

Computational Discourse

Textual Coherence

- John hid Bill's car keys. He was drunk.
 - John hid Bill's car keys. He likes spinach.
- ➔ Why one is more coherent than the other?
- ➔ Can we come up with an algorithm to determine which is more coherent than the other?

Textual Coherence

- John went to his favorite music store to buy a piano.
 - He had frequented the store for many years.
 - He was excited that he could finally buy a piano.
 - He arrived just as the store was closing for the day.
-
- John went to his favorite music store to buy a piano.
 - It was a store John had frequented for many years.
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- Two entities --- John and the store: Depending on the sentence structure, the focus differs
 - Entity-based coherence (Centring Theory)

Discourse

- Definition
 - Discourse is a *coherent* structured group of textual units (e.g., sentences)
- Monologues
 - Speaker/writer + hearer/reader
- Dialogues
 - Human-human
 - Human-computer
 - Conversational agent

Discourse exhibits structure

Writers use linguistic device to make certain discourse structure

- e.g., cue phrases, paragraphs, content flow

Speakers also use linguistic device to make certain discourse structure

- e.g., intonation, gesture, cue phrases

Readers/Listeners comprehend discourse by recognizing this structure

Discourse Relations

- Discourse relations (Coherence relations) specify the relations between sentences or clauses. Due to these relations, two adjacent sentences can look coherent.
- What is the discourse relation between the following two sentences?

→ John hid Bill's car keys. He was drunk.

(in comparison to)

John hid Bill's car keys. He likes spinach.

Discourse Relations

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- What is the discourse relation between the following two sentences?
- *“Explanation” relation*
 - ➔ John hid Bill’s car keys. He was drunk.

(in comparison to)

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More Discourse Relations

- Elaboration

- Dorothy was from Kansas. She lived on the Kansas prairies.

- Result

- The tin woodman was caught in the rain. His joints rusted.

- Parallel

- The scarecrow wanted some brains. The tin woodsman wanted a heart.

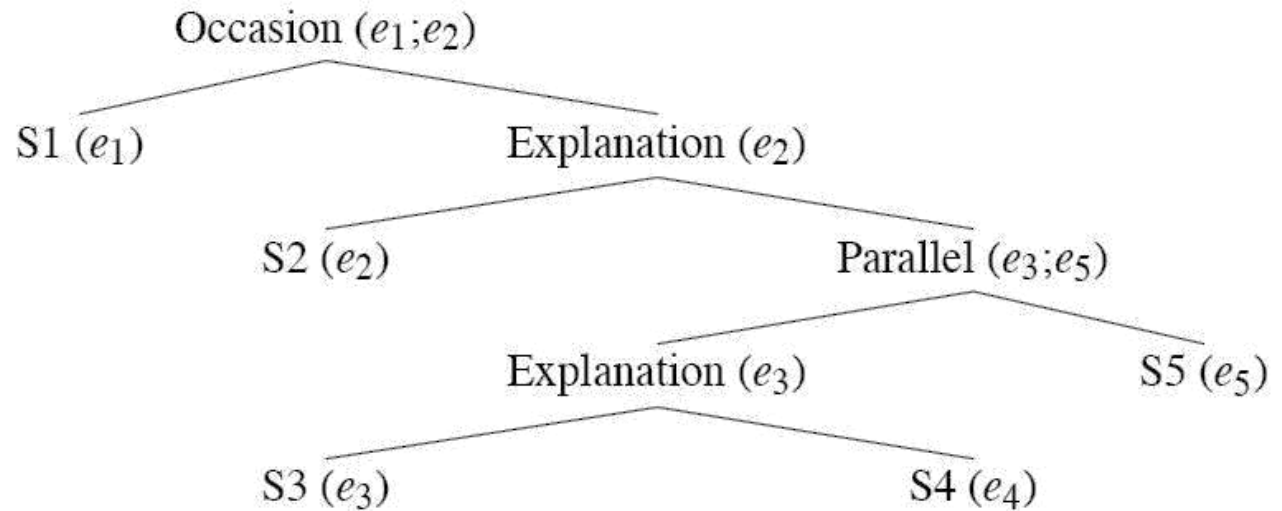
- Occasion

- Dorothy picked up the oil-can. She oiled the Tin Woodman's joints.

