

Logical Forms

Lecture 1 Section 2.4

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1 Statements

2 Logical Operators

3 Truth Tables

4 Assignment

Outline

1 Statements

2 Logical Operators

3 Truth Tables

4 Assignment

Statements

- A **statement** is a sentence that is either true or false, but not both.
- These are statements:
 - Today is Saturday.
 - Discrete Math meets today.
- These are *not* statements:
 - Hello.
 - Are you there?
 - Go away!

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Logical Operators

- Binary operators
 - Conjunction – “and”.
 - Disjunction – “or”.
- Unary operator
 - Negation – “not”.
- Other operators
 - XOR – “exclusive or”.
 - NAND – “not both”.
 - NOR – “neither”.

Logical Symbols

- Statements are represented by letters: p , q , r , etc.
- \wedge means “and”.
- \vee means “or”.
- \sim means “not”.

Examples

- Basic statements

- $p =$ “Today is Saturday.”
- $q =$ “Discrete Math meets today.”

- Compound statements

- $p \wedge q =$ “Today is Saturday and Discrete Math meets today.”
- $p \vee q =$ “Today is Saturday or Discrete Math meets today.”
- $\sim p =$ “Today is not Saturday.”

False Negations

- Statement: “Everyone loves Raymond.”
- Incorrect negation: “Everyone does not love Raymond.”
- Correct negation: “Someone does not love Raymond.”

False Negations

- Statement: “Someone loves Raymond.”
- Incorrect negation: “Someone does not love Raymond.”
- Correct negation: “No one loves Raymond.”

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Truth Table of an Expression

- Make a column for every variable.
- List every possible combination of truth values of the variables.
- Make one more column for the expression.
- Write the truth value of the expression for each combination of truth values of the variables.

Truth Table for “and”

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

- $p \wedge q$ is true if p is true *and* q is true.
- $p \wedge q$ is false if p is false *or* q is false.

Truth Table for “or”

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

- $p \vee q$ is true if p or true *and* q is true.
- $p \vee q$ is false if p and false *or* q is false.

Truth Table for “not”

p	$\sim p$
T	F
F	T

- $\sim p$ is true if p is false.
- $\sim p$ is false if p is true.

Example: Truth Table

p	q	r	$(\sim p) \vee (q \wedge r)$
T	T	T	T
T	T	F	F
T	F	T	F
T	F	F	F
F	T	T	T
F	T	F	T
F	F	T	T
F	F	F	T

- Truth table for the statement $(\sim p) \vee (q \wedge r)$.

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Assignment

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- Read Section 2.1, pages 23 - 29.
- Exercises 6 - 8, 10, 12 - 15, page 37.