Title
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Permalink
https://escholarship.org/uc/item/5746v21b

Journal

ISSN
1069-7977

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Publication Date
2006

Peer reviewed
Automating Text Propositionalization: An Assessment of AutoProp

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Propositions are psychological representations of textual units that capture the overall gist of a sentence or clause (Kintsch, 1988; Kintsch, 1998). Such is the complexity of constructing these propositions that no computational system has yet been able to match human hand-coded examples.

The recent advent of major computational projects such as iSTART (McNamara, Levinstein, & Boonthum, 2004) and Coh-Metrix (Graesser et al., 2004) has highlighted the need for an automated tool capable of accurately converting thousands of sentences into propositional units. In this study, we introduce a working prototype of a propositionalization tool, AutoProp, and assess its automated output of propositions against a corpus of published hand-coded propositions.

AutoProp, written in Visual Basic, first directs text through the Charniak parser (Charniak, 2000) before allocating the parsed data into propositional units. A final proposition is displayed on AutoProp’s interface, and can be saved to a file or printed upon request. As an example, the sentence The hemoglobin carries the oxygen is represented by Kintsch (1998) as CARRY[HEMOGLOBIN,OXYGEN]. AutoProp separates the sentence into primary elements (pe) and sub-propositional elements (sub prop) rendering the Kintsch sentence above as:

\[
\text{carries (the \{pe\} hemoglobin, \{pe\} oxygen)} \\
\text{sub prop: the \((\{pe\} \text{ hemoglobin})\)} \\
\text{sub prop: \((\{pe\} \text{ oxygen})\)}
\]

For an initial test of the tool’s effectiveness, we constructed a corpus of 29 previously published sentences taken from Kintsch (1998). These sentences were processed through AutoProp to derive the tool’s propositional representations.

The types of contrasts (i.e., output differences) between the tool and the Kintsch model were categorized a priori as follows:

Type 1: Superficial, easily correctable differences.
Type 2: Easily correctable contrasts
Type 3: Systematic contrasts caused by parser limitations
Type 4: Systematic, but correctable contrasts
Type 5: Difficult to correct systematic contrasts

Based on these criteria, we analyzed contrasts between the propositional tool and the hand-coded Kintsch textbase.

Analysis and Discussion

While all of the AutoProp propositions recorded Type 1 contrasts, the results of the analysis suggested that major differences between the Kintsch and AutoProp generated propositions were minimal. Our results offered only one propositional contrast caused by parser limitations (Type 3), and eleven further correctable Type 4 contrasts. There were no Type 2 or Type 5 contrasts. Thus, AutoProp was highly successful. The success of these initial results, however, must be tempered by the fact that our corpus of propositions stem from sentences no longer than two clauses. Subsequent AutoProp algorithms must address far more complex multi-clausal sentence constructions.

In addition to generating textbase propositions, future AutoProp research will also develop modules for comparing these propositions to recall and self explanation propositions. Thus, AutoProp stands to contribute to the field by substantially reducing preparation time and substantially increasing the accuracy and reliability of scores generated from recall data.

This research initiates a response to a growing need for an automated propositionalization tool. The current version of AutoProp is the first step toward building a tool capable of converting a wide range of sentence types into propositional units, as well as comparing and scoring textbase propositions from recall and self-explanation examples.

Acknowledgments

This research was supported by the Institute for Education Sciences (IES R3056020018-02).

References