Can Machine Translation be As Effective as Human Translation? A Cross-Linguistic Analysis of Machine Translation Ambiguity between English, French and Armenian

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Abstract

Statement/Research Question: Machine Translation (MT) still remains a tough challenge for both linguists and programmers. In spite of all the promises and hopes, it failed to meet the satisfactory standards. Actually, translation itself is a tough process, even for human beings. Can MT be compared with Human Translation? The paper discusses the difference between MT and Human Translation focusing on the effectiveness of each and pointing out semantic ambiguity in English, French and Armenian translations. Ambiguity still results in huge barriers on the effectiveness of Machine Translation.

Methodology: We carried out an experiment by translating many texts of English, French and Armenian through different Machine Translators and analyses the error patterns1 by a dictionary method technique. We paid proper attention to translation of words, idioms, preservation of source text information in the target text, grammatical structure etc.

Findings: Finally, this paper also discusses the factors causing ambiguity in MT from three main perspectives:
a) Linguistic,
b) Extra-linguistic,
c) Security.

Introduction

Inevitably, human beings are in a race of developing new gadgets to make our lives easier. With the innovation of computers have been a great blessing. With time it has made things unbelievably faster and efficient. Similarly, we use computers / gadgets specifically developed for converting one language into another which is called Machine Translation. Now we use Machine not only to translator for us, but also instead of us. Machine Translation, which came to replace human in the process of translation, is yet to get purified a lot. But is Machine Translation a challenge for human translation nowadays? How long will it past until Machine Translation will dominate over the human translation from the perspective of effectiveness and will it ever happen? Will it ease the hard translation task of each person who needs a very specific piece of text to be translated from one natural language into another?

Why did human create Machine Translation? Was it merely a scientific achievement or it was directed to meet the daily translation needs of people? Or is there something beyond this very expensive and much investment depending scientific goal?

These questions are yet to be discussed in this paper, which consists of two main parts. In the first part we will discuss the factors causing decrease of effectiveness of Machine Translation. The second part will be dedicated to analysis of the level of language ambiguity created by Machine Translation in English, French and Armenian.

Can Machine Translation be as effective as human transition?

The general view for Machine Translation[1] is that the main task of Machine Translation is to translate a text from one natural language into another, i.e. from source text into target one. But before continuing we should note that in linguistics this simple act of translation, which Machine Translation fulfils as a result of programing, is not enough. We expect Machine Transition to produce and present a better target text keeping the style of the source text, be clear and interesting. It is one thing to expect Machine Translation to produce a target text, which is equivalent to the source one, but it is something else to expect Machine Translation to produce an interesting and valuable target text at the same time keeping the style of the source text.

Building a Machine Translator is not an easy task. One needs a huge knowledge base to generate and describe the information that will be used while translating. Saying knowledge, we, roughly speaking mean world knowledge: beginning from such basic information as *most people have two legs*, *tiger is predator* and finishing with deep linguistic information as *the subject always stands before the verb in English*. Coding this information into the system for later to be decoded as a result of translation also implies a hard task which requires vast amount of programming knowledge.

It is crystal clear that we only ever expect from Machine Translation is just a draft quality text. But what do we expect from human translator?

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[1] In this this paper we will not focus on any specific type of Machine Translation, everything stated must be accepted generally.

Language, no matter how many disciplines have since been created to describe it, is a hard phenomenon. According to scientists approximately 6500 spoken languages exist. No language is like other language. Their differences stand in many aspects: writing system, morphology, grammar, syntax etc. To understand a very specific phrase or sentence in a language and interpret in another one can be dealt only by a competent speaker of both languages. Nonetheless, translating is a many faced skill that goes well beyond mere competence in two languages (Arnold, 2000). Roughing speaking the task of human translation is to take the source text and produce it in the target one, but human translation is expected to do more than just this. Human translator is expected not only to have a good knowledge of two languages but also be aware of the background information of the culture that language covers. To understand a text in one languages is not enough. Human translator is also supposed to be flexible enough to present already understood text in a correct way according to linguistic norms of the target language. Humans have been very successful in their translation activates so far.

