Sinica Semantic Parser for ESWC'14 Concept-Level Semantic Analysis Challenge

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Abstract. We present a semantic parsing system to decompose a sentence into semantic-expressions/concepts for ESWC'14 semantic analysis challenge. The proposed system has a pipeline architecture, and is based on syntactic parsing and semantic role labeling (SRL) of the candidate sentence. As to the former task, we use Stanford English parser; as to the later task, we use an in-house developed SRL system. The "concepts" are formulated from syntactically and semantically annotated sentences using a set of hand-build concept-formulation patterns. We also compare proposed system's performance to SenticNet with the help of few examples.

Keywords: Syntactic Parsing, Semantic Parsing, Semantic Role Labeling, Concept Formulation Templates

1 Introduction

Natural languages are both complex and ambiguous. Unless machines are capable of handling these issues in an intelligent way, building smart natural language processing (NLP) applications is a tough and challenging task. Maybe, one way to ease this toughness is to try to make computers understand natural language text. For the same purpose, the trend in NLP is shifting from exploring 'what it is' to 'what it means' (i.e. from syntax to semantics).

During the last couple of decades, a number of sub-fields have emerged under the umbrella term *computational semantics*, and one such sub-field is *semantic parsing*. This and many other such subfields (e.g. sentiment analysis, textual entailment, question answering, etc.) are among the rapidly growing sub-areas of NLP. The research community has recognized their worth and importance in recent times. This can be realized by the fact that their are many workshops, and special tracks/challenges in conferences, dedicated to these tasks. The ESWC'14 challenge on semantic analysis is one among those special challenges, and is scheduled to be held together with the 11th European Semantic Web Conference 2014 (ESWC'14). The challenge has a number of advanced tasks in addition to an elementary task on polarity detection. The advanced task#2 is titled "Semantic Parsing", and refers to the task of de-constructing natural language text

into a number of semantic-expressions/concepts. Though the term semantic-expression/concept is very general in itself, and is hard to define clearly, we take it to be a single-word/multi-word expression for which we have semantics.

In this paper, we propose a system for *semantic parsing* in the context of task#2 of the challenge. The system has a pipeline architecture and relies on syntactic and semantic analysis of the candidate sentence. We use Stanford English parser [3] for syntactic parsing, and an in-house developed semantic role labeling (SRL) system for semantic interpretations. To formulate the concepts into desired format, we propose a set of hand-build concept formulation templates.

2   Proposed System

The architecture of the proposed system is shown in Fig. 1. It has three major components: a syntactic parsing, a semantic role labeling, and a concept formulation component. The purpose and importance of each component is explained in the following paragraphs.

Syntactic Parsing: As a preliminary step, the input sentence is syntactically
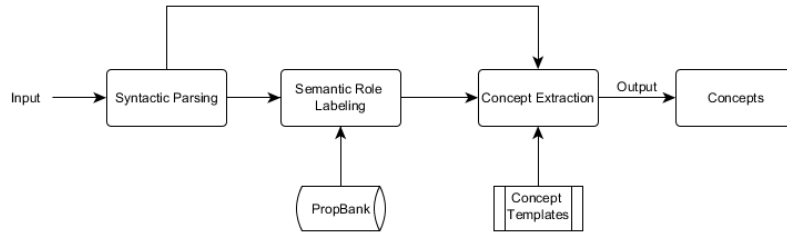

Fig. 1: System Architecture

analyzed to get a syntactic parse tree. This step is necessary for the major reason that almost all automatic semantic role labeling system rely on a preliminary syntactic parsing step [10].

Semantic Role Labeling: Semantic role labeling (SRL), also known as shallow semantic parsing, is the task of semantically annotating natural language text. Conventionally, a syntactically parsed sentence is taken as input, and semantic arguments associated with predicate of the sentence are identified and classified to a particular semantic class. The first automatic semantic role labeling systems was reported by Gildea and Jurafsky in 2002 [5], and since then, their ideas have been dominating the field. In their approach, they emphasized on selection of appropriate lexical and syntactical features for SRL, use of statistical classifiers and their combinations, and ways to handle the data sparseness issue. Researchers have tried to build on that by augmenting and/or altering the feature set [9], by experimenting with various classification approaches [11, 6], and

by attempting different ways to handle data sparseness [1]. For this challenge, we developed a SRL system, which is based largely on previously explored features and maximum entropy classifiers. The classifiers were trained using English Penn Treebank [8], and Propbank [7] data. However, we have proposed a number of additional features to enhance its performance. The details of the SRL system are beyond the scope of this paper, and are supposed to be covered in another planned article.

