DISCOURSE LEARNING:
Dialogue Act Tagging with Transformation-Based Learning[1]

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My central goal is to compute *dialogue acts* automatically. A dialogue act is a concise abstraction of a speaker's intention, such as SUGGEST and REQUEST. Recognizing dialogue acts is critical to understanding at the discourse level, and dialogue acts can also be useful for other applications, such as resolving ambiguity in speech recognition. But, often, a dialogue act cannot be directly inferred from a literal reading of an utterance.

Machine learning offers promise as a means of discovering patterns in corpora of data, since the computer can efficiently analyze large quantities of information. My research is the first to investigate using Brill's (1995) *Transformation-Based Learning* (TBL) algorithm to compute dialogue acts (Samuel, Carberry, & Vijay-Shanker 1998). There are several reasons that I selected this machine learning method over the alternatives for my task: TBL has been applied successfully to a similar problem, Part-of-Speech Tagging (Brill 1995); TBL produces an intuitive model; TBL can easily accommodate local context as well as distant context; TBL demonstrates resistance to overfitting; etc.

To address some limitations of the original TBL algorithm and to deal with the particular demands of discourse processing, I developed some extensions to my system, including a *Monte Carlo* approach that randomly samples from the space of available rules, rather than exhaustively generating all possible rules. This significantly improves efficiency without compromising accuracy (Samuel 1998). Also, to circumvent a sparse data problem, it is necessary to transform the input data by extracting values for a set of simple *features* of utterances, such as cue phrases and nearby dialogue acts. I am utilizing a very general set of *cue phrases* that includes patterns such as "but", "thanks", "what time", and "busy". To automatically collect those cue phrases that appear frequently in dialogue and provide useful clues to help determine the appropriate dialogue acts, I devised an *entropy approach* (selecting words so that the dialogue acts co-occurring with those words have low entropy) with a *filtering mechanism* (removing cue phrases that merely provide redundant information).

Other researchers have been investigating machine learning approaches for computing dialogue acts. Previously, the greatest experimental success was reported by Reithinger and Klesen (1997), whose system could correctly label 74.7% of the utterances with dialogue acts. As a direct comparison, I applied my system to exactly the same training and testing data that Reithinger and Klesen used, attaining an accuracy of 76.2%. Applying a Decision Trees implementation, C5.0 (Rulequest 1998), to this data produced an accuracy of 70.4%.

For the future, I have several plans to revise and extend this work. The main deficiency of TBL is that it doesn't offer any measure of confidence in its taggings, but I am working on a committee-based strategy to address this problem. In addition, I plan to examine the utility of other features, such as surface speech acts, subject type, and verb type. Also, as tagged dialogues are still difficult to acquire, I have proposed a weakly-supervised learning strategy, to learn from a small set of tagged data and a large set of untagged data.

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References

Brill, E. 1995. Transformation-based error-driven learning and natural language processing: A case study in part-of-speech tagging. *Computational Linguistics* 21(4):543–566.

Reithinger, N., and Klesen, M. 1997. Dialogue act classification using language models. In *Proceedings of EuroSpeech-97*, 2235–2238.

Rulequest Research. 1998. Data mining tools see5 and c5.0. [http://www.rulequest.com/see5-info.html].

Samuel, K.; Carberry, S.; and Vijay-Shanker, K. 1998. Computing dialogue acts from features with transformation-based learning. In *Applying Machine Learning to Discourse Processing: Papers from the 1998 AAAI Spring Symposium*, 90–97. Technical Report SS-98-01.

Samuel, K. 1998. Lazy transformation-based learning. In *Proceedings of FLAIRS*.