Noun-Noun Metaphor Identification in Myanmar Language

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***Abstract*— Figurative languages can be found in all areas of human activities, literary, discourse and conversation. Metaphor, which is one of the figurative languages, becomes a problem in natural language processing (NLP). In Myanmar language, there is a gap for specific work of metaphor in NLP research field. This paper presents about the identification of noun-noun metaphor by using Myanmar WordNet (MMWN) and additional resources, such as wordnet2sql, bilingual dictionary and compound noun corpus. In this work, step by step processing of noun-noun metaphor identification are explained in details. Sentences are used for the experiments and categorized in five domains. Semantic relations in the WordNets are used for metaphor identification (MI) and compound noun corpus is used to identified the literal usage. The experimental results of noun pairs extraction and metaphor identification are described in this paper. The precisions are 57% in News, 76% in Novels, 79% in Articles, 81% in Formal and 76% in Conversational sentences. The issues found in metaphor identification and overall discussion about these issues are also presented in this paper.**

Keywords—noun-noun metaphor, metaphor identification, semantic relations, noun pairs, WordNet relations

I. INTRODUCTION

In communication technology, language to language communication is becoming critically important. In everyday communications, figurative language is one of the barriers in communication from one language to another. Figurative uses are difficult to understand and sometimes it leads to misunderstanding and miscommunication. In natural language processing, these usages are becoming a problem and obstacle in machine translation. Metaphor is one of the figurative languages. The metaphorical concepts are difficult to handle and hard to understand directly. It may lead to misunderstanding and misinterpretation in communication of one language to another language. Therefore, metaphor becomes a problematic of natural language processing (NLP). In machine translation, these types of problems become bottle neck and considerably significant in natural language processing research area. Metaphorical concepts are difficult to interpret directly and hard to recognized the meaning that they intend. Even though, metaphors are used in several forms of discourse, conversation and many other human communications. For this reason, metaphor work is interested by many researchers and become popular topic in NLP research field. Metaphor understanding will help many areas of NLP application such as automatic text summarization, question and answering, information extraction and especially in machine translation.

For most people, metaphor is a device of poetic creativity and rhetoric, a matter of exceptional rather than ordinary words and usages. The human conceptual system's metaphorical structure and mappings between two conceptual domain, source and target domains, were proposed by Lakoff and Johnson [1]. The use of metaphor is not described the things or events in conventional way of thinking and view. They use complex imagine and need to think different ways to understand. A metaphor is a figure of speech which is used to make a comparison between two things that are not alike in their existence, but for those two things, there is at least a common property or concept. As an example:

- Life is a journey.

The "Life" in the above example is not really a "journey." When people going a journey, there may be many wonderful surprises and fun or there may be various inconveniences among this journey. Anyone cannot know what the new knowledge will be come in this journey. As a journey, "Life" has some similarities with the journey. From the start of the life, there are many experiences with fun or sad until the end of life. Everyone cannot know what will happen tomorrow. The word "journey" is used as metaphor. "Life" and "journey" are describing by comparing their similarities.

Three kinds of metaphor can be specified: nominal metaphor, verbal metaphor, and adjective metaphor [2]. Metaphor recognition or identification and metaphor interpretation are the two main sub tasks found in metaphor understanding [3]. The process of identification is performed before interpretation. In the field of metaphor research, a lot of work has been done to identify metaphors. For the English language, much of the metaphor work has been finished. For other languages, such as German, Italian, Russian and Chinese, there is a little metaphor work can be found.

There is no particular attention to metaphor in the field of machine translation research for the Myanmar language. The purpose of this contribution is to identify nominal metaphors in Myanmar language. Myanmar language includes noun-noun metaphor and the referential nominal metaphor as two subtypes. This paper presents the identification of noun-noun metaphors for Myanmar language. The method of metaphor identification requires semantic relationships to identify the metaphor noun pairs, and WordNets provides these relationships. Moreover, additional resources are used in metaphor identification process. These resources are noun corpus, pronoun corpus, compound noun corpus, Myanmar-English bilingual dictionary and wordnet2sql 0.99.4a [4]. In noun-noun metaphor identification experiments, sentences are used and preprocessing steps are carried out in the metaphor identification process for these sentences. The steps of preprocessing are also explained in this paper. The structure

of this paper is described as follows. In Section II, related works are presented and the types of metaphors in the Myanmar language are discussed in Section III. Section IV expresses preprocessing steps and the extraction of noun pairs. The overall experimental results for noun-noun metaphor identification will be presented and discussion about the results are described in section V. Section VI shows all the experiments and their results. The last section, section VII, is the conclusion.

