

A Brief Analysis of Bengali Natural Language Processing: Universal Networking Language Perspective

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Abstract

Now a days, whatever information we receive by the website are based on computer application. Recent trends depend on E-Commerce based service. Using this application people can communicate and have an access to information. It enables us to access innumerable documents with a huge variety of topics from any place around the world. Despite abundance of information, language is a very big obstacle. When the web pages are written in different languages like English, French, Hindi, Chinese etc., it becomes difficult for a person with insufficient prerequisite knowledge of languages to access all the information. Translation of native language to another is very demandable now due to increasing the usage of web based application. Every country has its own language. Therefore, Language is very essential part for communication skill with each other. Firstly, a sentence of a language is converted to Universal Networking Language (UNL) expressions and then UNL expressions can be converted to any native language. UNL system that developed among the 16 languages has been translated into English here but appropriately that not converted into Bengali sentence through UNL expressions. Since Bengali is our mother tongue and the richest language among all the languages exist in the world, as it is necessary for translation into Bengali through UNL expressions. Therefore, we have decided to develop a system by which we will convert Bengali sentence into English sentence appropriately using the UNL expressions through internet technology. Here empirical examples are displayed to prove the claim. As for example, we can exemplify the names; mail, webpage, document conversion etc. In doing this work, we have analyzed Bengali grammatical rules that has given an effort to be implemented for designing an embedded compiler for converting Bengali sentence into English sentence using UNL expressions.

Keywords: UNL, Universal Networking Language, Natural Language, Machine Translation, En-Converter, Bengali Language.

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I. INTRODUCTION

To meet the challenge of the current century, every system has to be controlled by the computer. In the modern civilization, computer has become an essential part in our everyday life. Most of the people are dependent on the computer. They can do any kind of business and can communicate and access information with each other through internet. The Main objective of this thesis work is to translate Bengali sentences into English sentences using UNL Expressions via Internet.

Universal Networking Language (UNL) ^[1], which is a formal language for symbolizing the sense of the sentences of natural languages. UNL system allows users to visualize websites in their native languages, which is to provide a common representation for accessing internet of multi-lingual websites by the majority of the people all over the world.

Systems that can deal with knowledge and contents have already been developed. But, their representation of knowledge or contents is different from each other. Moreover, their representations are language dependent. Merely concept of primitives, used in representation of knowledge is language dependent. Knowledge or contents of a system cannot be used in other systems. The situation is the same as machine translation. For example, if we put all the results of research and development of machine translation, we cannot realize multi-lingual machine translation systems, which can break language barriers.

Bengali is the 4th widely spoken language with more than 193 million speakers. Most of them live in Bangladesh and the Indian states of West Bengal, Assam and Tripura ^[2]. The alphabet consists of forty nine consonants and eleven vowels. Most of the words are built from a sense of consonantal roots in which inflections and derivations are generated by vowel changes, insertions and deletions.

Currently, UNL includes 16 Languages ^[3], from which 6(six) are the official languages of the United Nations

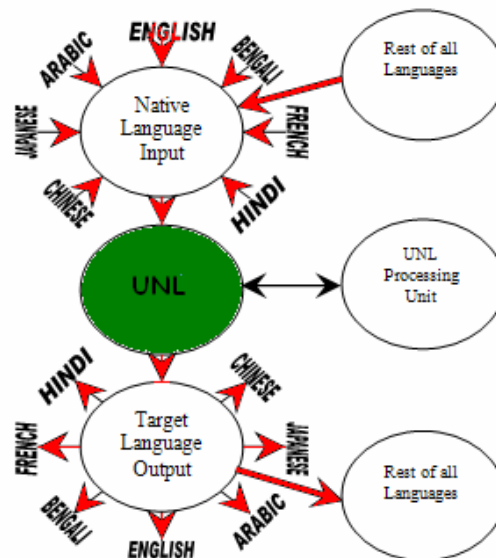


Figure 1: The Existing UNL System

(Arabic, Chinese, English, French, Russian, Spanish), in addition to ten other widely spoken languages (German, Hindi, Italian, Indonesian, Japanese, Latvian, Mongol, Portuguese, Swahili and Thai).

