Computational Linguistics: Semantics II

Raffaella Bernardi

KRDB, Free University of Bozen-Bolzano

P.zza Domenicani, Room: 2.28, e-mail: bernardi@inf.unibz.it

Contents

1. Recall: Formal Semantics Main questions

The main questions are:

1. What does a given sentence mean?
2. How is its meaning built?
3. How do we infer some piece of information out of another?

1.1. Building Meaning Representations

To build a meaning representation we need to fulfill three tasks:

Task 1 Specify a reasonable **syntax** for the natural language fragment of interest.

Task 2 Specify semantic representations for the **lexical items**.

Task 3 Specify the **translation** of constituents **compositionally**. That is, we need to specify the translation of such expressions in terms of the translation of their parts, parts here referring to the substructure given to us by the syntax.

Moreover, when interested in Computational Semantics, all three tasks need to be carried out in a way that leads to computational implementation naturally.

1.2. Lambda-calculus: Functional Application

Summing up:

- FA has the form: Functor(Argument). E.g. $(\lambda x.love(x, mary))(john)$
- FA triggers a very simple operation: Replace the λ-bound variable by the argument. E.g. $(\lambda x.love(x, mary))(john) \Rightarrow love(john, mary)$

Correction of Lab exercise .

2. Extending the lexicon

Before we have left open the question of what does an expression like “a” contribute to? FOL does not give us the possibility to express it’s meaning representation. We will see now that instead lambda terms provide us with the proper expressivity.

2.1. Quantified NP

a) Every Mexican student of the EM in CL attends the Comp Ling course.

b) No Mexican student of the EM in CL attend the Logic course.

a) means that if Sergio and Luis constitute the set of the Mexican students of the EM in CL, then it is true for both of them that they attend the Comp. Ling course.

b) means that for none of the individual members of the set of Mexican student of the EM in CL it is true that he attends the Logic course.

What is the interpretation of "every Mexican student" and of "no Mexican student"?

Individual constants used to denote specific individuals cannot be used to denote quantified expressions like "every man", "no student", "some friends".

Quantified-NPs like "every man", "no student", "some friends" are called non-referential.

2.2. Generalized Quantifiers

A Generalized Quantifier (GQ) is a set of properties, i.e. **a set of sets-of-individuals**.

For instance, "every man" denotes the set of properties that every man has. The property of "walking" is in this set iff every man walks. For instance,

$$\begin{array}{lcl} [\![\texttt{man}]\!] & = & \{a, b, c\}; \\ [\![\texttt{fat}]\!] & = & \{a, b, c, d\}; \\ [\![\texttt{dog}]\!] & = & \{d\}; \\ [\![\texttt{run}]\!] & = & \{a, b\}; \\ [\![\texttt{jump}]\!] & = & \{b, c, d\}; \\ [\![\texttt{laugh}]\!] & = & \{b, d\}; \end{array}$$

Which is the interpretation of "every man"?

$$[\![\texttt{every man}]\!] = \{X | [\![\texttt{man}]\!] \subseteq X\} = \{\{a, b, c\}, \{a, b, c, d\}\}.$$

2.3. Generalized Quantifiers

$$
\begin{array}{lcl}
[\![\texttt{no man}]\!] & = & \{X \subseteq E \mid [\![\texttt{man}]\!] \cap X = \emptyset\}. \\
[\![\texttt{some man}]\!] & = & \{X \subseteq E \mid [\![\texttt{man}]\!] \cap X \neq \emptyset\}. \\
[\![\texttt{every man}]\!] & = & \{X \subseteq E \mid [\![\texttt{man}]\!] \subseteq X\}. \\
[\![\texttt{man which VP}]\!] & = & [\![\texttt{man}]\!] \cap [\![\texttt{VP}]\!].
\end{array}
$$

Therefore, determiners are as below:

$$
\begin{array}{lcl}
[\![\texttt{no N}]\!] & = & \{X \subseteq E \mid [\![\texttt{N}]\!] \cap X = \emptyset\}. \\
[\![\texttt{some N}]\!] & = & \{X \subseteq E \mid [\![\texttt{N}]\!] \cap X \neq \emptyset\}. \\
[\![\texttt{every N}]\!] & = & \{X \subseteq E \mid [\![\texttt{N}]\!] \subseteq X\}. \\
[\![\texttt{N which VP}]\!] & = & [\![\texttt{N}]\!] \cap [\![\texttt{VP}]\!].
\end{array}
$$

Generalized quantifiers have attracted the attention of many researchers working on the interaction between logic and linguistics.

New exercises Ex. 5

3. Remarks

- No lab this afternoon.
- Seminar:

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Working Day on "IT and Deaf People"
Monday April 14, 2008
10:30 -- 12:40
Seminar Room, CS Faculty, Free U. of Bozen-Bolzano
Piazza Domenicani 3, Bolzano
<http://www.inf.unibz.it/~gennari/wd>
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