Semantics and Pragmatics of NLP
Dynamic Semantics and Drawbacks

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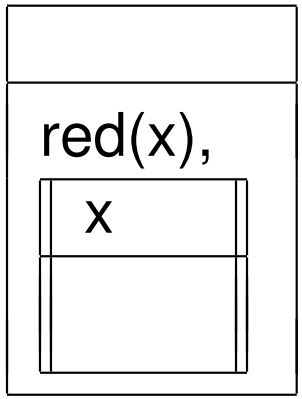
Outline

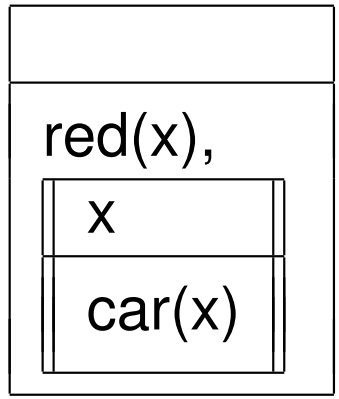
Revision: Construction of LFs for clauses with anaphora

- Pronouns and presupposition triggers introduce special conditions during LF construction:
  - The α-operator (or double-lined boxes).

It is red:



The car is red:



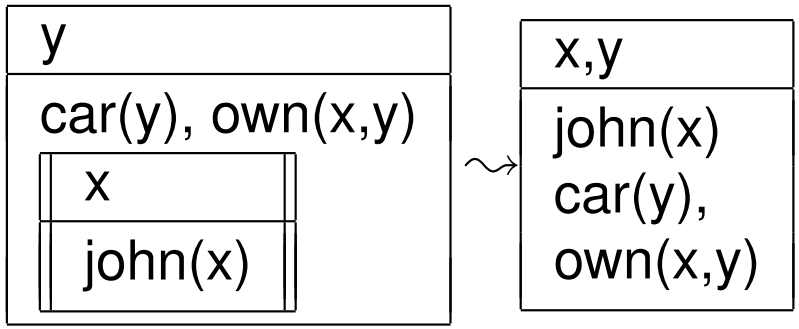
Revision: Discourse Update

- Constructing the LF for the discourse involves:
  1. Constructing the LF of the current clause (using λ-DRSs, α-operator etc);
  2. Merging the result with the LF of the discourse context (using $\oplus$);
  3. Resolving the α-embedded (i.e., anaphoric) conditions.

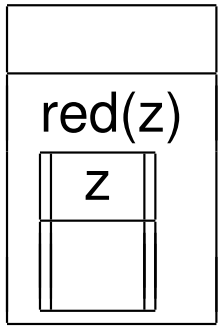
Pronouns:	bind to an accessible antecedent
Presuppositions:	(i) bind to an accessible antecedent (with same content), otherwise (ii) add to the highest accessible site, proviso consistency and informativeness.

Example: *John owns a car. It is red*

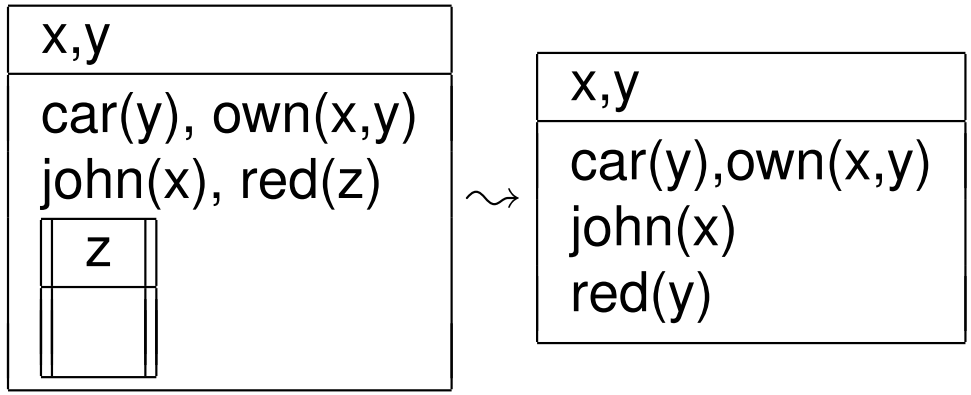
John owns a car:



It is red:

