Semantic composition
Chris Potts, Ling 130a/230a: Introduction to semantics and pragmatics, Winter 2019
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1 Overview

• This handout describes our theory of semantic composition. It’s a bare-bones theory, but still powerful.

• The most important conceptual move is to interpret lexical items as functions. Meanings might not literally be functions, but, following Lewis’s advice, functions at least do what meanings do.

• The grammar is defined by a set of rules for interpreting syntactic structures. Some of these rules come from the optional Heim & Kratzer reading, while others are new. My notation is slightly different (to more strongly suggest a computational perspective), but the underlying ideas are the same as in H&K. (I’ve set up these correspondences largely to try to build some bridges into this advanced optional reading.)

• We need a bunch of rules in order to respect the syntactic structures. However, all the rules just do function application.

• So, in essence, if you know the lexical meanings of your language and you can put them together according to the syntactic rules, then the only other concept you need to be a full-fledged interpreter is function application.

2 Basic semantic objects

2.1 Truth values

I use T for truth and F for falsity. (Heim & Kratzer use 1 and 0, respectively.)

2.2 Universe

\[ U = \{ , , , \} \]
### 3 Characteristic sets and characteristic functions

**Characteristic function of a set**  For a universe of entities $U$ and any set $A \subseteq U$, the characteristic function for $A$ is the function that maps every member of $A$ to $T$ and all members of $(U - A)$ to $F$.

**Characteristic set of a function**  If $f$ is a function into truth values, the characteristic set of $f$ is $\{x \mid f(x) = T\}$

<table>
<thead>
<tr>
<th>Set</th>
<th>Function</th>
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</thead>
<tbody>
<tr>
<td>${\text{Maggie, Homer, Bart, Lisa}}$</td>
<td>$\rightarrow T$</td>
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</tr>
<tr>
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</table>
4 Notation for describing functions

4.1 Functions

\[
\begin{pmatrix}
T & T & T \\
T & T & T \\
T & T & F
\end{pmatrix}
\]

\[
\lambda x \left( \begin{array}{l}
T \text{ if } x \in \{ Maggie, Lisa, Bart, Homer \}, \\
\text{else } F
\end{array} \right)
\]

1. if \( x \in \{ Maggie, Lisa, Bart, Homer \} \)
2. return T
3. else return F

4.2 Function application

\[
\left( \lambda x \left( \begin{array}{l}
T \text{ if } x \in \{ Maggie, Lisa, Bart, Homer \}, \\
\text{else } F
\end{array} \right) \right)(\text{child}) =
\]

T if \( \text{child} \in \{ Maggie, Lisa, Bart, Homer \} \), else F = T

5 Semantic lexicon

5.1 PNs  Type: entities

\[
\begin{align*}
[Maggie] &= \text{Maggie} & [Lisa] &= \text{Lisa} & [Bart] &= \text{Bart} & [Homer] &= \text{Homer}
\end{align*}
\]

5.2 Ns  Type: functions from entities to truth values

(1) \([\text{Simpson}] = \lambda x \left( \text{if } x \in \{ Maggie, Lisa, Bart, Homer \}, \text{else } F \right)\)

(2) \([\text{child}] = \lambda x \left( \text{if } x \in \{ Maggie, Lisa, Bart, Homer \}, \text{else } F \right)\)
(3) \([\text{student}] = \lambda x \left( T \text{ if } x \in \{ \text{student}, \text{person} \}, \text{ else } F \right)\)

(4) \([\text{parent}] = \lambda x \left( T \text{ if } x \in \{ \text{person} \}, \text{ else } F \right)\)

5.3 Intransitive Vs

(5) \([\text{skateboards}] = \lambda x \left( T \text{ if } x \in \{ \text{skateboard} \}, \text{ else } F \right)\)

(6) \([\text{studies}] = \lambda x \left( T \text{ if } x \in \{ \text{student} \}, \text{ else } F \right)\)

(7) \([\text{introspects}] = \lambda x \left( T \text{ if } x \in \{ \text{student}, \text{person} \}, \text{ else } F \right)\)

(8) \([\text{speaks}] = \lambda x \left( T \text{ if } x \in U - \{\text{skateboard}\}, \text{ else } F \right)\)

5.4 Transitive Vs

(9) \([\text{tease}] = \lambda y \left( \left( \lambda x \left( \text{ if } (x, y) \in \{ \text{student}, \text{person} \}, \text{ else } F \right) \right) \right)\)

Type: functions from entities to truth values

Type: functions from entities into functions from entities to truth values
\[ \text{[admires]} = \lambda y \left( \lambda x \left( \text{T if } (x, y) \in \{ \begin{array}{c} \text{John} \\
\text{Mary} \end{array} \}, \text{else F} \right) \right) \]

\[ \text{[loves]} = \lambda y \left( \lambda x \left( \text{T if } (x, y) \in \{ \begin{array}{c} \text{John} \\
\text{Mary} \end{array} \}, \text{else F} \right) \right) \]

