

# Transferring of Prepositional phrases in English into Tamil: A machine learning approach

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## 1 Introduction

Ambiguity is the core problem in computational linguistics. Ambiguity arises at almost every level of language processing, from word level processing tasks like part of speech tagging to high-level tasks like discourse planning. A machine has to be able to resolve these ambiguities and combine the information from different levels into an unambiguous meaning representation in order to understand a human language. Preposition is one of the word classes which are both frequent and highly ambiguous. The different senses of a preposition express different relations between the preposition complement and the rest of the sentence. The sense is related to the semantic role of the dominating prepositional phrase. To understand the semantics of a prepositional phrase, a system would need access to both the higher level semantics of the semantic role and the finer word-token level semantics of the preposition. Prepositions are not given the attention they deserve in the earlier studies on resolution of ambiguity. Even in lexicographic works including dictionaries, prepositions are not elaborately discussed explicating the ambiguity they carry along with them. Presuppositions are not deeply studied in the corpus analysis unlike the other parts of speech. Though prepositions are only a closed set of words exhibiting certain grammatical functions, their polysemous nature is comparable to other parts of speech. Similar to the major parts of speech like noun and verb, preposition also creates problem in their interpretation. The interpretation of prepositions becomes a challenge to the computational community who are involved in natural language processing. They are closely related to verbs as the indicators of their internal arguments.

Preposition is a term used in grammatical classification of words referring to the set of items which typically precede NP (often single nouns or pronouns) to form a single constituent of structure. Prepositions normally precede nouns or pronouns. For example

***The cow is grazing in the field.***

The preposition 'in' shows the relationship between *cow* and *field*. In the above sentence object of the preposition *field* comes after the preposition *in*. Hence the noun or pronoun which is used with a preposition is called its object. It is in the accusative case and is said to be governed by the preposition. In the above given sentence the noun *field* is in accusative case and is governed by the preposition *in*. A preposition may have two or more objects as in the following sentence.

***The road runs over hill and plain.***

It has to be noted here that prepositions can also be an adverb and that is they can be used without an object. If personal pronouns *I, we, he, she, they* etc are used as the object of a preposition, then their objective form *me, us, him, her, them*, have to be used.

Tamil makes use of postpositions instead of prepositions; these postpositions could be affixes or free forms or a combination of both.

*avan meecai meel puttakattai vaittaan*  
*he table on book-ACC keep-PAST-3PS*  
*'He kept the book on the table'*

Though we can draw one to one correspondence between English prepositions and Tamil postpositions in many instances, there are drastic differences between them in some instances. This paper aims at transferring of prepositional phrases in English into Tamil by making use of a machine learning approach. We are considering only two prepositions 'for' and 'with' to substantiate our arguments.

## 2 Ambiguity in prepositions

Actually prepositions themselves are ambiguous at the source language level. One can expect 'transfer ambiguity' at the transfer level when we move from English to Tamil. Take for example the following sentences with the preposition 'for'.

1. He boarded the train for Jaipur.
2. I waited for you.
3. Ram has sympathy for the poor.

Look at their translations into Tamil.

- 1a. *avan jaipUrukku rayil ERinAn*
- 2a. *wAn unakku vENti/Aka kaththiruwthEn*
- 3b. *rAmukku EzaikaL itam irakkam irukkiRathu.*

In the first sentence the preposition 'for' is matched to dative suffix *-ukku* in Tamil; in the second sentence 'for' is matched against the benefactive *vENti/Aka* and in the third sentence 'for' is matched with the receiver postposition *iTam* 'to'. This three way distinction of 'for' in Tamil exhibit the three-way ambiguity at the source language which is reflected at the transfer level.

Now let us look at the sentences with 'with' preposition.