A Somalian proverb says, 'The last camel in the line walks as fast as the first one'. Unfortunately, this last camel sometimes come to be Machine Translation. With its very slow development it bans and shadows the development of both Computer Science and Linguistics along with Translation studies. At least it is one thing to ask computer to produce a target text, which is (in some sense) equivalent to the source text, it is something else to ask the computer to make it interesting (Arnold, 2000).

Below we will discuss some main factors which cause the delay in the development of Machine Translation decreasing effectiveness of it and increasing ambiguity. As Machine Translation is not a merely linguistic or computational phenomenon, hence it will be useless to cover only one of these aspects. For this purpose we will have two main categories: linguistic and extra-linguistic factors, which will come with their sub-categories.

1. Linguistic factors
   1.1 Polysemy
   1.2 Lack of idioms and equivalents
   1.3 Syntax/ill-structured sentences
   1.4 Cultural words
   1.5 Non translatable words

2. Extra-linguistic factors
   2.1 Programming
   2.2 Lack of word knowledge
   2.3 Performance time
   2.4 Lack of linguistic purposes
   2.5 Lack of linguists

3. Security

1. Linguistic factors

1.1 Polysemy

Polysemy grounds problems not only for Machine Translation, but also for human translation. Hence, unlike Machine Translation, human translation process is rather flexible as human mind is flexible and analytic. Human mind is fully capable to understand the context of the sentence meanwhile mapping out the exact meaning of the word presented. Machine Translator not fully able to understand the context of the sentence, has the highest possibilities to fail while choosing the right meaning of the word.

e.g He deposited money in the bank account with a high interest.
Sitting on the bank of Thames, a passing ship piqued his interest.

The word 'interest' which is presented in different contexts and accordingly with different meanings in these two sentences, is not translated correctly by most Machine Translation systems, if not by none. But in contrary to this, the word 'bank' has been translated accurately in both sentences as the words 'money' and 'Thames' played a good role of determiner. Undoubtedly, human translation process will not face any problem while dealing with polysemy.

1.2 Lack of idioms and equivalents.

It is a well-known fact that natural languages are highly ambiguous, they do not always express the same context, expression and sometimes even words in the same way. There are lots of cases in all language when one language lacks the equivalent in another.

E.g. the dictionary meaning of the idiom '*to feel blue'* is '*to feel bad'*. Machine Translator will face a problem while translating this idiom. It does not recognise the combination of these words as one unit with one meaning and do word to word translation.

Gender cases come as another ambiguity reason. Gender case exists in some languages and does not exist in other ones.

e.g. My friend is very hardworking.

It is not an easy task for Machine Translation to decode this sentence in English and then encode in French. Machine Translation has to choose between male '*ami'* and female '*amie'*. Usually in this case computer automatically use the masculine gender. The possibility that the noun is in feminine gender is approximately 50 percent, which means that the possibility that Machine Translator will create ambiguity is 50 percent, which in turn will lead to wrong translation. The problem is the same while translating from English into Armenian.

Competent human translator is fully capable to overcome the hardships of idioms, but genius human mind can also stumble while dealing with gander in case the context is not allowing the translator to guess the gander.

1.3 Syntax/ill-structured sentences

The syntax of English is very strict. Each new learner of English language is taught with the sentence word order: subject-verb-object (SVO). This word order is not necessarily the same for other languages. Unlike English, Armenian doesn't have strict syntactic rules. Because of its word order source text can often been considered to be ambiguous by Machine Translator again leading to hardships while working out the context.

Sometimes the source text will contain ill-structured sentences. Machine Translation components analysis will probably fail while mapping out the subject and other members of sentence.

Human translator will start to bring together the lacking parts of puzzle as much as possible and act more effective.

1.4 Cultural words

Another limiting factor for good translator is cultural words. Cultural differentiation implies different words typical only for that specific culture. Global software development requires close cooperation of individuals with distant cultural background (Calafato, Lanubile, Minervini, 2010).

