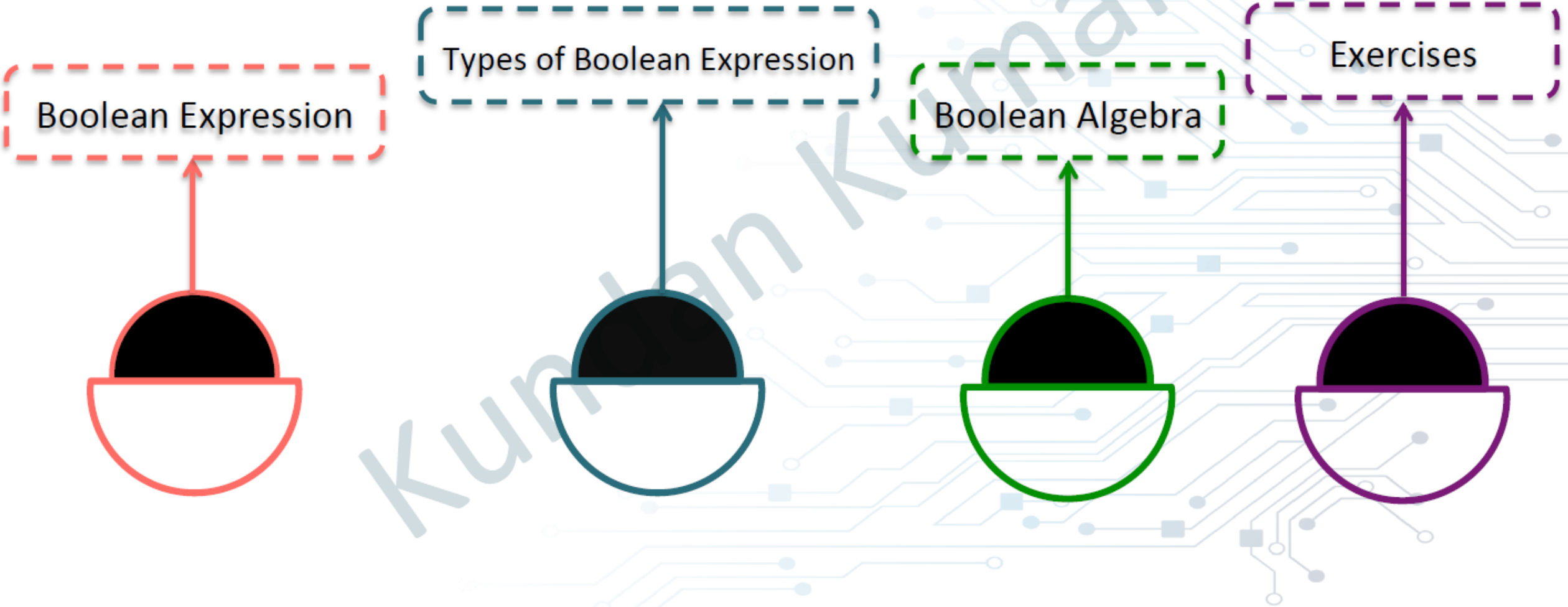
Boolean Algebra

Dr. Kundan Kumar

A	A’	(A’)’=A
0	1	0
1	0	1

Session Agenda

Prepared by:
Dr. Kundan Kumar



What is Boolean Expression?

What is Boolean Expression?

Prepared by:
Dr. Kundan Kumar

A Boolean expression is composed of a combination of the Boolean constants true or false, Boolean-typed variables, Boolean-valued operators, and Boolean-valued functions

Example 1:
(A + B) . C

Example 2:
A . (B + 1)

