and each of these operators have different behaviors. The result of an expression, separated using the "=" sign, can also be any real number.
- In Boolean algebra, variables can only be assigned a value of 1 or 0. Variables are connected by the logical connectors like AND, OR, etc and the result of an expression can only be 1 or 0.

Works Cited:

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