Cultural differences are manifested in two forms: organisational and natural culture. While the first one embarrasses norms and values of units, the latter encompasses an ethic group's norms, values and spoken language, often delineated by national boundaries. (Carmel, Agarwal, 2001) Here, not only Machine Translation can face hardships, but even human translator as it is a challenge for gaining a shared understanding of the requirements, especially due to language disparities between stakeholders involved. (Carmel, Agarwal, 2001). Language is an important component of a national culture, but when language difficulties begin to cause confusion, cultural differences can worse awkward situation. (Herbsleb, 2007). But sometimes even being aware of the cultural differences is not a sufficient base to avoid wrong translation or ambiguity.

e.g. լավաշ[lavash]-Armenian word

Lavash is traditional thin Armenian bread mainly famous only in Armenia and among Armenians in the world. An equivalent in no other language exists. Human translator will have the advantage to explain the word in footnotes or in a quick remark. Nevertheless, only explaining is not sufficient to a good translation; one must not only be able to extract the meaning from a text, but also to be able to think about what meaning a potential reader would extract (Arnold, 2000).

1.5 No translatable words

The existence of these words can sometimes be described as a matter of culture, but basically they are not.

e.g. French word '*peck'*, which means '*donner de coupe de la bec'* will be '*attack with the front of the beak'* in English.

In spite of the hardship that human translator can come across it will be overcome again by either footnote explanations, if the translation is done in written form, or with proper words and syntactical structural giving ground to the real essence of the translated word to be understandable. Machine Translation system failure will more vivid.

2. Extra-linguistic factors

2.1 Programming mistakes

Computers are fundamentally just devices for following the rules, mechanically and literary, albeit with considerable speed and precision. Hence, each machine software or gadget are created based on rules. They are given specific rules and they follow those rules. The quality of the written rules of the Machine Translation system, the professionalism with which the rules were written and described into system are bases for high quality Machine Translation.

Unfortunately many of Machine Translation systems are done with rough programming mistakes about which the programmer becomes aware rather later, especially in the case of small Machine Translation systems. The process of overcoming those challenges faces with problem of permanent and rapid development of language and computers.

2.2. Lack of world knowledge

Machine Translation is one of the most exciting examples of artificial intelligence, but its intelligence is still artificial: it does not have the real world knowledge. This is the core problem as all other factors mentioned above could be easily solved if computer knew more about culture, could orient better in the case of ill-structured sentences and had the knowledge of each language in such extend not to get lost while searching for proper equivalent. This problem is otherwise called lack of 'common sense' reasoning. It literary implies millions of fact about the world, like man never get pregnant, dogs bark, stars are shining in the night etc. D. Arnold says that most of coding up the vast amount of knowledge required is daunting. (Arnold, 2010) Basically, all what is understood by common sense reasoning is far beyond the reach of modern computers. How long it will take until computer have the world knowledge is yet to be answered by programmers and by time.

2.3 Performance time

Translation quality and effectiveness are directly connected with the speed of performance. We can find good time responses for many of Machine Translation systems available nowadays. However we found out that performance time of one translation system can vary from another Machine Translation system which is basically based on the type of Machine Translation: statistic, semantic, phrase-based etc. The average performance speed is considered to be between 30ms to 70ms. At the

time of our test Google Translation[2], which is the most famous Statistical Machine Translation system, was not doing better job than Translation.am[3]: But we also noticed that the response time of Translation.am becomes longer with the length of sentence while Google Translate performance is rather stable in this perspective.

2.4 Lack of linguists

Nevertheless, no matter of existence or absence of many linguistic or extra-linguistic factors, which come up as a restriction to high quality Machine Translation, the most important guarantee leading to better quality Machine Translation is the joint work of both high qualified linguists and high qualified programmers. Unfortunately, I should mention that the very important and utmost role of a linguist is minimised as much as possible sometimes deliberately and sometimes by different circumstances. Programmers and engineers are mainly engaged in the process of creation of Machine Translation. Linguists are only part-time staff members or short term workers. They are hired by the company or organisation working on the creation of this or that specific Machine Translation for fixing some definite linguistic problems or helping with the categorisation. Their role is limited in assisting the programmers in this or that stage of development. Surely, I must admit, that it is much more easer for a qualified programmer with good or basic linguistic knowledge to launch a Machine Translation software than for a highly qualified linguist with basic or good programming knowledge. But the fact is that Machine Translation is not a serious threat to the employment prospects of human (Arnold, 2010).

