1 Basic Logic Summary

1.1 Basic Operations

- **Negation**, the "not" operation, denoted $\neg$

p	$\neg p$
T	F
F	T

- **And**, sometimes called "conjunction," denoted $\wedge$

p	q	$p \wedge q$
T	T	T
T	F	F
F	T	F
F	F	F

- **Or**, sometimes called "disjunction," denoted $\vee$

p	q	$p \vee q$
T	T	T
T	F	T
F	T	T
F	F	F

- **Implication**, sometimes called "material implication" or "if ... then," denoted $\Rightarrow$

p	q	$p \Rightarrow q$
T	T	T
T	F	F
F	T	T
F	F	T

- **Equivalence**, sometimes called "material equivalence" or "iff" denoted $\iff$

p	q	$p \iff q$
T	T	T
T	F	F
F	T	T
F	F	T

2 Derivation & Inference Rules

2.1 Derivation Rules

- **Equivalence Rules**

Equivalence			Name
p	$\iff$	$\neg\neg p$	Double Negation
$p \Rightarrow q$	$\iff$	$\neg p \vee q$	Implication
$\neg(p \wedge q)$	$\iff$	$\neg p \vee \neg q$	De Morgan's Laws
$\neg(p \vee q)$	$\iff$	$\neg p \wedge \neg q$	
$p \vee q$	$\iff$	$q \vee p$	Commutativity
$p \wedge q$	$\iff$	$q \wedge p$	
$p \wedge (q \wedge r)$	$\iff$	$(p \wedge q) \wedge r$	Associativity
$p \vee (q \vee r)$	$\iff$	$(p \vee q) \vee r$	

- **Inference Rules**

  Note: Curly braces indicate "$\wedge$"

Inference			**Name**
$\left.\begin{array}{r} p \\ q \end{array}\right\}$	$\Rightarrow$	$p \wedge q$	Conjunction
$\left.\begin{array}{r} \neg q \\ p \Rightarrow q \end{array}\right\}$	$\Rightarrow$	q	*modus ponens*
$\left.\begin{array}{r} p \Rightarrow q \\ \neg q \end{array}\right\}$	$\Rightarrow$	$\neg p$	*modus tollens*
$p \wedge q$	$\Rightarrow$	p	Simplification
p	$\Rightarrow$	$p \vee q$	Addition

2.2 Quantifiers

- **Universal** - "for all," denoted by $\forall$
- **Existential** - "exists," denoted by $\exists$

Equivalence			**Name**
$\neg[(\forall x)P(x)]$	$\iff$	$(\exists x)(\neg P(x))$	Universal Negation
$\neg[(\exists x)P(x)]$	$\iff$	$(\forall x)(\neg P(x))$	Existential Negation