Discourse Relations: Exercise

- Explanation
 - Elaboration
 - Result
 - Parallel
 - Occasion
- John went to the bank to deposit the paycheck. (e1)
 - He then took a train to Bill's car dealership. (e2)
 - He needed to buy a car. (e3)
 - The company he works for now isn't near any public transportation. (e4)
 - He also wanted to talk to Bill about their softball league. (e5)

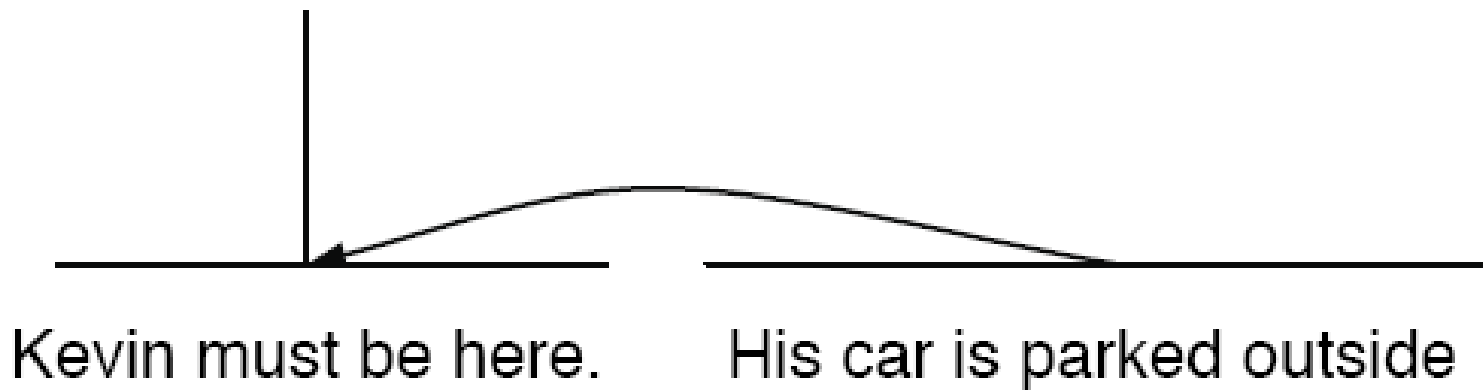
Discourse parsing



- John went to the bank to deposit the paycheck. (e1)
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Rhetorical structure theory (RST)

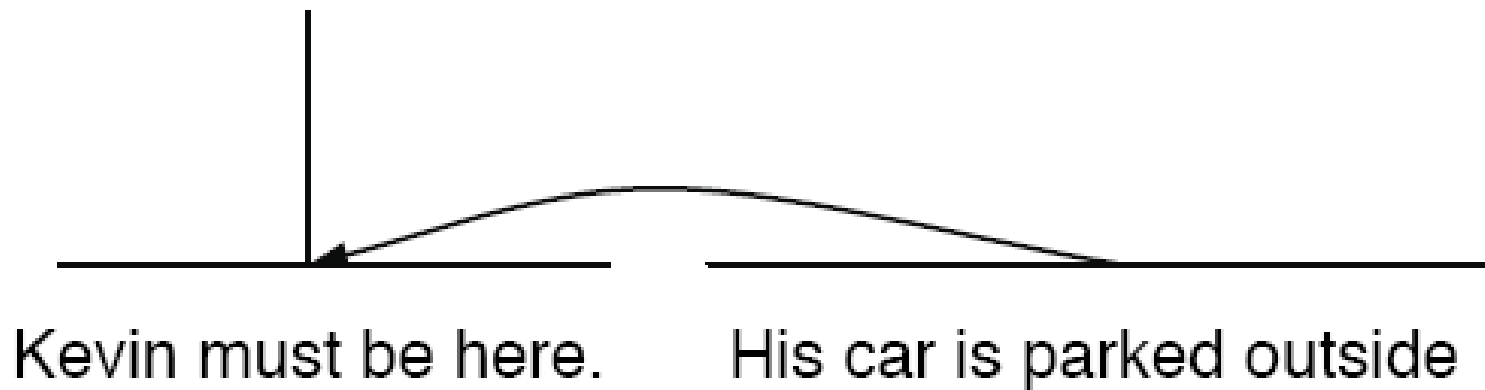
- **N**ucleus – the central unit, interpretable independently.
- **S**atellite – less central, interpretation depends on N
- Mann and Thompson, 1987
- RST relation is formally defined by a set of constraints on the nucleus and satellite, with respect to the goals/beliefs/effects of the writer (W) and the reader (R)