5.5 Adjectives

\[ \text{[female]} = \lambda f \left( \lambda x \left( \text{T if } x \in \{ \text{female skateboarder} \} \text{ and } f(x) = \text{T}, \text{else F} \right) \right) \]

\[ \text{[male]} = \lambda f \left( \lambda x \left( \text{T if } x \in \{ \text{male skateboarder} \} \text{ and } f(x) = \text{T}, \text{else F} \right) \right) \]

\[ \text{[hungry]} = \lambda f \left( \lambda x \left( \text{T if } x \in \{ \text{hungry} \} \text{ and } f(x) = \text{T}, \text{else F} \right) \right) \]

\[ \text{[alleged]} = \lambda f \left( \lambda x \left( \text{T if someone claimed that } f(x) = \text{T}, \text{else F} \right) \right) \]

\[ \text{[Springfieldian]} = \lambda f \left( \lambda x \left( \text{T if someone claimed that } f(x) = \text{T}, \text{else F} \right) \right) \]
5.6 Negation

To be completed:

\[
\begin{array}{c|cc}
T & T & F \\
F & T & F \\
\end{array}
\]

5.7 Quantificational determiners

(18) \[
[every] = \lambda f \left( \lambda x \left( T \text{ if } \{ x \mid f(x) = T \} \subseteq \{ x \mid g(x) = T \}, \text{ else } T \right) \right)
\]

(19) \[
[some] = \lambda f \left( \lambda x \left( T \text{ if } \{ x \mid f(x) = T \} \cap \{ x \mid g(x) = T \} \neq \emptyset, \text{ else } F \right) \right)
\]

(20) \[
[no] = \lambda f \left( \lambda x \left( T \text{ if } \{ x \mid f(x) = T \} \cap \{ x \mid g(x) = T \} = \emptyset, \text{ else } F \right) \right)
\]

(21) \[
[most] = \lambda f \left( \lambda g \left( T \text{ if } \frac{|\text{chose}(x) \cap \text{chose}(y)|}{|\text{chose}(x)|} > \frac{1}{2}, \text{ else } F \right) \right)
\]

\[
\text{chose}(x) = \{ x \mid f(x) = T \}
\]

(22) \[
[three] = \lambda f \left( \lambda g \left( T \text{ if } |\text{chose}(x) \cap \text{chose}(y)| \geq 3, \text{ else } F \right) \right)
\]

(23) \[
[few] =
\]
6 Semantic grammar

(NB) Given a syntactic structure \( X \downarrow Y \), \([X] = [Y]\)

(S) Given a syntactic structure \( S \), \([S] = [VP]([PN])\)

(A) Given a syntactic structure \( NP_j \), \([NP_j] = [AP]([NP_i])\)

(N) Given a syntactic structure \( VP_j \), \([VP_j] = [\text{not}]([VP_i])\)

(TV) Given a syntactic structure \( VP \), \([VP] = [V]([PN])\)

(Q1) Given a syntactic structure \( QP \), \([QP] = [D]([NP])\)

(Q2) Given a syntactic structure \( S \), \([S] = [QP]([VP])\)

(With apologies to the morphosyntax of English for providing no do support.)
7 Illustrations

(24) \[ \lambda x \left( \begin{array}{l}
T \text{ if } x \in \{ \text{bart}, \text{student} \}, \text{ else } F
\end{array} \right) = \]

\[ \lambda x \left( \begin{array}{l}
T \text{ if } x \in \{ \text{bart}, \text{student} \}, \text{ else } F
\end{array} \right) \]

(25) \[ \lambda f \left( \begin{array}{l}
\lambda x \left( \begin{array}{l}
T \text{ if } x \in \{ \text{bart}, \text{student} \} \text{ and } f(x) = T, \text{ else } F
\end{array} \right) \end{array} \right) \]

This meaning is correct but would not satisfy the requirement of the homework that all substitutions be performed.
Maggie teases Bart.
every child skateboards

T if \( \{ x \mid [\text{child}](x) = T \} \subseteq \{ x \mid [\text{skateboards}](x) = T \} \), else F

\( \lambda g \left( T \text{ if } \{ x \mid [\text{child}](x) = T \} \subseteq \{ x \mid g(x) = T \}, \text{ else } F \right) \) [skateboards]

\( \lambda f \left( \lambda g \left( T \text{ if } \{ x \mid f(x) = T \} \subseteq \{ x \mid g(x) = T \}, \text{ else } F \right) \right) \) [child]
(31)  
\[(\text{no}) \text{ skateboards}\]  

(32)  
\[(\text{every female}) \text{ studies}\]  

(33)  
\[(\text{a hungry}) \text{ studies}\]