Universal Dependency Treebank for Odia Language

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Abstract

This paper presents the first publicly available treebank of Odia, a morphologically rich low resource Indian language. The treebank contains approx. 1082 tokens (100 sentences) in Odia selected from “Samantar”, the largest available parallel corpora collection for Indic languages. All the selected sentences are manually annotated following the “Universal Dependency (UD)” guidelines. The morphological analysis of the Odia treebank was performed using machine learning techniques. The Odia annotated treebank will enrich the Odia language resource and will help in building language technology tools for cross-lingual learning and typological research. We also build a preliminary Odia parser using a machine learning approach. The accuracy of the parser is 86.6% Tokenization, 64.1% UPOS, 63.78% XPOS, 42.04% UAS and 21.34% LAS. Finally, the paper briefly discusses the linguistic analysis of the Odia UD treebank.

Keywords: Universal Dependency, Odia UD Treebank, UPOS

1. Introduction

Odia (earlier known as Oriya) is an Indian language belonging to the Indo-Aryan branch of the Indo-European language family. It is the predominant language of the Indian state of Odisha. Odia is written in Odia script, which is a Brahmic script. There are 37 million Odia speakers in India. Odia is one of the many official languages of India and is designated as a Classical language. Odia is an agglutinative language (Sahoo, 2001), and hence, a morphologically rich language. Odia’s verb morphology is rich with a three-tier tense system, person, number, and honorific markers. The prototypical word order is subject-object-verb (SOV) (Parida et al., 2020a; Parida et al., 2020b). Odia nominal morphology differentiates between plural and singular numbers; case marking on nouns; first, second, and third-person pronouns. But it does not have grammatical gender marking, which reduces the complexities of learning the language. Odia language allows Noun-verb, Adjective-verb, and Verb-verb compounding but does not allow elision. It has 28 consonants, 6 vowels, 9 diphthongs, and 4 semivowel phonemes. Most vowels can be short or long, and care must be taken to remember that the length of the vowel changes the word meaning completely. Odia’s vocabulary is influenced by Sanskrit and also a little influence from Arabic, Persian, and Austrotronesian languages as the Kalinga empire (Odisha’s ancient name) was connected to different other kingdoms. Odia language lacks online content and resources for natural language processing (NLP) research.

2. Odia Language Grammar

Odia is an SOV language. Usually, a simple sentence begins with a subject and ends with a finite verb. The major word classes found in Odia are nouns, pronouns, verbs, adjectives, and postpositions. Certain minor categories like classifiers, complementizers, and conjunctions are also found. The objects occur between the subject and the verb, the Indirect Object precedes the Direct Object. The modifier precedes the item it modifies: the adjective precedes the substantive it qualifies, and the adverb precedes the verb. Although scrambling is allowed, usually, the word-order sticks to the V-final constructions except for poetic inversion (Sahoo, 2001).

Declension Odia has two numbers: singular and plural; and three persons: 1st person, 2nd person, and 3rd person. The subject NP agrees with the verb in person, number, and honorific. Honorificity goes along with person and number and it is marked in various word classes like nouns, pronouns, verbs, and, interestingly enough, with some of the post-positions that function as genitive, locative, and ablative markers. Generally, the person-number suffixes also go together.

There are eight cases in Odia: nominative, accusative, in-
Pronouns Odia pronouns are shown in Figure 1.

(Sahoo, 2001)

![Figure 1: Odia Pronouns](image)

- Personal: mun ‘I’, tu ‘you’, tame ‘you’, aapaNa ‘you’, se ‘she’ / ‘he’
- Reflexive: se nje ‘he himself / she herself’
- Reciprocal: paraspara ‘each other’
- Correlative: jie ‘who (ever)’ — se ‘he’ / ‘she’
- Relative: je ‘whoever’, jaahaaku ‘whosoever’
- Demonstrative: eha / ehi ‘this’, eguDika / eguDaaka ‘these’, sehi ‘that’ and seguDika / seguDaaka ‘those’
- Distributive: prytyeka ‘each’ / ‘every’
- Universal: samaste ‘all’
- Existential: jaNe ‘one person’, goTe ‘a’ / ‘one’
- Interrogative: kie ‘who’, kauhauku ‘whom’
- Compound: kehi jaNe / kie jaNe ‘somebody’

Case morphemes Odia case morphemes are shown in Table 1.

| Case          | Singular | Plural/ [+Hon] sg |
|---------------|----------|-----------------|
| Nominative (NOM) | -        | -               |
| Accusative (ACC) | ku      | nku, maananku  |
| Instrumental (INST) | re, dwaaraa, dei | re, dwaaraa, dei |
| Dative (DAT) | ku      | nku, maananku  |
| Ablative (ABL) | ru, Thaaru | MaanankaThaaru |
| Genitive (GEN) | ra      | nkaara, maanankara |
| Locative (LOC) | re, Thaare | MaanankaThaare |
| Vocative (VOC) | he, bho |                 |

Table 1: The Case morphemes in Odia

Conjunctions Conjunction markers include o / eben / aau ‘and’, kimba / abaalathabaa ‘or’, madhya ‘also’, tathaapi ‘still’, kintu ‘but’ etc.