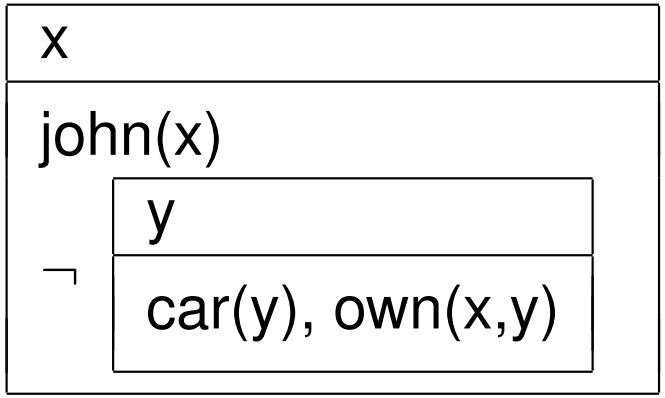


John owns a car.
It is red:

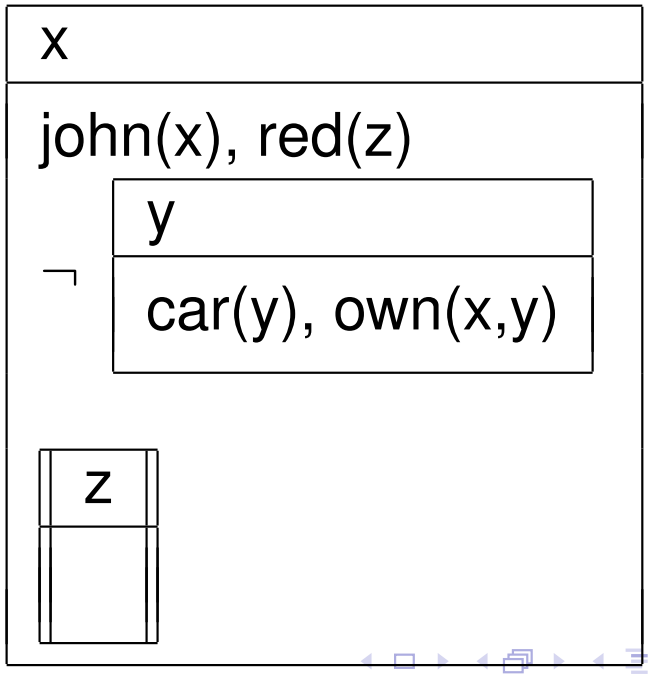


Example: *John doesn't own a car. ??It is red*

John doesn't own a car:

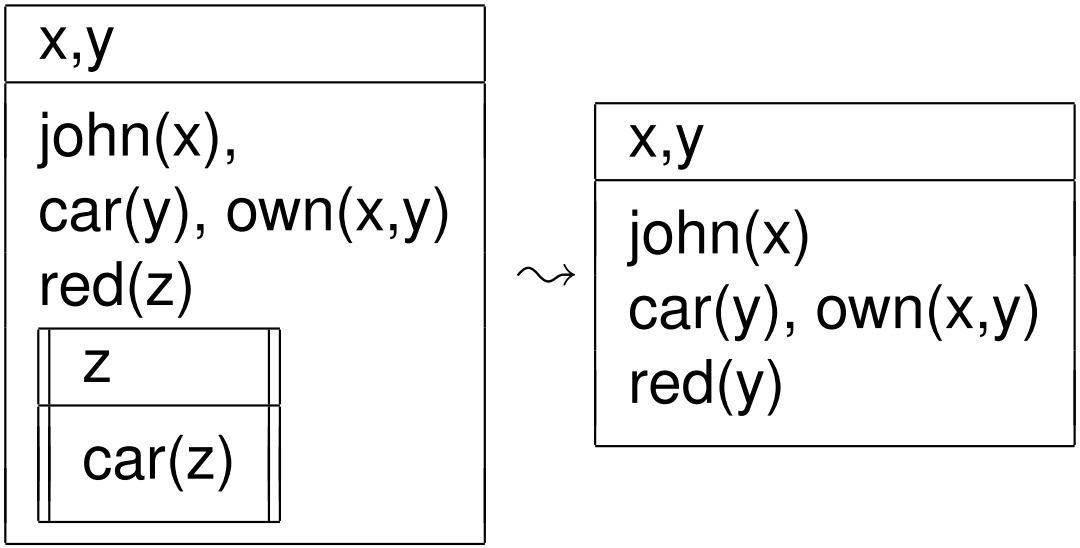


John doesn't own a car.
It is red.