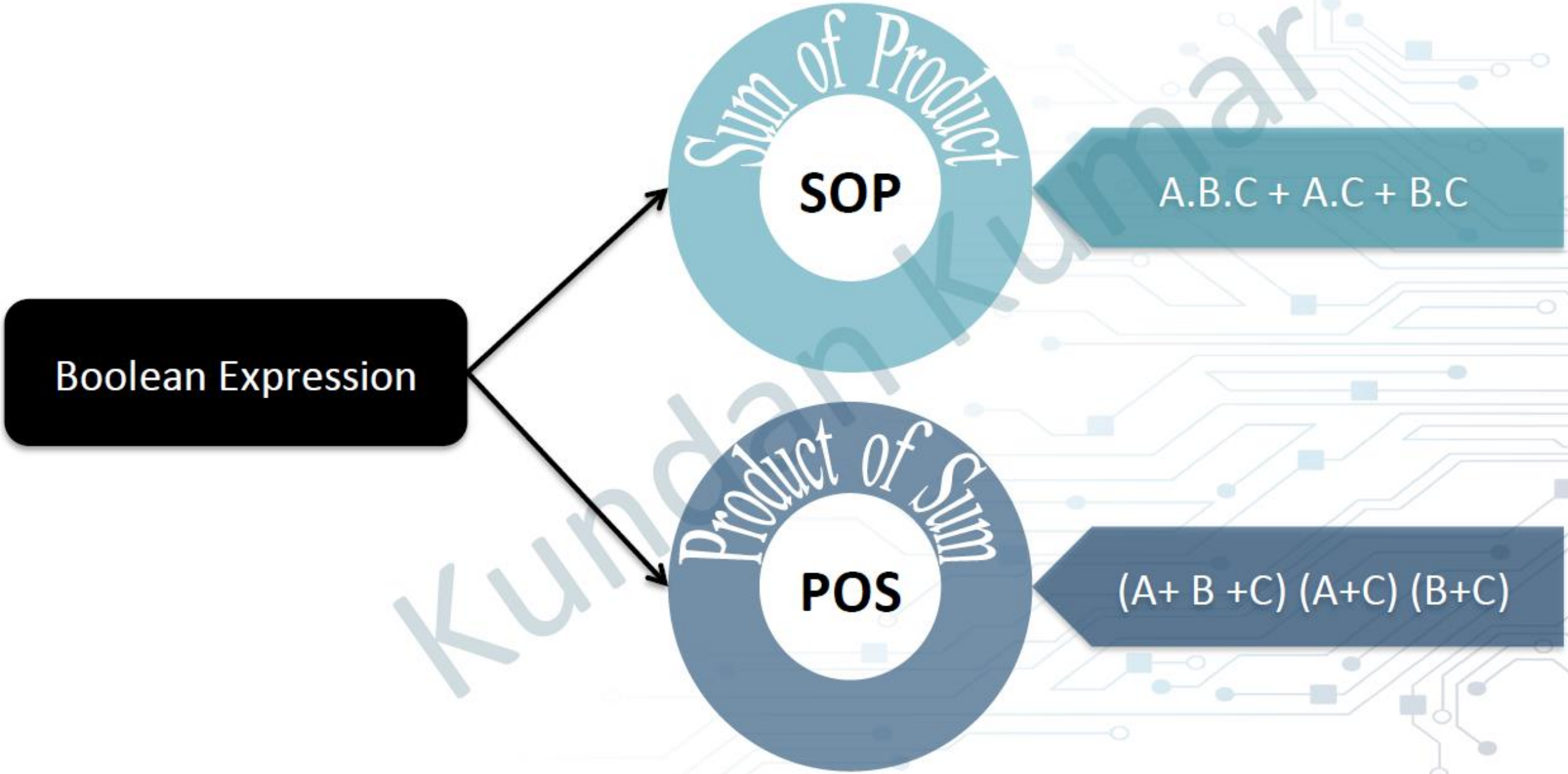
A Boolean expression produces a Boolean value as an output when evaluated.