2.5 Lack of linguistic purposes

Machine Transition is two sided system one of which is programming and the other one is linguistics. Only the permanent existence of these two sides can make Machine Translation more balanced. As we try to understand the minoring of the role of linguists in majority of Machine Translation systems, we better look down deeper to roots of the reasons for creating that very specific system. Some systems were created by world famous electronic companies based on non-English speaking countries and they have an aim to make their product more available for international market by giving their customers the possibility to conquer language barriers. Once this was widely accepted practice in Japan, one of the world leading countries of high technology. While observing different Machine Translation systems we found out that some machine Translations produce high quality target text, but in one sphere only, e.g. law or economics. Big organisations or even governmental sections sometimes fund the development of one aspects of a specific machine Translating system to make their work easier. Instead of paying much money to a human translator, they can

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[2] https://translate.google.com/: Google Translator is an example of Statistical Machine Translation, it does not apply grammatical rules since its algorithms are based on statistical analysis. It implies statistical learning techniques to build a language and translation models for a large number of texts, both monolingual text in the target language and text consisting of examples of human translation between the source and the target text (Calafato, Lanubile, Minervini,2010).

[3] https://translation.am : Transaltion.am is a Semantic Machine Translation which is widely used in Armenia.

make investments in development of law text translation quality thus saving money and time.

3. Security

From the first look it is like security has nothing to do with Machine Translation effectiveness. While doing translation with the help of Machine Translator we provide the system with information. That information can be a short part of an online chat with friends, a part of scientific text or an important document. Alike with other software most Machine Translation systems have a server for keeping the information provided to Machine Translator for translation. No one can ever be sure who get the information that users provide the system and how much is the possibility that the information will not be used by the third person. If the users' information is not secure, hence the effectiveness of the system is not high.

Studying different Machine Translator and mainly online ones, as they have more accessibility and high usage, we found out that some specific Machine Translation systems were very effective for a language. In a few years that language was replaced by other one, i.e. the system switched its effectiveness to other language. We also compared the historical, political and socio-economical situations of the countries where that languages were spoken by majority of population, and found out that during these periods those countries faced social, political or economic crisis. And the consequence was that some governments banned the use of some Machine Translation systems in their countries.

Cross-linguistic analysis

We have carried out a cross-linguistic analysis to map out the percentage of efficiency of work done by Machine Translators in English, French and Armenian and determining the level of ambiguity. The ambiguity level will be evaluated not only from the perspectives of ambiguity caused by word meaning, but we will take into consideration grammatical correctness, syntax etc. Basically, evaluation of the quality of translating is an extremely subjective task and disagreement about analysis evaluation methods are rampant. Nevertheless, evaluation and analysis are essential.

We have translated 50 text in three languages: English, French and Armenian. The evaluation was done in terms of ambiguity which was caused by word meanings not translated words, mistranslations or wrong translations and grammatical errors. We also paid proper attention whether translation, i.e. the target text contained the information of the source text. Context were also taken into account.

We have chosen Google Translator for the experiment. In order to identify the quality of translation produced by Google Translator, we has chosen 4-point scoring scheme, i.e. we evaluated how many sentences were evaluated as non-ambiguous, poorly ambiguous, fairly ambiguous and completely ambiguous (see Table 1). The text used for analysis were ordinary texts from news stories in English, French and Armenian. English and French were translated into Armenian and Armenian was translated into English and French.