II. Related Works

Many studies related to the identification of metaphors were initiated years ago. In human language, metaphor can be found everywhere. Metaphor identification and understanding are turn into a significant issue in comprehending natural language text. Krishnakumaran and Zhu introduced three main types of syntactic structures of metaphor. For the type I, a subject noun and an object noun are connected by a form of the copula verb "to be". For the type II, the subject noun is related to an object noun with a verb used as metaphorically. Structure Type-III is the usage of phrase in adjective-noun. For nominal metaphor recognition, relations of WordNet, hypernymy-hyponymy, are used in identification task [2].

Jia, Zan, Fan, Yu and Wang presented metaphor recognition for noun-noun metaphor. In this paper, with the help of the lexical knowledge base, the authors proposed a method for evaluating word relevance for noun-noun metaphor recognition [5]. They proposed a HowNet-based word relevance computation method Rel_{hownet}. The combination of sememes is used to describe idea or word sense in HowNet. The representation of metaphors in lexical knowledge bases and their impact on the lexical knowledge bases construction were also examined in this paper.

A supervised machine learning method was proposed by Wang, Wang, Duan, Han, and Yu. [6]. They used contextual information to identify Chinese noun phrase metaphors but they omitted collocation information inside the noun phrases. A maximum entropy (ME)-based model was proposed for Chinese noun phrase metaphor recognition in this paper. Their findings showed that within the same context windows, the ME-based metaphor recognizer is significantly better than the Example-based methods.

Oo and Thida presented nominal metaphor identification in Myanmar language [7] using Myanmar WordNet. In this paper, only noun pairs are used to identify metaphor and these noun pairs are collected manually from the sentences. The results showed a little high recall and high false positive rate. In the next paper in [8], identification of nominal metaphor is done not only with Myanmar WordNet. The additional resources are also used for metaphor identification. wordnet2sql 0.99.4a and Myanmar-English bilingual dictionaries are also used to search the absent synsets in Myanmar WordNet. Unidentified noun pairs are reduced after using bilingual dictionaries. Moreover, meronym and holonym relations are also considered for literal usage.

III. Metaphor

Metaphor arises when one concept is viewed in terms of the properties of the other [9]. In metaphor processing, there are there types of metaphors: nominal metaphor, verbal metaphor and adjective metaphor [2]. Among these three types of metaphor, in this paper, only nominal metaphor is emphasized to present. Nominal metaphor has two sub types, noun-noun metaphor and referential nominal metaphor. Here, noun-noun metaphor identification is highlighted in this work. Noun-Noun metaphors can be found in everywhere of Myanmar sentences. This section explains about the nominal metaphors in details.

A. Nominal Metaphor in Myanmar Language

In Myanmar language, nominal metaphor is called “ရူပကအလင်္ကာ” (Yupaka Alinkar). Nominal metaphor in Myanmar language has two subtypes, noun-noun metaphor and referential nominal metaphor. These two types of metaphor are different in grammatical structure but the concept of metaphor is the same. A common definition of a metaphor can be described as a comparison that shows how two things that are not alike in most ways are similar in another important way [10]. In Myanmar language, some examples of nominal metaphors are described here. “ဒေါသ မုန်တိုင်း”, “ပညာ ဆီမီး”, “လောင်စာ ရန်ငြိုး” are noun-noun metaphors and “ဂုဏ် ဆိုတဲ့ တံတိုင်း”, “လောဘ တည်းဟူသော မီး”, “အပါယ် ဟူသော ချောက်” are referential nominal metaphors. The concept of metaphor can be seen as the attributes of the source words is used as the properties of the target words.

B. Noun-Noun Metaphor in Myanmar Language

Noun-Noun metaphor is one of the subtypes of Myanmar nominal metaphor. In this work, noun-noun metaphor is highlighted for metaphor identification and intend to present in details. “ဒေါသ မုန်တိုင်း” “ပညာ ဆီမီး” and “လောင်စာ ရန်ငြိုး” are some examples of noun-noun metaphor.

