

Evaluation of Machine Translation in Languages

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1 Introduction

According to Ethnologue [1], 7,164 languages currently exist and in use today, with 40% of them considered endangered.

As of July 2024, 243 languages and languages varieties are supported by Google Translate (according to Wikipedia [9])

Machine translation (MT) has emerged as a pivotal technology in facilitating cross-cultural communication and global information exchange. With the exponential growth of digital content in diverse languages, the demand for accurate and efficient translation systems has never been greater. This paper aims to evaluate and compare the performance of various machine translation models across multiple languages, shedding light on their effectiveness and limitations in real-world applications.

Effective machine translation hinges on the ability of algorithms to comprehend and accurately render meaning from source text in one language to target text in another. Traditionally, statistical methods dominated the landscape, employing linguistic rules and alignment techniques. However, the advent of neural machine translation (NMT) has revolutionized the field, leveraging deep learning architectures to achieve remarkable improvements in translation quality.

Statistical machine translation, which previously dominated MT research for many years with its reliance on various count-based models, has largely been surpassed by neural machine translation (NMT) [6].

The languages chosen for evaluation in this study represent a wide overview, striking a balance between resources and diversity.

The evaluation criteria encompass standard metrics such as BLEU (Bilingual Evaluation Understudy) [4], METEOR (Metric for Evaluation of Translation with Explicit ORdering) [2] to capture nuances in translation quality. These metrics not only quantify the fidelity of translations but also offer insights into the models' adaptability and robustness across different linguistic pairs.

Through simple experimentation and analysis, this paper aims to evaluate existing techniques across different languages and contribute valuable insights into the current state of machine translation technology. By comparing metrics among languages, I hope to inform future researchers of the effectiveness of machine translation on each individual languages that are included in this paper.

Evaluating languages enhances understanding of linguistic structures, phonetics, syntax, semantics, and other linguistic components. This knowledge contributes to the broader field of linguistics and helps in developing theories about language evolution, language families, and the cognitive processes involved in language acquisition and use.

Machine translation can be tracked to as early as 1949 [8]

2 Related Work

As is the case of most fields within Natural Language Processing (NLP), the current state-of-the-art (SOTA) in machine translation (MT) is characterised by the significant advancements brought by large language models (LLMs) like OpenAI's GPT-4. These models have surpassed traditional neural machine translation (NMT) systems in several areas, offering more nuanced and accurate translations, especially in handling context and idiomatic expressions.

mBART [3] is considered one of the State-of-the-Art as of this moment for multilingual translation.

T5 [5]

3 Tatoeba Dataset

3.1 Overview

Tatoeba is a vast, continuously expanding database consisting sentences and their translations, built through the contributions of thousands of volunteers, offering a tool that allows users to see examples of how words are used in sentences [7]. They currently have 12,132,349 sentences and 423 supported languages, with around one to two thousand new sentences added daily, on average



Figure 1: Tatoeba languages repository with 10,000+ sentences and 100,000+ sentences [7]

Tatoeba English sentence dataset contains 1,905,089 sentences, the largest one in their repository, with Russian in the second place with 1,066,633 sentences. Some of the languages supported in the website is shown in Figure 1 and Figure 2, sorted from the biggest corpus. Low-resource languages such as Rendille, Southern Haida, and Cuyonon can be seen at the bottom of the list, having only a single sentence example. Ancestor languages such as Old Saxon and Old Turkish can also be seen in the list, subsequently with low number of examples.

3.2 Analysis





















Sentences typically consist of everyday phrases such as 'I have to go to sleep', 'That is intriguing', and 'Where do you live?' They may also include single-word exclamations like 'Speak!' or 'Look!' Additionally, multiple sentences such as 'You may write in any language you want. On Tatoeba, all languages are considered equal', and 'Guns don't kill people. People kill people' can be found inside the corpus. A few of them also include human names, 'Compare your answer with Tom's', 'Muiriel is 20 now'. All of the sentences are straightforward and literal, without the use of linguistic devices such as metaphors or sarcasm. Therefore, machine translation process should be straightforward on this level.

4 Methodology

Take the list of most spoken language by population according to Wikipedia [10], then take one for each branch.

Sentences in English are downloaded, 1,898,494 sentences (it is unclear why it is less than the number stated in the Tatoeba website). Then for each languages, download sentence pairs compared to English. Merge every language sentences into one big dataframe, only keep where sentences exist for every language.

Target language will be English, with machine translation task defined as Many-to-English.

		Language		Sentences
1		eng	English	1,906,613
2		rus	Russian	1,067,167
3		ita	Italian	881,287
4		epo	Esperanto	760,064
5		tur	Turkish	734,083
6		kab	Kabyle	714,233
7		deu	German	667,177
8		ber	Berber	660,836
9		fra	French	614,521
10		por	Portuguese	432,384
11		spa	Spanish	410,509
12		hun	Hungarian	409,148
13		jpn	Japanese	243,341
14		heb	Hebrew	201,220
15		ukr	Ukrainian	186,145
16		nld	Dutch	185,628
17		fin	Finnish	149,285
18		pol	Polish	127,893
19		lit	Lithuanian	108,016
20		ces	Czech	79,393






















404		kxi	Keningau Murut	4
405		tso	Tsonga	4
406		crk	Plains Cree	4
407		hsn	Xiang Chinese	4
408		hnj	Hmong Njua (Green)	4
409		pfl	Palatine German	3
410		syc	Syriac	3
411		ayl	Libyan Arabic	3
412		mni	Meitei	3
413		hdn	Northern Haida	3
414		gan	Gan Chinese	3
415		osx	Old Saxon	3
416		gaa	Ga	3
417		urh	Urhobo	2
418		aym	Aymara	2
419		nys	Nyungar	2
420		sot	Southern Sotho	2
421		mnc	Manchu	2
422		rel	Rendille	1
423		hax	Southern Haida	1
424		cyo	Cuyonon	1

Figure 2: Tatoeba top 20 and bottom 20 languages based on sentences count [7]

No.	Language
1	Dutch
2	Finnish
3	French
4	German
5	Hebrew
6	Hungarian
7	Italian
8	Japanese
9	Mandarin Chinese
10	Polish
11	Portuguese
12	Russian
13	Spanish
14	Turkish
15	Ukrainian

Table 1: List of chosen languages for evaluation

Sentences dataset from Tatoeba is used ¹. Languages that has more than fifty thousand sentences are selected. Accordingly, languages that are available for mbart is also selected based on the list here ²

For translation, all languages are translated into English as the target language. Then compare the true English sentence and the predicted one, calculated BLEU.

5 Evaluation

6 Conclusion

References

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¹<https://tatoeba.org/>

²https://dl-translate.readthedocs.io/en/latest/available_languages/