Preprocessing for Parts of Speech (POS) Tagging in Dogri Language

Shivangi Dutta, Bhavna Arora

Abstract: Natural language processing (NLP) is viewed among the most crucial fields of computer science, information retrieval and artificial intelligence. One such challenging feature in NLP is Parts of speech (POS) tagging. It is the process of labelling the words present in the corpus as the parts of speech. According to English grammar there are eight major parts of speech which are: noun, pronoun, verb, adjective, adverb, preposition, conjunction, interjection. Over the past few years, various researchers have compassed considerable amount of work using various pursuits to closely supervised tagging and unmonitored tagging. These methods of labelling are further divided into rules-based, stochastic and hybrid approaches. The language that has been taken for research work is Dogri Language which is based on Devanagari script. The paper presents the related work in the languages having same script as Dogri. The study helps in the selection of appropriate technique to be used for POS tagging for Dogri language. The paper also presents grammatical and inflectional analysis of Dogri language along with few rules for designing POS tagger. A section of the paper also demonstrates the results of preprocessing i.e. tokenization and stemming of Dogri text, which are considered as the initial steps in POS tagging.

Index Terms: Dogri language, Parts of speech tagging, stemming, tokenization.

I. INTRODUCTION

Language contains words and words are categorized into several types or parts of speech. Parts of speech tagging is the entire process of labelling the words present in the corpus as the parts of speech. As in the English, there are eight distinctive parts of speech viz Noun, Pronoun, Adjective, Verb, Adverb, Conjunction, Preposition, Interjection. Frequently used approaches that are used to actually enforce part-of-speech tagger are Rule Based approach, Statistical approach and Hybrid approach. Rule-based tagging system uses various rules associated with languages to tag the words in the corpus. In another type of approach i.e. Statistical approach or statistical parts of speech taggers the probabilities are calculated. Statistical taggers calculate the frequency or existence of words for a specific tag. Hybrid approach make use of both the rule-based approach as well as the statistical approach. The analysis of languages is a complex task. Numerous Indian tongues like Hindi, Malayalam, Tamil, Punjabi and Marathi have several part-of-speech taggers but less work is done in Dogri comparatively which is the regional language of Jammu and Kashmir. Dogri is a contemporary Indo-Aryan linguistic primarily vocalized in the states of Jammu and Kashmir and the connecting ranges including Punjab, Himachal Pradesh and in some tehsils in Pakistan. Like any other language. Dogri is a language which is rich in morphology. Dogri Language has the pre-dominant word order such as Subject-Object-Verb (SOV) and has the flexibility to rearrange the constituents. Usually nouns are modulated for number, sex and case. Numbers are –singular and plural; two-genders-masculine and feminine; and three-cases- simple case, oblique case and vocative case [1]. In the first section, different techniques of POS tagging are discussed which is followed by the related work in the Devanagari script. The following section deals with grammatical and inflectional analysis of the Dogri language and some rules to identify different tags in Dogri Language. In the terminal section preprocessing of Dogri corpus will be performed.

II. POS TAGGING TECHNIQUES

The two basic POS taggers are the Supervised & Unsupervised Taggers. The previously interpreted corpus is used in supervised system tagging. The corpus is used to train the system and hence to acquire the occurrence frequencies of word-tags, rules and tag-set, sets etc. On the contrary, the pre-tagged corpora are not the prerequisite in case of unsupervised POS tagging. The unsupervised taggers make use of the methods according to which automatically tag allocation is done to the words present in the corpus [3]. Supervised and unsupervised techniques fall into three subcategories as described below:

A. Rule Based

The rule-based Parts of speech tagging system may be constructed using a set of hand-made rules as defined by the researcher with the help of linguistics. Relative information is essential for allocation of POS tags to
the words present in the context. The executed system doesn’t show effective results when the textual information is unknown [3].

B. Stochastic Based POS Tagger

To observe the adequate probable tag sequence, when we are given the observation sequence of n words w1n, that is, find maximum P (t1n |w1n). To compute P (t1n |w1n) Bayesian classification rule is used which is given in equation 1.

\[ P(x | y) = P(x).P(y|x)/P(y) \] (1)

- **Hidden Markov Model (HMM) Based Tagger**: A hidden Markov model (HMM) based tagger explore the adequate probable tag intended for respective term in a sentence. An HMM constructed tagger works by finding a label(tag) arrangement for entire sentence, rather than discovering a label for respective word discretely. For a given sentence w1, wn, an HMM based Parts of speech tagger works by finding a tag/label sequence t1,...,tn that maximizes the joint probability[4] which is given in the following equation 2.

\[ P(t_1,...,t_n, w_1,...,w_n) = P(t_1,...,t_n).P(w_1,...,w_n | t_1,...,t_n) \] (2)