Rhetorical structure theory (RST)

- **N**ucleus – the central unit, interpretable independently.
- **S**atellite – less central, interpretation depends on N

Relation Name:	Evidence
Constraints on N:	R might not believe N to a degree satisfactory to W
Constraints on S:	R believes S or will find it credible
Constraints on N+S:	R's comprehending S increases R's belief of N
Effects:	R's belief of N is increased



Rhetorical structure theory (RST)

- RST TreeBank (Carlson et al., 2001) defines 78 different RST relations, grouped into 16 classes.

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Examples of RST relations (Carlson & Marcu (2001))

- Elaboration (S, N)
 - [The company wouldn't elaborate]
 - [citing competitive reasons]
- Attribution (S, N)
 - [Analysts estimated,]
 - [that sales at U.S. stores declined in the quarter, too]
- Background (S, N)
 - [T is the pointer to the root of a binary tree.]
 - [Initialize T.]

Examples of RST relations (Carlson & Marcu (2001))

- Elaboration (S, N)

[The company wouldn't elaborate]_N

[citing competitive reasons]_S

- Attribution (S, N)

[Analysts estimated,]_S

[that sales at U.S. stores declined in the quarter, too]_N

- Background (S, N)

[T is the pointer to the root of a binary tree.]_S

[Initialize T.]_N

Examples of RST relations (Carlson & Marcu (2001))

- Contrast (N, N)

[The priest was in a very bad temper,]_N

[but the lama was quite happy.]_N

- List (N, N)

