

## Key Logical Equivalences

- De Morgan's Laws     $\neg(p \wedge q) \equiv \neg p \vee \neg q$   
 $\neg(p \vee q) \equiv \neg p \wedge \neg q$
- Identity Laws:         $p \wedge T \equiv p$        $p \vee F \equiv p$
- Domination Laws:     $p \vee T \equiv T$        $p \wedge F \equiv F$
- Idempotent laws:     $p \vee p \equiv p$        $p \wedge p \equiv p$
- Double Negation Law:     $\neg(\neg p) \equiv p$
- Negation Laws:         $p \vee \neg p \equiv T$        $p \wedge \neg p \equiv F$
- Commutative Laws:      $p \vee q \equiv q \vee p$   
 $p \wedge q \equiv q \wedge p$
- Associative Laws:       $(p \wedge q) \wedge r \equiv p \wedge (q \wedge r)$   
 $(p \vee q) \vee r \equiv p \vee (q \vee r)$
- Distributive Laws:      $(p \vee (q \wedge r)) \equiv (p \vee q) \wedge (p \vee r)$   
 $(p \wedge (q \vee r)) \equiv (p \wedge q) \vee (p \wedge r)$
- Absorption Laws:         $p \vee (p \wedge q) \equiv p$        $p \wedge (p \vee q) \equiv p$

$\begin{array}{l} p \\ p \rightarrow q \\ \hline \therefore q \end{array}$	$(p \wedge (p \rightarrow q)) \rightarrow q$	Modus ponens
$\begin{array}{l} \neg q \\ p \rightarrow q \\ \hline \therefore \neg p \end{array}$	$(\neg q \wedge (p \rightarrow q)) \rightarrow \neg p$	Modus tollens
$\begin{array}{l} p \rightarrow q \\ q \rightarrow r \\ \hline \therefore p \rightarrow r \end{array}$	$((p \rightarrow q) \wedge (q \rightarrow r)) \rightarrow (p \rightarrow r)$	Hypothetical syllogism
$\begin{array}{l} p \vee q \\ \neg p \\ \hline \therefore q \end{array}$	$((p \vee q) \wedge \neg p) \rightarrow q$	Disjunctive syllogism
$\begin{array}{l} p \\ \hline \therefore p \vee q \end{array}$	$p \rightarrow (p \vee q)$	Addition
$\begin{array}{l} p \wedge q \\ \hline \therefore p \end{array}$	$(p \wedge q) \rightarrow p$	Simplification
$\begin{array}{l} p \\ q \\ \hline \therefore p \wedge q \end{array}$	$((p) \wedge (q)) \rightarrow (p \wedge q)$	Conjunction