Introduction to Semantics (EGG Wroclaw 05)

0. Preliminaries

0.1 Semantics vs. pragmatics

<u>Semantics</u> only concerned with *literal* meaning as opposed to non-literal, or situational meaning, most of which is covered by *pragmatics*. (Division of labour)
<u>Examples</u>: irony (= meaning the opposite of what is literally said), can only be accounted for on the basis of literal meaning.

0.2 Ambiguity

What is interpreted is not the (superficial) form but the *expression*. Sometimes the same form may correspond to two expressions.
<u>Homonymy</u>: **book** as a verb and as a noun (moprho-syntactic structure); **bank** (pure disambiguation, no structure: $\mathbf{bank}_1$, $\mathbf{bank}_2$,…)
<u>Structural ambiguity</u>:

(0) ***John hit the donkey with the stick*** **2 constituent structures => expressions**

(0') ***Every man loves a woman.*** **2 LFa => 2 expressions**

Relevant level of structure (Logical Form) may be semantically motivated.

0.3 Lexical vs. logical semantics

<u>Lexical sematics</u> asks: What is the meaning of a given simple expression?
<u>Logical sematics</u> asks: What is the meaning of a complex expression, given its structure and the meanings of the simple expressions it contains?
Answer given in terms of <u>Compositionality</u>:
The meaning of a complex expression is determined by its structure (LF) the meanings of its immediate parts.

1. Sentence meaning

1.1 Basic ideas

- Sentence meanings as starting points, then take meanings of other expressions as contributions to sentence meanings (Frege's strategy).
- Descriptive aspect of sentence meaning:
  sentences describe/characterize/classify situations

(1) **Laura is knocking at the door.**

1.2 Descriptions

Desriptions make a distinction between objects of a given domain:
to describe something as a computer = to put it into the same category with other objects (= computers) and distingushing it from still others (= non-computers).

Mathermatical model:

- domains as *sets*

… satisfying two principles:

Extensionality

Sets A and B are identical as soon as they have the same members.

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Comprehension

For every condition there is a set containing precisely those objects as members that meet the condition.

Notation: $\{x \mid \ldots x\ldots\}$ (= the set of objects x such that $\ldots x\ldots$)

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- distinctions as charateristic functions

A *function from* set A *to* set B is a set of ordered pairs (x,y) ['arrows' $x \to y$] where $x \in A$ and $y \in B$ and such that, for any $x \in A$ there is precisely (= at least and at most) one $y \in B$ such that $(x,y) \in f$.

Notation: f: $A \to B$; 'f is *of type* (AB)'

NB: Ordererd pairs individuated by members and order: $(x,y) = (x',y')$ justincase $x = x'$ and $y = y'$!

A *characteristic function on* a set U (= the domain) is a function from U to $\boldsymbol{t}$, the set of truth values ($\{0,1\}$).

Simplification:

Replace characteristic function by *characterized set*: $\{x \mid f(x) = 1\}$

1.3 Situations

- maximally specific:

A situation talked about (say, *this* situation) has many unknown aspects that are nonetheless *settled*.

- temporally located/limited:

(2) **The German chancellor is a woman.**

false now, probably true in the future; i.e. false *of* this situation, probably true of (some) future situation

- spatially unlimited

… can talk about the president of the US, wherever he is, etc.

Hence:

We may as well identify a situation with the world (at large) at some particular time (interval). BUT NOT WITH THE TIME ITSELF -because situations are:

- not necessarily actual

(3) **The Pope is a woman.**

(4) **The Roman emperor is a woman.**

There is no situation which (3) describes correctly; likewise for (4). Hence (3) and (4) would characterize the same set of situation *unless* …
SOME SITUATIONS ARE NON-ACTUAL (or MERELY POSSIBLE) WORLDS at particular times.

Logical Space (***s***)
… …contains all possibilities, i.e. all possible worlds at particular times (as ordered pairs (w,t)). [Metaphysical simplification: cross-world identity of time]
Terminology: *Index* for point in ***s***

1.4 Main definitions

- The *intension* of a sentence is a function of from ***s*** to ***t***. Hence it is of type (***st***).

Notation: $[\![\mathrm{S}]\!]$

- The *content* of a sentence is the set characterized by its intension.

Notation: $\| \mathrm{S} \|$

- The *extension* of a sentence (relative to some index (w,t)) is the truth value its intension determines at (w,t).