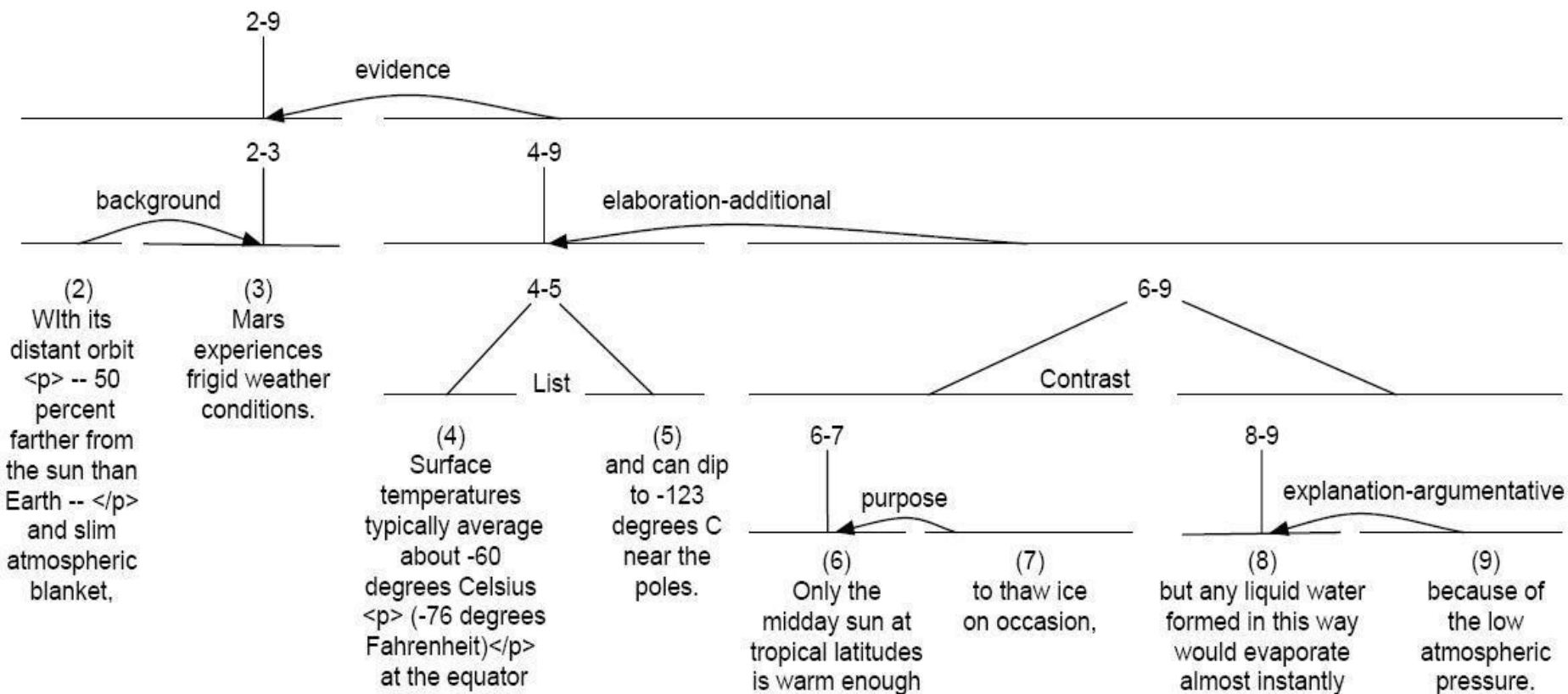
[Billy Bones was the mate;]_N

[Long John, he was quartermaster]_N

Discourse Parse Tree for an excerpt from *Scientific American* (Marcu (2000))

- With its distant orbit-50 percent farther from the sun than Earth-and slim atmospheric blanket, Mars experiences frigid weather conditions. Surface temperatures typically average about -60 degrees Celsius (-76 degrees Fahrenheit) at the equator and can dip to -123 degrees C near the poles. Only the midday sun at tropical latitudes is warm enough to thaw ice on occasion, but any liquid water formed in this way would evaporate almost instantly because of the low atmospheric pressure.

Discourse Parse Tree for an excerpt from *Scientific American* (Marcu (2000))



Discourse Parsing

- Two related problems:
 - Discourse Segmentation
 - Discourse Relation Classification
- Automatic discourse parsing is a very hard problem. (open research problem)
- Check out Penn Discourse Treebank (<http://www.seas.upenn.edu/~pdtb/index.shtml>) for some of recent research, including downloadable discourse parsers

Discourse Segmentation

- loosely speaking, segmenting a given document into a sequence of subtopics.
- The unit of segmentation can be a sentence, or a clause, or even a set of sentences. (depending on how the result of discourse segmentation will be used.)
- Useful for
 - IR
 - summarization
 - information extraction
 - question answering

Discourse Segmentation:

-- **Discourse Marker** based Approach

- Broadcast News Segmentation: suppose you have a transcript of broadcast news
 - *good evening, I'm <PERSON>*
 - typically the beginning of segments
 - *joining us now is <PERSON>*
 - typically the beginning of segments
 - *Coming up*
 - the end of segments
- ➔ Above phrases that are indicative of discourse segments are called as **Discourse Markers** or **Cue Phrases**

Discourse Segmentation:

-- **Cohesion** based Approach (Halliday & Hasan, 1976)

- Lexical cohesion

- Use of the same word

→ Before winter I built a chimney, and shingled the sides of the house...I have thus a tight shingled and plastered house.