UNL is a system where language is converted into English language and then UNL system can convert it to any native language. The present problem is the Bengali sentences are not translated properly into English Language. We analyzed it in the previous research but we didn't find satisfactory algorithm for converting Bengali sentences into UNL.

This paper presents digital dictionary for UNL to translate Bengali to English sentences, Bengali and English grammar, rules that can be used to successfully convert Bengali sentences into English sentences. Hundreds of millions of people, almost all levels of education, attitudes and different jobs all over the world use the internet for different purposes where English is the prime language of the internet. But language is very often causes problem because some of the people who know only their native language. Henceforth, Interlingua translation programs are needed to develop en-converter and de-converter for translating Bengali to UNL expression. Therefore, the scope of this thesis is to design en-converter and de-converter using Bengali and English grammatical rules.

II. RESEARCH METHODOLOGY

For converting Bengali sentence to UNL expressions, firstly, we have gone through Universal Networking Language ^[1], where we have learnt about Universal Words ^[5], Relations ^[6], Attributes ^[7], UNL Expression ^[8], Basis of UNL Knowledge ^[9], Knowledge Representation in UNL ^[10], Logical Expression in UNL ^[11] and UNL Systems ^[12]. All these are key factors for preparing Bengali to UNL word dictionary, En-Conversion and De-Conversion rules in order to convert a natural language sentence into UNL expressions. Secondly, we have gone through the Bengali and English grammar like as Parts of Speech (শব্দ), Inflection (বিকৃতি), and its uses in different Bengali sentences, Case (কারক), Tense (কাল) etc.

a. Considering points regarding Bengali and English Sentence Structure and Representation:

One of the main objectives towards the sentence generation system is the subject-object-verb structure for Bengali sentences as against subject-verb-object structure for English sentences.

Bengali Sentence: ছাত্ররা ব্যাকরণ পড়ে

Sentence Pattern: Subject–Object-Verb

In Bengali sentences, in each sentence, first comes subject and then comes object and the verb (পড়ে) will be after object.

English Sentence: Students study grammar

Sentence Pattern: Subject-Verb-Object

Again in English sentences, almost in each English sentence, there first comes the subject and then the verb and the object will be after verb.

The main difference between the Bengali and English sentences is in Bengali sentences; object will be after subject and then verb. In English sentences first come the subject and the object will be after the verb. Again, we analyzed the above English sentence as we see that the students in subject positions and grammar in object position are nouns. There are many verbs in English Language that need intransitive verb to perform their task of main verb.

Example: Babies cry. She sleeps. He laughs.

This kind of verb is called intransitive verb (In. V.).

Again the verb that needs objects after them is called transitive verb (Tr. V.).

b. Considering sentence patterns are given below^[19]:

Rule 1: NP + Be verb + Adjective (I am honest, You are rich)

Rule 2: NP + Be + Adverbs (I am here, He is there)

Rule 3: NP + Be + NP (I am a student, Jinnat is a doctor)

Rule 4: NP + In. V (or Vi) (Birds Fly, She dances)

Rule 5: NP1 + Tr. V + NP2 + Preposition + Pronoun (He bought a shirt for me, I owe some money to him)

c. Our Consideration of Bengali and English sentence :

When we talk to each other in that moment we do not give much attention to grammar. But when we go for translation from English to Bengali then importance should be given to grammar. We cannot write sentences correctly without applying grammar. As Bengali is our mother tongue, we can easily express our sentences without accurate grammar. But in other languages, we cannot write correct sentences without grammar.

As for example, let us look at the following sentences:

Bengali Sentence: নোভা ঢাকার শাহবাগে থাকে

English Sentence: Nova lives at Shahbagh in Dhaka

If we notice the above Bengali sentence then we see that the sentence has four words. Among these four words ‘নোভা’, ‘ঢাকা’, ‘শাহবাগ’ are nouns and the rest word ‘থাকে’ is a verb. Therefore, the necessity of ‘Parts of Speech’ (পদ) in Bengali sentences is very important.