- **Maximum Entropy Based Tagger**: The Hidden Markov Model based taggers are relatively easy to construct but it is really problematic to include additional complicated structures into such models. The maximum entropy (ME) based tagger however offers an ethical technique of integrating additional complicated structures into (HMM) probabilistic models. For a certain sentence say w1,...,wn, a Maximum Entropy based tagger produces theconditional possibility of a labelled tag sequence: t1,...,tn as:

\[ (w_1, ..., w_n | t_1, ..., t_n) = \prod_{i=1}^{n} P(t_i | C_i) \] (3)

Where C1, …Cn are mainly described as the context used for respective word in the assumed sentence. The Maximum Entropy based taggers take the features to calculate (t1 | C1) [5].

- **Conditional Random Field Model (CRF)**: CRF is mainly a discriminatory model based on probabilism. CRF model has the advantages of ME model and overcomes the disadvantage of ME model i.e. CRF model is without the label bias problem [6].

C. Hybrid POS Tagger

Hybrid models combine both i.e. rules-based models and statistical models. Hybrid models use strong features from both the approaches i.e. stochastic approaches and the rules- based approaches which make it more efficient. The working of the system includes making a probabilistic model and hence applying certain rules to remove the ambiguity or errors and vice versa.

III. RELATED WORK

The section describes the associated work in the languages having script as Devanagari i.e. Hindi, Marathi, Sanskrit. Various POS tagging techniques used by different researchers to tag the words is presented in the Tables below. The table highlights the techniques used by various authors. The proposed work by the researchers and the results are also described in the following tables:

<table>
<thead>
<tr>
<th>Technique</th>
<th>Author &amp; reference no.</th>
<th>Proposed work</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RULE BASED APPROACH</strong></td>
<td>Smriti Singh et.al [7]</td>
<td>Used corpora of 15,562 words, comprehensive morphological study, high-coverage lexicon including CN2 (algorithm based on decision tree) are some of the techniques used by the author.</td>
<td>Accuracy = 93.45%</td>
</tr>
<tr>
<td></td>
<td>Navneet Garg et.al [9]</td>
<td>have done parts of speech tagging for Hindi language by Rule Based tagger. The data set taken was from news:17233, essay:5039, Stories:3877</td>
<td>News: precision = 89.94%, Recall: 92.84%, F-measure: 91.37%, Essay: Precision:81.36%, Recall:87.32%, F-measure:84.23%, Stories: Precision:85.11%, Recall:88.32%, F-measure:87.06%.</td>
</tr>
<tr>
<td></td>
<td>Aniket Dalal et.al [10]</td>
<td>The paper gives an overview of maximum entropy models, feature functions used in Hindi POS tagging and chunking</td>
<td>POS=89.346% and Chunking=87.399%</td>
</tr>
<tr>
<td>STATISTICAL APPROACH</td>
<td>Author &amp; reference no.</td>
<td>Proposed work</td>
<td>Results</td>
</tr>
<tr>
<td>----------------------</td>
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<tr>
<td>Nisheeth Joshi et.al [4]</td>
<td>To train the system, 3,58,288 words from tourism field were used. Not much effort was put in developing morphological analyser instead 5 annotators for creating POS tagged corpora was used. A clear description of HMM is given to resolve the ambiguity of the words</td>
<td>Accuracy = 92.13%</td>
<td></td>
</tr>
<tr>
<td>Rajesh Kumar et.al [11]</td>
<td>have done parts of speech tagging for Hindi language using a probability-based model called Hidden Markov Model (HMM)</td>
<td>Precision=96.46% Recall=90.13% f-measure=93.17%</td>
<td></td>
</tr>
<tr>
<td>Kanak Mohnot et.al [12]</td>
<td>Hindi text is tokenized into singular form and POS category is applied by POS rules with the help of Hindi Database. If no rule is formed, then apply rules considering previous and next token and display the results</td>
<td>Accuracy=89.9%</td>
<td></td>
</tr>
<tr>
<td>Praveshkumar Dwivedi et.al [13]</td>
<td>designed an algorithm which after normalizing the text, checks the word properties and analysis of word root/stem. Tagging is done word root/stem exist otherwise morphological analysis is done in which prefix and suffix is applied to root/stem and morphological synthesizer is applied and hence words are tagged.</td>
<td>----</td>
<td></td>
</tr>
<tr>
<td>Vijeta Khicha et.al [14]</td>
<td>built a combination of hidden markov model and rule based model using java language. Firstly, the Devanagari format is checked and segmentation is done. After that tokenization is done and hence tagging is done using HMM</td>
<td>Precision = 92.56% and Accuracy = 87.55%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HYBRID APPROACH</th>
<th>Author &amp; reference no.</th>
<th>Proposed work</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pallavi Bagul et.al [15]</td>
<td>discussed rule-based technique for POS tagger in Marathi text and have shown number of rules which work well. The ambiguity is resolved using Marathi grammar rules as described in the paper and assignment of particular tags are done.</td>
<td>----</td>
<td></td>
</tr>
<tr>
<td>Shubhangi Rathode et.al [16]</td>
<td>developed a part of marker for Marathi Language in particular. The approach used by them is rule</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table II: POS Tagger for Marathi Language
Based and according to the researcher the effectiveness of the proposed POS tagger in Marathi is relatively more than that of Shallow-Parser and NLTK.