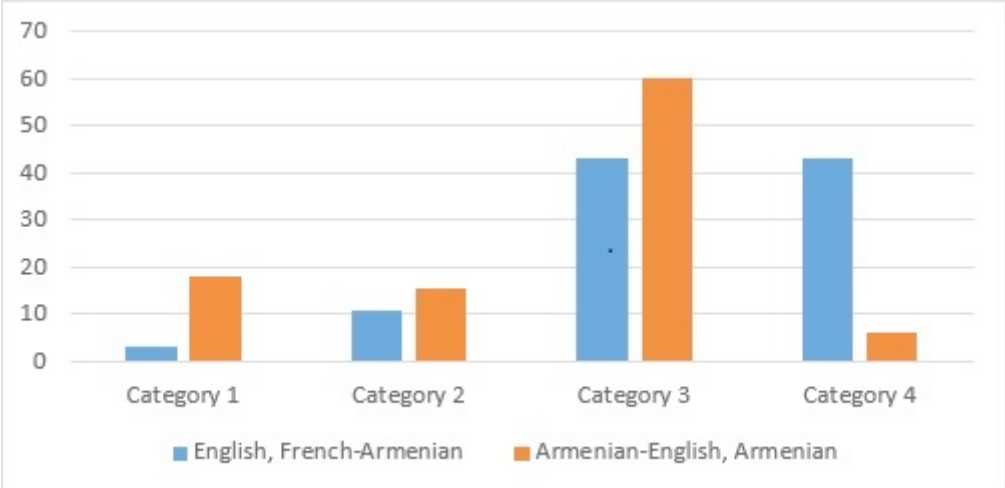
Table 1: Ambiguity scale

Value	Description
1.	Non-ambiguous The target text reflects the information contained in the source text. The target text is perfectly clear, intelligible, and grammatically correct and reads like ordinary text.
2.	Poorly ambiguous The target text generally reflects the information contained in the source text, despite some inaccuracies or infelicities of the translation. In general the target text is intelligible and one can immediately understand what it means.
3.	Fairly ambiguous The target text poorly reflects the information contained in the source text. It contains grammatical errors, wrong choice of word pairs. One can get the general idea of the source text only after considerable study.
4.	Completely ambiguous It is not possible to obtain the source text information from target text. It is hopeless to study the meaning of the words posted next to each other as target text. Guessing would be unreliable.

The results

Before coming to the results I would like to reiterate once again that Google Translator is a Statistical Machine Translator. The essential role in the main translation process is not carried out by the translating application, but by its searching engine. Google Translator searches for already translated source texts or parts of them. Here we found lots of grammatically incorrect sentences, i.e. gender cases, time cases, singular and plurals were sometimes omitted. Table 2 shows the results.

Table 2: Results



As we can see from the chart Armenian- English and French translations are relatively better as it is a common practice for Armenian media to have multilingual web many

Armenian news stories appears on the web pages with translations, which allows Google to find already translated texts by human translators or parts of them and present them. Therefore, it is not surprising that English, French-Armenian is not meeting even the satisfactory standards. Besides, Armenian has very complex grammatical structure which is also another boundary toward a good translation.

We also carried out an additional experiment. We translated the same English text into Armenian thought *Translation.am* and vice versa. It is a semantic Machine Translation system. *Translation.am* is not included in our main experiment as it does not provide French translation. As this system was built by Armenians, it understands Armenian grammatical and syntactical system very well, which is not done by Google Translator. But this Machine Translating is yet far from being good.

Conclusion

Some existing Machine Translation systems, which has been developed for many years, became very successful, especially from the practical viewpoint. These systems and especially statistical ones, rely on dictionaries and phrase tables which require much efforts to generate and their performance is still far behind the performance of human expert translators.

Unfortunately, the Machine Translation systems and software existing nowadays both on-line or off-line, to which people have full access and are free, don't give any other chance to expect more than just a draft quality target text. The development life cycle seem very slow but at the same time it is also recognised as a very established technology with over 50 years of history and is making significant achievements from an end user perspective. That's why the effectiveness of Machine Translation and its domination or weakness over human translation is particularly appealing to researchers as day by day developing technology facilitate new possibilities and chances of creating much superior quality machine translation. Specific Machine Translations has been impressively successful and well known with widely used languages.

Much efforts has gone in the development of Machine translation and much more has been constantly going in to further improvise the quality of the output with many more languages. Probably soon self-learning Machine Transitions will come to replace statistic, semantic and other types of traditional machine Translations bringing programmers most ambitious goals in reality. But it is yet a matter of time and hard work.

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