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English and Sanskrit Language Comparison and Machine Translation Approaches

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----------ABSTRACT----------

Sanskrit is thought as the old jargon in Hinduism, in it was worn as a mechanism of message and conversation by the Hindu Supernatural Gods, and outburst by the Indo-Aryans. Sanskrit is in the bargain at large in Jainism, Buddhism, and Sikhism. But Sanskrit language is not widely used in today's time. English is currently the language that is spoken the most. Most documents are written in the English language, which is regarded to be the legal language. This paper provides a basic comparison of the English and Sanskrit languages. This comparison makes it simple to construct a translation model. Without the help of a human translator, machine translation is a highly useful tool for people from different regions to understand a foreign tongue. This study introduces the idea of machine learning, which will offer the translation answer. Sanskrit has already been translated using neural machine translation employing rule-based methods and encoder-decoder mechanisms. The traditional Rule-Based technique is laborious, necessitates a lot of manual work from the linguist, and has poor learning capabilities. But LSTM-based models have a propensity to overfit more quickly. The many-to-many encoder-decoder sequence model will be used to create a language translator app that we have suggested as a machine learning idea in this work. With English as the input text and Sanskrit as the destination text, our model will be trained using LSTM to translate between the two languages.

Keywords - Machine Learning Approaches, Natural language processing, Neural Machine Translation, Translation

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1. Introduction

An Indo-Aryan or Indic language with a 3,500-year history, Sanskrit is from the ancient Indian subcontinent. The majority of Hindu philosophical writings, as well as some of the key texts in Buddhism and Jainism, are written in this language, which is also the primary liturgical language of Hinduism. Because it includes the entire range of mutually interpretable Old Indo-Aryan dialects used in North-Western India at the time the Vedas were written, Sanskrit can be seen as the ancestor of the Prakrits and Pali, and consequently of all Modern Indo-Aryan languages like Hindi, Marathi, Bengali, Punjabi, Gujarati, Sindhi, etc. Besides a lengthy tradition of philosophical and theological texts, Sanskrit literature spans a wide range of genres, including poetry, music, theater, science, and technical publications. Sanskrit is only spoken by less than 1% of Indians today, and Hindu priests mostly use it during religious ceremonies.

The Indo-European language family includes Frisian, German, and Dutch (also known as Flemish in Belgium), while English is a West Germanic language. English, a language with English roots, is widely used in the United States, the United Kingdom, Canada, Australia, Ireland, New Zealand, and other island countries in the Caribbean Sea and the Pacific Ocean. Several countries in sub-Saharan Africa, including South Africa, the Philippines, Singapore, and India, also have a sizable population that speaks it. English has earned the title of "international lingua franca" since it is the first foreign language that most other nations choose to study. An estimated two billion people, or approximately a third of the world's population, utilize English now.[1] Because English is a language that is widely used throughout the world, the majority of official correspondence and papers are written in it. English seems to be the language of coding in the realm of computer programming. No matter what the original programming language was, the majority of keywords are still in English.

As one of the first synthetic languages with a large body of prehistoric literature, Sanskrit is regarded as the mother tongue of all Indian languages and is also the oldest. Because English is now considered to be a "global language," a lot of effort has been done on English title generation, but Sanskrit title generation has received less attention due to its less widespread use. Finding an effective method for this translation pair has always been difficult in the field of natural language processing.

Natural language processing (NLP), a field of computer science, is concerned with how computers and human languages interact. One way for people to communicate with computers is through natural language processing (NLP). Making a computer understand a human language is tough due to the connection between NLP and the field of human-machine interaction.[2]

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2. Need for Machine Translation

Without the aid of a human translator, Machine Translation is incredibly useful for people from varied backgrounds to understand an unknown language. This paper discusses issues with the Natural Language Processing field of Machine Translation.

The language that has to be translated is known as the Source Language (SL), and the language that is being translated is known as the Target Language (TL). The syntactic and semantic structures of the source and target languages should both be taken into account when translating. The meaning of the raw input text is fully decoded. The translator must interpret and evaluate the text. This approach demands a deep grasp of the grammar, semantics, syntax, idioms, etc. of both the source language and the target language.

