

Research Report on Bangla Verb and Noun Morphological Analysis

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Abstract

This report describes the inflection Bangla verb and noun morphology and rules, lexicons and grammar for Bangla morphological analysis.

1. Introduction

This report describes Bangla verb and noun morphology and also the two level rules, lexicon and unification based grammar for Bangla verbs and nouns. These rules, lexicon and grammar are based on PC-KIMMO (a two level morphological Analyzer) and JKimmo (A multilingual computation morphology frame work for PC-KIMMO). JKimmo is a multilingual wrapper around PC-KIMMO that enables to use Bangla language for input and output.

2. Bangla morphological analysis

2.1. Verbs

Verbs divide into two classes: finite and non-finite. Non-finite verbs have no inflection for tense or person, while finite verbs are fully inflected for person (first, second, third), tense (present, past, future), aspect (simple, perfect, progressive), and honor (intimate, familiar, and formal), but not for number. Conditional, imperative, and other special inflections for mood can replace the tense and aspect suffixes. The number of inflections on many verb roots can total more than 200. A few example of Bangla verb inflexion are given below in Table 1.

Table 1: Verb inflections

Verb Root	Present				Past				Future	
	Simple	Continuous	Perfect	Subjunctive	Simple	Habitual	Continuous	Perfect	Simple	Subjunctive
কর (1st person)	করি	করছি	করেছি		করলাম	করতাম	করছিলাম	করেছিলাম	করব	
বল (2nd Person)	বল	বলছ	বলেছ	বলো	বললে	বলতে	বলছিলে	বলেছিলে	বলবে	বলো
খাওয়া (3rd person)	খাওয়ায়	খাওয়াচ্ছে	খাইয়েছে	খাওয়াক	খাওয়াল	খাওয়াত	খাওয়াছিল	খাইয়েছিল	খাওয়াবে	খাওয়াক

2.2. Noun

Nouns are inflected for case, including nominative, objective, genitive (possessive), and locative. The case marking pattern for each noun being inflected depends on the noun's degree of animacy. When a definite article such as -টা (singular) or -গুলো (plural) is added, as in the Tables (2 and 3) below, nouns are also inflected for number.

Table 2: Singular noun inflections

	Animate	Inanimate
Nominative	ছাত্রটা	জুতাটা
Objective	ছাত্রটাকে	জুতাটা
Genitive	ছাত্রটার	জুতাটার

	Animate	Inanimate
Locative		জুতাগাতে

Table 3: Plural noun inflections

	Animate	Inanimate
Nominative	ছাত্ররা	জুতাগুলো
Objective	ছাত্রদের(কে)	জুতাগুলো
Genitive	ছাত্রদের	জুতাগুলোর
Locative		জুতাগুলোতে

3. Components

3.1. Transliteration file

The original PC-KIMMO software is written in C programming language and uses only Latin alphanumeric characters for input and output purposes. For inputs using scripts other than Latin, the user has to come up with his/her own transliteration scheme that uses Latin characters corresponding to characters of the non-Latin script. Viewing and understanding the input and output strings in such a way can be cumbersome and non-intuitive for the user.

JKimmo solves this problem in a modular, abstract fashion. It requires that the whole

transliteration scheme be written down in a separate file. The user can then load that transliteration file. Once the transliteration file is loaded, the user can input strings and view output strings in his preferred language in an intuitive way. Transliteration scheme for Bengali language is given in Table 4.

3.2. Rule file

Two level orthographic rules are required for JKimmo and PC-KIMMO. The general structure of the rule file is a list of declarations composed of a keyword followed by data. The set of valid keywords in a rules file includes COMMENT, ALPHABET, NULL, ANY, BOUNDARY, SUBSET, RULE, and END. The COMMENT, SUBSET and RULE declarations are optional and also can be used more than once in a rules file. The END declaration is also optional, but can only be used once. PC-KIMMO only recognizes Latin characters in rule file. To implement rule for language that uses other than Latin script we must follow the transliteration scheme. There is a free rule compiler for PC-KIMMO called kgen is available. It takes rule specification and it generate rule for PC-KIMMO. There are more free tools available that can be used for rule generation. A sample rules file has shown in Table 5.

