Text Coherence

Computational Linguistics

Coherence

- John hid Bill's car keys. He was drunk.
- ??John hid Bill's car keys. He likes spinach.

What makes a text coherent?

- Discourse structure
  - In a coherent text the parts of the discourse exhibit a sensible ordering and hierarchical relationship
- Rhetorical structure
  - The elements in a coherent text are related via meaningful relations ("coherence relations")
- Entity structure ("Focus")
  - A coherent text is **about** some entity or entities, and the entity/entities is/are referred to in a structured way throughout the text.

Conventions of Discourse Structure

- Differ for different genres
  - Academic articles:
    - Abstract, Introduction, Methodology, Results, Conclusion
  - Newspaper stories:
    - Inverted Pyramid structure:
      - Lead followed by expansion, least important last
  - Textbook chapters
  - News broadcasts
  - NB: We can take advantage of this to 'parse' discourse structures

Discourse Segmentation

- Simpler task: Separating document into *linear sequence of subtopics*
- Applications
  - Information retrieval
    - Automatically segmenting a TV news broadcast or a long news story into sequence of stories
    - Audio browsing (e.g. of voicemail)
  - Text summarization
  - Information extraction
    - Extract information from a coherent segment or topic
  - Question Answering

Cohesion-Based Segmentation

- Sentences or paragraphs in a subtopic are cohesive with each other
- But not with paragraphs in a neighboring subtopic
- So, if we measured the cohesion between every neighboring sentences
  - We might expect a ‘dip’ in cohesion at subtopic boundaries.

What makes a text coherent?

- Appropriate sequencing of subparts of the discourse -- discourse/topic structure

- ***Appropriate use of coherence relations between subparts of the discourse -- rhetorical structure***

- Appropriate use of referring expressions

Applications of Coherence Metrics

- **Text Generation:**
  - concept-to-text generation
  - summarization, text simplification
  - question answering, machine translation
  - essay grading
- **Text Understanding**
  - Improving coreference resolution
- **Potential uses**
  - automatic evaluation tool for text quality
  - during system development (avoids repeated human evaluations)

Hobbs '79: Coherence Relations

- Result
  - Infer that the state or event asserted by S0 causes or could cause the state or event asserted by S1.

The Tin Woodman was caught in the rain. His joints rusted.

- Explanation
  - Infer that the state or event asserted by S1 causes or could cause the state or event asserted by S0.

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

- Parallel
  - Infer p(a1, a2..) from the assertion of S0 and p(b1,b2…) from the assertion of S1, where ai and bi are similar, for all i.

The Scarecrow wanted some brains. The Tin Woodman wanted a heart.

- Elaboration
  - Infer the same proposition P from the assertions of S0 and S1.

