Semantic Theory
week 8 – DRT: Syntax and Interpretation

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Mass nous again (exercise sheet 5, ex. 2)

To interpret mass nouns, we use the model $M = \langle\langle U, \leq_i\rangle, \langle M, \leq_m\rangle, V\rangle$, where:

- $U \cap M = \varnothing$
- $\langle U, \leq_i\rangle$ is an atomic join semi-lattice
- $\langle M, \leq_m\rangle$ is a non-atomic and dense join semi-lattice
- V is a value assignment function

- Variables referring to matters: $\boldsymbol{x}$, $\boldsymbol{y}$, $\boldsymbol{z}$, ...
- A material fusion operation $\oplus_m$ and a material part relation $\lhd_m$ (to be distinguished from $\oplus_i$ and $\lhd_i$, respectively)
- $[\![m(\alpha)]\!]^{M,g} = h([\![\alpha]\!]^{M,g})$, where $\alpha \in WE_e$ is a well-formed expression denoting an individual entity

DRS Syntax

A discourse representation structure (DRS) K is a pair $\langle U_K, C_K \rangle$, where:

- $U_K \subseteq U_D$ and U_D is a set of discourse referents, and
- C_K is a set of well-formed DRS conditions

Well-formed DRS conditions:

• $R(u_1, \ldots, u_n)$	*where:*	R is an n-place relation, $u_i \in U_D$
• $u = v$		$u, v \in U_D$
• $u = a$		$u \in U_D$, a is a constant
• $\neg K_1$		K_1 is a DRS
• $K_1 \Rightarrow K_2$		K_1 and K_2 are DRSs
• $K_1 \vee K_2$		K_1 and K_2 are DRSs

Anaphora and accessibility

Mary knows a professor. If she owns a book, he reads it. ?It fascinates him.

w u s t

w = Mary

professor(u)

knows(w, u)

x y		z v
x = w book(y) owns(x, y)	⇒	reads(z, v) z = u v = y

fascinates(s, t)

t = u

s = **???**

Non-accessible discourse referents

Cases of non-accessibility:

(1) *If a professor owns a book, he reads it. It has 300 pages.*

(2) *It is not the case that a professor owns a book. He reads it.*

(3) *Every professor owns a book. He reads it.*

(4) *If every professor owns a book, he reads it.*

(5) *Peter owns a book, or Mary reads it.*

(6) *Peter reads a book, or Mary reads a newpaper article. It is interesting.*

Accessible discourse referents

The following discourse referents are accessible for a condition:

- DRs in the same local DRS
- DRs in a superordinate DRS
- DRs in the universe of an antecedent DRS, if the condition occurs in the consequent DRS.

We need a formal notion of DRS subordination

Subordination

A DRS K_1 is an immediate sub-DRS of a DRS $K = \langle U_K, C_K \rangle$ iff C_K contains a condition of the form

- $\neg K_1$, $K_1 \Rightarrow K_2$, $K_2 \Rightarrow K_1$, $K_1 \vee K_2$ or $K_2 \vee K_1$.

K_1 is a sub-DRS of K (notation: $K_1 \leq K$) iff

- $K_1 = K$, or
- K_1 is an immediate sub-DRS of K, or
- there is a DRS K_2 such that $K_2 \leq K_1$ and K_1 is an immediate sub-DRS of K (i.e. reflexive, transitive closure)

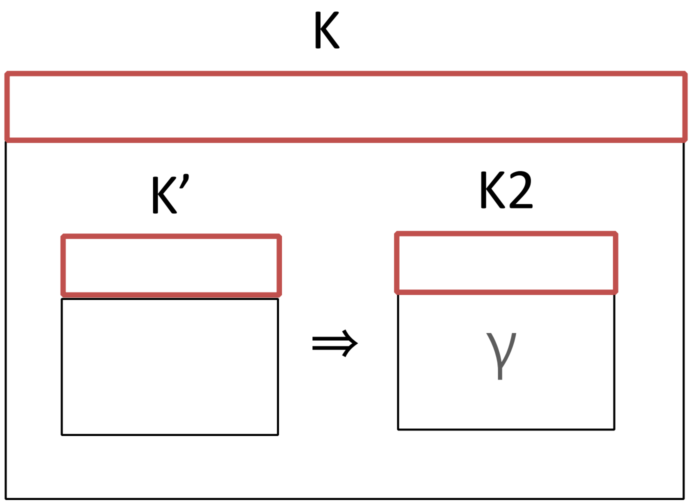
K_1 is a proper sub-DRS of K iff $K_1 \leq K$ and $K_1 \neq K$.

Accessibility

Let K, K_1, K_2 be DRSs such that $K_1, K_2 \leq K$, $x \in U_{K_1}$, $\gamma \in C_{K_2}$

x is accessible from γ in K iff

- $K_2 \leq K_1$ or
- there are $K_3, K_4 \leq K$ such that $K_1 \Rightarrow K_3 \in C_{K_4}$ and $K_2 \leq K_3$



Free and bound variables in DRT

A DRS variable x, introduced in DRS K_1, is bound in global DRS K iff there exists a DRS $K_j \leq K$, such that:

(i) $K_i \leq K_j$;

(ii) $x \in U(K_j)$.

Properness: A DRS is *proper* iff it does not contain any free variables

Purity: A DRS is *pure* iff it does not contain any *otiose declarations* of variables

$x \in U(K_1)$ and $x \in U(K_2)$ and $K_1 \leq K_2$

Playing in the sandbox

PDRT-SANDBOX is a Haskell library that implements Discourse Representation Theory (and its extension Projective Discourse Representation Theory)

http://hbrouwer.github.io/pdrt-sandbox/

PDRT
SANDBOX

- Define your own DRSs, using the internal syntax or the set-theoretic notation
- Show the DRSs in different output formats (boxes, linear boxes, set-theoretic, internal syntax)
- Composition of DRSs (more on that next week)
- Translate DRSs to FOL formulas
- … and more!

DRS Syntax in PDRT-SANDBOX

DRS: `DRS [...] [...]` referents conditions

Referents: `DRSRef “x”, DRSRef “Mary”`

Conditions:

- Relation: `Rel (DRSRel "man") [DRSRef “x"]`
- Identity: `Rel (DRSRel "=") [DRSRef “x”,DRSRef “y"]`
- Negation: `Neg (DRS [...] [...])`
- Implication: `Imp (DRS [...] [...]) (DRS [...] [...])`
- Disjunction: `Or (DRS [...] [...]) (DRS [...] [...])`

Properties: `isPure(DRS [...] [...]), isProper(DRS [...] [...])`

This week's take-home assignment:

- Download and install PDRT-SANDBOX

  http://hbrouwer.github.io/pdrt-sandbox/

- Get familiar with the software by trying out the DRS tutorial

  https://github.com/hbrouwer/pdrt-sandbox/blob/master/tutorials/DRSTutorial.hs

  (you can skip the part about "Combining DRSs" for now)

- Playing in the sandbox: create your own DRSs, and see what else you can do with it.