Before beginning the translation process, comparison and analysis help to highlight the differences between the two languages.

Table 1: Basic Difference between the two Languages

Basis	ENGLISH	SANSKRIT
Type of Alphabets	2 types of alphabets	Almost 50 types of alphabets
Vowels	5 Vowels (A, E, I, O, U)	10 Vowels (Matras, Half Letters, Halants, etc,..)
Consonants	21 Consonants - B, C, D , etc...	4O Consonants
Tenses	Mainly Three in sub partition Twelve Tenses mainly the Past, Present, and Future. Twelve different tenses can be created by combining all three of the tenses: Perfect, Indefinite, Continuous, and Perfect Continuous.	Six Tenses primarily six tenses: order, blessing, present, past, and future.
Numbers	Two Numbers Singular and Plural	Three numbers Singular, Dual and Plural
Order of Sentence	Subject- Verb-Object	Free Word Order
Mood	Five: indicative,imperative, interrogative,conditional and subjunctive	Four: imperative, potential, benedictive and conditional

[3-4-5]

3. Basic Comparison

3.1 Era

Language's historical period is known as era. Because it was created in the present, the English language is referred to be a modern language. Language experts refer to Sanskrit as a classical language. Its earliest known ancestors lived in the fourth century B.C. [6]

3.2 Essence

The language's history is outlined in Essence. Since the English language has evolved, it is a natural language, but Panini and other sages created Sanskrit, which makes it an artificial or synthetic language. [7]

3.3 Person

Person is a grammatical feature of the language that allows us to ascertain "who" is being mentioned. [8]

Table 2: Difference of Person between the two Languages

Sanskrit		English	
Uttam Purush	It is third in the order and is directed towards me.	First Person	It is the first word in the language and refers to myself or I.
Example:	I am going.	Example:	अहम गच्छामि।
Madhyam Purush	It is second in order and refers to you.	Second Person	It is second in the language and is a reference to yourself.
Example:	You are going.	Example:	त्वम गच्छसि।
Pratham Purush	It is the first in the order and alludes to them.	Third Person	It is third in the language's sequence of occurrence and alludes to they.
Example:	He is going.	Example:	सः गच्छति।

[6]

3.4 Tense

A grammatical feature of the language is tense. Tense allows us to identify which "time" is being referenced.

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There are a total of twelve tenses in the English language, which are divided into three groups: Past, Present, and Future. For a total of twelve tenses, all three have forms in the Perfect, Indefinite, Continuous, and Perfect Continuous. Sanskrit does not have simple or continuous tenses. There are a total of 10 tenses in Sanskrit, and they are as follows:

1. लट-लकार (lat-lakarah) i.e. Present Tense
2. ्लट-लकार (lit-lakarah) i.e. Past Perfect
3. लट-लकार (lut-lakarah) i.e. First Future
4. लट-लकार (Irt-lakarah) i.e. Simple Future
5. लोट-लकार (lot-lakarah) i.e. Imperative Mood
6. लड-लकारः (lan-lakdrah) i.e. (Past Imperfect)
7. ि्मलड-लकार (vidhilin-lakarah) i.e. (Potential Mood)
8. आश्लड-लकार (Gsulin-lakarah) i.e. (Benedictive)
9. लड़-लकार (lun-lakdrah) i.e. (Aorist)
10. लड़-लकार (Iri-lakarah) i.e. (Conditional)

3.5 Morphological Analysis

It is regarded as a crucial component of language. It speaks of the grammatical details of the words that make up a sentence. Words in the English language only convey a small amount of information, such as verb, form, tense, and number. For instance, Ram is going. [6]

3.6 Root Word

The root words have a significant impact on the entire language; none of the terms can be observed without root words. In Sanskrit, root words define the substance or derivation of the words present in the language, i.e., the new words are drawn from basic words or "dhatu shabd." [6]

Although the English language does include the idea of a root word, there are occasions when it seems that no new words are generated altogether instead of deriving from a root word.

