Laws of Propositional Logic

- Any tautology can be considered a "law of prop. logic".

① Law of negation: $\neg\neg p \equiv p$

② Self-combination: $p \vee \neg p \equiv \text{TRUE}$ $\quad p \vee p \equiv p$

$p \wedge \neg p \equiv \text{FALSE}$ $\quad p \wedge p \equiv p$

③ Constant-combination: $p \vee \text{TRUE} \equiv \text{TRUE}$ $\quad p \vee \text{FALSE} \equiv p$

$p \wedge \text{TRUE} \equiv p$ $\quad p \wedge \text{FALSE} \equiv \text{FALSE}$

④ Commutativity: $p \vee q \equiv q \vee p$ $\quad p \wedge q \equiv q \wedge p$

⑤ Associativity: $p \vee (q \vee r) \equiv (p \vee q) \vee r$ $\quad p \wedge (q \wedge r) \equiv (p \wedge q) \wedge r$

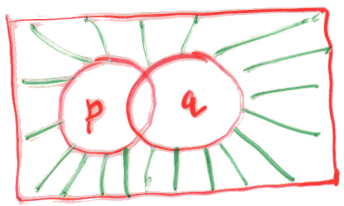
⑥ Distributivity: $p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$

$p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$

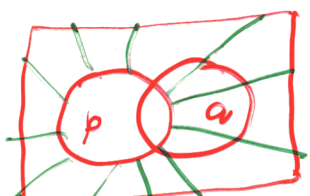
⑦ DeMorgan's law: $\neg(p \vee q) \equiv \neg p \wedge \neg q$ $\quad \neg(p \wedge q) \equiv \neg p \vee \neg q$

⑧ Subsumption: $p \wedge (p \vee q) \equiv p$

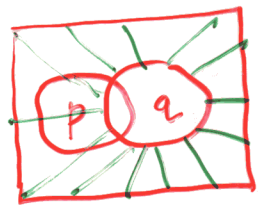
- These laws/tautologies can be verified using truth-table or Venn-Diagram:



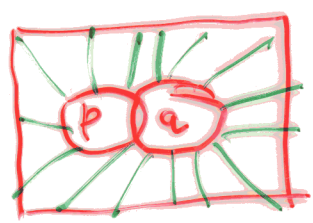
$\neg(p \vee q)$



$\neg p$



$\neg q$



$\neg p \wedge \neg q$

DeMorgan's law through Venn-Diagram