Classifiers A classifier is a noun-related element but has no independent nominal reading. Having insufficient referential or predicative content, it is not fully lexical. -Taa ‘one [+def]’, Topaa ‘drop’, muThaa ‘fist’, gochhaa ‘bundle’, jaNa ‘one [+Human]’, paTa ‘slice’, asaraa ‘shower’, menchaa, etc. are usually identified as classifiers.

Complex verbs Complex verb constructions like the combination of a verbal with a nominal (N-V sequences), and the combination of a verbal with a verbal (V-V sequences) are found in Odia.

Serial verbs Odia is a verb serializing language. A series of verbs along with their complements and adjuncts (if any) can occur in a single clause having a common subject. Very often, the series of verbs have a common object too.

Verbal Nouns Many verbal nouns are found in Odia, such as chaasa ‘ploughing’, chaDa ‘release’, maajaNaa ‘bath’, rahaNi ‘stay’ bikaa ‘selling’, baahuDa ‘return’.

Some verbal nouns have been borrowed from Sanskrit, e.g. anubhava ‘feeling’, bidroha ‘revolution’, prabeesha ‘entrance’, sthiti ‘existence’, etc. which are used along with a light verb in Odia.

Copular sentences Copular constructions are usually sentences with a subject and a predicate. The predicate may be either a noun (nominal predicate) or an adjective (adjectival predicate).

Adverbs Like English, Odia also has Time, Place, and Manner adverbials.

Finite Verbal Forms Agreement features contribute to the finiteness of a verbal form in Odia. All the finite verbal forms have an agreement in concord with the subject NP. The agreement features of the verbal form are marked for the person, number, and honorific of the subject NP.

The Infinitive In Odia, the infinitival form is realized by the verbal ending – ibaaku ‘to do’.

The Conditional affix -ile (or –le) The morpheme -ile (or –le) functions as a conditional marker. It is suffixed to the bare verbal root. It is nonfinite as it does not carry any Agr feature and thus can co-occur in a verbal form irrespective of person, number, or gender of the subject.
3. Related Work

Under the leadership of IIIT-Hyderabad, a consortium was formed in 2013 to start a project sponsored by TDIL (Government of India), called Development of Dependency Treebank for Indian Languages. This project aimed to restore annotation work in monolingual treebanks for various languages such as Hindi, Marathi, Bengali, Kannada, and Malayalam. To achieve this model, the Pāṇinīn Kāraka Dependency scheme was followed (Begum et al., 2008; Husain et al., 2010; Bhat, 2017; Ojha and Zeman, 2020). The same annotation scheme was used to annotate data in Telugu, Urdu, and Kashmiri. NLP research of Odia has led to development of a statistical POS tagger (Ojha et al., 2015), neural network-based POS tagger (Das and Patnaik, 2014), POS tagging using Support Vector Machine (SVM) (Das et al., 2015), a shallow parsing tool and English-Odia machine translation system (Parida et al., 2020a). Within the Universal Dependencies framework, as of UD release 2.8, treebanks and parsers are available for Bhojpuri, Hindi, Marathi, Sanskrit, Tamil, Telugu and Urdu (Zeman and et al., 2021). Nevertheless, there is no prior work on Odia dependency treebanking and parser.

4. Data and Methodology

To collect Odia text, we used Samanantar, the largest parallel corpora collection for 11 Indian languages (Ramesh et al., 2021). The parallel corpora collection includes English-Odia parallel text that covers many domains. We selected the Odia sentences of word length between 5 to 15 words per sentence. For annotation, all selected sentences are converted into CoNLL-U format consisting of 10 fields (Buchholz and Marsi, 2006). The fields are “ID”, “Word”, “Lemma”, “UPOS”, “XPOS”, “FEATS”, “HEAD”, “DEPREL”, “DEPS”, and “MISC”. The “UPOS” tags are based on the universal POS tags following the UD guidelines, version 2. For “XPOS”, we annotated according to Bureau of Indian Standards (BIS) Part of Speech (POS) tagset guideline released by the department of information technology ministry of communications & information technology, the government of India. The guideline includes a POS tagset for the Odia language. The dependency relations were marked on Universal dependency tags which is an updated version of Stanford Dependencies (de Marneffe et al., 2014). Out 17 UPOS tags, we use 15 UPOS tag in this dataset, while out of 37 dependency tags, we use only 24 tags (see the Table 2 & 3). The annotation task was performed by 6 native Odia speakers including 2 linguists.