Concept Formulation: Once the sentence has been annotated syntactically and semantically, the concepts can be formulated using a set of hand-build concept templates. Table 1 lists few of the templates used in our experiments. Here,

# Concept Template	# Concept Template
1 ARG0_Pred	10 Pred_in_the_direction_ARGM-DIR
2 Pred_ARG1	11 Pred_because_ARGM-ARGM-CAU
3 Pred_ARG1_ARG2	12 Pred_when_ARGM-TMP
4 Pred_ARG1_ARG2_ARG3	13 Pred_ARGM-GOL
5 Pred_ARG1_ARG2_ARG3_ARG4	14 Pred_by_ARGM-EXT
6 Pred_ARG1_ARG2_ARG3_ARG4_ARG5	15 Pred_ARGM-MNR
7 Pred_with_ARGM-COM	16 Pred_ARGM-NEG
8 Pred_in_ARGM-LOC	17 ARGX's
9 Pred_in_order_to_ARGM-PRP	18 ARGM's

Table 1: Concept Templates

Pred and ARG1, ARG2, ARGM-LOC, ARGM-GOL, etc. refer to the predicate, and to the semantic role classes used in the prop-bank labeling scheme respectively (see [2] for details on these classes).

3 An Example

To explain how our proposed system works at different levels, lets take an example sentence: *This film served as great entertainment for young people.*, and go through all the steps that the proposed system will perform to extract the semantic-expressions/concepts. As a first step the sentence will be syntactically parsed, which will be then semantically annotated by the SRL system. The resulting syntactically and semantically annotated tree is shown in Fig 2. From the semantically annotated tree, the extractable predicate-argument information is given in Table 2. Using this information and the templates given in Table 1, the following concepts can be formulated:

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(1) This_film_serve (2) serve_as_great_entertainment
(3) serve_for_young_people (4) great_entertainment
(5) This_film (6) young_people
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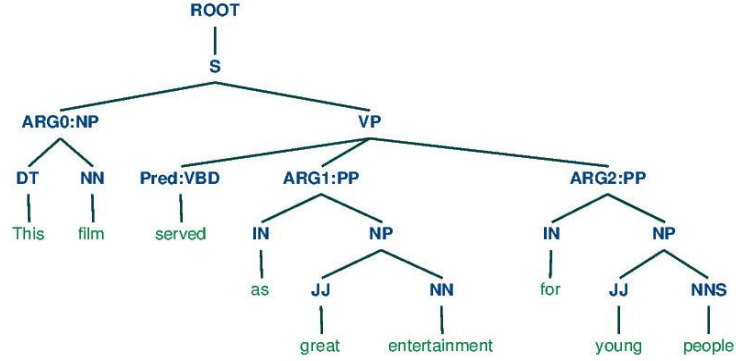
Fig. 2: Syntactically and Semantically Annotated Parse Tree

Predicate	Arguments
serve	Arg0: This film
	ARG1: as great entertainment
	ARG2: for young people

Table 2: Predicate-Argument Information

4   Comparison to SenticNet

At the current stage of our experiments, we did not perform any automatic comparison or performance measurement leaving it to the official evaluation during the challenge days. However to give an idea to the reviewers, Table 3 lists a couple of example sentences together with the extracted concepts both by the proposed system[1], and SenticNet[2] [4]. We leave it to the reviewers to compare the outputs.

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[1] A web-demo of the system is available at:
[2] We used web-demo available at () to generate these concepts

Sentence	Proposed System's Output	SenticNet's Output
I went to the market and bought fresh fruits and vegetables and came back	(1)bought_fresh_fruits (2)I_went (3)I_bought (4)vegetables (5)went_to_ the_market (6)bought_vegetables (7)fresh_fruits (8)came_{in_the_direction}_ back (9)to_the_market (10)came_I	(1)go_to_market (2)market (3)buy_fruit (4)buy_vegetable (5)fresh_fruit (6)some_fruit (7)back_come
We also ordered the bedding and got the pillow	(1)got_the_pillow (2)the_pillow (3)We_got (4)the_bedding (5)We_order (7)order_also (8)order_the_bedding	(1)also_order (2)order_bed (3)bed (4)get_pillow (5)pillow

Table 3: Example Sentences and Extracted Concepts

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