Notation: $[\![\mathrm{S}]\!]^{w,t}$

Terminology:
Among semanticists, 'proposition' denotes both intensions and contents of sentences.

2. *Predication*

2.1 *Content as Contribution*

(1) **Olaf is coughing.**

(2)
‖ **Olaf is coughing** ‖
= {(*w*,*t*) | Olaf is coughing in *w* at *t* }
= ‖ **Olaf** ‖ "+" ‖ **is coughing** ‖

‖ **Olaf** ‖ = $?_1$ ‖ **is coughing** ‖ = $?_2$

(3a) ‖ **Olaf is coughing** ‖ = {(*w*,*t*) | Olaf is coughing in *w* at *t* }
(b) ‖ **Tim is coughing** ‖ = {(*w*,*t*) | Tim is coughing in *w* at *t* }
(c) ‖ **Tom is coughing** ‖ = {(*w*,*t*) | Tom is coughing in *w* at *t* }

Kripke's Hypothesis
‖ **Olaf** ‖ = Olaf , ‖ **Tim** ‖ = Tim , ‖ **Tom** ‖ = Tom ,..
More generally: ‖ ***NN*** ‖ = the bearer of ***NN***

(4)
‖ **Olaf is coughing** ‖
= {(*w*,*t*) | Olaf is coughing in *w* at *t* }
= ‖ **Olaf** ‖ "+" ‖ **is coughing** ‖

‖ **Olaf** ‖ = Olaf   ‖ **is coughing** ‖ = $?_2$

Contents as contributions
(5) ‖ **is coughing** ‖
= ‖ **Olaf is coughing** ‖ "–" ‖ **Olaf** ‖
= {(*w*,*t*) | Olaf is coughing in *w* at *t* } "–" Olaf
= {(*w*,*t*) | ____ is coughing in *w* at *t* }

Contributions as functions
The content of the predicate must contain sufficient information to determine the proposition expressed by the sentence once the content of the subject is provided:

Filling subject content …	*into the predicate content yields …*
Olaf	{(*w*,*t*) | Olaf is coughing in *w* at *t* }
Tim	{(*w*,*t*) | Tim is coughing in *w* at *t* }
Tom	{(*w*,*t*) | Tom is coughing in *w* at *t* }
…	…

Table 1: The content of **is coughing**

The table can be thought of as (representing) a function. This function is taken to be the content of the predicate. More generally:

Frege's strategy G. Frege: *Die Grundlagen der Arithmetik*. Breslau [*sic*] 1884

Unless independently identifiable (by the semanticist), the meaning of an expression ***E*** may be construed as the contribution ***E*** makes to the meaning of (larger) expressions in which ***E*** occurs, i.e. as a function that assigns the meaning of the whole to the meanings of alternative complementary part(s):

from:

| ***Rest*** * ***E*** |

| ***Rest*** | | ***E*** |
= r = **?**

where * is the relevant syntactic combination

to:

| ***Rest***$_1$ * ***E*** | | ***Rest***$_2$ * ***E*** |
= ¶(r_1) = ¶(r_2) ,…

| ***Rest***$_1$ | | ***E*** | | ***Rest***$_2$ | | ***E*** |
= r_1 = ¶ = r_2 = ¶

where f is the function assigning to any |***Rest***| the value |***Rest*** * ***E***|.

NB: Only one of the consituents (immediate parts) may receive its meaning by Frege's strategy.

Semantic composition

If one of the constituent's meaning is obtained by Frege's principle, then the meaning of the whole is obtained by *functional application*:

|***r***| "+" f = f(|***r***|) [= the value f assigns to |***r***|]

Conclusion

The content of the predicate ***is coughing*** – and of predicates in general – is a function from individuals to sets of indices.

2.2 Lambdas

… changed my life (B. Partee)

…	…
x	{(w,t) | x is coughing in w at t }
…	…

Table 2: Typical line of (the table representing) the content of **is coughing**

The typical line contains enough information to completely determine the whole table (and thus the function |**is coughing**|); it may therefore be used as a *name* of the function. the

Notational Convention

If a is a set (type), then:

$[\lambda x_a.\ \ldots x \ldots]$

denotes the function that assigns to every x in $a$whatever object '…x' denotes.

Definition

e is the set of all (possible) individuals (persons, tables, cities, numbers,…).