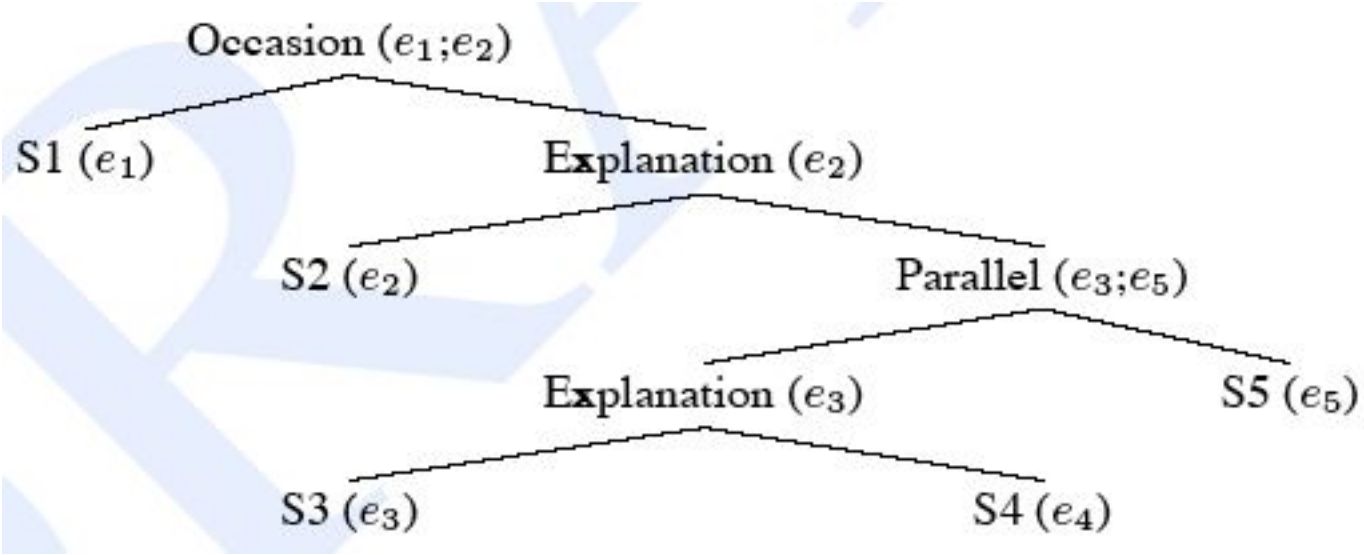
Dorothy was from Kansas. She lived in the midst of the great Kansas prairies.

- Occasion
  - A change of state can be inferred from the assertion of S 0 , whose final state can be inferred from S 1 , or or a change of state can be inferred from the assertion of S 1 , whose initial state can be inferred from S 0

John bought an Acura. He drove to the ballgame.

Coherence Relations

John went to the bank to deposit his paycheck. (S1)
He then took a train to Bill's car dealership. (S2)
He needed to buy a car. (S3)
The company he works for now isn't near any public transportation. (S4)
He also wanted to talk to Bill about their softball league. (S5)



What makes a text coherent?
Entity-based Coherence

- Appropriate sequencing of subparts of the discourse -- discourse/topic structure

- Appropriate use of coherence relations between subparts of the discourse -- rhetorical structure

- ***Appropriate use of referring expressions***

Centering Theory: Grosz, Joshi and Weinstein, 1995

- The way entities are introduced and discussed influences coherence
- Entities in an utterance are ranked according to salience.
  - Is an entity pronominalized or not?
  - Is an entity in a prominent syntactic position?
- Each utterance has one center (≈topic or focus).
  - Coherent discourses have utterances with common centers.
- Entity transitions capture degrees of coherence
  - (e.g., in Centering theory CONTINUE > SHIFT).

Claim: Entity coherence:

Discourses without a clear 'central entity' feel less coherent

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.

He was excited that he could finally buy a piano.

It was closing just as John arrived.

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Concepts and definitions, I

- Every UTTERANCE U in a discourse (segment) DS updates the LOCAL FOCUS - a PARTIALLY RANKED set of discourse entities, or FORWARD-LOOKING CENTERS (CFs)
- An utterance U in discourse segment DS updates the existing CF set by replacing it with the set of CFs REALIZED in U, CF(U,DS) (usually simplified to CF(U))
- The most highly ranked CF realized in utterance U is CP(U)

(1) u1. Susan gave James a pet hamster.

CF(u1) = [Susan,James,pet hamster]. CP(u1) = Susan

(2) u2. She gave Peter a nice scarf.

CF(u2) = [Susan,Peter,nice scarf]. CP(u2) = Susan

Concepts and Definitions,II: The CB

- The BACKWARD-LOOKING CENTER of utterance U_i,
- $CB(U_i)$,
- is the highest-ranked element of $CF(U_{I-1})$ that is realized in U_i

The CB: Examples

(1) u1. Susan gave James a pet hamster.

CF(u1) = [Susan,James,pet hamster]. CB = undefined CP=Susan

(2) u2. She gave Peter a nice scarf.

CF(u2) = [Susan,Peter,nice scarf]. CB=Susan. CP=Susan

NB: The CB is not always the most ranked entity of the PREVIOUS utterance

(2') u2. He loves hamsters.