4. He apologized with her.
- 4a. *avan avaL-itam mannuppu kEttAn*
5. Blend water with milk.
- 5a. *taNNIrutan pAlaik kala*
6. We walk with legs.
- 6a. *wAm kAlkaLAI natakkinROm*

In the first sentence the preposition 'with' is matched with the addressee marker *itam* in Tamil; in the second sentence 'with' is matched against the sociative postposition *utan* and in the third sentence 'with' is matched with the instrumental case suffix *Al* 'by'. This three way distinction of 'with' in Tamil exhibit the three-way ambiguity at the source language which is reflected at the transfer level. Proposition sense disambiguation requires lexical and world knowledge, and contextual information as generally with word sense disambiguation.

## 3 Earlier works

A number of researchers have studied disambiguation of the preposition. Alam (2004) studied the disambiguation of the preposition 'over' by taking into account two things: one is the meaning expressed by the complement noun phrases of the prepositions and the other is the head of the prepositional phrases (verb or noun phrases). Harabagiu (1996) made use of

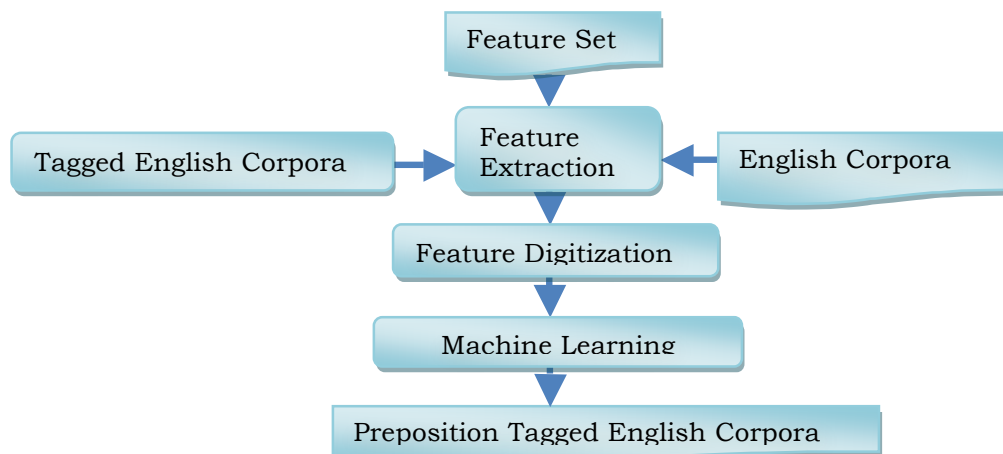
WordNet to disambiguate prepositional phrase attachment. A special issue of *Computational linguistics* (Baldwin et al., 2009) was devoted to discuss about the issues on preposition. Preposition sense disambiguation was one of the SemEval 2007 tasks (Litkowski and Hargraves, 2007), and was subsequently explored in a number of papers using supervised approaches. The present study is much rarer of the kind of studies mentioned above as it aims to resolve the prepositional ambiguity at the transfer level.

#### 4 Methodology

English sentences with the prepositions “*for*” and “*with*” are collected and manually tagged with equivalent postpositions in Tamil. We divided the annotated English preposition corpus into train and test sets. The training dataset consists of 430 sentences and testing set has 100 sentences. Sample English sentences with preposition tag are given in Table.1. The preposition tag contains the Tamil postposition information. By using this method, the prepositions of English are disambiguated and translated into Tamil postpositions. To disambiguate a preposition  $p$ , our system uses the bag-of-words and linguistic information as features. The essential linguistic information for each English sentence is extracted using the Stanford parser toolkit. This linguistic information such as lemma, POS tag, and dependency tag is used as features in machine learning based disambiguation model. For training the model we utilized SVM-Light, a public distribution of SVM (Support Vector Machines) by (Joachims, 1999). The preposition disambiguation framework is shown in the Figure.1.

