Theories of discourse and dialogue and their applications

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Slides borrowed from Advaith Siddharthan and Julia Hirschberg

Lecture overview
- Coherence and cohesion
- Centering theory
- Rhetorical structure theory and applications
- Dialogue

Terminology
- Coherence
  - Is text interpretable by the reader?
  - Mental/semantic phenomenon (reader-centric)
- Cohesion
  - Textual phenomenon
  - Use of linguistic devices to link discourse elements
  - Contributes to coherence

Cohesion
- Conjunctive (Intentional) Approaches
  - Model: Rhetorical relations between text spans
  - Linguistic devices: coordination/subordination/cue phrases
  - Dominant theory: RST (Mann and Thompson, 1988)
- Referential (Attentional) Approaches
  - Model: discourse focus and changes in focus
  - Linguistic devices: pronouns, referring expressions, voice
  - Dominant theory: Centering (Grosz et al, 1995)

Centering theory
- Consecutive utterances are linked
  - by the entities mentioned in then
  - the forms of the entity mention (pronoun, NP)
- Forward looking centers (Un)
  - A list ranked by salience
  - SUBJ>IND OBJ>OBJ>OTHER
- Backward looking centers (Un+1)
  - The highest ranked entity from Un realized in Un+1

Example (Hudson-D’Zmura 1988)
- 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.
- John went to his favorite music store to buy a piano. It was a store John had frequented for many years. He was excited he could finally buy a piano. It was closing just as John arrived.
Transitions

<table>
<thead>
<tr>
<th>Cb(Ui) = Cp</th>
<th>Cb(Ui) ≠ Cp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continue</td>
<td>Smooth shift</td>
</tr>
<tr>
<td>Retain</td>
<td>Rough shift</td>
</tr>
</tbody>
</table>

Continue > Retain > Smooth Shift > Rough Shift

Applications of centering

- Uses for generation by computers
  - Choice of anaphora/referring expressions
  - Sentence ordering
- Uses for analyses by computers
  - Anaphora resolution
  - Assessment of text cohesion

Evaluation of writing skills (Miltskaki and Kukich 2000)
- 100 GMAT essays
- Marked for centering transitions
- High percentage of ROUGH shifts correlates with low essay score

Automatic models of local coherence (Barzilay & Lapata 2005)
- Grid representation of text
  - Rows correspond to sentences
  - Columns indicate the type of occurrence of a given entity
    - S: subject
    - O: object
    - X: neither subject nor object
    - -: does not occur in the sentence
- Use automatic co-reference resolution to equate for example Microsoft Corp, Microsoft, the company, it.

Results: pairwise ranking accuracy

<table>
<thead>
<tr>
<th>Model</th>
<th>Ordering</th>
<th>Summarization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coreference+Syntax+Salience</td>
<td>87.3</td>
<td>68.8</td>
</tr>
<tr>
<td>Coreference+Salience</td>
<td>86.9</td>
<td>62.5</td>
</tr>
<tr>
<td>Syntax+Salience</td>
<td>83.4</td>
<td>81.3</td>
</tr>
<tr>
<td>Coreference+Syntax</td>
<td>76.5</td>
<td>75.0</td>
</tr>
</tbody>
</table>

Tasks
- Text ordering
- Evaluating summary coherence

Features
- The percentage of each transition type
  - SS, SO, S-, XX etc
- Salience
Rhetorical structure theory

- Online intro: http://www.sfu.ca/rst
- Mann and Thompson (1988)
  ... for every part of a coherent text, there is some function, some plausible reason for its presence, evident to readers...
  - RST models intentional structure
  - Every span of text is linked to the rest of the discourse by an RST relation
  - Originally 24 relations: motivation, antithesis, background, elaboration, circumstance, contrast...
  - RST does not consider referential relations

Main ideas: text structure

- Text spans are linked by RST relations
- Text spans are of two types
  - Nucleus: more essential to the author’s purpose
  - Satellite: often incomprehensible without the nucleus
- A text is a hierarchical structure of text spans connected by relations

Analysis of the title and abstract from the beginning of a Scientific American article

Uses of RST

- Text generation
  - Description of tourists sites/museum artifacts
  - Tutoring systems
- Automatic summarization
  - Deleting satellites for shorter summaries
  - Identifying important claims in legal summaries, patent applications
- Evaluation of student essays
- Analysis of scientific articles

Automatic grading of student essays (Bernstein et al 2003)

- Part of standardized tests
- Expensive to grade—can the task be automated
- Yes!
  - A system assigned score coincides with that of a human as often as two different humans assign the same score
  - One of the graders is a machine

Essay structure

- Introduction
- Thesis statement
- Main points (supporting the statement)
  - Elaboration of each point
- Conclusion

→ Detecting organizational problems can be used to give user feedback
Analysis of scientific articles

- Overall predictable global structure
  - Introduction
  - Method
  - Results
  - Discussion
  - Conclusion
- Makes searching more efficient
  - In a Psycholinguistics paper, where do you quickly find the number of experimental subjects?
  - In a Chemistry paper, where do you look for spectroscopy tables?