**STATISTICAL APPROACH**

<table>
<thead>
<tr>
<th>Author</th>
<th>Research Approach</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jyoti Singh et.al [17]</td>
<td>have developed the part of speech tagger primarily for Marathi language using a probabilistic approach. Unigram, Bigram, Trigram and HMM are approaches used by the researchers for the development of the tagger.</td>
<td>Unigram accuracy =77.38%, Bigram accuracy= 90.30%, Trigram accuracy =91.46% and HMM accuracy=93.82%.</td>
</tr>
<tr>
<td>Nita V. Patil [18]</td>
<td>used HMM technique to train and test POS tagger for Marathi Language. Unigram, bigram and trigram language models are used for the prediction of the most probable sequence of labels for the specified sequence of words. Viterbi decoding algorithm is used.</td>
<td>Accuracy = 86.61%</td>
</tr>
</tbody>
</table>

**RULE BASED APPROACH**

<table>
<thead>
<tr>
<th>Author</th>
<th>Proposed work</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Namrata Tapaswi et.al [19]</td>
<td>developed a simple POS tagger to tag each word of the sentence automatically. The approach is tested for 15 tags and 100 words of the language to acquire the desired results.</td>
<td>----</td>
</tr>
<tr>
<td>ArchitYajnikn [20]</td>
<td>presents POS tagging method for Nepali script using both HMM and the Viterbi algorithm. Viterbi algorithm is found to be faster than HMM and the system</td>
<td>Accuracy = 95.43%</td>
</tr>
</tbody>
</table>

**IV. GRAMMATICAL AND INFLECTIONAL ANALYSIS**

This section presents the study of modification in different grammatical aspects like number, gender etc. in Dogri Language [21].

In grammar, inflection is defined as the modification of a word to denote different categories of grammar such as number, tense, person, case, voice, aspect, gender, and mood. An inflection denotes one or more grammatical categories with an infix, prefix or suffix.

- **Noun:**
  It refers to people, animal, object, idea, concept, feeling etc. In Dogri a noun hosts the attributes like gender, number and case.

### Inflection of nouns by gender

In Dogri language, the genders- masculine and feminine are mostly same as in Hindi language.

The Dogri consonants which are ending with noun in the masculine form have certain different feminine forms which can be formed by using certain suffixes like अनी, आनी, ई and एआनी or ऐनी

Example:

<table>
<thead>
<tr>
<th>MASCULINE</th>
<th>DOGRI FEMININE</th>
</tr>
</thead>
<tbody>
<tr>
<td>शेर</td>
<td>शेरनी</td>
</tr>
<tr>
<td>जेठ</td>
<td>जेठनी</td>
</tr>
</tbody>
</table>
Inflection of nouns for number
In Dogri language, the conversion of masculine nouns having suffix (आ) into their corresponding plural forms can be done by replacing the suffix with (ए).
Examples:

<table>
<thead>
<tr>
<th>SINGULAR FORM</th>
<th>PLURAL FORM</th>
</tr>
</thead>
<tbody>
<tr>
<td>बोतल</td>
<td>बोतले</td>
</tr>
</tbody>
</table>

In feminine noun आं (āṃ) is added at the suffix, e.g.,

| कताब       | कताबां       |

- **Pronoun:**
The words used in place of Noun and substitute a noun or Noun phrase are called pronoun. Some Dogri pronouns are: आपूं, असें, इक-दुए, कोहदा

- **Adjectives:**
Words that describe nouns. Adjectives are used before or after the noun.