With these notational conventions…

| **is coughing** | $= [\lambda x_e.\ \{(w,t) \mid x \text{ is coughing in } w \text{ at } t\}]$

Three logical laws concerning λ-notation

- "Law of α-conversion" — general law of variable binding

The 'x' is schematic and can be replaced by any variable y. In particular, '$[\lambda x_a.\ \ldots x \ldots]$' and '$[\lambda y_a.\ \ldots y \ldots]$' denote the same function (provided that variable confusion is avoided):

(α) $[\lambda x_a.\ \ldots x \ldots] = [\lambda y_a.\ \ldots y \ldots]$

Example:

$[\lambda x_e.\ \{(w,t) \mid x \text{ is coughing in } w \text{ at } t\}] = [\lambda y_e.\ \{(w,t) \mid y \text{ is coughing in } w \text{ at } t\}]$

- "Law of β-conversion" — important in applications ['β-reduction']

The value obtained by applying a function $[\lambda x_a.\ \ldots x \ldots]$ to some object A of type a can be described by substituting 'A' for 'x' in the right hand side:

(β) $[\lambda x_a.\ \ldots x \ldots](A) = \ldots A \ldots$

Example:

$[\lambda x_e.\ \{(w,t) \mid x \text{ is coughing in } w \text{ at } t\}]$ (Tom) $= \{(w,t) \mid \text{Tom is coughing in } w \text{ at } t\}$

- "Law of η-conversion" — less important

If 'f' is the name of a function of some type (ab), then f assigns to any x in a the value $f(x)$ and can thus be described by the lambda-term '[λx_a. ¶(x)]':

(η) [λx_a. ¶(x)] $= f$

Example:

$[\lambda y_e.\ [\lambda x_e.\ \{(w,t) \mid x \text{ is coughing in } w \text{ at } t\}](y)] = [\lambda x_e.\ \{(w,t) \mid x \text{ is coughing in } w \text{ at } t\}]$

2.3 Generalizing Frege's strategy

TWO STEPS

- Transfer the notion of extension from sentences to names.

The truth value of a sentence ***S*** can be thought of as (an indicator of) whatever the sentence refers to at a given index i (viz. i itself if ***S*** is true, and nothing otherwise). By analogy, the extension of a name is its bearer.

- Apply Frege's strategy to extensions (in *lieu* of meanings)

As a consequence, the extension of the predicate **is coughing** – and of predicates in general – is a function from individuals to sets of indices, i.e. of type (***et***), e.g.:

*Individual (Type **e**)*	*truth value (**t**)*
Olaf	1
Tim	0
Tom	0
…	…

Table 2: Extension of **is coughing** in a situation (w^*,t^*) in which only Olaf is coughing

Using (and extending) λ-notation:

(*) $[\![$**is coughing**$]\!]^{w^*,t^*}$ = [λx_e. [whether] x is coughing in w^* at t^*]

(This must be understood as a function assigning 1 if the condition in the *whether*-clause is met, and 0 otherwise. [*whether*-convention] In the future, we will omit the '*whether*'.)

Again we obtain functional application as the mode of (extensional) composition:

$[\![$**Olaf is coughing**$]\!]^{w^*,t^*}$

= $[\![$**is coughing**$]\!]^{w^*,t^*}$($[\![$**Olaf**$]\!]^{w^*,t^*}$) — functional application

= [λx_e. x is coughing in w^* at t^*](Olaf) — by (*)

= 1 — by Table 2 + the *whether*-convention

NB. Extensions of predicates correspond to sets of individuals, viz. the sets they characterize; it will turn out to be convenient to think of them as sets.

Intensions

… in general are functions assigning extensions to indices. If ***A*** is any expression:

- $[\![\boldsymbol{A}]\!] = \lambda i_s\, [\![\boldsymbol{A}]\!]^i$

Intensions

… of proper names assign their bearer to any index ; hence they are of type (***se***)

- $[\![$**Alice**$]\!]$ = λi_s Alice — Alice? Who the …

Intensions

… of predicates assign (charateristic functions of) sets of individuals to indices; hence they are of type (***s***(***et***)).

- $[\![$**is coughing**$]\!]$ = [λi_s $[\![$**is coughing**$]\!]^s$]

= [λi_s [λx_e. x is coughing in the world of i at the time of i]] — nested lambdas

= [$\lambda(w,t,)$ [λx_e. x is coughing in w at t]] — notational simplification

References (mostly implicit, or made in class)

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