

# Lecture 14

## LCD 306: Semantics & Pragmatics

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Tuesday 31 March 2015

# Outline

- 1 Administrativa
- 2 Predicate Logic
  - Quantifiers

# Table of Contents

- 1 Administrativa
- 2 Predicate Logic
  - Quantifiers

# Quiz

Group Experiments	30%	→	28%
Assignments	10%	→	9%
Exam 1	20%	→	19%
Exam 2	20%	→	19%
Exam 3	20%	→	19%
Quiz		→	5%

# Calendar

- 31 March: *Quantifiers*
- 2 April: **Group presentations**

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# Well-formed formulae

The set of wff (aka grammatical sentences) in Predicate Logic is defined recursively as follows:

- If  $\phi$  is a formula in PL, then  $\neg\phi$  is a formula in PL.

# Well-formed formulae

The set of wff (aka grammatical sentences) in Predicate Logic is defined recursively as follows:

- If  $\phi$  and  $\psi$  are formulae in PL, then so are  $(\phi \vee \psi)$ ,  $(\phi \wedge \psi)$ ,  $(\phi \rightarrow \psi)$ ,  $(\phi \leftrightarrow \psi)$ .

# Predicate Logic

The additional vocabulary of (first-order) predicate logic consists of the following:

- a set of constant symbols  $a, b, c$ , etc.
- a set of variable symbols  $x_1, x_2$ , etc.

# Predicate Logic

The vocabulary of (first-order) predicate logic consists of the following:

- a set of predicate letters  $P, Q, R$ , etc., each having its own fixed *arity* (e.g. unary symbols, binary symbols, etc).

# Well-formed formulae

The set of wff (aka grammatical sentences) in Predicate Logic is defined recursively as follows:

- If  $P$  is an  $n$ -ary predicate letter and  $t_1, \dots, t_n$  are constant and/or variable symbols, then  $P(t_1, \dots, t_n)$  is a formula in PL.

# Thematic Heirarchy

UTAH: *Agent* < *Theme* < *Experiencer* < *Other*

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# Predicate Logic

The vocabulary of (first-order) predicate logic consists of the following:

- the quantifiers  $\forall, \exists$  (“for-all”, and “exists”).

# Well-formed formulae

The set of wff (aka grammatical sentences) in Predicate Logic is defined recursively as follows:

- If  $\phi$  is a formula in PL and  $x$  is a variable symbol, then  $\forall x\phi$  and  $\exists x\phi$  are formulae in PL.

# Universal Quantifiers

“every person is friendly”

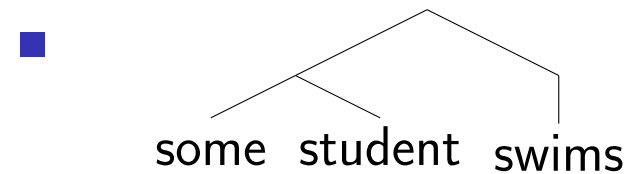
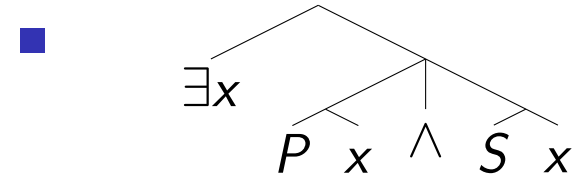
- $\forall x(P(x) \rightarrow F(x))$

# Existential Quantifier

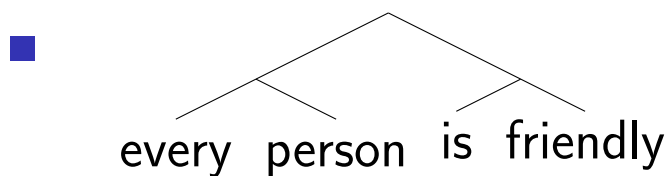
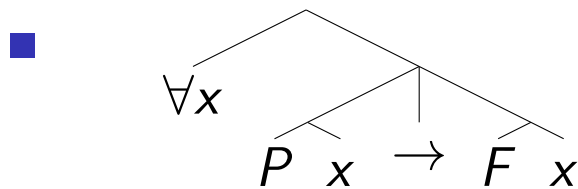
“some student swims”

- $\exists x(P(x) \wedge S(x))$

Syntactic arrangement differences



Syntactic arrangement differences



# Negation

What is the negation of the universal?

- the existence of one case
- $\neg(\forall x(P(x))) \leftrightarrow \exists x(\neg P(x))$

# Negation

- $\neg \forall x[S(x)] \leftrightarrow \exists x[\neg S(x)]$ 
  - “Not all students smoke” is equivalent to “some students don’t smoke”
- $\forall x[\neg S(x)] \leftrightarrow \neg \exists x[S(x)]$ 
  - “All students don’t smoke” is equivalent to “no student smokes”

# Negation

What is the negation of the existential?

- every entity doing  $P$
- $\neg(\exists x(P(x))) \leftrightarrow \forall x(\neg P(x))$

# Negation

- $\neg(\exists x[S(x)]) \leftrightarrow \forall x[\neg S(x)]$ 
  - “No student smokes” is equivalent to “all students don’t smoke”
- $\exists x[\neg S(x)] \leftrightarrow \neg \forall x[S(x)]$ 
  - “Some student doesn’t smoke” is equivalent to “Not all students smoke”