| UPOS Tags | UPOS description | Statistics |
|-----------|------------------|------------|
| NOUN      | Noun             | 570        |
| VERB      | Verb             | 234        |
| PUNCT     | Punctuation      | 192        |
| PROPN     | Proper noun      | 170        |
| ADJ       | Adjective        | 102        |
| ADP       | Adposition       | 82         |
| DET       | Determiner       | 75         |
| PRON      | Pronoun          | 55         |
| CCONJ     | Coordinating conjunction | 48  |
| ADV       | Adverb           | 45         |
| NUM       | Numeral          | 26         |
| PART      | Particle         | 23         |
| AUX       | Auxiliary        | 13         |
| SCONJ     | Subordinating conjunction | 7    |
| SYM       | Symbol           | 1          |

Table 2: Statistics of used UPOS Tags in the Odia treebank
5. Experiment and Results

As mentioned earlier, the Odia treebank was manually annotated using the UD annotation framework. In this, we have built Odia parser on 2026 tokens using the UDPipe open-source tool (Straka and Straková, 2017). We conducted our experiment in two parts. The first experiment was conducted on 50 sentences, while the second experiment was conducted on the rest of the dataset. We used a cross-validation 90:10 average for the data splitting where the batch size, learning rate, and dropout were 50, 0.005, and 0.10, respectively; while the other hyperparameters were randomized. The results are demonstrated in Table 4. Due to the small size of the data, the parser’s accuracy is very low except on Tokenization.

6. Linguistic Analysis

We are providing few sample tree constructions along with their linguistics analysis in Figures 2 to 6. In Figure 2, ‘karaajaithilaa’ is a finite verb. So, it forms the root. The adjective ‘guruttara’ modifies the noun ‘abasthaare’. The main verb has ‘taanku’ as the external argument (the subject) and ‘MKCG hospitalre’ as internal argument (the object) of it. It has the adverbial modifier ‘prathame’.

In Figure 3, the finite intransitive verb ‘chaahinle’ ‘wanted’ is the root of the sentence. It takes ‘shishyamaane’ ‘pupils’
as the subject argument. Being intransitive, it does not take any object or internal argument.

In Figure 4 ‘pakaantu’ ‘put’ is the finite verb, which forms the root. Being an imperative sentence, the subject noun is not realized, and ‘luNa o haLadi’ ‘salt and turmeric’ functions as the adverbial modifier for the sentence. ‘tua pare’ ‘after that’ functions as the adverbial modifier. ‘aabashyaka anujaayi’ ‘as per the requirement’ functions as the subject argument. Being intransitive, it does not take any object or internal argument.

In Figure 5 the main verb ‘karantu’ ‘do Pl/Honorific’ takes ‘aapaNa’ ‘you’ as the subject noun and ‘paatrare’ ‘in a pot’ as the locative modifier for the sentence. In Figure 6 ‘karantu’ ‘do Pl/Honorific’ which is a finite verb, forms the root of the sentence. The det ‘anya’ ‘another’ and the numeral modifier ‘eka’ ‘one’ modify the locative modifier ‘paatrare’ ‘in a pot’. The nsubject ‘aapaNa’ ‘you Pl/Honorific’ is not realized in the sentence. The main verb ‘karantu’ ‘do Pl/Honorific’ takes ‘tel’a ‘oil’ as the object and ‘paatrare’ ‘in a pot’ as the locative modifier.

7. Conclusion and Future Work

We presented the first UD Odia treebank aimed for linguistic research and applications in NLP, primarily for POS tagging, parser, semantic analyzer, and machine translation. Also, we built a preliminary Odia parser using the UD-Pipe tool. The accuracy of the Odia parser is 86.6% Tokenization, 64.1% UPOS, 63.78% XPOS, 42.04% UAS and 21.34% LAS.

Future research direction includes: i) enrich the Odia treebank with more annotated data for training, development, and validation, ii) including lemma for the Odia tokens, iii) perform detail morphological analysis, and iv) experiment with neural network based models for performance evaluation.

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