**Table:1 Sample English Sentences and its Prepositional Tag**

| S.No | English Sentences                                      | Preposition Tag |
|------|--------------------------------------------------------|-----------------|
| 1    | Dussehra is celebrated <i>for</i> ten days.            | NUL             |
| 2    | I have played outside <i>for</i> an hour.              | DAT-Aka         |
| 3    | She does not bring water <i>for</i> me.                | DAT             |
| 4    | I had headache <i>for</i> two or three days.           | Aka             |
| 5    | His body is covered <i>with</i> hair.                  | AI              |
| 6    | Peter has fallen out <i>with</i> his boss.             | il-iruwthu      |
| 7    | I have lived <i>with</i> my parents for over 10 years. | utan            |
| 8    | She did not come <i>with</i> me.                       | utan            |



**Figure:1 Framework for English Preposition disambiguation**

Our investigation revealed that machine learning method for solving the preposition disambiguation problem using existing knowledge sources as features improved the

performance of preposition translation. In future, the feature set can be further tuned with the use of English WordNet and the Semantic role's of verb in the sentences.

## 5 Conclusions

It can be inferred by linguistic analysis that within the context for prepositions, the governor (head of the NP or VP governing the preposition), the object of the preposition (i.e., head of the NP to the right), and the word directly to the left of the preposition have the highest influence. While disambiguating prepositions the maximal accuracy can be achieved by considering the context, features, and granularity. Though the preliminary result is encouraging, various issues still need to be addressed, *i.e.* improving the result by disambiguating noun senses or using world knowledge or context information. Preposition sense disambiguation has many potential uses. For example, due to the relational nature of prepositions, disambiguating their senses can help with all-word sense disambiguation. In machine translation, different senses of the same English preposition often correspond to different translations in the foreign language. Thus, disambiguating prepositions correctly may help improve translation quality.

## References

- Alam, Y. 2004. Decision trees for Sense Disambiguation of Preposition: Case over. In HLT-NAACL, Computational Lexical Semantics Workshop, Boston: MA, pp 52-59.
- Baldwin, T. V. Kordoni, and A. Villavicencio. 2009. Prepositions in applications: A survey and introduction to the special issue. *Computational Linguistics*, 35(2):119–149.
- Bannard, C and T. Baldwin. 2003. Distributional Models of Preposition Semantics. In ACL-SIGSEM, Workshop on the Linguistic Dimensions of Prepositions and their use in Computational Linguistics Formalism and Applications, Toulouse: France, pp 169-80.
- Boonthum C. S. Todia and I. Levistein. 2005. Sense Disambiguation of preposition 'with'. Department of Computer Science, Old Dominion University, USA.
- Dorr, Bonnie 1992. The Use of Lexical Semantics in Intelingual Machine Translation, *Machine Translation*, 7:3, pp 135-193.
- Harabagiu S. 1996. An Application of WordNet to Prepositional Attachment. In *ACL*, Santa Cruz, pp. 360-363.
- Joachims, T. 1999. Transductive Inference for Text Classification using Support Vector Machines. *International Conference on Machine Learning (ICML)*, 1999.
- Levin, B. 1993. *English Verb Classes and Alternations: A Preliminary Investigation*, University of Chicago press, Chicago; IL.
- Litkowski, K. 2002. Digraph Analysis of Dictionary Preposition Definition. In *ACL-SIGLEX, SENSEVAL Workshop on Word Sense Disambiguation: Recent Success and Future Directions*, Philadelphia: PA, pp. 9-16.
- Litkowski, K. and O. Hargraves. 2007. SemEval-2007 Task 06: Word-Sense Disambiguation of Prepositions. In *Proceedings of the 4th International Workshop on Semantic Evaluations (SemEval-2007)*, Prague, Czech Republic.
- O'Hara T. and J. Wiebe. 2002. *Classifying Preposition Semantic Roles using Class-based Lexical Associations*. Technical Report NMSU-CS-2002- 013, Computer Science Department, New Mexico State University.

- Saint-Dizier, P and G. Vazquez. 2001. A Compositional Framework for Prepositions. In *ACLSIGSEM*, International Workshop on Computational Semantic, Tilburg: Netherlands.
- Sopena, J. A. Lloberas, and J. Moliner. 1998. A Connectionist Approach to Prepositional Phrase Attachment for Real World Text. In *ACL*, Montreal, Quebec: Canada, pp. 1233-1237.
- Sablayrolles, P. 1995. The Semantics of Motion. In *EACL*, Toulouse: France, pp. 281-283.