3.7 Verb Form

In the language, the verb describes the activity. For example, the verb "go" has three different forms in the English language: "go," "went," and "gone," but the verb "dhatu" has twenty-seven different forms in Sanskrit, including the past, present, and future tenses. [6]

3.8 Types of Verb

The kind of verb determines how many attributes an action can display. The Sanskrit language has two sorts of verbs: "Tigant Kriya" and "Kridant Kriya," whereas the English language has verbs in general.

3.9 Nature of Verb

According to the verb's nature, a language's sentence construction options are determined. The verbs transitive, intransitive, and bi-transitive are the three categories of verbs used in English. The verb in Sanskrit is divided into ten gan, such as bhavadigan, churadigan, and divadigan, among others.

3.10 Forms of Noun

The various ways that nouns can be written are determined by their forms. Only the single and plural noun forms exist in the English language. [9]

Nouns in the Sanskrit language can take at least twenty-one distinct forms depending on the number, and bhaktis like Ram can take twenty-one different forms depending on the sort of vibhakti they possess (pratham, dritya, etc.) and the number they possess (singular, dual, or plural). This attribute provides details about a word and also strengthens and informs the typing of words, allowing them to take any position in a sentence.

3.11 Word Order

The way words are arranged plays a big part in verifying the sentence's structure. The sentence's main idea is what gives it its meaning. Languages express themselves through predetermined subject, verb, and object patterns.[10] The subject is always placed first, followed by the verb, and then the object in English phrases. Any deviation from this pattern results in sentences that have no meaning at all or have a completely new meaning that may not accurately express the speaker's meaning. For instance, saying "Ram eats fruit" actually means "Ram is eating fruit," saying "eats fruit Ram" is incorrect from a semantic standpoint, and saying "fruit eats Ram" actually means "fruit is eating Ram." [6] In light of the possibility of completely new meanings or senses, it follows that any modification to the subject-verb-object form is forbidden.[11]

Sanskrit is an exception in this regard because it recognizes the subject-verb-object structure but does not adhere to it rigidly.[12] Sanskrit words are firmly typed, meaning that each word holds all of the information in terms of number, person, tense, or gender. As a result, the words can be arranged in any order. Because of this, they typically provide the desired translation or sense, regardless of where they are in the sentence.[13]

Consider the following example “ramaH phalam khadati” (रामः फलम खादि्मि) which means “ Ram eats fruit’, can be in any order like “phalam ramaH khadati”(फलम रामः खादि्मि) or “khadati phalam ramah”(खादि्मि फलम रामः). The sentence will continue to signify the same thing. Even if the words have been rearranged in this case, the sentence's meaning is still clear. There are several statements where rearranging the words might affect their meaning.[14] In that situation, the sentence's common reference can be used, e.g., fruit eats book (फलम पस्तकम खादि्मि). The similar portrayal of the neutral gender in vibhakti is to blame for this.

4. Machine Translation Approaches

There are several approaches to Machine Restatement. They're Direct, Rule Grounded, Statistical grounded, Corpus Based, Example Based and Knowledge Based.[15]

4.1 Direct Machine Translation Approach

Direct machine language to another process relying on translating text from one

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intermediate representation or alignment with an intermediary language. The goal is to create a translation model that directly converts source language sentences into target language sentences.

4.2 Rule Grounded Machine Translation Approach

Rule-based machine translation (RBMT) is an approach to machine translation that relies on linguistic rules and structures to perform translation. In RBMT, the translation process is guided by a set of predefined rules and linguistic knowledge. Unlike statistical or neural machine translation, which learn from data, RBMT systems are explicitly programmed with linguistic rules.

4.3 Statistical Grounded Machine Translation Approach

Statistical machine translation (SMT) is an approach to machine translation that relies on statistical models trained on bilingual text corpora. Unlike rule-based machine translation, which uses explicitly defined linguistic rules, SMT learns translation patterns and probabilities from data. This approach gained popularity before the rise of neural machine translation (NMT) but still serves as a foundation for certain language pairs and domains.