A Boolean value is either true or false

Types of Boolean Expression

Types of Boolean Expression

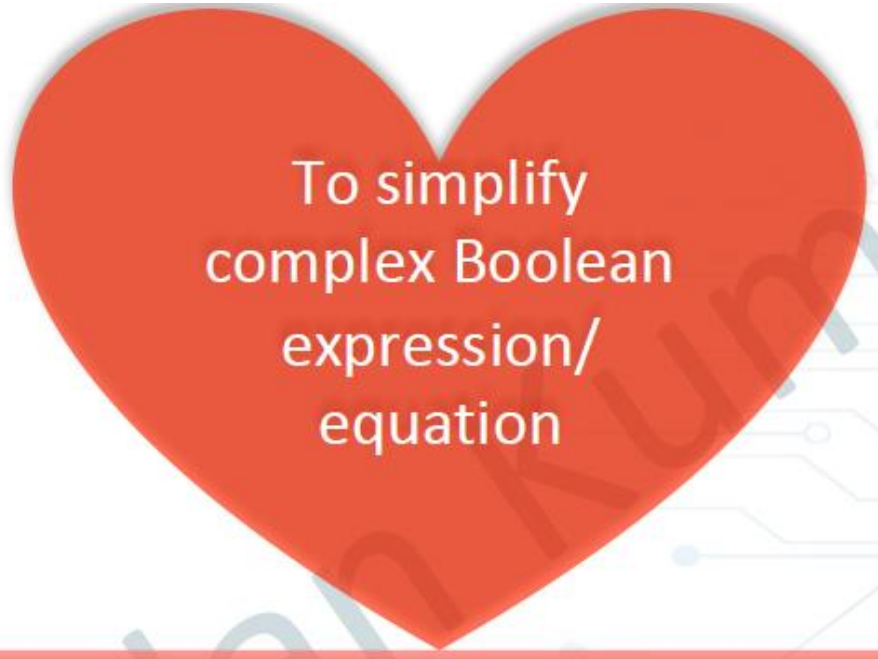
Prepared by:
Dr. Kundan Kumar



Why Boolean Algebra?

Why Boolean Algebra?

Prepared by:
Dr. Kundan Kumar



Selected laws and rules are applied, step by step, to the original equation, so as to eventually arrive at a simplified version that can be implemented with a smaller number of gates and therefore lead to a simpler circuit.

What is Boolean Algebra?

What is Boolean Algebra?

Prepared by:
Dr. Kundan Kumar

Boolean Algebra is ***used to analyze and simplify the digital (logic) circuits***.
It uses only the binary numbers i.e. 0 and 1.
Boolean algebra was ***invented by George Boole*** in 1854.

Rule in Boolean Algebra

Complement of a variable is represented by an overbar (-). Thus, complement of variable X is represented as X Bar. Thus if X = 0 then X Bar = 1 and X = 1 then X Bar = 0.

ORing of the variables is represented by a plus (+) sign between them. For example ORing of A, B, C is represented as A + B + C.

Logical ANDing of the two or more variable is represented by writing a dot between them such as A.B.C. Sometime the dot may be omitted like ABC.

Boolean Algebra Laws

Boolean Algebra laws

Prepared by:
Dr. Kundan Kumar

1) A + 1 = 1

OR

A		X
0	1	1
1	1	1

2) A + 0 = A

OR

A		X
0	0	0
1	0	1

3) A . 1 = A

AND

A		X
0	1	0
1	1	1

4) A . 0 = 0

AND

A		X
0	0	0
1	0	0

Cont...

Prepared by:
Dr. Kundan Kumar

5) A + A = A

OR

A	A	X
0	0	0
1	1	1

6) A . A = A

AND

A	A	X
0	0	0
1	1	1

7) $A + \overline{A} = 1$

OR

A	A’	X
0	1	1
1	0	1

8) $A \cdot \overline{A} = 0$

AND

A	A’	X
0	1	0
1	0	0

Cont...

Prepared by:
Dr. Kundan Kumar

9) $\overline{\overline{A}} = A$

A	A’	(A’)’=A
0	1	0
1	0	1

This is known as Complement law

Cont...

Prepared by:
Dr. Kundan Kumar

Commutative Laws

The **order** of variables does not affect the result.

10) A + B = B + A

11) A . B = B . A

Associative Laws

Grouping (parentheses) of variables does not affect the result.

12) (A + B)+C = A+B+C

13) (A . B).C = A.(B. C)

Distributive Laws

You can **distribute** one operation over another.

14) A . (B+C) = A.B+A.C

15) A+(B . C) = (A+B).(A+ C)

Cont...

Prepared by:
Dr. Kundan Kumar

Law	Practical Use
Commutative	Input order doesn’t matter- simplifies circuit layout.
Associative	Can regroup logic expressions- helpful in gate reduction.
Distributive	Used for factoring expressions and optimizing gate usage.

Cont...

Prepared by:
Dr. Kundan Kumar

De-Morgan's Laws

$$\overline{A.B} = \overline{A} + \overline{B}$$

The complement of the product of two variables is equal to the sum of the complements of the variables

$$\overline{A+B} = \overline{A} \cdot \overline{B}$$

The complement of the sum of two variables is equal to the product of the complements of the variables.

Exercises

Exercise Solved

Prepared by:
Dr. Kundan Kumar

#1:

A.(A+B+C)+A

A . (A + B + C) + A

(A.A + A.B +A.C) + A — Distributive Laws

(A + A.B +A.C) + A — Since, A.A=A

A.(1 + B + C) + A — Common Factor out

A .1 + A — Since, 1+A=1

A + A — A — Since, A+A=A

#1:

Simplified Expression

A.(A+B+C)+A = A

Class Activities Exercises

Thank You