Translation of acetatosILN\_TL-aula4a.pdf

4.1

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—

Semantic Knowledge

—



What is meaning? Can it be represented and processed? 

How can we computationally model

semantic knowledge? 

How does semantic processing articulate with

syntactic processing? 4.2

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Semantic

knowledge

q

Semantic knowledge is the knowledge of

the meaning of expressions…

q

….what is the

meaning

of natural language expressions? 4.3

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Well then, the meaning…

Pedro sees João with the telescope

4.4

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Semantic knowledge

q

Knowing the meaning of a declarative sentence f from language L

is knowing the truth conditions of f

•

i.e. the conditions in which f is true

•

i.e. how the world is when f is true



By the way: what is the meaning of imperative and interrogative sentences? q

Describing the meaning of f is describing (/representing/determining)

the truth conditions of f



like any description, the description of the truth conditions can only be made

with … a language. 4.5

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Semantic representation

q

Description



the description of the truth conditions of the sentences of the object language

is made in a language called meta-language

q

Meta-language



The meta-language can be another natural language



Exs:

•

The sentence

O Pedro é careca

is true iff Pedro is bald. •

The sentence

O Pedro é careca

is true if and only if Pedro is bald. •

…

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Description, Translation and Synonymy

q

Translation



The significant part of the description of the meaning of f from L consists

in the translation of f in the meta-language L’:

•

Object language L

:

Portuguese

•

Meta-language L’

:

English

•

Sentence

:

O Pedro é careca

•

Sem. repr. :

O Pedro é careca

is true iff Pedro is bald

•

Translation

:

Pedro is bald

q

Synonymy



f' from L' is a translation of f from L if and only if f and f' are synonymous



Pedro é careca

;

Pedro is bald

;

C(p);

careca(pedro)

;... 4.7

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Meta

-

language

q

Formal representation of meaning



translation into a meta-language of semantic description... 

... into a formal language, in practical terms

q

Language of semantic representation



well-defined semantics (...through another meta-language)



sufficient expressive power



support for the automation of reasoning

q

Options



FOL, First Order Logic



GQ, Generalized Quantification Logic



DRT, Discourse Representation Theory



... 4.8

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FOL: Syntax

q

Syntax (

quick sketch

)



F

®

Fatom | F Cnt F | Quant Var, ...,Var F | ¬F | (F)



Fatom

®

Pred

n

(Term,...,Term) [with n terms]



Term

®

Cons | Var



Cnt

® L

| V |

Þ



Quant

® "

|

$



Cons

®

pedro

|

rita

|

boby

|

xpto

| ... 

Var

®

x

|

y

| ... 

Pred1

®

P

|

Q

|

Blonde

|

Man

|

Woman

| ... 

Pred2

®

Loves

|

Saw

| ... 4.9

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FOL: Semantics

q

Semantics (

quick sketch

)



pedro

denotes Pedro



Blonde

denotes the set of blonde objects



Loves

denotes the binary relation between two sets (lovers and loved ones)



F1

Ù

F2 is true iff F1 is true and F2 is true



F1 V F2 is true iff F1 is true or F2 is true



¬F is true iff F is not true



F1

Þ

F2 is true iff if F1 is true then F2 is true



$

xPred(x)

is true iff there is at least one object in the set

denoted by

Pred



"

xPred(x)

is true iff all objects belong to the set

denoted by

Pred



what is the semantics of

Pred(x)

… ? 4.10

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Some translations

Rita is blonde. Blonde(rita)

Pedro loved Rita. Loves(pedro,rita)

Rita did not love Pedro and Pedro loved himself. ¬(

Loves(rita, pedro))

Ù

Loves(pedro,pedro)

There is at least one man (in this city, in this universe,...). $

x(Man(x))

4.11

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More translations

Everyone is blonde. "

x(Blonde(x))

Everyone was a blonde man. "

x(Man(x)

L

Blonde(x))

All men are blonde. "

x(Man(x)

Þ

Blonde(x))

All women love a man. "

x (Woman(x)

Þ $

y

(Man(y)

L

Love(x,y)))

$

y (Man(y)

L "

x (Woman(x)

Þ

Love(x,y)))

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Þ

Calculation of representation

q

What we already know how to do…



how to represent the meaning of (some) lexical items

•

Pedro

pedro

•

Rita

rita

•

loves

Love( , )



how to represent the meaning of some sentences:

q

What we still don't know how to do…



How to represent the meaning of their constituents? 

