

## Lecture 9

LCD 306: Semantics &amp; Pragmatics

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## Outline

- 1 Administrativa
  - Group Project
- 2 Set Theory - Homework
- 3 Truth Values
  - Truth Conditions
- 4 Propositional Logic
  - Negation
  - Propositional Interaction
  - Conjunction
  - Disjunction
  - Conditionals

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## Group Project

- Chance to review handout after last class
- Are there any questions?

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## Homework No. 8

## Sets

For assignment no. 7 you defined a set  $U_{\langle w,t \rangle}$  with individual objects in it, then used the members of  $U_{\langle w,t \rangle}$  to illustrate the concepts below. The sets denoted by the pairs (or triplets) of related words that you listed were defined using **extension** notation (e.g. the sets were defined by simply listing the elements of the set). For this exercise, using the same words to illustrate the concepts below, define the sets using **set-builder** notation.

- mutually exclusive antonyms
- not mutually exclusive antonyms
- perfect synonyms
- close enough synonyms
- hypernyms
- hyponyms

## Assignment No. 8

## Translating between notations

- Extension notation
  - $A = \{\text{Pretoria, Bloemfontein, Cape Town}\}$
  - $B = \{\text{Netherlands, Aruba, Curaçao, Sint Maarten}\}$
- Set-builder notation
  - $A = \{x : x \text{ is a capital of the Republic of South Africa in 2015}\}$
  - $B = \{x : x \text{ is a constituent country of the Kingdom of the Netherlands in 2015}\}$
- English prose
  - "A is the set of all elements  $x$ , such that  $x$  is a capital of the Republic of South Africa in 2015"
  - "B is the set of all elements  $x$ , such that  $x$  is a constituent country of the Kingdom of the Netherlands in 2015"

## Assignment No. 8

## Extension notation

Set-builder notation  $\rightarrow$  extension notation and English prose

- 1  $A = \{x : x \text{ is a territory of Canada in 2015}\}$ 
  - $A = \{\text{Northwest, Yukon, Nunavut}\}$
  - $A$  is the set of all elements  $x$ , such that  $x$  is a territory of Canada in 2015.
- 2  $B = \{x : x \text{ is a spouse of Elizabeth Taylor}\}$ 
  - $B = \{\text{Conrad Hilton, Jr., Michael Wilding, Mike Todd, Eddie Fisher, Richard Burton, John Warner, Larry Fortensky}\}$
  - $B$  is the set of all elements  $x$ , such that  $x$  is a spouse of Elizabeth Taylor
- 3  $C = \{x : x \text{ is borough of the City of New York in 2015}\}$ 
  - $C = \{\text{The Bronx, Brooklyn, Manhattan, Staten Island, Queens}\}$
  - $C$  is a set of all elements  $x$ , such that  $x$  is a borough of the City of New York in 2015

## Assignment No. 8

## Set-builder Notation

Extension notation  $\rightarrow$  Set-builder notation and English prose

- 1  $A = \{a, b, c\}$ 
  - $A = \{x : x \text{ is one of the first three characters of the alphabet used for American English}\}$
- 2  $B = \{1, 2, 3, 4, \dots\}$ 
  - $B = \{x : x \text{ is a positive whole number}\}$
- 3  $C = \{\text{Obama, Bush Jr., Clinton, Bush Sr., Reagan}\}$ 
  - $C = \{x : x \text{ is a president of the United States of American since 1981}\}$

## Assignment No. 8

## Translating

Set-theoretic notation  $\rightarrow$  English prose

- $A \cap A^c = \emptyset$ , for any set  $A$
- "The intersection of set  $A$  and the complement of set  $A$  is the empty set

## Assignment No. 8

## Translating

Set-theoretic notation  $\rightarrow$  English prose

- 1  $\emptyset \subseteq A$ , for any set  $A$ 
  - For any set  $A$ , the empty set is a subset of  $A$
- 2  $A \subseteq A$ , for any set  $A$ 
  - For any set  $A$ ,  $A$  is a subset of  $A$
- 3  $A \subseteq B$  iff  $A \in \mathcal{P}(B)$ , for any two sets  $A, B$ 
  - For any two sets  $A$  and  $B$ ,  $A$  is a subset of  $B$  if and only if  $A$  is a member of the power set of  $B$
- 4 If  $A \subseteq B$  and  $B \subseteq C$ , then  $A \subseteq C$ , for any three sets  $A, B, C$   
 typo
  - For any three sets  $A, B$ , and  $C$ , if  $A$  is a subset of  $B$  and  $B$  is also a subset of  $C$ , then by the commutation principle  $A$  is a subset of  $C$

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## Truth Conditions

- What makes for the truth of an utterance
- We are able to assess what goes into deciding if a statement is true or not

## Assignment No. 8

### Truth Conditions

For the sentences below, list all the truth conditions for that statement

- 1 “Italian court upholds Berlusconi acquittal in prostitution case”
  - There is a legal entity called Italy
  - The state of Italy has a judicial system with courts
  - There is an individual names Berlusconi
  - ...
- 2 “Mexico calls on U.S. to probe police killings of its nationals”
  - There is a legal entity called Mexico
  - There is a legal entity called the U.S.
  - The U.S. has a security forced called “police”
  - Individuals can be nationals of Mexico
  - Individuals have been killed by police
  - ...

