Information-based Language Analysis for Thai

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Abstract
Thai language is recognized as an isolative language having neither a lexicon inflection due to word agreement and tense (as in English) nor an obvious syntactic case marker (as in Japanese). The position of a word in a sentence is the important superficial syntactic information for recognizing the meaning and the syntactic role [6]. In this paper, we describe a methodology and algorithm to effectively deal with the issues in Thai language processing. The relatively fixed relationship between word position and its syntactic role provides a well-formed pattern for phrases. Therefore, localization of pattern analysis helps in phrasal recognition and works well in lexicon disambiguation. In a sentence, the relatively less ambiguous concept of words from a variety of concepts is first examined to make up a sub dependency tree. Then, according to the information retrieved from the dictionary, subcategorization employed by the verb of the sentence will finally create the relation between the groups of concepts to build a dependency structure [3] to represent the meaning of the sentence. In addition to the lexicon information from the dictionary, the grammatical rules are employed to identify the appropriate semantic relations between concepts with lexicon functional reasoning in the pair of *provides* and *requires* attributes.

Keywords: subcategorization, dependency structure, functional reasoning, interlingua, machine translation, Thai translation

1. Introduction

This paper presents a methodology and algorithm for the parser in the Thai sentence analysis part of the multilingual machine translation system. The language analysis methodology is partially based on dependency grammar [3], representing the meaning of a sentence in an interlingual representation--in other word is called a conceptual dependency structure. As Thai language is an isolative language and has many lexical ambiguities, the methodology is constructed to extract those ambiguities by interpreting both syntactic and semantic roles of the language. The difficulties of Thai language in constructing an analysis system are described in Section 2. Then, we introduce our analysis architecture in Section 3. The first part of Section 3 explains the nature of subcategorization of verb and its arguments. The verb pattern table is created as the information based knowledge. The second part of Section 3 describes the implementation of the *provides* and *requires* attributes to define the semantic relation of two concepts by using lexicon functional reasoning.

The system is authorized in the name of the Machine Translation Project for Asian Languages, supported by the Ministry of Trade and Industry (MITI) of Japan, conducted by the Center of the International Cooperation for Computerization (CICC) cooperating with other four governments of the People's Republic of China, the Republic of Indonesia, Malaysia and Thailand. The parser, discussed in this manuscript is an out-come of the joint research between CICC and the National Electronics and Computer Technology Center (NECTEC), Ministry of Science, Technology and Environment of Thailand.

2. Difficulties in Thai Sentence Analysis

Isolative and mono-syllable characteristics in Thai sentences leave us with many classes of problems for a computer system. One surface word usually has more than one meaning and/or more than one syntactic category. In the information preparation step, we have tried to identify the grammatical role of words in each sentential form. As a result, we realized that besides the meaning of the word itself, the word position is properly notified to be the grammatical role for itself. After testing the words with any arbitrary position in a sentence form, we grouped up a set of word categories [4] [6] with the consideration of the implementation of grammatical rule when applying to the organization.

The difficulties in Thai sentence analysis, from language computing stand point, may be raised in this prototyping analysis system to the following summary :

(1) Polysemy phenomenon which occurs in most Thai single words. The more frequently the word appears, the more meaning derivations it has. This is the nature of the easy-to-use words. So that, formulating the constraints for their usage distinction is needed. The constraints may include grammatical role (Word category; CAT, SUBCAT) or syntactic usage pattern (Verb pattern; VP) or the information of neighboring words in the sentence (in pragmatic rules). For instance, the word "/caak/" has at least three meanings as follows:

L1; /caak/ #CAT.{V}, #CP.{LEAVE}
#CAT.{PREP}, #CP.{FROM}
#CAT.{N}, #CP.{NIPA^PALM}

(2) Appropriate word, as well as sentence, boundary assignment. Thai language has a nature of being written in a string of characters without any remarkable word boundary or sentential marker. This really causes difficulties in the analysis as it must be segmented into words. In addition, Thai language has no punctuation marker to mark the clause boundary. To separate the clause, space between string of characters is proposed to be the marker determining the boundary of the clause or the sentence. But the word segmentation is still the problem in analyzing as how precise the word segmentation is. As the word formation in Thai language is formed by attaching each word together to form the new word, so the problem is how to keep the word in dictionary, single word or compound word. For instance, "/kaanplxxphaasaaduaikhoomphiuter/" is composed of 5 single words as "/kaan/", "/plxx/", "/phaasaa/", "/duai/", "/khoomphiuter/". The word can be interpreted as follows:

L2; /kaanplxxphaasaaduaikhoomphiuter/
can be segmented in 4 different ways:-
5 words as /kaan/, /plxx/, /phaasaa/, /duai/, /khoomphiuter/
4 words as /kaanplxx/, /phaasaa/, /duai/, /khoomphiuter/
3 words as /kaanplxxphaasaa/, /duai/, /khoomphiuter/
1 words as /kaanplxxphaasaaduaikhoomphiuter/

(3) No inflection, no verb agreement. Thai language is an isolative and monosyllable language. There is no inflection to mark morphology of the language like English or Japanese. Instead, the morphology is designated by the lexical item. For example, the passive voice is indicated by a lexical item in the position of pre-verb.

