Semantic Parsing and Knowledge Hunting for the Winograd Schema Challenge

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Abstract. A field of artificial intelligence is the analysis of the interaction of machines. For the distinction of the interaction of machines and humans the Turing test exists, with the Winograd Scheme Challenge (WSC) as an alternative. In the WSC, a sentence and a related question is presented, which has to be answered. This summary examines the WSC and an approach to tackle it that consists of a semantic parser with the K-Parser algorithm and knowledge hunting.

1 Introduction

This summary is based on the article "Towards Addressing the Winograd Schema Challenge - Building and Using a Semantic Parser and a Knowledge Hunting Module" by Arpit Sharma, Nguyen H. Vo, Somak Aditya & Chitta Baral [1] and deals with the Winograd Scheme Challenge (WSC), which can be used for evaluating whether a system exhibits human-like intelligence, similar to the Turing test. The WSC consists of a sentence and a question, which can be easily answered by humans as this only requires commonsense knowledge, but which makes it difficult for machines to answer. Answering the question means resolving the definite pronoun or the possessive adjective to one of two used co-referents. The co-referents follow the scheme that they have the same gender and the same number, singular or plural, which impedes the unambiguity. The sentence contains a special word, by which the answer to the question changes when it gets changed. An example of a sentence is:
"Sentence: The man couldn't lift his son because he was so heavy. Question: Who was heavy? Answer: son".
If the word *heavy* gets changed to *weak*, the answer would change from *son* to *man*.
[1] presents an approach for addressing human-like intelligence to answer WSCs by the determination of what kind of common-sense is needed, the automatic extraction of knowledge by knowledge hunting and the not further discussed knowledge reasoning.

2 Semantic Parsing

One type of commonsense knowledge are direct causal events (event-event causality), with two mutually existing causal events, where one co-referent participates

in one event and the other one in the other. A causal attribute on the other hand holds an event and a participant entity with an associated attribute, that is causally related to the event.
For the development of the semantic parser, a good semantic representation of the text as a basis for the graph based semantic parser is important. A good representation of the text means that it should express the structure of the text, that the semantic representation should be distinguished between events and participants and that it should represent same events or entities in different perspectives. The graph based semantic parser, K-Parser, has an acyclic graphical representation for the text. As there exist different semantic relations with event-event relations, event-entity relations and entity-entity relations, these and the existential and unifying quantification of entities should be representable. The knowledge parser derives two levels of conceptual class information for words, gathers semantic roles of entities and extracts tenses of the used verbs among other features.
The K-Parser Algorithm consists of multiple parts, as it firstly extracts syntactic dependencies from the input text into the graph and then moves on to the semantic mapping. The latter contains three parts, where syntactic dependencies get mapped into semantic relations (like a nominal subject dependency getting mapped to an agent relation), the disambiguation of different senses of prepositions and the labeling of event-event relations with discourse connectives. Later, word classes are added for the disambiguation of word senses and mappings are corrected using these class information. Lastly, semantic roles for the entities can be added. This algorithm is engineered so that it extracts the pronoun to be resolved from the sentence and outputs it.

3 Knowledge Hunting

As human-like learning happens by reading, this system imitates reading by retrieving in an on-demand manner relevant information to a given sentence and question. Queries are created from concepts in the sentence and the question, to retrieve sentences from text repositories. Knowledge hunting is a two-step process which uses for the first set of queries a formal representation of Winograd sentences and questions. The words of the questions are mapped into a formal representation of a given sentence, where all non-nominal entity nodes are joined together. An example for the ongoing example is *".*could not lift.*because.*weak.*"*. In the second set of queries verbs of the first set of the queries get replaced by synonyms. Through merging of the two sets, the combined set of queries are used for an automatically search of a large corpus of English texts, here the Google search engine API with sentence splitting is used, which outputs: "She could not lift it because she is a weak girl". It should be noted that two mentions of the same pronoun are regarded as the same entity.

4 Conclusion

As a subfield of artificial intelligence, the semantic parsing and knowledge hunting mechanism for addressing the Winograd Scheme Challenge is implemented, which works by searching text repositories and finding needed knowledge for the schema. That way, commonsense knowledge can be scraped to pass this test, which normally is very hard for machines to pass as this type of knowledge actually is only accessible to humans. Here it should be noted that also deep knowledge could theoretically be emitted, but this also raises the questions when this can be regarded as knowledge or just as extracted evidence.

References

1. Arpit Sharma, Nguyen Ha Vo, Somak Aditya, Chitta Baral: Towards Addressing the Winograd Schema Challenge - Building and Using a Semantic Parser and a Knowledge Hunting Module. IJCAI 2015: 1319-1325