CF(u2) = [James,hamsters]. CB=James. CP=James

… or the most highly ranked entity of the CURRENT one

(2'') u2. Peter gave her a nice scarf.

CF(u2) = [Peter,Susan, nice scarf]. CB=Susan. CP=Peter

Constraint 1

CONSTRAINT 1 (STRONG): All utterances of a segment except for the first have exactly one CB

CB UNIQUENESS: Utterances have at most one CB

ENTITY CONTINUITY: For all utterances of a segment except for the first, $CF(U_i) \cap CF(U_{i-1}) \neq \emptyset$

CONSTRAINT 1 (WEAK): All utterances of a segment except for the first have AT MOST ONE CB

Claims of the theory: Local salience and pronominalization

- Grosz et al (1995): the CB is also the most salient entity. Texts in which other entities (but not the CB) are pronominalized are less felicitous

(1) a. Something must be wrong with John.

b. He has been acting quite odd.

c. He called up Mike yesterday.

d. John wanted to meet him quite urgently.

(2) a. Something must be wrong with John.

b. He has been acting quite odd.

c. He called up Mike yesterday.

d. He wanted to meet him quite urgently.

Rule 1

RULE 1: if any CF is pronominalized, the CB is.

Claims of the theory: Preserving the ranking

- Discourses without a clear 'central entity' feel less coherent

(1) a. John went to his favorite music store to buy a piano.
b. He had frequented the store for many years.
c. He was excited that he could finally buy a piano.
d. He arrived just as the store was closing for the day.

(2) a. John went to his favorite music store to buy a piano.
b. It was a store John had frequented for many years.
c. He was excited that he could finally buy a piano.
d. It was closing just as John arrived.

Transitions

- Grosz et al.: utterances are easier to process
  - if they preserve CB of previous utterance or
  - if CB(U) is also CP(U).

CONTINUE: U_i is a continuation if $CB(U_i) = CB(U_{i-1})$, and $CB(U_i) = CP(U_i)$

RETAIN: U_i is a retain if $CB(U_i) = CB(U_{i-1})$, but $CB(U_i)$ is different from $CP(U_i)$

SHIFT: U_i is a shift if $CB(U_i) \neq CB(U_{i-1}$

Utterance classification

(0) u0. Susan is a generous person.

CF(u0) = [Susan] CB = undefined CP = Susan.

(1) u1. She gave James a pet hamster.

CF(u1) = [Susan,James,pet hamster]. CB = Susan CP=Susan

CONTINUE:

(2) u2. She gave Peter a nice scarf.

CF(u2) = [Susan,Peter,nice scarf]. CB=Susan. CP=Susan CONTINUE

Utterance classification, II

(0) u0. Susan is a generous person.

CF(u0) = [Susan] CB = undefined CP = Susan.

(1) u1. She gave James a pet hamster.

CF(u1) = [Susan,James,pet hamster]. CB = Susan CP=Susan

SHIFT:

(2') u2. He loves hamsters.

CF(u2) = [James]. CB=James. CP=James SHIFT

Utterance classification, III

(0) u0. Susan is a generous person.

CF(u0) = [Susan] CB = undefined CP = Susan.

(1) u1. She gave James a pet hamster.

CF(u1) = [Susan,James,pet hamster]. CB = Susan
CP=Susan

RETAIN:

(2'') u2. Peter gave her a nice scarf.

CF(u2) = [Peter,Susan, nice scarf]. CB=Susan.
CP=Peter RETAIN

Rule 2

RULE 2: (Sequences of) continuations are preferred over (sequences of) retains, which are preferred over (sequences of) shifts.

Summary of the claims

CONSTRAINT 1: All utterances of a segment except for the first have exactly one CB

RULE 1: if any CF is pronominalized, the CB is.

RULE 2: (Sequences of) continuations are preferred over (sequences of) retains, which are preferred over (sequences of) shifts.