Reference Sheet for Logic and Program Proofs

Logical Equivalences

Definition of $\wedge$ $P \wedge \neg P \equiv False$ $P \wedge False \equiv False$ $P \wedge True \equiv P$	Idempotent Laws $p \vee p \equiv p$ $p \wedge p \equiv p$	DeMorgan's Laws $\neg(p \wedge q) \equiv \neg p \vee \neg q$ $\neg(p \vee q) \equiv \neg p \wedge \neg q$	Distributive Laws $p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$ $p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$
Definition of $\vee$ $P \vee \neg P \equiv True$ $P \vee False \equiv P$ $P \vee True \equiv True$	Double Negation $\neg(\neg p) \equiv p$	Absorption Laws $p \vee (p \wedge q) \equiv p$ $p \wedge (p \vee q) \equiv p$	Associative Laws $(p \vee q) \vee r \equiv p \vee (q \vee r)$ $(p \wedge q) \wedge r \equiv p \wedge (q \wedge r)$
	Commutative Laws $p \vee q \equiv q \vee p$ $p \wedge q \equiv q \wedge p$	Implication Laws $p \rightarrow q \equiv \neg p \vee q$ $p \rightarrow q \equiv \neg q \rightarrow \neg p$	Biconditional Laws $p \leftrightarrow q \equiv (p \rightarrow q) \wedge (q \rightarrow p)$ $p \leftrightarrow q \equiv \neg q \leftrightarrow \neg p$

Inference Rules

Simplification $p \wedge q$ ——— Therefore, p	Modus Ponens p $p \rightarrow q$ ——— Therefore, q	Modus Tollens $\neg q$ $p \rightarrow q$ ——— Therefore, $\neg p$	Hypothetical Syllogism $p \rightarrow q$ $q \rightarrow r$ ——— Therefore, $p \rightarrow r$
Conjunction p q ——— Therefore, $p \wedge q$	Addition p ——— Therefore, $p \vee q$	Resolution $p \vee q$ $\neg p \vee r$ ——— Therefore, $q \vee r$	Disjunctive Syllogism $p \vee q$ $\neg p$ ——— Therefore, q
Universal Instantiation $\forall x P(x)$ ——— Therefore, $P(c)$	Universal Generalization $P(c)$ ——— Therefore, $\forall x P(x)$	Existential Instantiation $\exists x P(x)$ ——— Therefore, $P(c)$	Existential Generalization $P(c)$ ——— Therefore, $\exists x P(x)$

Inference Rules For Program Proofs

Composition Rule $p\{S_1\}q$ $q\{S_2\}r$ ——— $p\{S_1; S_2\}r$	Conditional Rule $(p \wedge condition)\{S\}q$ $(p \wedge \neg condition) \rightarrow q$ ——— $p\{$ if $condition$ $S\}q$	Conditional with Else Rule $(p \wedge condition)\{S_1\}q$ $(p \wedge \neg condition)\{S_2\}q$ ——— $p\{$ if $condition$ S_1 else $S_2\}q$