Bivokti (বিভক্তি)	Singular Number	Plural Number
Prothoma Bivokti (প্রথম বিভক্তি)	০, অ, এ, (স), তে, এতে	রা, এরা, গলি (গলো), গণ
Ditiya Bivokti (দ্বিতীয় বিভক্তি)	০, অ, কে, রে, (এরে), এ, স, তে	দিগে, দিগকে, দিগেরে
Tritiya (তৃতীয় বিভক্তি)	০, অ, এ, তে, দারা, দিয়া (দিয়ে), কর্তৃক	দিগের দিয়া, দের দিয়া, দিগকে দিয়া, দিগকে দারা, দিগ কর্তৃক, গুলির দারা, গুলির কর্তৃক, গুলিকে দিয়া, গলো দিয়ে, দের কর্তৃক
Choturthi (চতুর্থী বিভক্তি)	২য়ার মত	২য়ার মত
Ponchomi (পঞ্চমী বিভক্তি)	এ, (সে, য), হইতে, থেকে, চেয়ে, হতে	দিগ হইতে, দের হইতে, দিগের চেয়ে, গুলি হইতে, গুলি চেয়ে, দের হতে, দের চেয়ে, দের থেকে
Shostthi (ষষ্ঠী বিভক্তি)	র, এর	দিগের, দের, গুলির, গণের, গুলোর
Soptomi (সপ্তমী বিভক্তি)	এ, স, তে, এতে	দিগে, দিগেতে, গুলিতে, গণে, গুলির মধ্যে, গুলোতে, গুলোর মধ্যে

Figure 2: Forms of Bivokti (বিভক্তি)

Again if we notice the above English sentence then we see that the sentence has six words. Among these six words ‘Nova’, ‘Shahbagh’, ‘Dhaka’, are nouns and the word ‘live’ is a verb. Therefore, the necessity of parts of speech in English sentences is very important. And we know that in Bengali grammar ‘পদ’ which is considered like as English Parts of Speech.

If we notice the above Bengali sentence then we see that instead of word ‘ঢাকার’ ‘in Dhaka’ and instead of word ‘শাহবাগে’ ‘at Shahbagh’ have been used. That means by adding ‘র’ bivokti (বিভক্তি) to the word ‘ঢাকা’ - ‘ঢাকার’ and ‘এ’ bivokti (বিভক্তি) to ‘শাহবাগ’ - ‘শাহবাগে’ connecting these words a meaningful sentence has been formed. No meaningful Bengali sentences can be

formed without using bivokti (বিভক্তি). Therefore, the use of bivokti(বিভক্তি) in Bengali sentences is very essential.

Again if we look at the above sentence, we find that before Shahbagh ‘at’ and before Dhaka ‘in’ have been used. So, the use of preposition in English sentences is very essential. ‘s’ has been added with the word ‘live’. Here Nova is 3rd person singular number so ‘s’ has been added to live. If the subject is 3rd Person singular number, ‘s’ or ‘es’ should be added to verbs. Here the word ‘live’ is in the present form of verb. With the help of the verb we can say that the sentence is in which tense. So, the necessity of tense is very important while in doing translation.

Now we will discuss about Parts of Speech (পদ), Inflections (বিভক্তি), Prepositions, Tense, Case (কারক) and some rule of these grammar.

c. Considering Bivokti for our Algorithm:

According to singular and plural number we considered the below table of Bivokti (বিভক্তি)

d. Prepositions

Pre means ‘পূর্বে’ (before) and position means ‘অবস্থান’ (Obosthan). So, the word that sits before noun or noun-equivalent and connects this word to build relationship with other noun or noun-equivalent is called preposition^[21]. For this conversion we considered all prepositions and added to our database.

Postpositions in Bengali are like prepositions in English but they are placed behind the noun or pronoun whereas prepositions typically come before a noun or pronoun. So, postpositions in Bengali to similar functions performed by prepositions in English^[24]. Postposition in Bangla has been conducted with the concept and behavioral aspects of Preposition in English, in mind. Like Preposition in English, Postposition in Bangla secures a quintessential position and plays a vital role in understanding of the language.