4.4 Corpus Based Machine Translation Approach

Corpus-based machine translation is an approach that relies on the analysis and exploitation of large parallel corpora, which consist of aligned texts in the source and target languages. The goal is to leverage statistical patterns and linguistic information present in the corpora to improve the quality of machine translations. This approach falls under the broader category of data-driven machine translation.

4.5 Example Based Machine Translation Approach

Example-based machine translation (EBMT) is an approach that relies on a database of examples to perform translation. In EBMT, the system learns from a collection of pre-existing translations or bilingual examples and uses this knowledge to generate translations for new sentences. This approach falls under the broader category of data-driven machine translation.

4.6 Knowledge Based Machine Translation Approach

Knowledge-based machine translation (KBMT) is an approach that involves integrating explicit linguistic or domain-specific knowledge into the translation process. Unlike data-driven approaches (such as statistical or neural machine translation), KBMT relies on predefined rules, ontologies, or knowledge bases to facilitate the translation. The goal is to use explicit knowledge to improve the accuracy and context-awareness of the translation.

Although once many times, numerous efforts have been made to restate Sanskrit to other languages using colorful Machine Restatement Approaches.

In recent years, Neural Machine Translation techniques like Sequence-to-Sequence Learning, Encoder-Decoder attention-based architectures, and Transformers have achieved State Of The Art (SOTA) results for supervised machine translation tasks.[16] However, for low resource methods like Back translation, Cross-Language Modelling, Phrase Based Machine Translation and Dual Learning Mechanism based upon reinforcement learning takes the benefit of monolingual data to improve the quality of translations over supervised approaches. Unfortunately, none of the given methods has been used for Sanskrit's machine translation task due to the lack of linguistic resources.

5. Related Work

Work by Mishra and Mishra (2009) mainly focuses on building tokenization, POS Tagger, and a Named Entity Recognition (NER) system for the Sanskrit language using statistical machine translation approach. [17]

Mane et al. (2010) introduced a dictionary-based approach for implementing machine translation on Sanskrit by parsing and replacing source word with the target using a bilingual dictionary.

Bahadur et al. (2012) developed Machine translation which primarily focused formulation of Synchronous Context-Free Grammar (SCFG) and a subset of Context-Free Grammar (CFG). The developed model firstly tokenizes input data and then match the exact word or phrase from the dictionary. The developed model also gathers information about parts of speech (POS) of input sentences. [17]

Neural machine translation is a newly emerging approach to machine translation, proposed by Kalchbrenner and Blunsom (2013), Sutskever et al. (2014) and Cho et al. (2014b). Unlike the traditional phrase-based translation system (see, e.g., Koehn et al., 2003) which consists of many small sub-components that are tuned separately, neural machine translation attempts to build and train a single, large neural network that reads a sentence and outputs a correct translation. [18]

The majority of the proposed neural machine translation models are encoder-decoder families with a language-specific encoder applied to each sentence whose outputs are then compared (Hermann and Blunsom, 2014; Sutskever et al., 2014; Cho et al., 2014a). [19]

Using a multilingual dictionary and speech synthesizer that also transforms speech to text, Rathod's (2014) study established a Rule Based and Example-based technique for machine translation. Grammar and spell checking were also features of the intended model. The government of India also built an open-source website portal 3 in 2015 that gathers data from areas like primary and secondary school Sanskrit literary books. Additionally, it employs statistical machine translation techniques and makes an effort to address the Word Sense Disambiguation (WSD) issue. [20]

According to Cho et al. (2014b), a basic encoder-decoder's performance does certainly decline quickly as the

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length of an input sentence rises. The Google Translator system operates similarly.

