Contrasting the Interaction Structure of an Email and a Telephone Corpus: A Machine Learning Approach to Annotation of Dialogue Function Units

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Interaction Structure

Origins in face-to-face spoken interaction

- Adjacency Pairs (Sacks, Schegloff, Jefferson 74)
- Speech Acts (Austen)

- RequestInformation → Inform
- RequestAction → Commit

- A: Will you marry me?
- B: <silence>
Email Example

- From: Melinda Solata  
  To: Kevin Glick, Gio diStefano  
  When did the package to DX go out? I am worried about them, they have hinted to me that they may switch providers. Who is in charge of that account?  
  Melinda

- From: Kevin Glick  
  To: Melinda Solata  
  The package went out last week, I think.

- From Gio diStefano  
  To: Melinda Solata, Kevin Glick  
  I am not sure who is in charge of the account, perhaps Ram. The package to DX went out yesterday.  
  GdS
Broader Notion of Interactive Communications: General Issues

Issue: underlying commonalities versus distributional differences

• Multiparty interactions
• No physical co-presence
• Asynchronous communication
• Non-linear discourse structure (tree, dag)
• Non-adjacent adjacency pairs
• Unanswered questions (or other openers)
• Answers to unasked questions (or other “volunteered” closings)
Outline

- Annotation Scheme: Dialog Function Units (DFU)
  - Dialog Acts
  - Links
  - Segments
- Corpora
- Automatic Prediction
Annotation Scheme: Dialog Acts (DAs)

- **Inventory: Reduced**
  - Goal: study interaction comparatively
  - Avoid massive data skew (and domain-specific labels)
  - Easier to generalize
  - Segmentation not given but determined by dialog act; therefore: too fine-grained DAs mean segments that are too small

- **Our set (n=8):** Request-Information, Inform, Request-Action, Commit, Conventional, Perform, Backchannel, Other
Annotation Scheme: Links

- Related segments are:
  - Not necessarily adjacent
  - Not necessarily predicted by dialog acts
  - Not necessarily complete
  - Don’t know where responding act will be
  - 1-to-many links
  - Discourse flow not necessarily linear: can be tree or dag

- Need explicit links between segments
  - Link: between request for information or action and its response
  - Secondary link: between any other DA pair
  - Dangling link
Annotation Scheme:
Segmentation

• Dialog Function Units: defined *functionally*

• Longest segment which has a single discourse purpose:
  – Same DA tag
  – Same link structure

• Note: subsequent responses can alter segmentation!

• Also content requirement: generally same topic
Corpus 1: Loqui
Telephone Conversation

- Recorded phone conversations at New York City's Heiskel Library
- Dialogs: 175 collected, 82 transcribed, 48 annotated
- Annotated dialogues pertain to one or more book requests by customers
- Annotators worked from combination of transcription and audio.
Corpus 2: Enron
Corporate Email

- 122 email threads of the Enron email corpus (with missing messages restored)
- Mostly information exchange, scheduling meetings, and solving problems, also purely social emails.
Corpora: Procedure

• Annotation developed looking at Enron, Switchboard, Dover Trial court transcripts
• Six people have been trained to annotate using our guidelines
• Most annotation used in experiments done by single annotator
• Guidelines have been under development and may be revised again (and data re-annotated)
• Have no inter-annotator agreement data for now
## Corpus: Size and Dialog Acts

| Dialog Act Labels        | Tel.  | Email |
|-------------------------|-------|-------|
| Words                   | 21,097| 17,924|
| Segments                | 3,845 | 1,400 |
| Inform                  | 50%   | 61%   |
| Request-Information     | 20%   | 11%   |
| Request-Action          | 1%    | 3%    |
| Commit                  | 9%    | 0%    |
| Conventional            | 7%    | 25%   |
| Backchannel             | 13%   | 0%    |
## Corpus: Links

|                             | Tel.  | Enron |
|-----------------------------|-------|-------|
| **Segments by Link**        |       |       |
| Part of a Paired Links      | 32%   | 14%   |
| **Links by Type**           |       |       |
| Link                        | 54%   | 28%   |
| Secondary Link              | 39%   | 37%   |
| Dangling                    | 7%    | 33%   |
Outline

- Annotation Scheme: Dialog Function Units
- Corpora
- Automatic Prediction
Automatic Tagging

• 2 Tasks
  – Dialog Act Tagging: Choose DA for given segment
  – Link Choice: decide if two DFUs with DA tags are linked

• 3 Methods
  – Baseline
    • DA tagging: majority baseline
    • Link prediction: next plausible DFU (Serious baseline!)
  – Regular SVM: binary classifier (extended to n-ary)
    • Yamcha
  – Structured SVM: chooses among structure
Automatic Tagging: Corpora

- 5-fold cross-validation
- Telephone: 3845 segments
- Email: 1400 segments
Structured SVM

• Learns discriminant function $F$: inputs $x$ outputs $\rightarrow R$
• DA tagging:
  – Input = structure of segments
  – Output = sequence of DA tags
• Link prediction:
  – Input = structure of segments + (predicted) DA tags + link consideration space
    • At most 1 link starts or ends in any given segment
    • No crossing links
  – Output = chosen links
  – Constraints on link consideration space limit accuracy of prediction!
Results for DA Prediction (Accuracy)

|          | Baseline | Regular SVM | Structured SVM |
|----------|----------|-------------|----------------|
| Telephone| 50%      | 68%         | 70%            |
| Email    | 61%      | 88%         | 89%            |

Conclusions:
- Task harder for Telephone than for Email
- Regular SVM does as well as Structured SVM; no surprise
Results for Link Prediction
(Recall, Precision, F-Measure)

|       | Baseline |        |        |        |        |        |        |
|-------|----------|--------|--------|--------|--------|--------|--------|
|       | R        | P      | F      | R      | P      | F      | R      |
| Tel.  | 30       | 56     | 39     | 44     | 61     | 51     | 44     |
| Email | 17       | 40     | 24     | 19     | 55     | 28     | 31     |
|       | 30       | 56     | 39     | 44     | 61     | 51     | 44     |
|       | 17       | 40     | 24     | 19     | 55     | 28     | 31     |

Conclusions:
- Task harder for Email than for Telephone
- Structured SVM paying off for Email corpus only!
Future Work

• Continue annotating Telephone and Email
• Start annotating web forum or similar
• Redo link prediction without restrictions (only one link per segment, no crossing links)
## Corpus: Links

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| **Links By Dialog Act**        |      |       |
| Inform                         | 50%  | 61%   |
| Request-Information            | 20%  | 11%   |
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