Propositional Equivalence

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Equivalence	Name
$P \wedge T \Leftrightarrow P$ $P \vee F \Leftrightarrow P$	Identity Laws
$P \vee T \Leftrightarrow T$ $P \wedge F \Leftrightarrow F$	Domination Laws
$P \vee P \Leftrightarrow P$ $P \wedge P \Leftrightarrow P$	Idempotent Laws
$\neg(\neg P) \Leftrightarrow P$	Double Negation Law
$P \vee Q \Leftrightarrow Q \vee P$ $P \wedge Q \Leftrightarrow Q \wedge P$	Commutative Law

Equivalence	Name
$(P \lor Q) \lor R \Leftrightarrow P \lor (Q \lor R)$, $(P \land Q) \land R \Leftrightarrow P \land (Q \land R)$	Associative Law
$P \lor (Q \land R) \Leftrightarrow (P \lor Q) \land (P \lor R)$	Distributive Law
$\neg(P \land Q) \Leftrightarrow \neg P \lor \neg Q$ $\neg(P \lor Q) \Leftrightarrow \neg P \land \neg Q$	De Morgan's Laws
$P \rightarrow Q \Leftrightarrow \neg P \lor Q$	Implication Equivalence
$P \rightarrow Q \Leftrightarrow \neg Q \rightarrow \neg P$	Contrapositive Law

Note: equivalent expressions can always be substituted for each other in a more complex expression - useful for simplification.

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Logic in Proof

- A theorem is a proposition that can be proved to be true.
- An argument that establishes the truth of a theorem is called a proof.
- An argument is a process by which a conclusion is drawn from a set of propositions.
- The given set of propositions are called premises or hypotheses.
- The final proposition derived from the given propositions is called a conclusion.

Logic in Proof….

- An argument is said to be logically valid argument if and only if the conjunction of the premises implies the conclusion.
- In other words, a valid argument is one when:

$$P_1 \wedge P_2 \wedge P_3 \ldots \ldots . \wedge P_n \longrightarrow C$$

is a tautology.