Translation of acetatosILN\_TL-aula4b.pdf

4.1

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—

Semantic Processing II

—



How to represent the semantics of quantifiers? 

What is the purpose of meaning representation? Can it be

used in technological solutions? 4.2

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(recap)

q

Meaning representation



translation to a formal language in the final analysis

q

Semantic representation language



"well-defined" semantics, sufficient expressive power, supports

automation of inference and reasoning



Previous class option: FOL + Lambda Formalism

q

Semantic processing



from the syntactic representation, obtain the description of its

meaning, i.e. its truth conditions

(or, "translation" of the sentence to its "logical form")

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Natural Quantification

q

First Order Logic (FOL)



does not have enough expressive power for all quantifiers

of natural language, in particular

most of

(Barwise & Cooper(1981))

q

Generalized quantifier



Syntax:

•

second-order binary predicate that relates two unary predicates,

the restrictor and the scope. 

Semantics (outline):

•

second-order relation between sets of individuals

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Logic

of

Generalized

Quantifiers

(LGQ)

With X\* the set of individuals with property X



syntax:

All(P,Q) (also All(x,P(x),Q(x)))



semantics: all elements of P\* are in Q\*; or P\*

Í

Q\*



syntax: Several(P,Q)



semantics: the intersection between P\* and Q\* is a set with more than one

element; or |P\*

Ç

Q\*|>1



syntax: Most\_of(P,Q)



semantics: |P\*

Ç

Q\*|>|P\*|/2



...etc

4.5

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Examples

FOL vs LGQ

(

format

Q(

x,P

(x),Q(x

)) )

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

x(Man(x))

One(x, U(x), Man(x))

All are blond. "

x(Blond(x))

All(x, U(x), Blond(x))

All were blond men. "

x(Man(x)

L

Blond(x))

All(x, U(x), (Man(x)

L

Blond(x)))

All(x, U(x), (

l

y.((Man(y)

L

Blond(y))(x)))

All men are blond. "

x(Man(x)

Þ

Blond(x))

All(x, Man(x), Blond(x))

All women love a man. "

x (Woman(x)

Þ $

y

(Man(y)

L

Love(x,y)))

All(x, Woman(x), One(y, Man(y), love(x,y)))

$

y (Man(y)

L "

x (Woman(x)

Þ

Love(x,y)))

One(y, Man(y), all(x, Woman(x), love(x,y)))

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Compositional Semantics: Lexicon

q

Lexical semantics

Syntax

Portuguese

Syntax

LGQ

Det

®

all the

Pred

® l

P. l

Q.All(P,Q)

Det

®

one

Pred

® l

P. l

Q.One(P,Q)

V

®

love

Pred

® l

x. l

y.Love(x,y)

Ncom

®

man

Pred

® l

x.Man(x)

Ncom

®

women

Pred

® l

x.Woman(x)

4.7

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Compositional Semantics: Rules

q

Structural semantics



Semantic rule 1:

•

If NP

®

Det Ncom, the semantic representation of Det is Det' and that of N is

N', then the semantic representation of NP is Det'(Ncom'). 

Semantic rule 2:

•

If VP

®

V NP, the sem. representation of V is

l

x. V' and that of NP is NP', then the

semantic representation of VP is

l

x. NP'(V'). 

Semantic rule 3:

•

If S

®

NP VP, the sem. representation of NP is NP' and that of VP is VP', then the

semantic representation of S is NP'(VP'). 