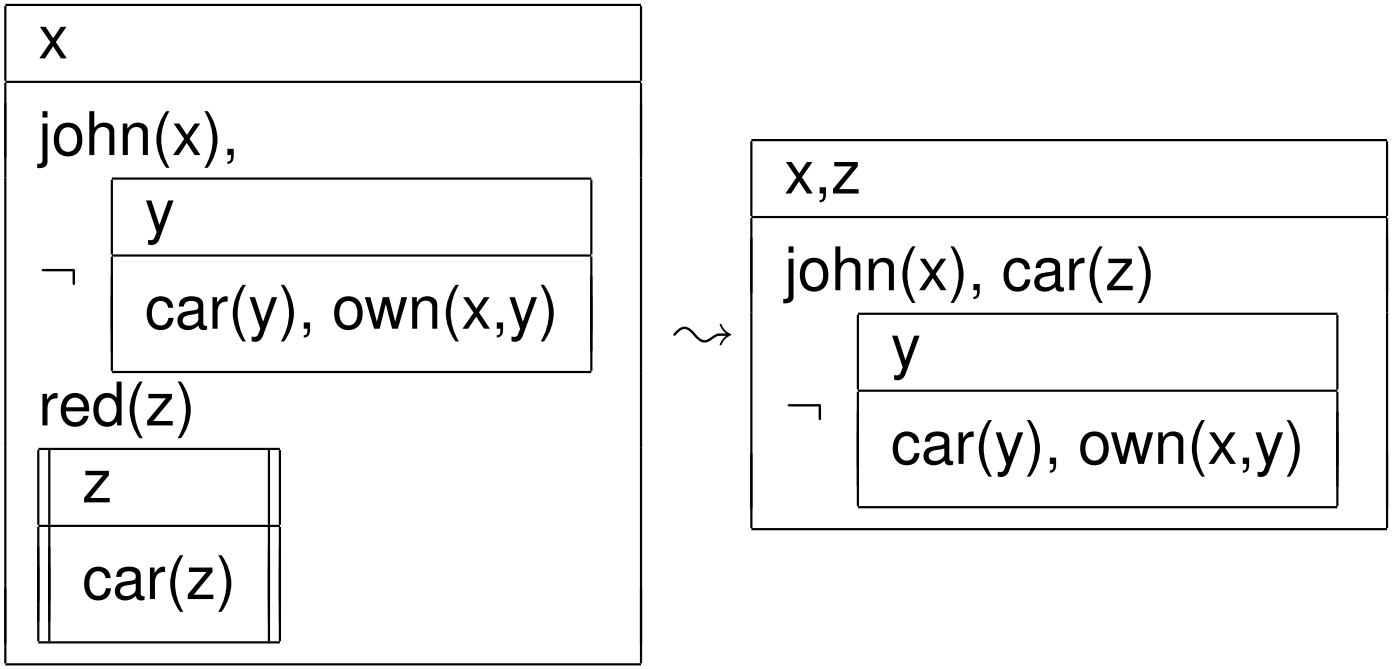


Unresolvable!

Example: *John owns a car. The car is red.*



Example: *John doesn't own a car. The car is red.*



Trouble ahead!

- Can already see constraints on accommodation are too weak. . .

Handling Tense in Discourse

(1) John came in. He sat down. The room was dark.

Observations: Events move time line forward; States temporally overlap the events.

Explanations: Tense is anaphoric!

- Syntax produces:
  Event sentences: $t_1 \prec t_2, e \subseteq t_2, t_1 =?, t_2 \prec n$
  State sentences: $overlap(s, t), t =?, t \prec n$
- Discourse Update:
  - $\oplus$ and then the reference time is identified with the prior one.

Semantics of DRSs: *Context Change Potential*

Treat utterances as *actions*!

- DRSs *relate* an input context to an output context.
- A context is a set of *variable assignment functions*!
- The output context is always a subset of the input context
  - More discourse amounts to strictly more semantic information
- If $f[K]g$, then g *extends* f
  - $dom(f) \subseteq dom(g)$ and $\forall x \in dom(f), f(x) = g(x)$
- Introduction of new discourse referents *transform* the input context;
  DRS conditions impose *tests* on the input context.

The Truth Definition

$$
\begin{array}{lll}
f[\langle U, \emptyset \rangle]g & \textit{iff} & f \subseteq g \wedge dom(g) = dom(f) \cup U \\
f[R(x_1, \cdots, x_n)]g & \textit{iff} & f = g \wedge (f(x_1), \cdots, f(x_n)) \in I(R) \\
f[\neg K]g & \textit{iff} & f = g \wedge \neg \exists h \, f[K]h \\
f[K \Rightarrow K']g & \textit{iff} & f = g \wedge \forall h \, f[K]h \rightarrow \exists \, i \, h[K']i \\
f[K \vee K']g & \textit{iff} & f = g \wedge \exists \, h \, f[K]h \vee \exists h' \, f[K']h' \\
f[K \oplus \langle \emptyset, \gamma \rangle]g & \textit{iff} & f[K]g \wedge g[\gamma]g
\end{array}
$$

- Use two variable assignment functions instead of one.
- Makes sense of what's accessible (output functions not defined for inaccessible referents).

