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Detection of contradictions by relation matching and uncertainty assessment

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Abstract

Contradiction detection is a difficult task in the field of natural language processing given the variety of ways contradictions occur across texts. If blunt negations, antonyms and numerical mismatches are obvious features to convey contradictions, they also arise from inconsistent domain knowledge, uncertain co-references or differences in the structures of assertions. In this paper, we investigate the problem of contradictions detection for uncertain statements when the author provides not only factual information but also clues about its plausibility. The problem is of particular interest for application fields relying on reported information, when decision makers receive information from various sources. Along with hints as to the derivation of the content, authors often embed clues as to how strong they support reported facts, in the form on confidence, skepticism, doubt or strong conviction. For such assertions, contradictions highlight not only impossible versions of reported events and actions but also discrepancies in the assessment of their plausibility. After analyzing various types of contradictions in subjective statements, we describe a model to detect contradictions thanks to a joint analysis of functional relations and uncertainty assessments.

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Keywords: contradiction identification; relation extraction; uncertainty assessment

1. Introduction

Contradiction identification is the task of detecting pairs of natural language statements conveying information about events or actions that cannot simultaneously hold. In contrast to this brief definition, there is a complex picture of contradictions in text and across different domains as incompatibilities are manifested in various ways.

For objective statements, contradictions can be factual disagreements, as sources would express their position on facts and events and over a period of time they came to distort the issue. Factual contradictions occurs via negation,

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antonymy and mismatches in locations, date or number estimates. More difficult to detect, conceptual contradictions capture the discrepancies arising when the information conveyed differs, sometimes significantly, from the community accepted conceptualization of common sense or domain specific knowledge. They cover slightly different relationships between concepts, distinct properties and attributes of entities and require in depth processing and reasoning in order to analyze the consistency of information with respect to a commonly accepted representation.

Various applications fields relying on human reporting deal not only with objective but especially with subjective statements, involving human attitudes and emotions. Falling under the same umbrella of subjectivity, they touch dimensions related to vagueness, ambiguity, imprecision or uncertainty. As an example, intelligence analysis is carried out from collections of incomplete, ambiguous, imprecise and most of the time biased information. Although the items reported can be more or less precise, subjective statements also may indicate confidence, conviction, doubt or skepticism about the information in communication. Detecting contradiction in such statements requires methods able to take into account both the factual information and the subjective dimension which often embeds clues as to how strong the authors support the content being conveyed.

In this paper we tackle the problem of detecting contradictions in uncertain statements. First we highlight various types of relations between subjective statements in order to gain a better understanding of contradiction. Then we develop a method based on natural language processing techniques able to extract facts and the expression of uncertainty attached to them in texts. The method represents facts as functional relations indicated by verbs and extracts those relations from texts using a combination of lexical and syntactic patterns. This representation is further enriched by adding values and polarity of uncertainty expressions, created by using a set of lexical clues of how humans assess certainty through their use of language. The solution developed builds an intuitive representation of subjective statements, which offers a straightforward approach to implement inference tasks in order to detect contradictions. The method allows describing the combined effects of factual and subjective dimensions on the identification of contradictory statements.

The paper is organized as follows: section 2 presents a selection of related approaches developed in various application contexts. A typology of contradiction relations is presented in section 3. Section 4 describes a model to detect contradictory sentences while the general architecture and information processing techniques needed to implement this model are discussed in 5. The last section presents directions for future work and concludes this paper.

2. Related work

Much of the earlier research in contradiction detection has been performed in the field of natural language processing, as question/answering systems needed new solutions to answer negative questions and multi-document summarization systems required innovative approaches to detect incompatible information in order to provide more accurate results.

First empirical results on contradiction detection are reported by Harabagiu and colleagues [12] who investigates specific types of contradictions featuring negations, antomnymy and semantic and pragmatic information characterizing contrastive discourses. The authors report good performances on experiments conducted with two corpora: one highlighting contradictions conveyed by negations and the other based on paraphrases. As contradictions are not limited to those constructions, the system must provide broader coverage to be practically useful.

An analysis of contradiction going beyond negation and antonymy is presented by De Marneffe and colleagues in [6]. The authors report on the implementation of a contradiction detection system build to take into consideration a set of features able to capture patterns of contradiction, such as: polarity of sentiments and opinions, number, date and time features, coherence of facts related and structure of sentences, modality and relational features. Quality of results and error analysis are discussed according to distinct features, and the main issue of the overall approach is the lack of feature generalization.

Stance analysis to detect rumors in tweets is adopted in [13] whose authors define stances as linguistic constructions capturing whether the speaker express is favorable or not towards an evaluation target, usually an entity, object or concept. Build on solutions proposed by [20] for rumors classifications, the authors provide a solution to detect contradictions in microposts based on algorithms that estimate the contextual proximity of the posts to be assessed. In an effort to improve accuracy, a stance-labeled data set [27] was released, and various research efforts tackle the integra-