

## Sets vs. Logic

For all sets  $A, B, C$  in the universe  $U$ :

$$\begin{aligned} A \cap (B \cap C) &= (A \cap B) \cap C \\ A \cup (B \cup C) &= (A \cup B) \cup C \end{aligned}$$

associative laws

$$\begin{aligned} A \cap B &= B \cap A \\ A \cup B &= B \cup A \end{aligned}$$

commutative laws

$$\begin{aligned} A \cap (B \cup C) &= (A \cap B) \cup (A \cap C) \\ A \cup (B \cap C) &= (A \cup B) \cap (A \cup C) \end{aligned}$$

distributive laws

$$\begin{aligned} \overline{\overline{A}} &= A \\ A \cap \overline{A} &= \emptyset \\ A \cup \overline{A} &= U \end{aligned}$$

$$\begin{aligned} \overline{A \cap B} &= \overline{A} \cup \overline{B} \\ \overline{A \cup B} &= \overline{A} \cap \overline{B} \end{aligned}$$

de Morgan's laws

$$A \subseteq B \text{ iff } \overline{B} \subseteq \overline{A}$$

contrapositive law

For all statements  $P, Q, R$ :

$$\begin{aligned} P \wedge (Q \wedge R) &= (P \wedge Q) \wedge R \\ P \vee (Q \vee R) &= (P \vee Q) \vee R \end{aligned}$$

$$\begin{aligned} P \wedge Q &= Q \wedge P \\ P \vee Q &= Q \vee P \end{aligned}$$

$$\begin{aligned} P \wedge (Q \vee R) &= (P \wedge Q) \vee (P \wedge R) \\ P \vee (Q \wedge R) &= (P \vee Q) \wedge (P \vee R) \end{aligned}$$

$$\begin{aligned} \sim(\sim P) &= P \\ P \wedge \sim P &= F \\ P \vee \sim P &= T \end{aligned}$$

$$\begin{aligned} \sim(P \wedge Q) &= \sim P \vee \sim Q \\ \sim(P \vee Q) &= \sim P \wedge \sim Q \end{aligned}$$

$$P \Rightarrow Q = \sim Q \Rightarrow \sim P$$