English Prepositions	Bengali Postposition	English Preposition	Bengali Postposition
	s	s	s
About	সমন্বিত	Into	মাঝখানে

Figure 3: English Prepositions and Bengali Postpositions

e. Uses of some Prepositions^[21]:

Rule 1: ‘In’ is used before large place and time whereas ‘at’ is used before small place and time.

Example: He went there at 7 o’clock in evening.

Rule 2: ‘On’ is used before day or date, ‘in’ before month or year, and ‘at’ before definite time.

Example: I shall meet you at 5 o’clock on Sunday in January

Rule 3: ‘After’ is used in longer period of time in the past

Example: I returned to my native village after six months.

Rule 4: ‘By’ is used to mean by the side of ‘and ‘besides’ to mean in addition to.

Example: (1) He sat beside me. (2) Besides this pen I have two other pens.

Rule 5: When something is concerned with two things or persons ‘between’ is used and in case of more than two ‘among’ is used.

Example: (1) Divide the mangoes between the two boys (2) Divide the mangoes among the boys

e. Tense:

To write English Sentence correctly, Tense^[21] is prerequisite. So, Tense is called the soul of English language. The necessity of Tense is overstated for forming a sentence, or its change or addition in all cases.

III. FINDINGS (PREVIOUS RESEARCH OUTCOME)

We studied lots of scholar’s research regarding sentence conversion from one language to another language using UNL expressions. After studying scholar’s research paper, we find some findings which are shown as below:

a. Thesis Title: *Finding Universal Word for Bangla Language: Attribute Analysis Approach*^[27]

Our Findings: This technique is not an attribute identification technique; it is a relation identification technique. By using this technique we can identify UNL relation^[7]. In UNL paper^{[1][4][6][17]}: plc, agt, frm, mod, tim etc. are UNL relation.

b. Thesis Title: *Conversion of Bangla Sentence into Universal Networking Language Expression*^[28].

Our Findings: In this paper, it can not be mentioned that Bivokti (বিভক্তি) and implementation in various sentences are clear. Without implementing Bivokti (বিভক্তি) it cannot be translated any simple and compound sentence into UNL Expression. This method provided good result in Arabic, German, and few other languages. But during our research we did not find satisfactory output.

c. Thesis Title: *English to Bangla Phrases-Based Machine Translation* [29].

Our Findings: They did not mention how inflections can be replaced instead of prepositions

d. Thesis Title: *Arabic Generation in the Framework of the Universal Networking Language*^[30].

Our Findings: From this paper, it is easily understood UNL expression for implementing Bengali sentence into UNL.

e. Google Translator: This Toolkit helps translators translate better and more quickly from one language to another language. Some sentences are given below to translate Bengali sentences to English and English to Bengali in Google Translate^[25]:

Our Findings: Those sentences in (Google Translator) can not implement Bengali Bivokti (বিভক্তি), verb (ক্রিয়া) properly. So, if we want to translate Bengali sentences into English using UNL expressions then we will have implement Bengali Bivokti (বিভক্তি), verb (ক্রিয়া), article, and tense (কাল) properly.

Bengali Sentences	English Sentences (Translate in Google Translator)	Correct English Sentences
নোভা ঢাকার শাহবাগে থাকে	Most of the Nova Shahbag	Nova lives at Sahbagh in Dhaka

প্রভা খেয়েছিল	Eat light	Prova ate
আমি করিয়াছিলাম	I kariyachilama	I did
নূর তানহাকে একটি চিঠি লিখেছিল	Noor wrote a letter tanahake	Noor wrote a letter to Tanha
গোলাপী এখন সুখী	Pink and happy	Now Golapi is happy
নোভা ঢাকায় থাকে	Most of the Nova	Nova lives in Dhaka

Figure 4: Bengali to English Sentences Translation (Google Translation)

English Sentences	Translating Bengali Sentences in Google Translate	Correct Bengali Sentences
Nova lives at Sahbagh in Dhaka	Sahbagh এ নোভা ঢাকায় বসবাস	নোভা ঢাকার শাহবাগে থাকে
Prova ate	Prova খেয়ে ফেলতাম	প্রভা খেয়েছিল
I did	আমি	আমি করিয়াছিলাম
Noor wrote a letter to Tanha	নূর Tanha একটি চিঠি লিখেছে	নূর তানহাকে একটি চিঠি লিখেছিল
Nova lives in Dhaka	নোভা ঢাকা মধ্যে বসবাস	নোভা ঢাকায় থাকে

Figure 5: English to Bengali Sentences Translation (Google Translation)

In Google Translator Toolkit, we can translate any native language into another native language but Bengali language can not translate into English Language or English Language can not be translated into Bengali language appropriately.

