Foundations of Natural Language Processing
Lecture 19b
Representing Discourse Coherence

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So Far

- Understanding discourse involves identifying the coherence relations
  - Narration, Explanation, Background, Contrast, Parallel, QA, Correction. . .

  that connect its parts.

- Inferring coherence relations influences
  - resolution of pronouns and elided constructions
    gesture, temporal and spatial inference
    agreement, disagreement, plausible deniability

  and *vice versa*.

Now: How do we formally represent the meaning of discourse?

SDRT: The logical form (LF) of monologue

LF consists of:

1. Set A of labels $\pi_1, \pi_2, \ldots$
   (each label stands for a segment of discourse)

2. A mapping $\mathcal{F}$ from each label to a formula representing its content.

3. Vocabulary includes coherence relations; e.g., *Elaboration*(π_1, π_2).

LFs and Coherence

Coherent discourse is a single segment of rhetorically connected subsegments. More formally:

- The partial order over A induced by $\mathcal{F}$ has a unique root.

An Example

π_1: John can open Bill's safe.
π_2: He knows the combination.

π_0 : *Explanation*(π_1, π_2)
π_1 : ιx(*safe*(x) & *possess*$(x,$ *bill*$)$ & *can*(*open*$(e_1,$ *john*$, x)$)
π_2 : ιy(*combination*(y) & *of*(y, x) & *knows*(*john*$, y)$)

- Bits in red are specific values that go beyond content that's revealed by linguistic form.
- They are inferred via commonsense reasoning that's used to construct a maximally coherent interpretation.

Unpacking its truth conditions

π_0 : *Explanation*(π_1, π_2)
π_1 : ιx(*safe*$(x) \wedge$ *possess*$(x,$ *bill*$) \wedge$ *can*(*open*$(e_1,$ *john*$, x))$
π_2 : ιy(*combination*$(y) \wedge$ *of*$(y, x) \wedge$ *knows*(*john*$, y))$

[$\mathcal{F}(\pi_0)$**]**iff **[**$Explanation(\pi_1, \pi_2)$**]**
iff $\mathcal{F}(\pi_1) \wedge \mathcal{F}(\pi_2) \wedge \varphi_{Expl}(\pi_1, \pi_2)$
iff ιx(*safe*$(x) \wedge$ *possess*$(x,$ *bill*$) \wedge$ *can*(*open*$(e_1,$ *john*$, x)) \wedge$
ιy(*combination*(y) & *of*$(y, x) \wedge$ *knows*(*john*$, y)) \wedge$
$\wedge cause(e_{\pi_2}, e_{\pi_1})$

SDRT: Logical form of dialogue Lascarides and Asher (2009)

- LF tracks all current public commitments for each agent, including commitments to coherence relations.

(1) a. M (to K and S): Karen 'n' I're having a fight,
b. M (to K and S): after she went out with Keith and not me.
c. K (to M and S): Wul Mark, you never asked me out.

Turn	M	K
1	π_{1M} : *Explanation*(a, b)	$\emptyset$
2	π_{1M} : *Explanation*(a, b)	π_{2K} : *Explanation*$(a, b) \wedge$ *Explanation*(b, c)

Dishonesty

Asher and Lascarides (2011)

(2) a. P: Do you have any bank accounts in Swiss banks?
b. B: No, sir.
c. P: Have you ever?
d. B: The company had an account there for 6 months.

Turn	Prosecutor	Bronston
1	$a : \mathcal{F}(a)$	$\emptyset$
2	$a : \mathcal{F}(a)$	π_{2B} : *Answer*(a, b)
3	π_{3P} : *Continuation*(a, c)	π_{2B} : *Answer*(a, b)
4	π_{3P} : *Continuation*(a, c)	π_{4B} : *Answer*$(a, b) \wedge$ *Continuation*$(a, c) \wedge$ *Indirect-Answer*(c, d)

1. Plausible Deniability: Must test rigorously whether it's safe to treat the implied answer as a matter of public record.

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4	$\pi_{3P} : \mathit{Continuation}(a, c)$	$\pi_{4B} : \mathit{Answer}(a, b) \wedge \mathit{Continuation}(b, d)$

1. Plausible Deniability: Must test rigorously whether it's safe to treat the implied answer as a matter of public record.

2. Neologism proof equilibria: distinguishes (2)d vs. "only".

Summary

- The LF of discourse should feature coherence relations
  - Rooted and recursive set of labels, each associated with content
- A coherent discourse is a discourse segment in which each of its parts is connected to another part with a coherence relation.
- Coherence relations can be assigned truth conditions and so support automated inference.

Next Time: Computational methods for constructing formal semantic representations of discourse