S1; /nakrian/ /thuuk/ /khruu/ /longthoot/
student passive marker teacher punish
"The student is punished by the teacher."

Like the passive voice, Thai language expresses tense, aspect, modality in lexical items modifying verb in pre- or post-position.

(4) Tense point of view. In (3), we have mentioned that tense in Thai is expressed overtly by a lexical item as auxiliary category. Only one lexical item of "/ca/=will", is a marker expressing that the event is not yet occurred. So it can be summarized that Thai recognizes only two tenses:-

(a) Irrealis tense expresses that the event is not yet occurred, corresponding to future tense.

(b) Realis tense expresses that the event has already occurred, corresponding to present and past tense which is not distinctive.

The difficulty appears in how to assign the universal tenses of present, past or future to the interlingual representation of a Thai sentence.

3. Analysis Architecture

The target of the analysis system is to produce an interlingual representation (dependency tree structure [3]) from a linear sequence of Thai character string. The output interlingual representation will then be transferred to a sentence generation system to generate any other specified language. Therefore, the interlingua must be exhaustive to represent all the meaning units of the source language. The research on interlingua is carried on in a separate framework of the project. Here the details of the interlingual representation and the generation part will not be discussed. We will limit our discussion to the analysis part of machine translation system.

Designing this analysis system scoped to process a syntactic sophisticated structure of Thai language needs special tactics in the rule implementation and requires a flexible parser with ample functions for data manipulation. The parser itself will be discussed in the next section of this paper. The following are the postulates for system construction. These are realized in both of the parser capability and methodology implemented in the rules.

(1) Sentence analysis. This is a restriction to narrow the possible information which can be taken into account in the parse time. But, this restriction protects us from unpredictable calculation time and misinterpretation. Especially for the Thai language, there is no sentential marker whether it is a comma between phrases or a full stop at the end of a sentence. Nevertheless, discourse analysis is believed to be another precise method to improve the translation. The idea of discourse analysis is also a part of our future plan.

(2) Lookahead in parsing [1]. This thought positively supports the idea of using all the available information in parsing. The full support of information from either its own lexicon specific features or surrounding constituents is important in drawing the most appropriate result in any step of parsing.

S2; /khon/ /khian/ /nangsuuniyai/ /khon/ /nan/ /kamlang/ /dean/ /maa/
person write novel person that -ing walk come
"That person who writes a novel is coming."
or "That novel writer is coming."

Considering an example of noun phrase in S2 above, it is difficult to determine the end of the noun phrase if the system has no lookahead capability. The embedded sentence of "/khon/ /khian/ /nangsuuniyai/=A person writes a novel." will actually be parsed as a sentence followed by an another sentence of "/khon/ /nan/ /kamlang/ /dean/ /maa/=That person is coming.". It makes sense but it is better to be parsed as one sentence with a noun phrase of "/khon/ /khian/ /nangsuuniyai/ /kon/ /nan/=That person who writes a novel (or That novel writer)." being the subject of the sentence. This lookahead function is very useful in selecting the suitable alternatives. Thus the information of all the constituents in the sentence must be referable at any point in the parse.

(3) Node instantiation. The system has to be able to recognize each node identically.

S3; /khao/ /maa/ /caak/ /haatyai/ /doi/ /rotfai/
he come from Haadyai by train
"He came from Haadyai by train."

The train "/rotfai/" as well as the others is instantiated as an object representing a train with the specific syntactic features while it appears in the sentence. In case of multiple concept of a node such as "/khao/", the concept of "he", "animal horn" and "mountain" are to be instantiated separately to maintain the 3 concepts attaching to the same node.

(4) Bottom-up parsing in top-down parsing

The significant ambiguity of word categories in languages such as Thai increases the search path for grammatical rules. This ambiguity cannot be easily resolved using only lexicon features before the top-down parsing mechanism rule set. The top-down parsing is introduced to produce all the possible interpretations. As a result, this will allow a large number of candidate to be taken into account because of the significant amount of word ambiguity in Thai. Thus, the system needs some heuristic rules to disambiguate the word category and some sentence constituent reducing rules in the bottom-up parsing mechanism according to the locality in analysis allowed in the language.