Apart from Koul and Manvi (2019) encoder-decoder model, no such work has been done on Sanskrit's Neural Machine Translation in the best of our knowledge. [21]

6. Proposed Methodology

Previous rule-based techniques and encoder-decoder mechanisms using LSTM units have been used for neural machine translation of Sanskrit. The traditional Rule-Based technique is laborious, necessitates a lot of manual work from the linguist, and has poor learning capabilities. But LSTM-based models have a propensity to overfit more quickly. The many-to-many encoder-decoder sequence model(Uni directional & Bidirectional) will be used to create a language translator app that we have suggested as a machine learning idea in this work. With English as the input text and Sanskrit as the destination text, our model will be trained using LSTM to translate between the two languages.

In fact, as a sentence's length increases, a basic encoder-decoder's performance rapidly declines. We present an extension to the encoder-decoder paradigm that concurrently learns to align and translate in order to overcome this problem.

Fig.1 shows the LSTM Encoder – Decoder Model. A Long Short-Term Memory (LSTM) Encoder-Decoder model is a type of neural network (RNN) architecture designed for sequence-to-sequence tasks such as machine translation.

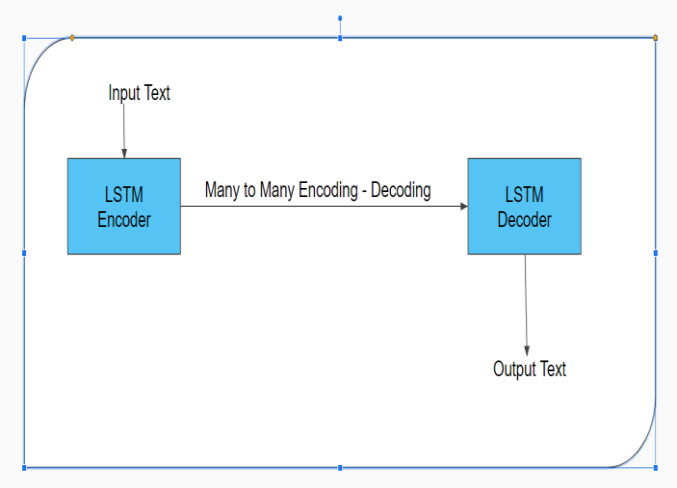

Fig.1: LSTM Encoder – Decoder Model

The LSTM Encoder – Decoder architecture consists of two main components: an encoder and a decoder. The input sequence (e.g., a sentence in the source language) is fed into the encoder one element at a time. The decoder is another LSTM network that generates the output sequence (e.g., a translation in the target language).

Fig.2 shows the Unidirectional many to many Encoder – Decoder Model. Unidirectional many to many Encoder – Decoder architecture is suitable for tasks where the output at each time step depends on the entire input sequence.

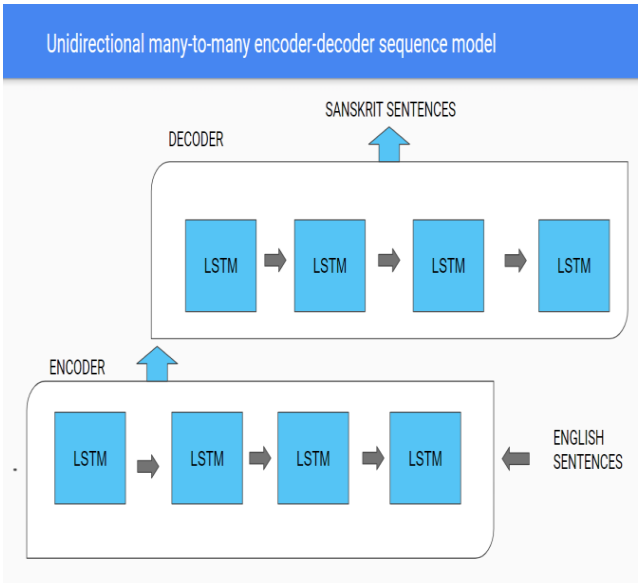

Fig.2 Unidirectional many to many Encoder – Decoder Model.

