

# **Discrete Mathematics**

## **Logic and Proof**

Pangyen Weng, Ph.D  
Metropolitan State University

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# De Morgan's Laws

# De Morgan's Laws for Compound Propositions

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

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

## De Morgan's Laws for Quantifiers

$$\neg(\forall x P(x)) \equiv \exists x (\neg P(x))$$

$$\neg(\exists x P(x)) \equiv \forall x (\neg P(x))$$

# Examples

Find the negation to:

1.  $p \vee q \vee (\neg r)$
2.  $\forall x (P(x) \rightarrow Q(x))$

## De Morgan's Laws for Nested Quantifiers

$$\neg(\forall x \forall y P(x, y)) \equiv \exists x \exists y (\neg P(x, y))$$

$$\neg(\exists x \forall y P(x, y)) \equiv \forall x \exists y (\neg P(x, y))$$

etc.