In the above example, noun-noun metaphor is the form of N+N structure.

- ဒေါသ (anger) + မုန်တိုင်း (storm)
- ပညာ (knowledge) + ဆီမီး (oil lamp)
- လောင်စာ (fuel) + ရန်ငြိုး (enmity)

In “ဒေါသ မုန်တိုင်း” and “ပညာ ဆီမီး”, “မုန်တိုင်း” and “ဆီမီး” are the metaphor source words and which is followed by “ဒေါသ” and “ပညာ”, the target words. The attributes of source words are used as the same concepts of the target words. The target words are in front of the source words. Another one, “လောင်စာ ရန်ငြိုး”, the source words “လောင်စာ” is in front of the target words “ရန်ငြိုး”. Here, source words and target words can be existing in front of or in the back of each words. Therefore, metaphor in Myanmar language can be found in various structures of source and target words.

IV. Preprocessing in Metaphor Identification

Preprocessing steps are the essential steps for Myanmar language in natural language processing. In Myanmar language script, sentences are clearly delimited by a sentence boundary marker but words are not always delimited by white spaces or any other delimiter [11]. Words are composed of one or more syllables. Spaces are often used to separate phrases for easier reading, but they are not necessary, and short sentences hardly use these spaces. In nominal metaphor identification, considering the noun pairs only did not require

the preprocessing steps [7]. For the sentences, the following preprocessing steps are needed to be done:

- Syllable segmentation
- Word segmentation
- Part of speech tagging (POS tagging)
- Post segmentation
- Part of speech tagging after post segmentation (Post tagging)

A. Syllable Segmentation

In Myanmar language, a syllable is the smallest linguistic unit, also means one sound unit. Myanmar syllable is composed of one or more multiple characters. In this system only one line regular expression is used for syllable segmentation [12].

Syllable = ((?<! *ssSymbol*) [*myConsonant*] (?! [*aThat ssSymbol*]) | [*enChar otherChar*])

Where,

ssSymbol: represented "္"

aThat: represented "ိ"

myConsonant: represented 33 Myanmar consonants from "က to အ" and "ဋ"

enChar: represented 26 English consonant "a to z", "A to Z" and number "0 to 9"

otherChar: represented "ဣဤဥဦဧဩဪသဿ၌၍၏၀-၉။!-/:-@[-`{-~\ऽ('"

Here, the main point for syllable segmentation is a consonant not after a subscript symbol and not followed by a-That character or a subscript symbol. The accuracy of syllable segmentation on tested data of metaphor and literal sentences is 99%.

B. Word Segmentation

In Myanmar script, words are not always delimited by specific markers. Words are composed of one or more syllables and that are not usually separated by white space or any other markers. Word Segmentation is a process to get the meaningful word by merging the segmented syllable words from the input sentences. Word segmentation is done by using the n-gram longest matching approach and mapped with lexicon. In the lexicon, there are 36053 Myanmar unique words. These words are collected from Lexique pro Myanmar lexicon[13] and different words list from myPOS corpus [14]. The lexicon cannot contain every possible word in a language. Some out-of-vocabulary terms, such as new compounds words, new derived words, and some technical words, may be existing.

Longest matching segmentation has some weakness. Some words are found in over segmentation because of its greedy process for longest words. For example, in Myanmar sentence

"ပွဲကိုကိုးရက်တိုင်တိုင်ကျင်းပသည်။"

The correct word segmented result is

"ပွဲ/n ကို/ppm ကိုး/tn ရက်/n တိုင်တိုင်/ppm ကျင်းပ/v သည်/ppm ။/punc."

But after word segmentation, the segmented words are

"ပွဲ/n ကိုကိုး/n ရက်/n တိုင်တိုင်/ppm ကျင်းပ/v သည်/ppm ။/punc."

In this segmentation, ကိုကိုး/n is an over segmentation due to longest matching approach. Due to the effect of wrong segmentation, the noun pairs extraction for metaphor identification can be found some errors. As a result, wrong extraction in segmentation is 4.53% of total extracted noun pairs and the result of errors that the system cannot extract the noun pairs due to the segmentation is 2.43% of total reference data.