**Inflection of adjectives by gender**
In Dogri language, adjectives in the masculine form mainly end with आ and in order to change the masculine adjective to its corresponding feminine form, we need to replace “आ” with “ई”

Examples:

<table>
<thead>
<tr>
<th>SINGULAR MASCULINE</th>
<th>SINGULAR FEMININE</th>
</tr>
</thead>
<tbody>
<tr>
<td>सपानाजागत</td>
<td>सपानीकुड़ी</td>
</tr>
</tbody>
</table>

**Inflection of adjectives by number**
In Dogri language, the singular masculine adjective ends by आई. To alter it into the plural form, we need to replace it with ए. Example:

<table>
<thead>
<tr>
<th>SINGULAR MASCULINE</th>
<th>PLURAL MASCULINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>कालाघोड़ा</td>
<td>कालेघोड़े</td>
</tr>
</tbody>
</table>

In Dogri Language, the feminine adjectives in the singular form that end with ई/ई is converted to its plural form by adding यां(yāṁ)
Example:

<table>
<thead>
<tr>
<th>SINGULAR FEMININE</th>
<th>PLURAL FEMININE</th>
</tr>
</thead>
<tbody>
<tr>
<td>कालीघोड़ी</td>
<td>कालीघोड़ड़यां</td>
</tr>
</tbody>
</table>

- **Verbs:**

  - **Verb inflection for gender**
In verbs in Dogri language, the gender in the masculine form have “आ” as suffix, and the verbs in feminine form have “ई” as suffix which is shown below:

Example:

<table>
<thead>
<tr>
<th>MASCULINE</th>
<th>FEMININE</th>
</tr>
</thead>
<tbody>
<tr>
<td>जागतरोआदा</td>
<td>कुड़ीरोआदी</td>
</tr>
</tbody>
</table>

In verb of number, singular is denoted by “दा” whereas plural is denoted by “दे” in suffix.
Example:

<table>
<thead>
<tr>
<th>SINGULAR</th>
<th>PLURAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>फुलखिलदाऐ</td>
<td>फुलखिलदेन</td>
</tr>
</tbody>
</table>

- **Compound verbs**
Compound verbs are the union of the main verb in addition to an auxiliary verb. Typically, the auxiliary verb is a word that complements sense to the main verb and drops its individual self-determining meaning.
Example:

  कम्मकरनापौना - the word “पौना” is the compound verb. “कर” is mainly the root word of the main verb and पौना are the auxiliary verbs

- **Adverb:**
Adverbs are mainly associated with the verb and describe the verbs.
Example: तौलेतौलेचलो – adverb here in the sentence is तौलेचलो

**FOLLOWING DOGRI RULES ARE USEFUL TO RECOGNIZE VARIOUS TAGS:**

1. There is a high probability that noun follows an adjective.
Example: ओइकसच्चादेसवासीऐ | सच्चा is an adjective and देसवासी is a noun.

2. There is a probability that a post position follows a noun.
Example: उन्पानीचबट्टासुटेया | पानी -noun and च -postposition.

3. There is a high probability of verb following a noun.
Example: ओरुट्टीिादा | िा -verb,

4. There is a probability that the word preceding “दा”, “दी”, “न”, “ने”, “दे” is a verb.

5. In Dogri language, the main verb is followed by an auxiliary verb.
Example: कब्जेकररयै | कब्जे -main verb, कररयै-auxiliary verb.

**V. PROPOSED WORK**
The proposed work in this research is designing and implementation of part of speech tagging system that closely tags Dogri words that are input to the system. The paper covers the initial stage of POS tagging which include acceptance of the relevant (Dogri) text, tokenization and stemming of the input text. The input data is the Dogri (Devanagari script) text collected from social media.

The Dogri text data which is saved in the form of a text file is an input to the system. The result of which is shown in the following Fig. 2.
A) Input Dogri text:

Fig. 2. Dogri text

B) Tokenization of text: The accepted Dogri corpus is converted into tokens as per delimiter. The result is shown as in the Fig. 3.

Fig. 3. Tokenization of Dogri Text

C) Stemming of text: Stemming is defined as the process of converting the words similar in morphology to their respective root words by removing the ending or suffixes from the words. Like any other language, Dogri language is rich in morphology. A set of rules are made considering the language to accomplish the process of stemming. The resulting words after performing stemming is not necessarily a root word. To overcome this problem a database of the root words is needed to be provided to provide the relevant output[22]-[24]. The result of the Dogri text before and after stemming is shown below in Fig. 4.

Fig. 4. Stemming

VI. CONCLUSION AND FUTURE WORK

Parts of speech tagger assigns appropriate tags to the words in the sentences. The process involves study of the techniques used to assign appropriate tags to words. Related study carried out by various researchers in the languages having Devanagari script has been done in the paper. The study helps us in having better knowledge about the language and the techniques used for tagging.

The paper also includes the study of various grammatical and inflectional analysis of Dogri language. Rules for the identification of various POS tags for Dogri language is also discussed with the help of appropriate examples. Initial step of POS tagging is acceptance of relevant script and chunking of sentences into words and converting morphologically rich words into their root words which is performed and corresponding results are also shown.

Dogri language contains number of ambiguous words. Ambiguity of the Dogri words will be removed and hence POS tagging will be accomplished in the future.

REFERENCES
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AUTHORS PROFILE

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