3.1 Lexicon Information Representation

The static information of a lexicon is assigned in the lexicon dictionary having a

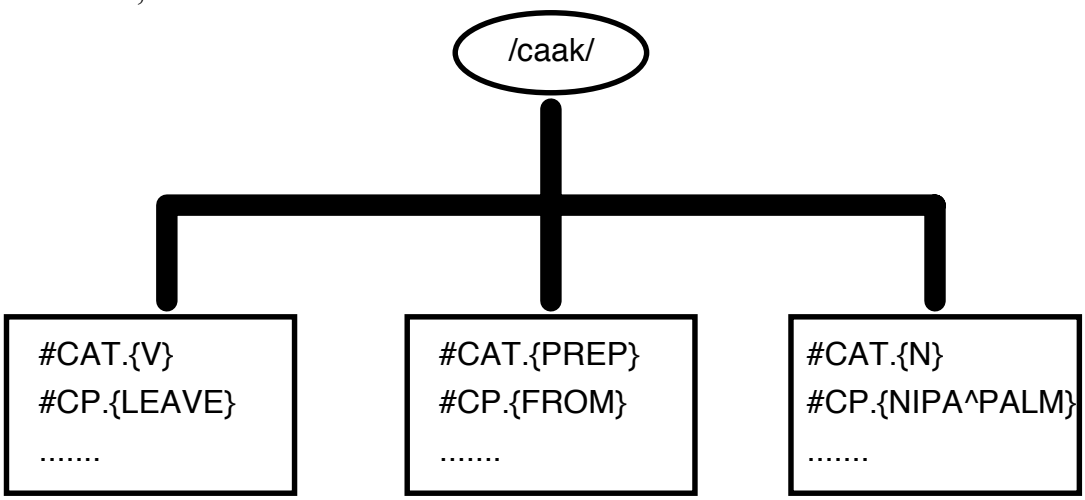
general surface form (word spelling) as a key to retrieve. The information assigned in the lexicon dictionary is in the form of feature and its value, #feature.{feature_value}. Such as,

```
L3;   /plxx/
      #CAT.{V}
      #SUBCAT.{VACT}
      #VP.{11}
      #MAPPING.{SUB=AGT,DOB=OBJ}
      #CP.{TRANSLATION}
      #AKO.{2111}
```

The feature can be word category (CAT), subcategory (SUBCAT), mapping constraints between syntax and semantic relation (MAPPING) or verb pattern(VP) for the information concerning the syntactic feature. And, there also includes word concept (CP) and conceptual hierarchy (AKO) for the information defining the meaning of word.

All of the information attached to each lexicon is instantiated when it is retrieved from the dictionary. The parser will treat every syntactic or semantic ambiguity to a surface word individually. For example, the word "/caak/" in L1, three instances of "/caak/" will be generated attaching to one same surface.

T1;



This nature of instantiation is very useful when a word appearing in the sentence has more than one meaning or one usage. Especially in the disambiguation process, the parser needs to know the syntactic feature of "/caak/" which means "to leave" as a verb rather than the possibility of "/caak/" to be either verb or preposition or noun and to mean "to leave" or "from" or "Nipa palm" without any discrimination standard. Because, "Nipa palm" cannot be treated as a verb as well as "from" cannot be treated as a noun.

During the parse time, the rules can assign additional information to the instance when its concept is augmented by other concept or its role in the sentence becomes clearer. For instance,

S4; /nangsuu/ /bon/ /to/ /nii/ /mii/ /raakhaa/ /phaeng/
book on table this have cost expensive
CAT: .... PREP N ... ...
"The book on the table is very expensive."

The prepositional phrase "/bon/ /to/=on the table" is reduced to be a "/to/=table" with the augmented value of #PSPL.{/bon/} to indicate that the current instance of "/to/" has something to be "/bon/=on". This point of view has come from the analyzing idea in case grammar theory which determines the prepositional phrase as the noun phrase.

3.2 Methodology

The parser refers to grammatical rules for examining the acceptable solution of a sentence. But, sometimes it cannot tell that which solution is favored over the others or near to the human preferences in parsing. To initiate the parse for selecting the best alternatives, we have implemented some of the results from psycho linguistic research concerning the human preferences in parsing as the parse principles. So far as this paper concerns we are not going to discuss the human preferences in detail. Followings are the parse principles implemented to supplement the grammatical rules.

(1) Right Association

S5; /nakrian/ /khit/ /waa/ /aacaan/ /ca/ /mai/ /maa/ /nai/ /wannii/
student think that teacher will not come in today
"The student thinks that the teacher will not come today."

New constituents tend to be interpreted as being part of the current constituent under construction rather than part of some constituent higher [1]. In S5, it is preferable to interpret that "the teacher will not come today" rather than "The student thinks ... today".

(2) Lexicon Preferences [1]

S6; /chan/ /suu/ /nangsuu/ /nai/ /raan/ /nii/
I buy book in shop this
"I buy a book in this shop."

S7; /chan/ /yaakdai/ /nangsuu/ /nai/ /raan/ /nii/
I want book in shop this
"I want a book in this shop."

In S6, the prepositional phrase "/nai/ /raan/ /nii/=in this shop" is most likely to modify the verb phrase "/suu/ /nangsuu/=buy a book", which is interpreted as "buy (a book) in this shop", rather than the noun "/nangsuu/=a book", which is interpreted as "buy the book which is in this shop". But, there is no alternative at all for the prepositional phrase "/nai/ /raan/ /nii/=in this shop" in S7 to modify the verb phrase "/yaakdai/ /nansuu/=want a book", which is interpreted as "want (a book) in this shop".