...etc

4.8

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Compositional Semantics: an example

All women love a man. l

P. l

Q.All(P,Q)(

l

x.Woman(x))(

l

P. l

Q.One(P,Q)(

l

x.Man(x))(

l

u. l

y.Love(u,y))

l

P. l

Q.All(P,Q)(

l

x.Woman(x))(

l

Q.One(

l

x.Man(x)

,Q)(

l

u. l

y.Love(x,y))

l

P. l

Q.All(P,Q)(

l

x.Woman(x))(

l

u. One(

l

x.Man(x),

l

y.Love(u,y)

))

l

Q.All(

l

x.Woman(x)

,Q

)

(

l

u.One(

l

x.Man(x),

l

y.Love(u,y)))

All(

l

x.Woman(x)

,

l

u.One(

l

x.Man(x),

l

y.Love(u,y)))

Alternative notation:

All(z, Woman(z), One(w, Man(w), Love(z,w)))

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Automatic Semantic Analysis

q

Implementation in Prolog --

format Q(x,P(x),Q(x))

:

v(Y^X^love(X,Y)) --> [loves];[love]. n(X^man(X)) --> [man] ; [men]. n(X^woman(X)) --> [woman] ; [women]. det((X^Res)^(X^Amb)^all(X,Res,Amb)) --> [all,the];[all,the]. det((X^Res)^(X^Amb)^one(X,Res,Amb)) --> [a];[an]. sn(SN) --> det((X^N)^SN), n(X^N). sv(X^SV) --> v(Y^X^V), sn((Y^V)^SV). f(F) --> sn((X^SV)^F), sv(X^SV). 4.10

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Example

All the women love a man

det((X^Res)^(X^Amb)^all(X,Res,Amb))

all(X,woman(X),a(Y,man(Y),love(X,Y)))

sv(X^a(Y,man(Y),love(X,Y)))

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

sn((Y^Amb)^a(Y,man(Y),Amb)

n(X^woman(X))

n

(X^man(X))

det((X^Res)^(X^Amb)^a(X,Res,Amb))

sn((X^Amb)^all(X,woman(X),Amb))

f(F) --> sn((X^SV)^F), sv(X^SV). sv(X^SV) --> v(Y^X^V), sn((Y^V)^SV). sn(SN) --> det((X^N)^SN), n(X^N). v(Y^X^love(X,Y)) --> [loves];[love]. n(X^man(X)) --> [man] ; [men]. n(X^woman(X)) --> [woman] ; [women]. det((X^Res)^(X^Amb)^all(X,Res,Amb)) --> [all,the];[all,the]. det((X^Res)^(X^Amb)^a(X,Res,Amb)) --> [a];[an]. 4.11

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Conclusion

—

q

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

Generalized quantification

F

We have seen the main ingredients of a representation of the

meaning of natural languages with some sophistication. What is the purpose of meaning representation? Can it be used in

technological solutions? 4.12

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Syntax-Semantics Isomorphism

q

Break of the isomorphism

syntactic predication vs. semantic predication:



syntax: verb is the nuclear predicative in the syntax of a sentence

•

love: V(SN

Subject

, SN

Direct Object

)



semantics:

•

LPO (without generalized quant.s) :

verbal predicate is the nuclear predicative in the semantic repr. of a sentence

– SV'=V'(SN') and F'=VP'(SN')

•

LGQ (with generalized quant.s):

quantifier is the nuclear predicative in the semantic repr. of a sentence

– SV'=

l

x. SN'(V') and F'=SN'(SV')

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Defined Descriptions

q

Defined and undefined descriptions

det((X^Res)^(X^Amb)^the(X,Res,Amb)) --> [the]. det((X^Res)^(X^Amb)^a(X,Res,Amb)) --> [a]. q

Logical form

•

syntax:

The(P,Q), A(P,Q)

•

Semantics (outline):

–

the intersection between P\* and Q\* is a set with one element, or |P\*

Ç

Q\*|=1,

and supposedly this element

is

"identifiable" by the addressee

–

the intersection between P\* and Q\* is a set with one element, or |P\*

Ç

Q\*|=1,

and supposedly this element

is not

"identifiable" by the addressee

q

Anaphora & Proper names

•

element identified as being a cognitively present or

accessible entity, or whose identification is inferable, etc, …

•

How to represent proper names in LGQ?