C. Part of Speech Tagging

In this research work, 16 Myanmar POS tag set [14] is used for nominal metaphor identification process. In this work, ripple down rules-based Part-Of-Speech tagger RDRPOSTagger [15], [16] is used for POS tagging. The training data for POS tagging is used myPOS corpus [14] and self-created tagged corpus as a training data corpus. myPOS corpus consist of 11000 tagged sentences and self-created tagged corpus consists of 427 sentences of 2 shorts novels of Ju [17]. The total sentences included in training corpus is 11427 tagged sentences. Due to the tagging errors, 2.83% of noun pairs are extracted incorrectly and 5.83% of noun pairs cannot be extracted.

D. Post Segmentation

In Myanmar language, transformation of nouns can be obtained by adding particles after verbs or adjectives [18]. In post segmentation, Myanmar grammatical rules are used for the words which are changed to nouns if a particle combined with an adjective or a verb. Particles are added to the word as the prefix of the other part of speech or sometimes added as postfix. As an example,

- ကြည်နူး/v + ခြင်း/part = ကြည်နူးခြင်း/n
- အ/part + လှ/adj= အလှ/n

The particles that can transform the verb as a noun are အ, မှု, ခြင်း, ချက်, ဖွယ်, စရာ, ဖို့, ရန်, ရေး. Furthermore, အ, မှု, ခြင်း are the particles that can transform the adjective as a noun. After the first-time tagging process, some of the segmented words are needed to combine with prefix particles or postfix particles. When the particles are combined with adjective and verb, the new segmented words are obtained which are different from before segmentation. These new segmentations are needed to tag again to get the require nouns and correct tagging.

E. Post Tagging

After post segmentation, some of the words are combined and the transformed words are needed to change their tags. Therefore, POS tagging process is required again after post segmentation. For the Myanmar words, noun and verb are sometimes ambiguous. As an example, "ချစ်ကြိုး" and "ချစ်သမီး". In "ချစ်ကြိုး", the word "ချစ်" is used as noun and in "ချစ်သမီး" the word "ချစ်" is used as adjective. When these words are found in sentence they are tagged as nouns in this system. Therefore, some adjectival forms are also tagged as nouns. This situation will be affected the identification result and this will increase the false positive result.

V. Noun-Noun Metaphor Identification

The identification of noun-noun metaphor is a process of identifying the two related nouns or the two consecutive nouns, that are used as metaphorically or literally in a sentence. After preprocessing steps, there are two steps to be done for noun-noun metaphor identification: noun pairs extraction and metaphor identification.

A. Noun Pairs Extraction

In noun-noun metaphor, two nouns are existing in consecutive form. Firstly, two consecutive noun pairs are extracted for metaphor identification. Before identification, these two nouns are needed to check for the possessive form or wrong tagging of pronouns. For this process, nouns corpus and pronoun corpus are used. In noun corpus, nouns are collected from Myanmar-English bilingual dictionary and lexique pro Myanmar lexicon. There are 34373 distinct nouns contained in the noun corpus. In pronoun corpus, there are 115 distinct pronouns and these are collected from the lexique pro Myanmar lexicon.

Possessive form of nouns in Myanmar language can be conflict with the noun-noun metaphor. As an example, "ဖေဖေ့စာအုပ်" is tagged as "ဖေဖေ့/n စာအုပ်/n". Therefore, these two nouns are extracted as noun-noun form. However, "ဖေဖေ့" shows the possessive form because of "့ ". These types of possessive noun form are check using noun corpus. Similar to the possessive noun, pronouns are also tagged as nouns. As an example, "သူ့စာအုပ်" is tagged as "သူ့/n စာအုပ်/n". For this problem, pronoun corpus is used to check the possessive form. After checking the noun pairs, the extracted noun pairs are identified as metaphor or literal. Metaphor identification is explained in next section.

B. Metaphor Identification

In metaphor identification, the semantic relations, hyponym-hypernym and meronym-holonym relations, of Myanmar WordNets [19] [20] are firstly used to identify the two nouns as metaphor or literal. If the two nouns have one of the relations in Myanmar WordNet, these two nouns are identified as literal. If not, these two nouns are identified as metaphor.