This kind of information is lexicon dependent so we assign it into the lexicon feature in the dictionary.

(3) No Dependency Crossing

S8; /khao/ /rotnam/ /tonmai/ /thukwan/ /nai/ /suan/
he water plant everyday in garden

S9; /khao/ /rotnam/ /tonmai/ /nai/ /suan/ /thukwan/
he water plant in garden everyday

S8 is interpreted as "water in the garden" while S9 has to be interpreted as "plant in the garden". It is impossible to interpret S8 to have a noun phrase of "plant in the garden" because of the relation between "/rotnam/=water" and "/thukwan/=everyday". In other words, the adverb "/thukwan/=everyday" cannot modify any other constituent except for the verb phrase "/rotnam/ /tonmai/=water a plant".

3.2.1 Bottom-up Parsing in Top-down Parsing

This is the base mechanism of parsing in the system. All the analysis paradigms discussed in the remain subsections are implemented consistently on this base parsing principle. This sub section describes the interrelation of the rules for making hypotheses in top-down parsing and the rules for pattern determining in bottom-up parsing. The top-down parsing has some distinctions from the conventional one. That is, all the possible interpretations are generated immediately as the hypotheses for following rules implementing. They are not generated one by one after the faulty detection and being caused backtracking as in the conventional parsing. This top-down parsing generates the hypotheses under the restriction on those lexicons. When all the possible hypotheses have been generated, the other processes (discussed in the next sub sections) will then conduct the elimination of flawed hypotheses or selection of the effective hypotheses, and finally select the only one plausible solution.

Following is a small grammatical rule set simplified in phrase structure form.

(1) Rules in top-down parsing :-

(1.1) S <- NP VP
(1.2) VP <- V NP PP
(1.3) VP <- V NP
(1.4) VP <- V

(2) Rules in bottom-up parsing :-

(2.1) V <- LAUX V RAUX
(2.2) V <- V RAUX
(2.3) NP <- N NUM CLAS DET
(2.4) NP <- N VATT CLAS DET
(2.5) NP <- N CLAS DET
(2.6) NP <- N DET
(2.7) NP <- N VATT
(2.8) PP <- PREP NP

S10; /chaang/ /yai/ /tua/ /nan/ /aasai/ /yuu/ /nai/ /paa/ /luk/
CAT: N V N,CLAS DET V V,AUX PREP N V
SUBCAT: NCMN VATT NCMN, DDAC VACT VSTA, RPRE VATT
CLAS XVAE NCMN
CP: BIG BODY THAT DWELL, STAY, IN FOREST DEEP
ELEPHANT RESORT^TO STATE
"That big elephant lives in a deep forest."

After inspecting all the words in the sentence, the parser generates all of the possibilities for the verbs "/yai/", "/aasai/", "/yuu/" and "/luk/" using the information and constraints retrieved from the lexicon dictionary. As a result, "/yai/", "/yuu/" and "/luk/" activate the rule (1.4), and "/aasai/" activates the rules (1.3) and (1.4). The rule (1.3) is also consulted for "/aasai/" because it also has the meaning of "to resort to".

The lookahead feature of the parser allows the prediction in the bottom-up parsing process. This can be simulated as :

"*" determines the position of the parse.

"f" determines the lookahead position.

Parse state 1:

Parse position	Parse rule
*	
/chaang/ /yai/ /tua/ /nan/..	(1.1) S <-* NP VP
	(2.3) NP<-* N NUM CLAS DET
	(2.4) NP<-* N VATT CLAS DET
	(2.5) NP<-* N CLAS DET
	(2.6) NP<-* N DET
	(2.7) NP<-* N VATT

Parse state 2:

Parse position	Parse rule
* f	
/chaang/ /yai/ /tua/ /nan/..	(1.1) S <-* NP f VP
	(1.4) VP<-f V
	(2.4) NP<-* N f VATT CLAS DET
	(2.7) NP<-* N f VATT

Parse state 3:

Parse position	Parse rule
* f	
/chaang/ /yai/ /tua/ /nan/..	(1.1) S <-* NP VP f
	(2.4) NP<-* N VATT f CLAS DET
	(2.7) NP<-* N VATT f

Rule (2.4) finally supports the decision to parse "/chaang/ /yai/ /tua/ /nan/" as an NP rather than a sentence because the existence of the verb "/aasai/" in the later part will break this sentence into two sentences of "/chaang/ /yai/" and "/tua/ /nan/ /aasai/

sentence at a time". And the longest parse preference will give the priority to the rule (2.4) rather then (2.7).

After a parse through the end of the sentence, the ambiguity still remains in what concept of the "/aasai/" is used whereas the "/aasai/" is firmly marked to be parsed as the main verb of the sentence.