Argumentative Zoning
Teufel and Moens 1999

- BACKGROUND Generally accepted knowledge
- OTHER Specific other work
- OWN Methods, results, future work
- AIM Specific research goal
- CONTRAST Comparison, weakness of other solution
- BASIS work that has been improved

Uses for summary lists

- Aim
  - In this work we propose a method for establishing the probability of such previously unseen word combinations using available information on "most similar" words.
  - …
- Basis
  - We present a different method that takes as a starting point the back-off scheme of Katz (1987).
  - …
- Contrast
  - Finally, while we have used our similarity model only for missing bigrams in a back-off scheme, Essen and Steinbiss (a992) used linear interpolation for all bigrams.

Uses for information retrieval

"Representing Txt Chunks". Erik. F. Tjong, Kim Sang and Jorn Veenstra

- Aim
  - In this paper we will examine seven different data representations for the problem of recognizing noun phrases
- Based on
  - Bosch 1998, Argamon et al. 1998
- Contrasts with
- Also cites

Dialogue

- Both dialogue and monologue need to be coherent/cohesive
  - Why is information conveyed
  - How is information structured
- More issues in dialogue
  - Turn taking
  - Grounding and repairing misunderstanding
  - Initiative and confirmation strategies
Segmenting Speech into Utterances

- Why is EOU detection harder than EOS?
- How does speech differ from text
- Single syntactic sentence may span several turns
  - A: We’ve got you on USAir flight 99
  - B: Yes
  - A: leaving on December 1
- Multiple syntactic sentences may occur in a single turn
  - A: We’ve got you on USAir flight 99 leaving on December 1. Do you need a rental car?
- Intonational definitions: intonational phrase, breath group, intonation unit

Turns and utterances

- Dialogue is characterized by turn taking
  – Who should speak next
  – When they should speak
- How do we know when a speaker is giving up or taking a turn? Holding the floor? Can we interrupt?

Dialogue acts and adjacency pairs

- Dialogue act: greeting, question, answer
- Adjacency pairs set up expectations
  – GREETING/GREETING
  – QUESTION/ANSWER
  – COMPLIMENT/DOWNPLAYER
  – REQUEST/GRANT
- Long silences are dispreferred
  – A: Is there something bothering you (1.0)
  – A: Yes or no? (1.5s)
  – A: EH?
  – B: No.

Intonational cues to turn taking

- Continuation rise (L-H%) holds the floor
- H-H% requests a response
  – L*H-H% yes/no question
  – H*H-H% highrise question contour
- Intonational contours signal dialogues acts in adjacency pairs

Initiative strategies

- System initiative
  S: Please give me your arrival city name
  U: Baltimore
  S: Please give me your departure city name...
- User initiative
  S: How may I help you?
  U: I want to go from Boston to Baltimore on November 8.
- Mixed initiative
  S: How may I help you?
  U: I want to go to Boston.
  S: What day do you want to go to Boston?

Grounding

- The HEARER must making it clear to the speaker if understanding has occurred
- How is this achieved?
  S: I can upgrade you to an SUV at that rate.
  – Continued attention
    (U gazes appreciatively at S)
  – Relevant next contribution
    U: Do you have RAV4 available
  – Acknowledgement/backchannel
    U: Ok/Great
  – Request for repair
    U: I beg your pardon?
System misconceptions reflected in user response (Krahmer et al 99)
- Responses to incorrect verifications
  - Contain more words (or are empty)
  - Contain more repetition
- NO after incorrect verification vs. other yes/no questions
  - Has higher boundary tone
  - Longer duration
  - Longer pauses before and after
  - More additional words after it

Grounding and confirmation strategies
U: I want to go to Baltimore
- Explicit
  S: Did you say you want to go to Baltimore?
- Implicit
  S: Baltimore (H*L-L%)
  S: Baltimore? (L*H-H%)
  S: What time do you want to leave for Baltimore?
- No confirmation

Non-Understanding Error Recovery (Skantze '05)
- Collected human/human interactions
- Humans tend not to signal non-understanding:
  - O: Do you see a wooden house in front of you?
  - U: ASR: YES CROSSING ADDRESS NOW
    (I pass the wooden house now)
  - O: Can you see a restaurant sign?
- This leads to
  - Increased experience of task success
  - Faster recovery from non-understanding

Dialogue system challenges
- More complexities
  - Requires speech recognition
  - Turn taking, grounding, error-recovery
- But imagine the possible benefits
  - Talking robots?
  - Games
- Check out some talking heads demos
  - http://www.speech.kth.se/multimodal/

More NLP applications
- Speech to speech translation systems
  - Verbmobil (http://verbmobil.dfki.de/overview-us.html)
- Analyzing meetings
  - http://labrosa.ee.columbia.edu/mapmeet/
  - Identifying agreement and disagreement
  - Meeting segmentation
  - Browsing

References
- S. Teufel, M. Moens. Argumentative classification of extracted sentences as a first step towards flexible abstracting. I. Mani, M. Maybury (eds.), Advances in automatic text summarization, 1999