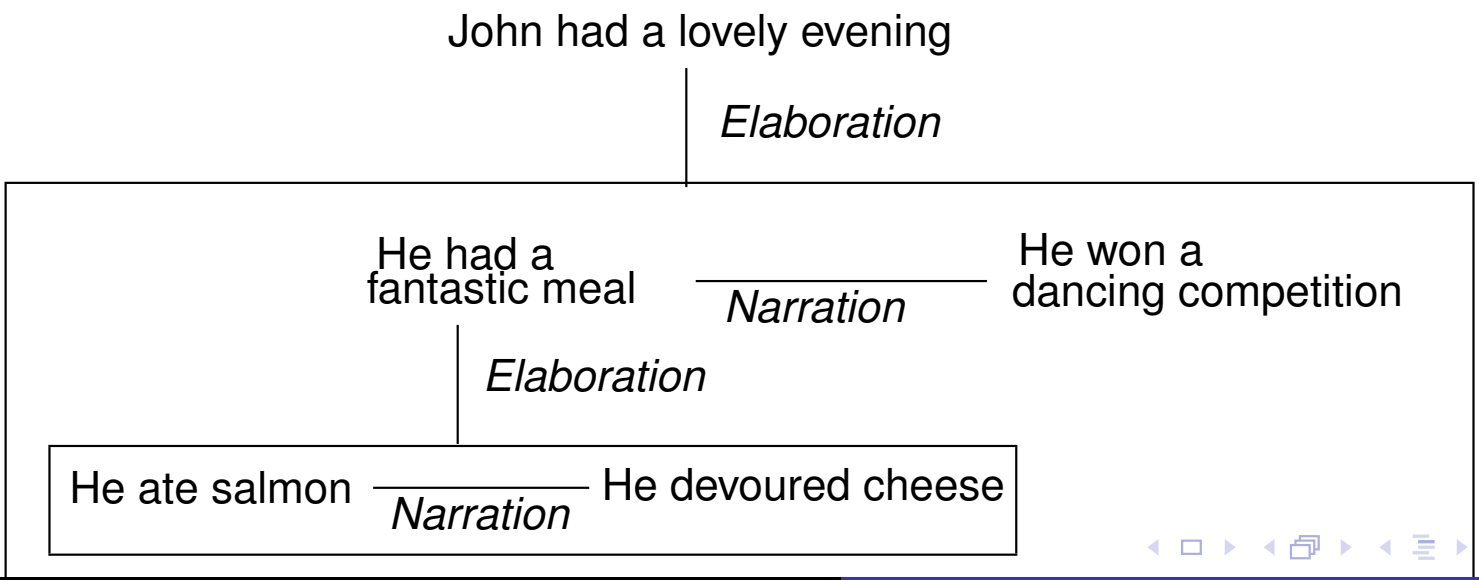
Problems: Pronouns

Accessibility in DRT both over-generates and under-generates antecedents to anaphora.
Constraints too weak:

(2) a. John took an engine to Dansville.
b. He picked up a boxcar.
c. ??It had a broken fuel pump.

More Over-generation. Solution: Right-Frontier Constraint

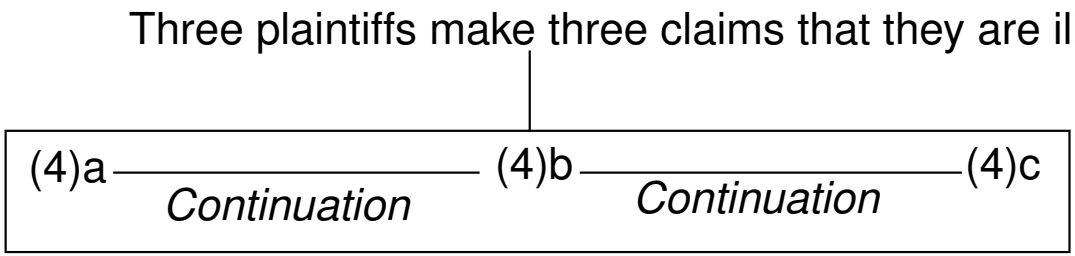
(3)
a. John had a great evening last night.
b. He had a great meal.
c. He ate salmon.
d. He devoured lots of cheese.
e. He won a dancing competition.
f. ??It was a beautiful pink.