S10'; /chaang/	/yai/	/tua/	/nan/	/aasai/	/yuu/	/nai/	/paa/	/luk/
CAT: N	V	~~N~~,CLAS	DET	V	~~V~~,AUX	PREP	N	V
SUBCAT: NCMN	VATT	~~NCMN~~, CLAS	DDAC	VACT	~~VSTA~~, XVAE	RPRE	NCMN	VATT
CP:	BIG ELEPHANT	BODY	THAT	DWELL, RESORT^TO	~~STAY~~, STATE	IN	FOREST	DEEP

The bottom-up rules will then reduce "/chaang/ /yai/ /tua/ /nan/" to be a NP by (2.4), "/aasai/ /yuu/" to be a V by (2.2), and "/nai/ /paa/ /luk/" to be a PP by (2.7) and (2.8).

Up to this stage, the top-down procedure still maintains two planes of parsing possibility of the main verb "/aasai/". The parse is resumed in the next subsection to extract the various plausible interpretations.

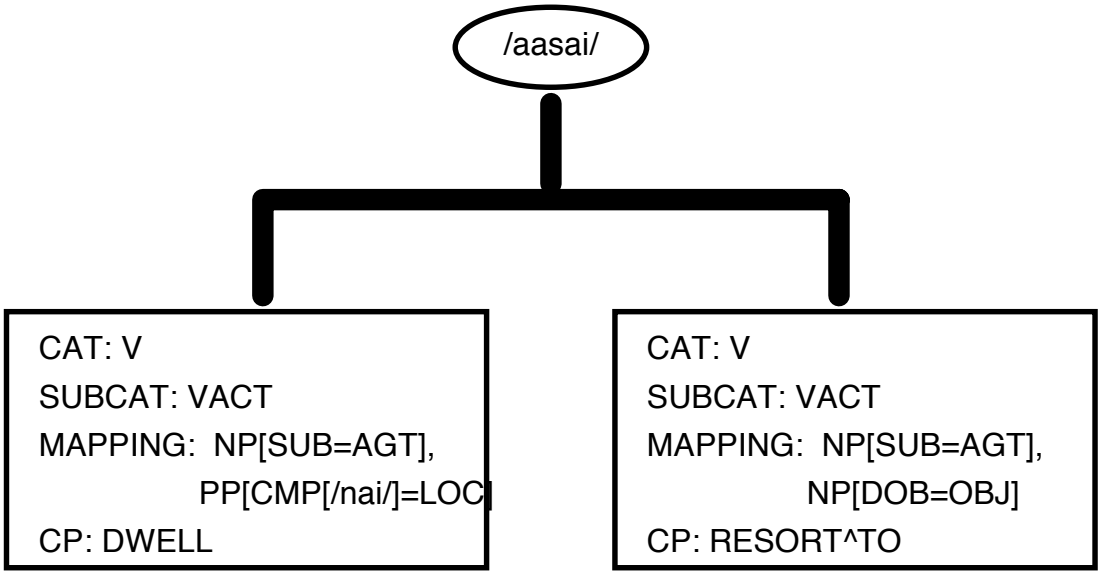
3.2.2 Subcategorization

The disambiguation of a word among its different word categories is explicitly realized by extracting the most plausible usage pattern as described in the previous subsection. Though the word usage according to its category can reduce the category ambiguity to some extent, the ambiguity still remains especially to the word which possibly acts as a verb. As a conclusion, the lexicon ambiguity is recognized in two different levels. First is the one in which a word occupies more than one category such as "/tua/" can be a common noun (NCMN) and a classifier (CLAS) or "/yuu/" can be a stative verb (VSTA) and a right auxiliary (XVAE) in the sentence labeled S10. The system reduces this kind of ambiguity according to its plausible usage pattern. Second is the ambiguity occurring within the same word category but different meaning such as "/aasai/" which is an active verb (VACT) having the meaning of both "to dwell" and "to resort to" in S10. In this case, with just only the word category the system cannot distinguishes its meanings at all. Therefore, the category of verb is specially defined correspondingly to its distinctive natures.

A verb apparently needs some other constituents to fulfill its meaning for detailing an event. For instance, the "/chaang/=elephant" in S10 referred to a kind of animal has a complete meaning within itself whereas "/aasai/=to dwell" in S10 needs a significant agent of the action and a place to where the action is attached to complete the meaning describing an event. On the other hand, the verb "/aasai/=to resort to "needs an agent of the action and an object to which the action is directed. Therefore, a verb having more than one meaning such as "/aasai/" can be described as to the number and the syntactic and semantic nature of the elements it combines with. The dependencies that hold between the verb and its dependent elements are referred to as subcategorization restrictions [7].