If the result shows the literal, which means the two nouns are included in Myanmar WordNet and there is a relation considered in metaphor identification system. However, if the result shows the metaphor, this result will be needed to consider more. There may be two situations in this step. The first situation is that the result is actually a metaphor and the two nouns have no relations. Second, the situation is that one of the two nouns or both are not included in Myanmar WordNet or all of their synsets are not included in Myanmar WordNet. Due to the missing synsets the system could not search their relations. Therefore, for the missing words or absent synsets in Myanmar WordNet, bilingual dictionary is used to translate the equivalent words in English and the relations of these translated English words are searched in wordnet2sql 0.99.4a. According to the results, identified as metaphor or literal in this way can reduce the unidentified noun pairs [8].

In noun-noun metaphor identification there is an issue that the two nouns are identified as metaphor and there are no relations in WordNets. However, in actually, these two nouns are not metaphor and they used as compound nouns. The way to resolve this issue is the use of compound nouns corpus. In compound noun corpus, there are 5238 compound nouns which are collected from the training corpus of tagging process. If the compound nouns are identified as metaphor, the evaluation result will show high false positive result and it can be affected the precision. After using compound noun corpus, precision is better than before.

VI. Experimental Result

A. Experimental Setup and Evaluations

In the experiment, 566 total sentences are used for the experiments of noun-noun metaphor identification. These sentences are considered in 5 categories according to the domain—News, Novels, Articles, Formal and Conversational. 24 sentences are collected from News, 55 sentences are collected from Articles, 487 sentences are collected from Novels as tested sentences. Among them, 24 News sentences, 55 Articles sentences and 406 Novel sentences are created as the catagory of Formal sentences and 81 Novel sentences are created as the category of Conversational sentences. These sentences are manually extracted from 40 Short Novels [21], "Myanmarsar Journal" for grade 11, 17 News and 31 Articles from Eleven Journal, 7-days Journal, Kyemon Newspaper and Myanmar Alinn Newspaper. TABLE I shows the number of sentences included in each domain.

TABLE I. Numbers of Tested Sentences

Domain	**#Sentences**
News	24
Novels	487
Articles	55
Conversational	81
Formal	485
Total Sentences	566

The detail experimental results of metaphor identification are shown in this section. The evaluation results are shown in Precision, Recall, F measure and Accuracy. The confusion matrix of metaphor identification is shown in the following TABLE II.

TABLE II. Confusion Matrix of Metaphor Identification

	Identify as Metaphor	**Identify as Literal**
Metaphor	True Positive (TP)	False Negative (FN)
Literal	False Positive (FP)	True Negative (TN)

Performance evaluations for the metaphor identification system are considered as follow:

- **Precision:** the number of words correctly identified as metaphorical is divided by the total number of words identified by the system as metaphorical

$$\text{Precision} = \frac{True\ Positive}{True\ Positive + False\ Positive}$$

- **Recall:** the number of words correctly identified as metaphorical is divided by the total number of metaphorical words

$$\text{Recall} = \frac{True\ Positive}{True\ Positive + False\ Negative}$$

- **F-Measure:** $F1 = \frac{2 * Precision * Recall}{Precision + Recall}$
- **Accuracy:** percentage of words correctly identified as metaphorical or as literal

$$\text{Accuracy} = \frac{True\ Positive + True\ Negative}{True\ Positive + False\ Negative + False\ Positive + True\ Negative}$$

B. Noun-Noun Metaphor Identification using Myanmar WordNet

This section discusses the results of experiment on noun-noun metaphor identification using Myanmar WordNet. In noun-noun metaphor identification, 566 sentences from 5 domains were used for the experiments. In these sentences, there are 823 total nouns pairs are included. 385 noun pairs are metaphor and 438 noun pairs are literal. The system correctly extracted the total of 755 noun pairs from these sentences. The noun pairs that cannot be extracted by the system are the effect of preprocessing, word segmentation or POS tagging. Data extraction results for each domain are shown in TABLE III.

TABLE III. DATA EXTRACTION RESULTS

	News	**Novels**	**Articles**	**Conversational**	**Formal**
Metaphor	87.50%	93.87%	85.19%	96.30%	92.22%
Literal	93.33%	92.75%	89.36%	96.88%	92.24%

Among the correctly extracted data, the system can identify 70.6% of total noun pairs and cannot identify 29.4% of noun pairs. The identified noun pairs and unidentified noun pairs results of the noun-noun metaphor by using Myanmar WordNet are presented in TABLE IV.