# Homework No. 7

## Exercise 2.1

Why might the following be difficult to assign a truth value?

- 1 'it is quite quiet.'
- 2 'it is a beautiful view.'
- 3 'there will be a storm tomorrow.'

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# Propositional Logic

To talk about the relationships between to propositions we are going to use a notation called **Propositional Logic**

Propositional logics do not contain terms that refer to individuals or predicates. Every basic (or atomic) expression **stands** for a proposition

# Propositional Symbols and Truth Values

- For the statement: "It is raining outside"
- Represent the statement with a propositional symbol
  - $p, q, r, \text{etc}$
  - $\phi, \psi$

$$\frac{r}{1}$$

0

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## Logical Connectives

- Negation:  $\neg$ 
  - $[[\neg\phi]] = 1$  iff  $[[\phi]] = 0$

## Negation

- For the statements:
  - $r$ : "It is raining outside"
  - $\neg r$ : "It is not raining outside"

$r$	$\neg r$
1	0
0	1

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## Two Propositional Statements

## ■ For the statements:

- $r$ : "It is raining outside"
- $c$ : "It is cold"

$r$	$c$
1	1
1	0
0	1
0	0

## Homework No. 7

## Exercise 2.4

If we refer to the statement 'it is raining' as  $p$  and the statement 'it is cold' as  $q$ , describe the state of the world for each row of the truth table below.

row	$r$	$q$
1.	1	1
2.	1	0
3.	0	1
4.	0	0

## Homework No. 7

## Exercise 2.4

If we refer to the statement 'it is raining' as  $p$  and the statement 'it is cold' as  $q$ , describe the state of the world for each row of the truth table below.

row	$p$	$q$	
1.	1	1	<i>It is raining and it is also cold</i>
2.	1	0	<i>It is raining but it is not cold</i>
3.	0	1	<i>It is not raining and it is cold</i>
4.	0	0	<i>It is neither raining nor is it cold</i>

## Logical Connectives

- And:  $\wedge$ 
  - $[[\phi \wedge \psi]] = 1$  iff  $[[\phi]] = [[\psi]] = 1$
- Or:  $\vee$ 
  - $[[\phi \vee \psi]] = 1$  iff  $[[\phi]] = 1$  or  $[[\psi]] = 1$
- Exclusive Or:  $\oplus$
- Entailment, Material Implication:  $\rightarrow$ 
  - $[[\phi \rightarrow \psi]] = 1$  iff  $[[\phi]] = 0$  or  $[[\psi]] = 1$
- Mutual entailment, biconditional:  $\leftrightarrow$ 
  - $[[\phi \leftrightarrow \psi]] = 1$  iff  $[[\phi]] = [[\psi]]$
- Brackets: ( )

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## Truth Values

- For the statements:
  - $r$ : "It is raining outside"
  - $c$ : "It is cold"
  - $r \wedge c$ : "It is raining outside and it is cold"

$r$	$c$	$r \wedge c$
1	1	1
1	0	0
0	1	0
0	0	0

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## Truth Values

- For the statements:
  - $r$ : "It is raining outside"
  - $c$ : "It is cold"
  - $r \vee c$ : "It is raining outside or it is cold"

$r$	$c$	$r \vee c$
1	1	1
1	0	1
0	1	1
0	0	0



## Assignment No. 7

## Exercise 2.8

Draw a truth table for the statement 'Michael Owen is injured or he is suspended'. Give the equivalent definition in English.

## Assignment No. 7

## Exercise 2.9

Draw truth tables for the following sentences (assume that alternatives connected by 'or' are not mutually exclusive):

- 1 'either the boat capsized or John fell in'
- 2 'either the Angels won and the Dodgers tied or the Giants lost'
- 3 Pooh will have honey and either he will have maple syrup or he will have clotted cream'

## Truth Values

■ For the statements:

- $r$ : "It is raining outside"
- $c$ : "It is cold"
- $r \oplus c$ : "Either it is raining outside or it is cold"

$r$	$c$	$r \oplus c$
1	1	0
1	0	1
0	1	1
0	0	0

## Assignment No. 7

## Exercise 2.20

Draw a truth table for the statement: 'either she passed the exam or she did not pass the exam'

# Truth Values

## ■ For the statements:

- $k$ : "Karen went to the party"
- $g$ : "Gita went to the party"
- $k \rightarrow g$ : "If Karen went to the party, then Gita went to the party"

$k$	$g$	$k \rightarrow g$
1	1	1
1	0	0
0	1	1
0	0	1

# Assignment No. 7

## Exercise 2.23

Draw a truth table for the statements:

- 1 'John is home and Mary is happy'
- 2 'John is home or Mary is happy'

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# Truth Values

## ■ For the statements:

- $s$ : "Sarah went to the party"
- $d$ : "Dani went to the party"
- $k \leftrightarrow d$ : "Sarah went to the party if and only if Dani went to the party"

$s$	$d$	$s \leftrightarrow d$
1	1	1
1	0	0
0	1	0
0	0	1