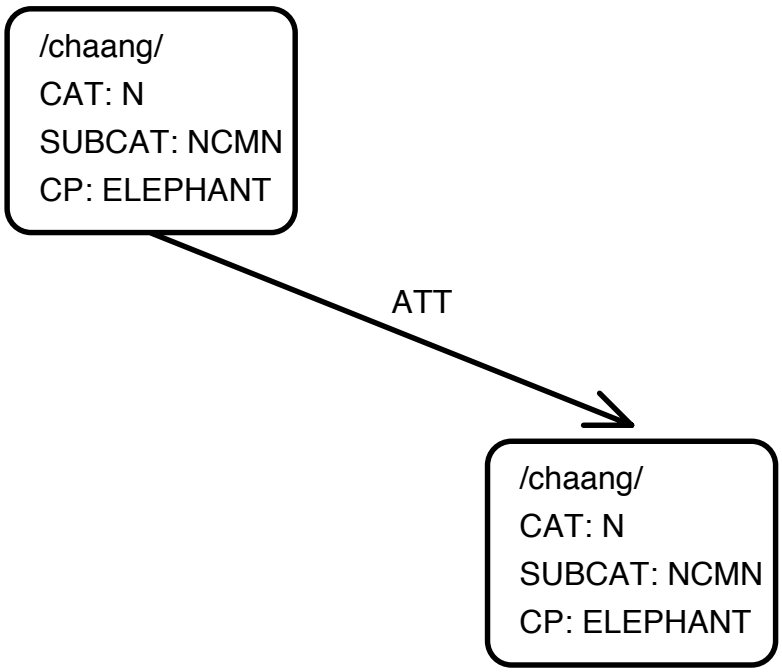
The top-down rule of (1.3) and (1.4) generate two planes of meaning for the verb "/aasai/" in S10. Both are different in the subcategorization restriction as simply depicted in the value of MAPPING below.

L4;

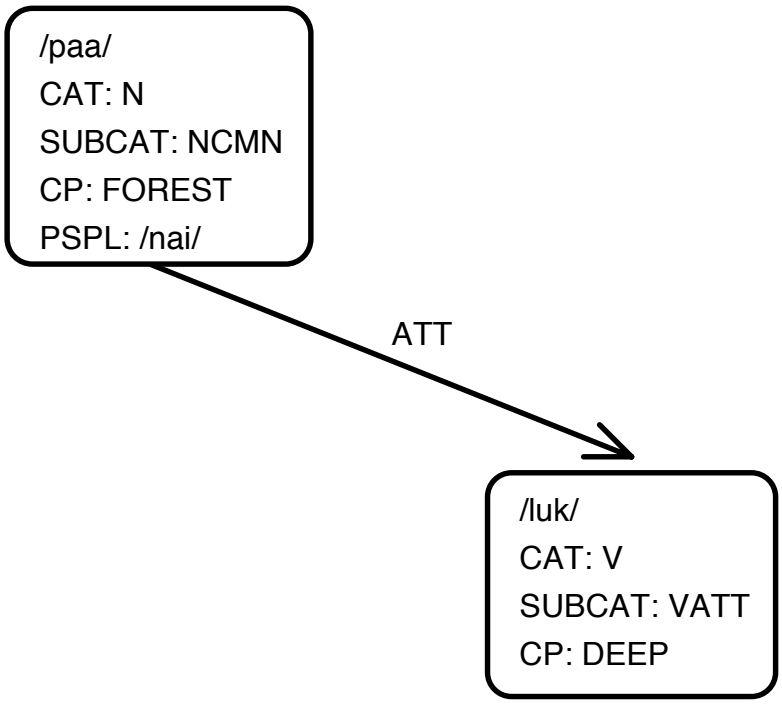


The partial structure and lexicon information of the other phrases are simplified as follows:

T2; /chaang/ /tua/ /yai/:

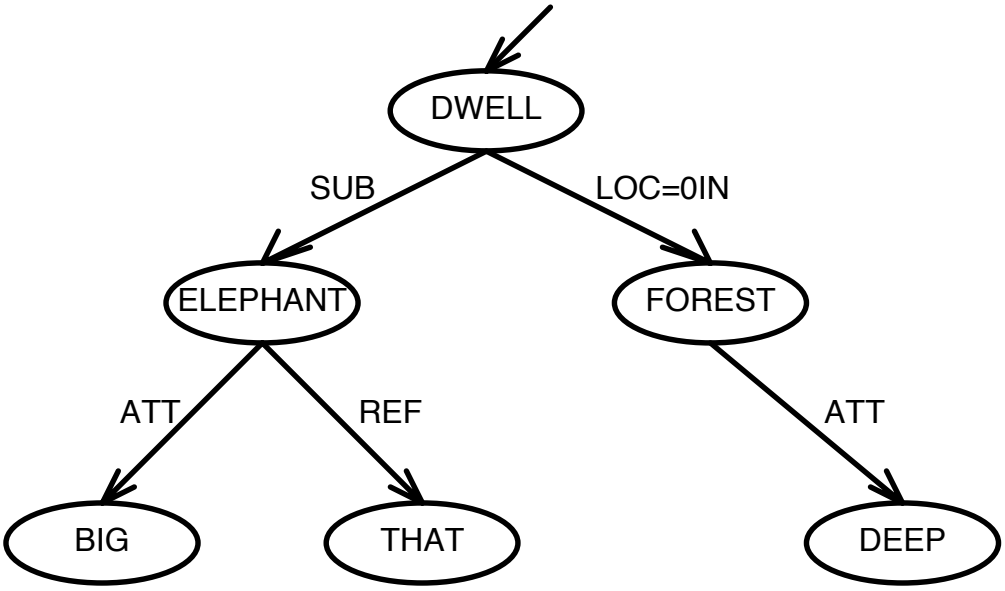


T3; /nai/ /paa/ /luk/:



The phrase "/chaang/ /tua/ /yai/" satisfies both MAPPINGs of the "/aasai/" because it provides the attribute of a noun phrase as required in the MAPPINGs. The phrase is subcategorized as the subject of the verb while the phrase "/nai/ /paa/ /luk/" is a prepositional phrase (PP) which has the feature value of PSPL (preposition information) satisfies only the MAPPING of "/aasai/=to dwell" according to the constraint of CMP value (verb complement) in the MAPPING.

T4; /chaang/ /yai/ /tua/ /nan/ /aasai/ /yuu/ /nai/ /paa/ /luk/



Both possible meanings of "/aasai/" are considered in parallel when they are generated. Comparing the degree of satisfactory, the "/aasai/=to dwell" has full number of elements which satisfy all the requirement while "/aasai/=to resort to" has only one element which satisfies the need. Thus "/aasai/=to dwell" is selected to build a dependency structure.

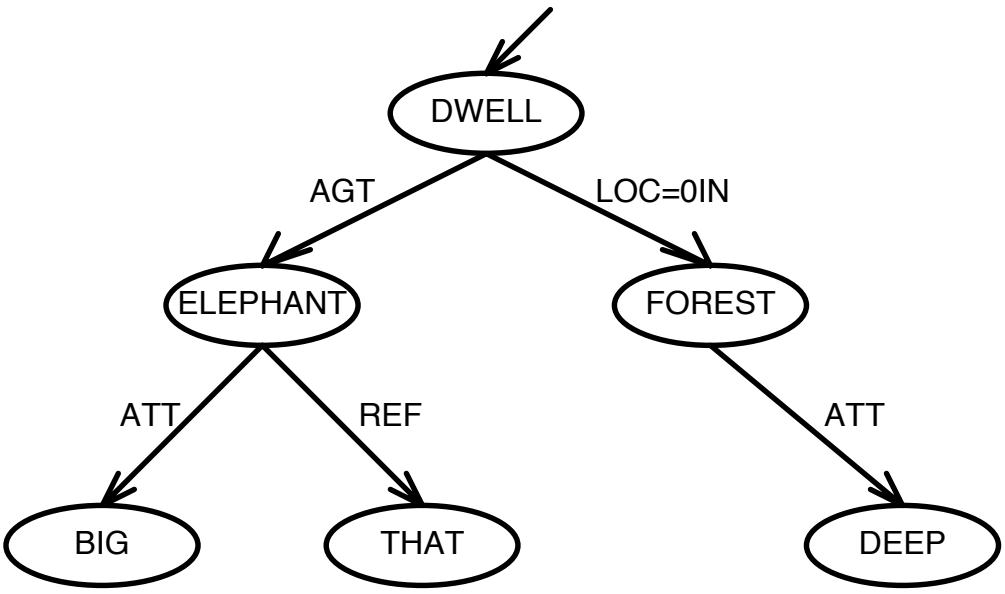
The syntactic dependency structure of the sentence labeled S10 is therefore constructed as shown in the tree T4 above.

However, in the rule implementation we need more information than describing above to justify the subcategorization of verb. For example, "/tuu/=cabinet" cannot "/aasai/ /yuu/ /nai/ /baan/=live in the house" like a living thing but the sentence must be "/tuu/ /yuu/ /nai/ /baan/=cabinet is in the house". In this case, we need some kind of conceptual hierarchy (AKO) to mark the property of the object. Therefore, the verb "/aasai/" will subcategorize for a subject which is a kind of living thing to give the meaning of "to dweller to live".

3.2.3 Case Mapping

T4 shows the syntactic dependency structure where the upper node is the head node and the lower node is the dependent node. To build a deep structure we have to compile the relation between nodes into a deep case representation (defined in the interlingua for multilingual machine translation) [5]. The syntactic relation obtained from MAPPING feature of verb determines the case between the nodes. Therefore, "/chaang/=elephant" in S10 is assigned to be the agent (AGT) of the action "/aasai/=dwell" and "/paa/=forest" is assigned to be the location (LOC) where the action takes place. The "/paa/=forest" is definitely not the object (OBJ) of the action "/aasai/=resort to" which becomes possible due to the ambiguity of the word "/aasai/".

DS1; /chaang/ /yai/ /tua/ /nan/ /aasai/ /yuu/ /nai/ /paa/ /luk/



Therefore, the MAPPING feature of the selected meaning of "/aasai/=dwell" confirms the semantic relation in the tree T4 to be in the form of DS1 shown above.