TABLE IV. IDENTIFIED AND UNIDENTIFIED RESULT USING MYANMAR WORDNET

	Identified (%)	**Unidentified (%)**	**Extracted Noun Pairs (%)**
Metaphor	30.99	15.50	46.49
Literal	39.60	13.91	53.51

The evaluation results of identified noun pairs for 5 domains are shown in the following TABLE V. When using Myanmar WordNet, the precision result is highest in Conversational and lowest in News. The accuracy result is highest in Conversational and lowest in Novels.

TABLE V. EVALUATION RESULTS OF 5 DOMAINS USING MYANMAR WORDNET

	News (%)	**Novels (%)**	**Articles (%)**	**Conversational (%)**	**Formal (%)**
Precision	42.86	74.06	73.68	88.24	72.27
Recall	75.00	89.71	93.33	88.24	89.83
F-measure	54.55	81.14	82.35	88.24	80.10
Accuracy	88.37	80.05	87.50	90.00	81.06

C. Noun-Noun Metaphor Identification Using Additional Resources

In this section, the results of experiment on noun-noun metaphor identification not only using the Myanmar WordNet but also combining the additional resources with Myanmar WordNet are presented. The additional resources are Myanmar-English bilingual dictionary, wordnet2sql 0.99.4a and compound noun corpus. In bilingual dictionary, total 36269 nouns are included. These nouns are collected from Myanmar-English bilingual dictionary and Lexique Pro Myanmar Lexicon. Bilingual dictionary and wordnet2sql is used to reduce the unidentified noun pairs and search the missing synsets of Myanmar WordNet. The compound noun corpus is used to reduce the false positive rate and to get better results. From the correctly extracted data, the system can identify 94.96 % noun pairs and cannot identify 5.04 % of noun pairs. Using Myanmar WordNet and additional resources, TABLE VI describes the identified noun pairs and unidentified noun pairs results of the noun-noun metaphor.

TABLE VI. IDENTIFIED AND UNIDENTIFIED RESULT USING ADDITIONAL RESOURCES

	Identified (%)	**Unidentified (%)**	**Extracted Noun Pairs (%)**
Metaphor	43.25	1.46%	44.72%
Literal	51.71	3.58%	55.28%

The evaluation results of identified noun pairs on five domains using additional resources can be seen in the table shown in below, TABLE VII. The precision result is highest in Conversational and lowest in News. The accuracy result is highest in Articles and lowest in Novels when using Myanmar WordNet combined with additional resources.

TABLE VII. EVALUATION RESULTS OF 5 DOMAINS USING ADDITIONAL RESOURCES

	News (%)	**Novels (%)**	**Articles (%)**	**Conversational (%)**	**Formal (%)**
Precision	57.14	76.10	79.17	81.48	75.64
Recall	66.67	86.25	95.00	88.00	86.31
F-measure	61.54	80.86	86.36	84.62	80.62
Accuracy	89.36	79.58	89.47	85.45	81.10

In this experiment, most of results are better than using Myanmar WordNet only. Firstly, unidentified result is significantly decrease and more noun pairs can be identified. The evaluation results of Conversational are a little decrease because the identification result include more new noun pairs. However, in overall, most of results for all domains are better than before experiment.

VII. CONCLUSION

The motivation of metaphor identification is the encouragement of machine translation to be perfect and accurate. The metaphor interpretation system can utilize the identification of the metaphor. In the Myanmar language, metaphors in translation systems are not properly considered before. This paper presents the noun-noun metaphor identification using Myanmar WordNet and additional resources which are bilingual dictionary, wordnet2sql and compound noun corpus. Moreover, noun corpus and pronoun corpus are also used to support the preprocessing steps and

noun pairs extraction. For the five domains, experiments are performed on sentences for metaphor identification. There are some problems with metaphor processing for the language of Myanmar, such as the absence of metaphor-labeled data and instruction, and the absence of clear features that indicate the metaphor. Myanmar WordNet is used to get the semantic relations for metaphor identification. Even though Myanmar language is the low resources language, metaphor identification can be done by using small size of resources. Moreover, Myanmar WordNet has some missing synsets but it can be solved by using additional resources to get the better results. The addition of the new synsets and absent synsets into Myanmar WordNet is also needed in future works.

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