Table 4: Bengali transliteration scheme

Bangla	Latin	Bangla	Latin	Bangla	Latin	Bangla	Latin	Bangla	Latin
্	^	া	a	গ	G	ণ	N	র	r
অ	A	ি	I	ঘ	G	ত	t	ল	l
আ	F	ী	I	ঙ	?	থ	T	শ	S
খ	H	ূ	u	চ	C	দ	d	ষ	\$
ঙ	L	্	U	ছ	C	ধ	D	স	s
জ	M	্	R	জ	J	ন	n	হ	h
ঝ	Q	ে	e	ঝ	J	প	p	ড়	'
ঞ	V	ৈ	E	ঞ	Q	ফ	P	ঢ়	"
এ	W	ো	o	ট	V	ব	b	য়	Y
ঐ	X	ৌ	O	ঠ	W	ভ	B	ং	%
ও	Z	ক	k	ড	X	ম	m	ঃ	&
ফ	F	খ	K	ঢ	Z	য	y	ঁ	~

Table 5: Sample rule file

```
¡MAIN RULE FILE BANGLAMORPHOLOGY.RUL
```

```
ALPHABET
```

```
 k K g G ? c C J q v w x z N t T d D n p P b B m y r l S $ s h ' ' Y & ~ ^ a i u U R e E o O A F H L M Q V W X Z f + j
```

```
NULL 0
```

```
ANY @
```


word grammar rules. Associated with each rule are feature constraints. A feature constraint consists of two feature structures that must unify with each other. Feature constraints have two functions: they constrain the operation of a rule and they pass features from one node to another up the parse tree. A sample grammar file is given in Table 7.

4. Results

4.1. Recognition

Sample recognition output is given in Figure 1.

```

করলাম ->.
  কর+ল+াম
  কর+সাধারণ+অতীত+প্রথম
করেছিলাম ->.
  কর+য়েছ+িল+াম
  কর+পুরাঘটিত+অতীত+প্রথম
করব ->.
  কর+ব
  কর+সাধারণ+ভবিষ্যৎ+প্রথম

```

Figure 1: Sample recognition output

Table 7: Sample grammar file

```

;GRAMMER FILE BANGLAMORPHOLOGY.GRM
Let vr be <pos> = VB
Let sd be <aspect> = SD
Let pg be <aspect> = PG
Let gh be <aspect> = GH
Let an be <aspect> = AN
Let nt be <aspect> = NT
Let b be <time> = B
Let a be <time> = A
Let v be <time> = V
Let p be <person> = P
Let d be <person> = D
Let t be <person> = T
Let dtu be <person> = DTU
Let dgo be <person> = DGO
Let tgo be <person> = TGO

Let SADHARON be <cat>=ASPECT
Let GHOTOMAN be <cat>=ASPECT
Let PURAGHOTITO be <cat>=ASPECT
Let NITTOBRITTO be <cat>=ASPECT
Let ANUGGA be <cat>=ASPECT

RULE
Word -> Verbroot VSuffix1
  <Word aspect> = <VSuffix1 aspect>
  <Word time> = <VSuffix1 time>

```

```

<Word person> = <VSuffix1 person>
<Word pos> = <Verbroot pos>

```

END

4.2. Generation

Sample generation output is given in Figure 2.

```

কর+ল+াম -> করলাম
কর+য়েছ+িল+াম -> করেছিলাম
কর+ব -> করব

```

Figure 2: Sample generation output

5. Conclusion

This report presents Bangla verb and noun morphology and rules, lexicons and grammar for inflectional verb and noun morphology.

6. References

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