The analysis process usually ends here after generating the deep structure as DS1. In some cases, the tree structure generated according to MAPPING feature of verb is not logically acceptable as a deep structure (this also depends on the definition of case set). The linguistic phenomena such as in S11 (is to be interpreted as S11') or contraction in S12 ("/yuu/ /nai/=be in" is to be interpreted to be a case of LOC) are considered to be in the case.

S11; /khruu/ /sang/ /nakrian/ /hai/ /tham/ /kaanbaan/
teacher order student to do homework

S11'; [/khruu/ /sang/ /hai/[/nakrian/ /tam/ /kaanbaan/]]
teacher order that student do homework

S12; /khruu/ /yuu/ /nai/ /hong/
teacher be in room

3.2.4 Lexicon Functional Reasoning

We introduce the functional reasoning [2] to be the fundamental guide to infer the appropriate semantic case that is set in between the nodes' connection. Every node is treated individually as an existing object. And, each object node has its own syntactic/semantic functions that can be deleted or modified during the process of reasoning. The functions of the object node are realized according to its currently occupying syntactic/semantic features. This means that the initial functions change continually during whole analysis process. For instance, a node of noun (provides: N) will be the head node of prepositional phrase (provides: PP, PSPL) after the connection with a preposition.

This reasoning process has the propositions to achieve the goal as follows:

Goal: Construct a semantic tree having all nodes connected together with the appropriate semantic case and a node being the head node of the tree.

Propositions:

(1) Each object node provides a set of functions.

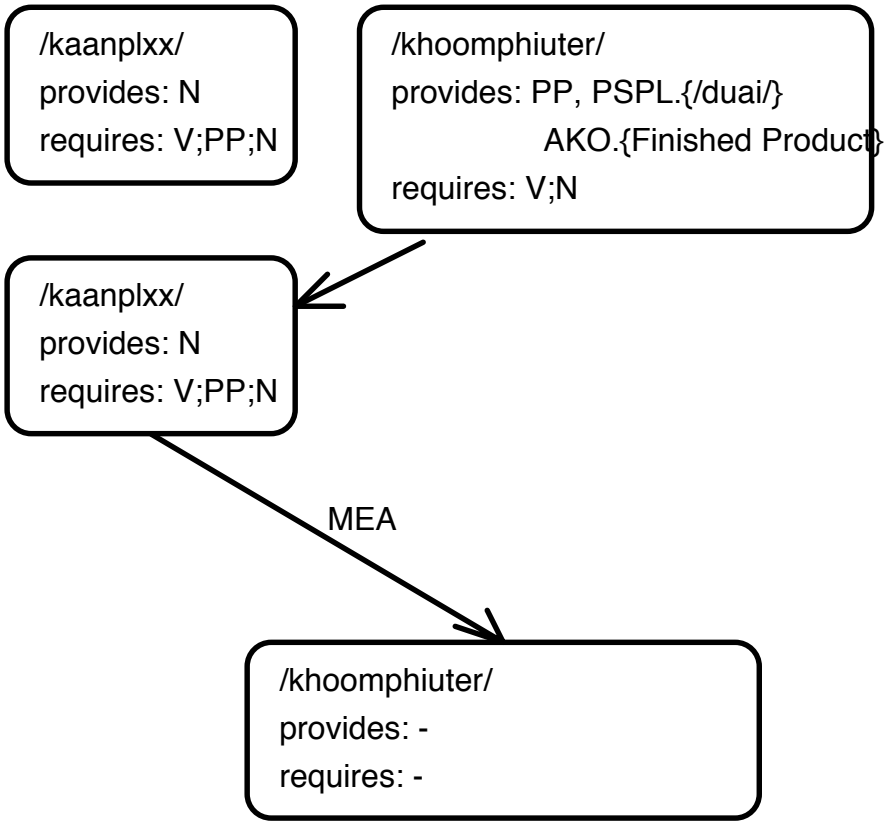
(2) For each function it provides, an object node requires a set functions.

(3) A functional connection can occur between two nodes if one provides a function required by the other.

(4) A constructed structure consists of a set of nodes having a node to be the head node of the structure and a set of functions installed in the head node.

(5) Semantic case indicates type of connection.

S13; /kaanplxx/ ..... /duai/ /khoomphiuter/
translate with computer



4. Conclusion

The system is the first prototype of a machine translation system designed to process Thai language. The language model should be extendible to other languages within the isolative language family. Many syntactic restrictions are raised to make the system feasible. At this stage, the system can manipulate most Thai sentences that have explicit grammatical words such as the demonstrative, quantitative and preposition. These grammatical word are very useful in the syntactic parsing process. The methodology we proposed, primarily uses the information on each word from the dictionary. Therefore, word information is very important to the performance of the system.

Furthermore, we have realized the need of semantic analysis at a deeper level to be performed interactively with the syntactic analysis. At present, we are preparing the knowledge base to improve the semantic disambiguation process. We are also interested in the concept of reader's model and reader's background knowledge generation and retrieval. Further studies will be conducted to support the development of multilingual machine translation and to form the natural language interfacing module.

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