Spatial Role Labeling

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Introduction

Spatial Role labeling task is defined as the extraction of main components of the spatial semantics and labelling of words and phrases in a sentence with a set of spatial roles and classifying them as trajectors, landmarks and spatial indicators.In this process, we first identify the spatial indicator and try to disambiguate it, then find the semantic role arguments i.e. trajectory and landmark from a given sentence. In this project we aim to extract the landmarks from a given natural language sentence through spatial role labelling.

The task can be illustrated form the following example [from SemEval 2013 Task 3] :

Input Sentence : Give me the gray book on the big table.
Output : Give me [the gray book]TRAJECTOR[on]SPATIAL_INDICATOR [the big table]LANDMARK.
(We intend to put this sentence in an XML format with proper tags.)

Here are some definitions used [Korjamshidi et al , Semeval 2012] :

Spatial Indicator : Spatial indicator is a spatial role label assigned to a word or a phrase that signals a spatial relation between objects (trajectors and landmarks) of a spatial scene.

Trajector : Trajector is a spatial role label assigned to a word or a phrase that denotes a central object of a spatial scene or an object that moves.

Landmark : Landmark is a spatial role label assigned to a word or a phrase that denotes a secondary object of a spatial scene, to which a possible spatial relation (as between two objects in space) can be established.

Motivation [From SemEval 2012] :

Spatial role labeling is a key task for applications that are required to answer questions or reason about spatial relationships between entities. Examples include systems that perform text-to-scene conversion, generation of textual descriptions from visual data, robot navigation tasks, giving directional instructions, and geographical information systems (GIS).

Related Work :

There are recent research papers (Ross et al., 2010; Hois et al., 2011; Tellex et al., 2011) which shows the moving interest of researchers toward the Spatial Role Labeling. Several annotation schemes have been proposed such as ACE, GUM, GML, KML, TRML. For us, most important research includes Mani et al., 2008) & Pustejovsky and Moszkowicz, 2009. Kordjamshidi et al., 2011c was the first approach in this field.

Method / Approach :

We plan to use machine learning to solve this problem. First we will select a spatial indicator and make a parse tree of the sentence. Mostly prepositions act like spatial indicator in a sentence but there is a need to disambiguate it from having a spatial sense or not. So in the learning process we learn how to identify spatial preposition(s) in the sentences of training set. We then use a multiclass classifier on the tree to identify the landmarks. Then we compare these landmarks to the real landmarks and find the error in our approach.

Algorithm [from Korjamshidi et al , ACM TLSP 2011] :

ALGORITHM 1: Spatial-Relation-Extraction(S : sentence) **returns** relations SR

1: {*preposition disambiguation*}
2: **for all** $w \in S$ **do**
3:    Estimate $\hat{I}(w)$ by training a probabilistic classifier and
4:    construct the set I of all spatial indicators of the sentence S.
5: **for all** $s \in I$ **do**
6:    {*trajector and landmark classification*}
7:    **for all** $w \in S$ **do**
8:       Estimate a probabilistic multi-class classifier $\hat{R}$ and
9:       construct the sets T_s and L_s according to the assigned labels.
10:   **if** $T_s = \emptyset$ **then** $T_s \leftarrow$ {*undefined*}
11:   **if** $L_s = \emptyset$ **then** $L_s \leftarrow$ {*undefined*}
12:   {*relation extraction*}
13:   $SR \leftarrow SR \bigcup \{\langle s, t, l \rangle \mid t \in T_s, l \in L_s\}$
14: **return** SR

Data :

The data we got from the organizers of SemEval is a subset of CLEF Corpus and Confluence Corpus in XML format. All the files in the training set have been split into sentences with proper tags. The <SENTENCE/> tag indicates the start of a sentence and all the other tags such as trajectory , landmark and spatial indicator are placed in this tag describing spatial relations of one sentence.

References :

1. P. Kordjamshidi, M van Otterlo, and M. F. Moens. Spatial role labeling: task definition and annotation scheme. In LREC, 2010.
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3. Parisa Kordjamshidi, Martijn van Otterlo, and Marie-Francie Moens. Spatial role labeling: Towards extraction of spatial relations from natural language. ACM Transactions on Speech and Language Processing, TSLP 8(3) , Dec. 2011.