# **Propositional Logic - Self Ass Report**

Atomic Proposition

- The most basic logical building blocks are called atomic propositions, and they are statements that can only be true or untrue. Usually, they are represented by a single letter, like.

  Simple statements like "It is raining" or "The sun is shining" can be represented using atomic propositions.

Compound Propositions

- Atomic propositions are combined with logical operators to generate compound propositions.
  The following are examples of common logical operators: AND (∧), OR (∨), NOT (¬), IMPLIES (→), and IF AND ONLY IF (↔).
  We can express more intricate links between statements using compound propositions.

Type of Compound propositions

- Conjunction (∧): Indicates the logical AND operation connecting two statements. Only when both of the atomic statements are true is the composite proposition true.
- The disjunction symbol (∨) signifies the logical action of OR between two propositions. If at least one of the atomic assertions is true, then the composite proposition is true.
- Negation (¬): Indicates the proposition on which the logical NOT operation is applied. It disproves the atomic proposition's veracity.
- The symbol for the logical inference between two statements is implication (→). Unless the antecedent is true and the consequent is false, the compound statement is true.
- Biconditional (↔): Indicates that two propositions are logically equivalent. If the truth values of the two assertions are the same, then the compound proposition is true.

Evaluation of Compound Proposition

- A compound proposition's truth value is determined by the logical operators employed as well as the truth values of its constituent atomic parts.
- To systematically assess the truth values of compound propositions for every possible combination of the atomic propositions' truth values, truth tables can be built.

Components of a truth table

- Variables: The truth table's columns contain a list of the atomic propositions that make up the compound proposition.
- Rows: Every set of truth values for the atomic propositions is represented by a distinct row in the truth table.
- Columns: In the expression being evaluated, each column corresponds to an atomic proposition or a compound proposition.
- Truth Values: The rows of the truth table are filled with the truth values of the compound propositions for every combination of the atomic propositions' truth values

Step to construct a truth table
- Determine each and every atomic and compound proposition that the phrase contains.
- Based on the number of atomic propositions (usually two times n, where n is the number of atomic propositions), determine the number of rows required.
- Make a list of every conceivable combination of the atomic propositions' truth values.
- Utilizing the logical operators, determine the truth values of compound propositions and update the truth table accordingly.

Usage of truth table
- Assessment of Logical Expressions: Truth tables offer a methodical and transparent approach to assessing the truth values of intricate logical expressions.
- Verification of Equivalences: By comparing the truth values of two expressions for every possible combination of the atomic propositions' truth values, truth tables can be utilized to verify logical equivalencies.
- Truth tables are a useful tool for demonstrating a variety of logical theorems and properties.

Components of Boolean algebra

- Boolean Variables: In Boolean algebra, variables stand for logical statements or conditions that may or may not be true.

- Logical Operators: A number of basic logical operators are present in Boolean algebra, including:
  - ✓ The symbol for logical conjunction is AND (∧). Only when both operands are true does it produce true.
  - ✓ OR (∨): Indicates a logical contradiction. If any one of the operands is true, it yields true.
  - ✓ NOT (¬): Indicates a logical rejection. It disproves the operand's truth value. Exclusive disjunction is represented by XOR (Exclusive OR). If precisely one operand is true, it returns true.
  - ✓ The symbol for a negated conjunction is NAND (Not AND). Only when both operands are true does it return false.
  - ✓ NOR (Not OR): Shows a disjunction that has been negated. Only when both operands are false does it produce true

- Applications of Boolean Algebra

  - ✓ Digital Logic Design: The cornerstone of digital logic design, which is used to create electrical circuits and systems, is boolean algebra.
  - ✓ Computer Science: The design of algorithms, the implementation of logic gates, and the creation of software all require boolean algebra.
  - ✓ Database Systems: Boolean algebra is utilized in database systems for indexing, data retrieval, and query optimization.
  - ✓ Boolean algebra is essential to the techniques and protocols used in cryptography, which ensures safe communication and data encryption.