- Use of synonyms, hypernyms

→ Peel, core and slice the pears and the applies. Add the fruit to the skillet.

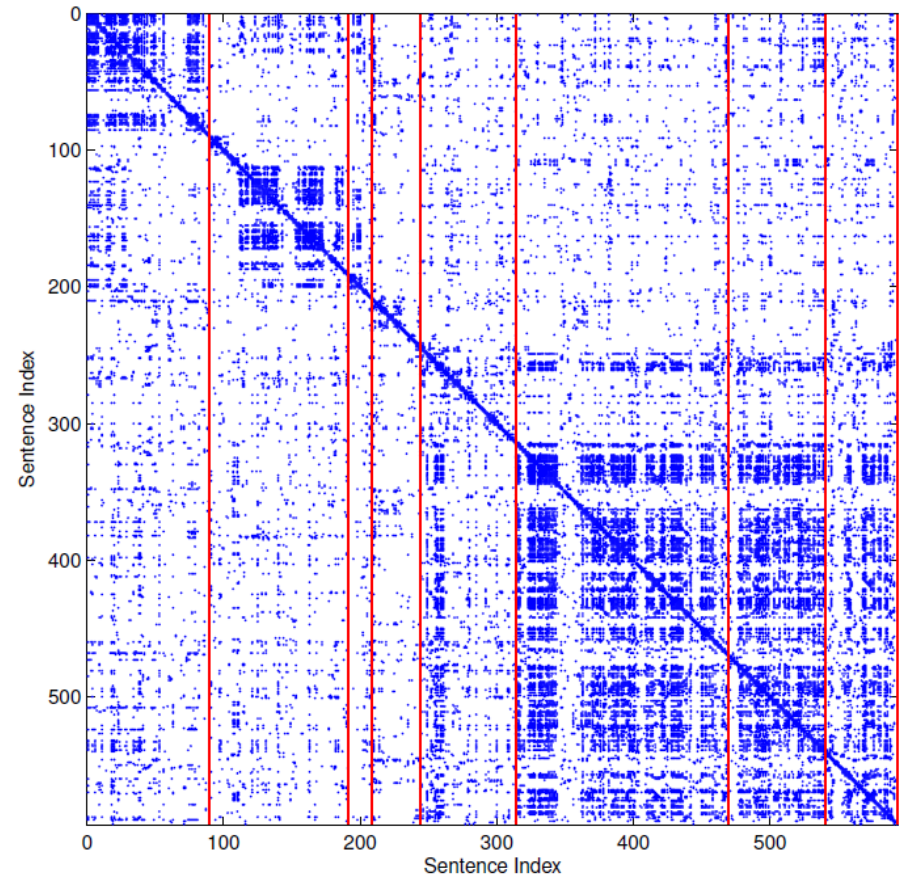
- Non-lexical cohesion

- **Anaphora** structure

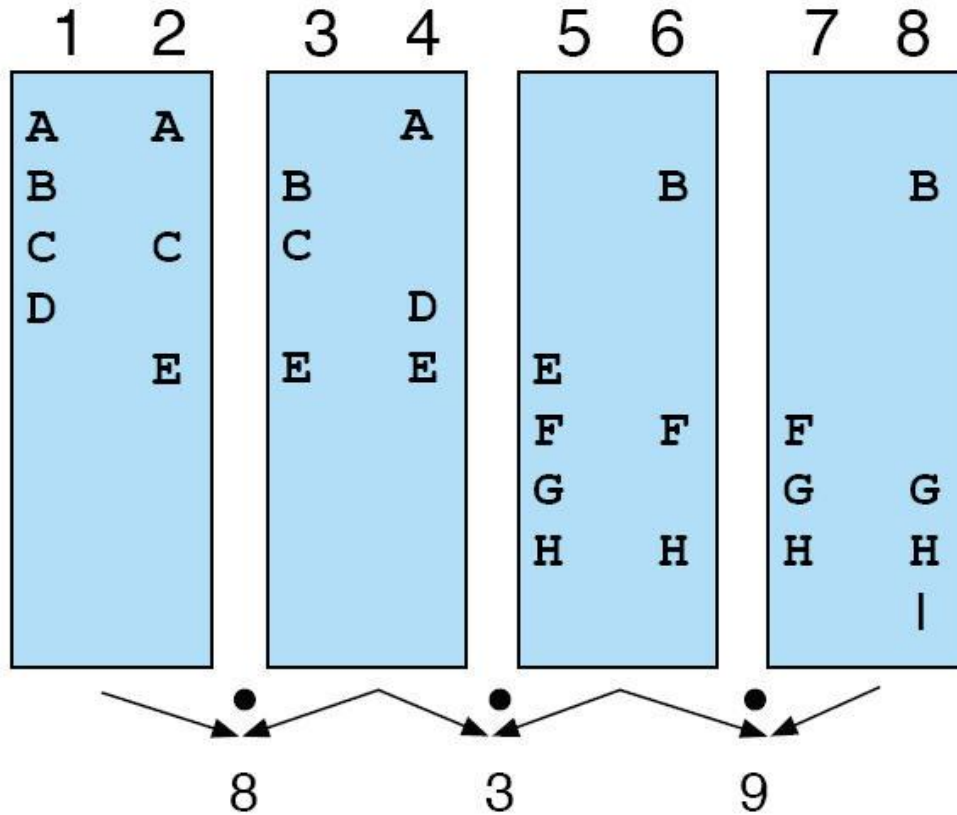
→ John went to the bank to deposit the paycheck. He then took a train to Bill's car dealership.

DotPlot Representation

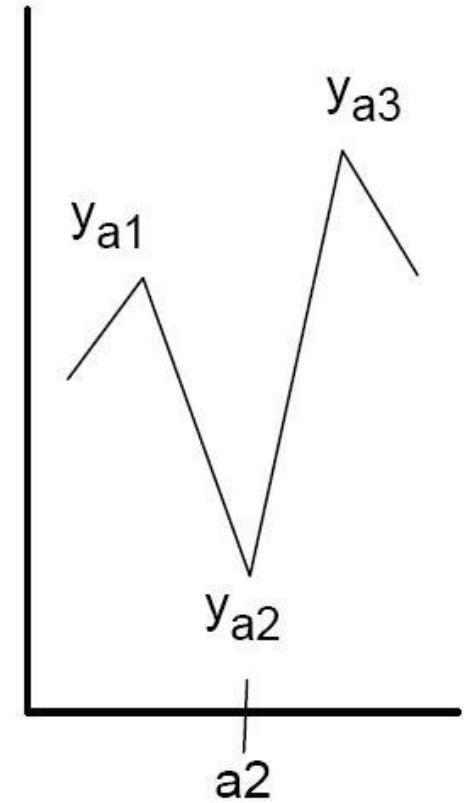
- Change in lexical distribution indicates topic change (Hearst (1994))
- (i,j) – similarity between sentence i and sentence j



TextTiling Algorithm (Hearst, 1997)



(a)



(b)

Discourse Marker (Cue Phrase)

- A **cue word/phrase** is a word or phrase that functions to signal discourse structure, especially by linking together discourse segments.
- e.g., *although, but, for example, yet, with, and, well, oh*
- Discourse Markers are useful for both
 1. Discourse Segmentation
 2. Discourse Relation Classification

Discourse Marker (Cue Phrase)

- Some discourse markers are ambiguous between “discourse use” V.S. “sentential (non-discourse) use”
 - **With** its distant orbit, Mars exhibits frigid weather conditions.
 - We can see Mars **with** an ordinary telescope.
- Some discourse markers can be used more than one discourse relations
 - “because” can indicate CAUSE, EVIDENCE
 - “but” can indicate CONTRAST, ANTITHESIS, CONCESSION
- Some discourse relations can appear without using any discourse markers.