The Unidirectional Many-to-Many Encoder-Decoder model is a specific configuration of sequence-to-sequence architecture, where both the input and output sequences have multiple elements, and the information flows in one direction. This architecture is commonly used for tasks such as sequence transduction, where an input sequence is transformed into an output sequence. However, it may have limitations in capturing dependencies that span a long range in both input and output sequences. In some cases, bidirectional models or attention mechanisms are used to address these challenges.

Fig.3 shows Bidirectional many to many Encoder – Decoder Model. Bidirectional many to many Encoder – Decoder Model overcome the challenges of Unidirectional many to many Encoder – Decoder Model.

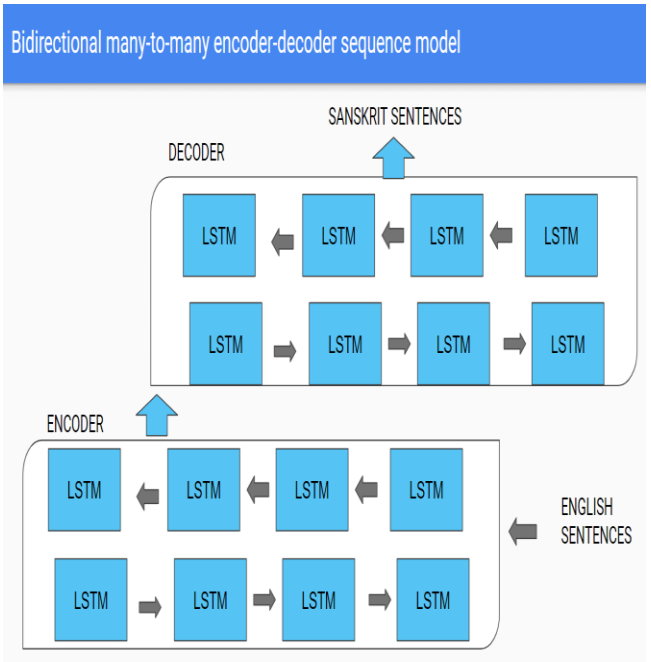

Fig.3: Bidirectional many to many Encoder – Decoder Model

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A bidirectional many-to-many encoder-decoder model is a variation of the sequence-to-sequence architecture that incorporates bidirectional processing in both the encoder and the decoder. This architecture is often used for tasks like sequence transduction, where the goal is to transform an input sequence into an output sequence.

The suggested approach (soft-)searches for a collection of spots in a source phrase where the most pertinent information is focused each time a word in a translation is generated. The model then predicts a target word based on all previously generated target words as well as the context vectors connected to these source positions. The main distinction between this method and the fundamental encoder-decoder is that it avoids attempting to compress the entire input sentence into a single fixed-length vector. Instead, it transforms the input sentence into a series of vectors, and then, while decoding the translation, it arbitrarily selects a subset of these vectors. This eliminates the need for a neural translation model to condense all the data from a source sentence—regardless of length—into a single, fixed-length vector. We demonstrate how this enables a model to handle lengthy sentences better.

In this study, we demonstrate that the suggested method of learning to align and translate simultaneously produces noticeably better translation performance than the conventional encoder-decoder method. Longer sentences show the progress more clearly, yet shorter sentences also show it. With a single model, the suggested approach delivers translation performance nearly as good as the traditional phrase-based system.

7. Conclusion

In Hinduism, Sanskrit is seen as an ancient language that was used by the Hindu Supernatural Gods and Indo-Aryans as a means of communication and outpouring. However, Sanskrit is not a language that is frequently spoken nowadays. English is currently the language that is spoken the most. Most documents are written in the English language, which is regarded to be the legal language. This paper provides a basic comparison of the English and Sanskrit languages and introduces the idea of machine learning, which will offer a translation solution. The conventional Rule-Based approach is time-consuming, requires the linguist to do a lot of manual work, and has limited learning capabilities. However, LSTM-based models tend to overfit more quickly. In this paper, we provide a many-to-many encoder-decoder sequence model and propose a machine learning approach to build a language translation app. Our model will be trained using LSTM to translate between English and Sanskrit utilizing the input text as the source language and the target text as the destination language.

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Biographies and Photographs

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