Bivokti (বিভক্তি) Name	English Meaning	Examples	
		Bengali Sentences	English Sentences
য়	In	সে ঢাকায় বাস করে	He lives in Dhaka
রা	S	ছেলেরা ফুটবল খেলে	Boys play football
গুলি/ গুলো/গণ	S	ছেলেগুলো ক্রিকেট খেলে	Boys play football
র	In	তিনি ঢাকার শাহবাগে থাকেন	He lives at Shahbagh in Dhaka
এ	At	তিনি ঢাকার শাহবাগে থাকেন	He lives at Shahbagh in Dhaka
এ	In	তাহারা এই ঘরে আছে	They are in this room
দ্বারা	By	আলমের দ্বারা এই কাজ হতে পারে না	This work can not be done by Alam
এ	To	সে স্কুলে যায়	He goes to school
হইতে, থেকে, হতে	From	সকাল হইতে সন্ধ্যা পর্যন্ত সে কাজ করে	He works from morning till evening.
দিয়ে	By	আমি রিক্সা দিয়ে কলেজে যাই	I go to college by Rickshaw
তে	At	আমি বাড়িতে	I am at home

Figure 6: English Prepositions instead of Bengali Bivokti (বিভক্তি)

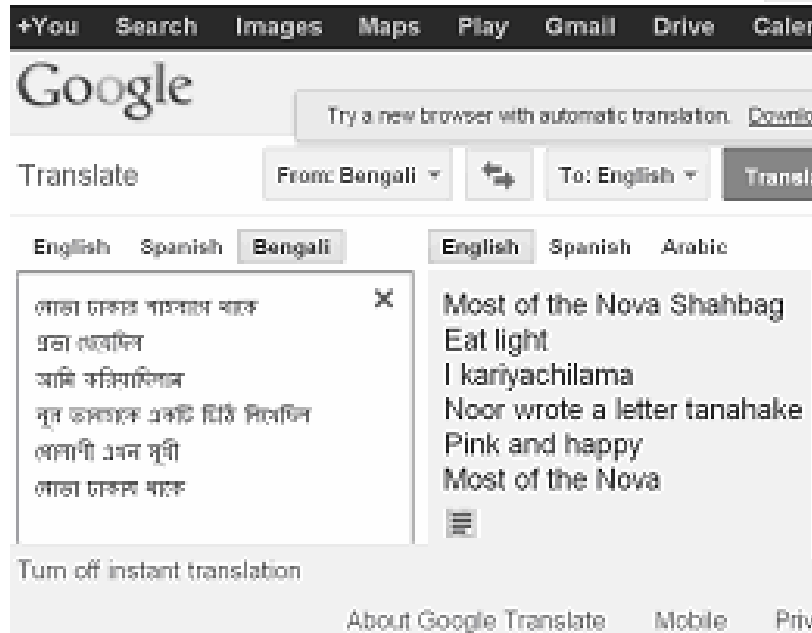


Figure 7: Bengali to English Sentence Translation in Google Translator (Screenshot)

IV. PROPOSED METHOD:

We choose English Language for converting Bengali into UNL expressions. As because of Bengali to English dictionary is the source for building Bengali to UNL dictionary as the universal words are English words mandated by UNL. Such dictionary has also provided all the attributes and relations along with the meaning of a word.