How to combine these (sub-)semantic representations? 4.13

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Compositionality

q

Principle of compositionality:



the meaning of an expression is a function of the meaning of its

subexpressions and the way they are combined



Also a natural imperative imposed by the finiteness of mental resources

q

Formal tool



a tool that dispenses us from creating "a symbol per function": i.e. dispenses from specifying

a priori

(in the lexicon) the semantic representation

of each of an infinite number of grammatical expressions

4.14

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Lambda formalism

q

Rationale:



Allows "creating functions from the combination of other functions already

applied to variables"



Allows to "open the arity" of an expression



Allows to change the syntactic category of an expression

q

Abstraction-

l



Example 1:

Example2:

•

Predicate

Blonde

l

x.(Blonde(x)

L

Bald(x))

•

Sentence

Blonde(x)

•

Predicate

l

x.Blonde(x)

•

Sentence

l

x.Blonde(x)(pedro)

q

Reduction-

b



Example:

•

sentence

l

x.Blonde(x)(pedro)

•

sentence

Blonde(pedro)

4.15

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A

simple

compositional

semantics

for

a

fragment

of

Portuguese

q

Lexical semantics

Form

Meaning



V

®

loves

Pred

® l

y. l

x. Love(x,y)



Nprop

®

Pedro

Cons

®

pedro



Nprop

®

Rita

Cons

®

rita

4.16

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A simple compositional semantics

q

Structural semantics



Semantic rule 1, for SN:

•

If SN

®

Det Nprop and the semantic representation of Nprop is Nprop',

then the semantic representation of SN is Nprop'. 

Semantic rule 2, for SV:

•

If SV

®

V SN, the semantic representation of V is V' and that of SN is SN',

then the semantic representation of SV is V'(SN'). 

Semantic rule 3, for F:

•

If F

®

SN SV, the semantic representation of SN is SN' and that of SV is SV',

then the semantic representation of F is SV'(SN'). 4.17

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Example

The Pedro loves the Rita

V

N

D

SN

SV

F

N

D

SN

Love(pedro,rita)

pedro

λ

x. Love(x,rita)

λ

y. λ

x. Love(x,y)

rita

pedro

rita

by

application

of

Rule 2

by

application

of

Rule 3

by

application

of

Rule 1

4.18

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Þ

Automatic

semantic

analysis

q

Encode translations to the metalanguage



Prolog terms

•

ex:

love(X,Y)

q

“Mimic” abstraction-

l



reuse of the infix ^ (arith. exp.: exponent;

setof

: variables

with any value)

•

ex:

Y^X^love(X,Y)

q

Associate each constituent with a translation



extra argument in categorical symbols in the DCG formalism

•

ex:

v(Y^X^love(X,Y)) --> [loves]. q

“Mimic” reduction-

b



instantiation and unification of variables

•

ex:

sv(SV) --> v(SN^SV), sn(SN). 4.19

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Example

sv(SV) --> v(SN^SV), sn(SN). f(F) --> sn(SN), sv(SN^F). sn(N) --> det, n(N). v(Y^X^love(X,Y)) --> [loves]. n(pedro) --> [pedro]. n(rita) --> [rita]. det --> [the]; [the]. | ?- f(LF,[the,pedro,loves,the,rita],[]). LF = love(pedro,rita) ? ;

no

the pedro loves the rita

det

f(love(pedro,rita))

sn(pedro)

sv(X^love(X,rita))

v(Y^X^love(X,Y))

sn(rita)

n(pedro)

n(rita)

det

4.20

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—

Conclusion

—

q

Index



Semantic knowledge



Metalanguage



Compositionality



Automatic semantic analysis

F

How to represent the semantics of remaining quantifiers? What is the purpose of representing meaning? Can it be used

in technological solutions?