Abstract Anaphora

(4)
a. One plaintiff complained of sex discrimination.
b. Another complained of racial discrimination.
c. A third complained of no pay rise for five years.
d. But the jury didn't believe **it**.

- No accessible discourse referents of right semantic type.
- But adding them replaces under-generation with over-generation.
- Right-frontier to rescue again; so need rhetorical structure!



Constraints too Strong

(5)
a. John said that Mary cried.
b. But Jane did.
b′ Jane did too.

- *Mary cried* is inaccessible, but this gives preferred reading of (5)ab.
- Changing rhetorical relation changes how the VP ellipsis is resolved.

Prefer interpretations that maximise discourse coherence.

Problems: Temporal Anaphora

(6) a. Max fell. John helped him up.
b. Max fell. John pushed him.

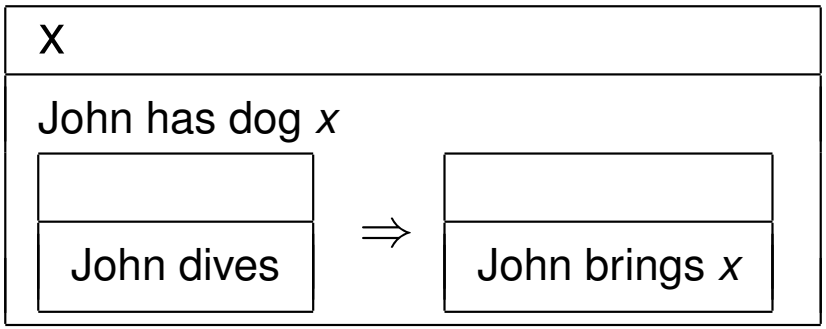
Rhetorical relations necessary:

(7) Max switched off the light.
The room became dark.
He drew the blinds.

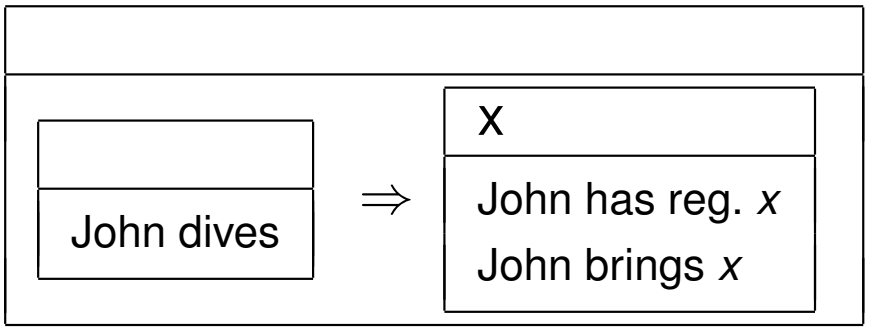
Problems: Presuppositions

(8) a. If John scuba dives, he'll bring his dog.
b. If John scuba dives, he'll bring his regulator.

Wide scope:



Narrow scope:



- The scope depends on what makes most 'rhetorical sense'
- World knowledge (cf Beaver) is not enough!

(9) I doubt that the knowledge that this logic paper was written by a PC will confound the editors.

Discourse Structure and Lexical Disambiguation

(10)
a. A: Did you buy the apartment?
b. B: No, but we rented it.
b′ B: Yes, but we rented it.

(11)
a. The judge asked where the defendant was.
b. The clerk said he was drinking in the pub across the street.
c. The bailiff found him slumped beneath the *bar*.
c′ But the bailiff found him slumped beneath the *bar*.

Things in Common

1. Resolving anaphoric dependencies (and other forms of underspecification) depends upon and interacts with rhetorical structure.
2. So rhetorical relations must be part of logical form.

Ramifications:

1. Need to enrich the language with rhetorical relations and their dynamic semantics.
2. Need to make LF construction much more complex, because rhetorical relations are inferred through commonsense reasoning.

Conclusions

- Dynamic semantics offers an elegant way of thinking about the meaning of discourse.
- Logical structure affects the interpretation of anaphora (i.e., words like *if*, *not*, *every*, *might*...).
- But logical structure isn't enough;
  you need rhetorical structure too.
- Adding rhetorical relations to LF impacts on LF construction;
- it must involve commonsense reasoning with linguistic and non-linguistic knowledge.
- So pragmatics interleaved with LF construction (cf. Levinson, 2000).