To write correct Bengali sentences, we need to add Bengali grammar and something more. For example: নূর তানহাকে চিঠি লিখেছিল (Noor Tanhake cithi likhechilo)

If we notice this sentence, we find ‘কে’ (‘ke’) Bivokti (বিভক্তি) has been added and the word “লিখেছিল (likhechilo)” refers to the past tense of the verb. For this reason, we get a meaningful sentence. If any Bivokti (বিভক্তি) was not used with the verb ‘লিখ (likho)’ something was not added, we would not get any meaningful sentence. We would not understand who (কে) wrote whom (কাকে) and without ‘এছিল (echilo)’ with the verb ‘লিখ (likho)’ as because that we know Bengali is a very difficult language in the world.

We know that no meaningful Bengali sentence can be formed without using Bivokti (বিভক্তি). We can not understand Bengali sentence completely without use of Bivokti (বিভক্তি). Though the Bengali sentence has the very importance use of Bivokti, it has no use of Bivokti (বিভক্তি) in English sentence. Meaningful English sentence is formed using prepositions. Prepositions usually sit before nouns or pronouns. A preposition usually indicates the temporal, spatial or logical relationships of its object to the rest of the sentence, whereas Bivokti (বিভক্তি) comes after a word. But like prepositions, Bivokti (বিভক্তি) also indicates the temporal spatial or logical relationships of its object to the rest of the sentence.

Again if we look at the above Bengali sentence, we can see by adding ‘কে (ke)’ Bivokti (বিভক্তি) to the word ‘তানহা (Tanha)’ has formed ‘তানহাকে (Tanhake)’ and thus formed a meaningful

sentence. If the Bivokti (বিভক্তি) were not added the sentence, it could be this ‘নূর তানহা চিঠি লিখেছিল (Noor Tanha chithi likhechilo)’. It would not be a meaningful sentence. If we can translate the Bengali sentence into English, the sentence would be like this ‘Noor wrote a letter to Tanha’. If we now look at the English sentence, we can see preposition ‘to’ has been used before the word ‘Tanha’. Again if we look at the translated English sentence, we find “to” has been used instead of ‘কে (ke)’ and thus it has been a correct English sentence.

Therefore, for translation from Bengali sentence into English sentence some prepositions can be used in the place of Bivokti (বিভক্তি). To Bengali Bivokti (বিভক্তি) as prepositions of English a table has been drawn below where letters of Bengali Bivokti (বিভক্তি) and what kind of prepositions used in English change of Bengali Bivokti (বিভক্তি) letter that change of Bengali Bivokti (বিভক্তি) letters. Which words can be used in English, it’s shown below:

We see many research papers on the conversion of Bengali to UNL Expressions they merely use the dictionary table and they do not use proper Bivokti and Preposition when the sentence is converted. As Bengali is the 4th largest language among other languages and Bengali is the very difficult language so we can not convert properly Bengali to UNL by only using the words from the dictionary. Therefore, we have to build two more tables besides this “word dictionary table”. One is ‘bivokti preposition’ and the other separate table of verbs. Because verb table has been used to learn different forms of verbs (in the present form), past, past participle form and to make understand UNL expression verb table has been used.

Now, our proposed method of using database is:

indexed	[not null]
head_word	[not null]
universal_word	[not null]
relation	[not null]
word_type	[not null]
pos	[not null]
bivokti	[not null]

Figure 8: DIC_BENGALI_ENGLISH Table Schema

bivokti	[not null]
e_meaning	[not null]

Figure 9: BIVOKTI_PREPOSITION Table Schema

verb_ben	[not null]
verb_ben_original_form	[not null]
verb_ben_bivokti	[not null]
verb_eng	[not null]
person	[not null]
verb_form	[not null]

Figure 10: VERB_TAB Table Schema

Some examples of dictionary entries for Bengali to English word according to Figure-8 are given below:

Ind.	H.W	U.W.	R.	W.T.	P	B.
চ	চিঠি	Letter	Obj	Document	Noun	০
আ	আমি	I	Agt	Person	Pronoun	০

Figure 11: DIC_BENGALI_ENGLISH Example

Some examples according to Figure-9 are given below:

bivokti	e_meaning
কে	To
র	In
এ	At

Figure 12: BIVOKTI to PREPOSITION Example

Some examples according to Figure-10 are given below:

V.B.	V.B. in Original Form	V.B.Biv.	V.E	P.	V.F.
লিখেছিল	লিখা	অ	Wrote	Third	Past
বাস করে	বাস করা	এ	Live	Third	Present
দিয়েছিলাম	দেওয়া	০	Given	First	Past participle

Figure 13: Verb Table Example

VI. RESULT AND DISCUSSIONS

Bengali to English sentence translation using UNL expression:

Bengali Sentence: নূর তানহাকে চিঠি লিখেছিল

English Sentence: Noor wrote a letter to Tanha

Step 1: From when above Bengali sentence at first 'letter' (চিঠি) word meaning will find from dictionary and 'wrote' (লিখেছিল) word will find from 'verb table'. As being added 'কে' Bivokti (বিভক্তি) after Tanha word then 'কে' word meaning that will find from 'bivokti table'. And the first step of the sentence will be:

Noor to Tanha letter wrote

Step 2: At the second step, it will find the word which is a verb into a meaningful sentence and depend on this verb word will convert from Bengali to English. Here somapika (সমাপিকা) verb word is 'wrote' (লিখেছিল) as understood some work here by writing the word that will find to the sentence of relating each word by the word 'wrote':

Who wrote? Noor

What wrote? Letter

Wrote whom? to Tanha

Here the work is done by Noor so that the word Noor is 'agt' and the word 'letter' written by Noor. So the word letter is 'obj' and as the letter given to Tanha so Tanha is 'gol'

At the second step that converted the sentence will be: Noor wrote letter to Tanha

Step 3: Here as Noor wrote letter to Tanha and does not indicate how many letters wrote so indefinite article 'a' will be added before the word letter.

At the third step that converted the sentence will be: Noor wrote a letter to Tanha and UNL Expression will be:

```
{unl}
agt(write(icl>do).@entry.@past, Noor(iof>person))
obj(write(icl>do).@entry.@past, letter(icl>document)@indef)
gol(write(icl>do).@entry.@past, Tanha(iof>person))
{/unl}
```

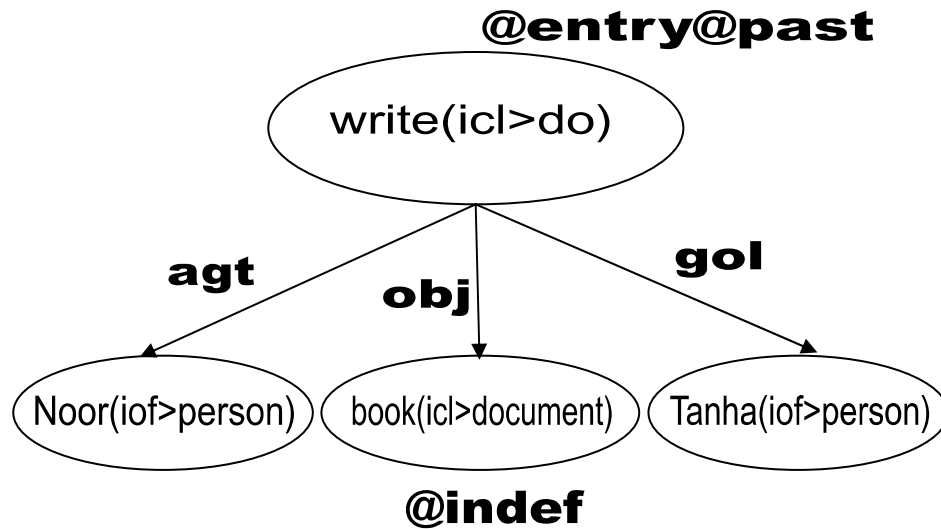


Figure 14: UNL Graph for Converting Bengali to English

Conclusion:

With all the problems in view, we have decided to develop a system by which we will convert Bengali sentence into English sentence appropriately using the UNL expressions through internet technology. We tried to display empirical examples are displayed to prove the claim. Many English words could be simplified too; mail, webpage, document conversion etc. In doing this work, we have analyzed Bengali grammatical rules that has given an effort to be implemented for designing an embedded compiler for converting Bengali sentence into English sentence using UNL expressions



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