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Investigation of the Role of Artificial Intelligence in Developing Machine Translation Quality.

Case Study: Reverso Context and Google Translate translations of Expressive and Descriptive Texts.

Language Combination: Arabic-English/ English-Arabic

A Dissertation Submitted in Partial Fulfilment of the Requirements for Master's Degree in Linguistics

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Dedication

This work is dedicated to our beloved parents, who have been our source of inspiration and provide us with their moral, emotional and financial support.

To our brothers and sisters who consider us their example.

To our loyal friends who shared their advices, and encouragement words. Those who made our journey of education passional, and our lives special.

To our teachers who worked hard for us to reach the higher positions.

Acknowledgement

Above all, praise be to Allah, because this work wouldn't have been finished without his help.

بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

'وَمَا تَوْفِيقِي إِلا بِاللَّهِ عَلَيْهِ تَوَكَّلْتُ وَإِلَيْهِ أُنِيبُ'

[هود من الآية:88]

Our most profound appreciation goes to our supervisor Dr. Allel Billel Fasla. We want to thank him for his time, efforts, guidance, support, and valued instructions he provided us during this journey.

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Abstract

Machine translation, powered by Artificial Intelligence has revolutionized the way to bridge language barriers in today's interconnected world. This research explores the role played by AI in advancing machine translation quality. By employing sophisticated algorithms and neural networks, AI-driven machine translation systems have made substantial progress in accuracy, fluency, and context sensitivity, investigating the key components and techniques employed in AI-based machine translation. This research focuses on evaluating machine translation quality by comparing it to human translation, aiming to provide insights into the strengths and limitations of automated translation systems. The study employs a comparative analysis approach, pitting machine-translated texts against human-translated ones. A diverse range of linguistic and textual features, including accuracy, fluency, and grammar are examined to measure the effectiveness of machine translation outputs in capturing the intended meaning. To conduct the evaluation, a corpus of expressive and descriptive texts written in both Arabic and English was selected. The translation process involves professional human translator and two different types of Machine Translation online applications: Google Translate, and Reverso Context to measure to what extent these machines are using AI developed technologies to enhance the translation's quality. The comparative analysis offers valuable insights into the conflict between human and machine translations and identifies areas where machine translation can be further improved. It also identifies the limitations of machine translation, particularly in capturing contextual, idiomatic expressions, and culture-specific references. By identifying the strengths and weaknesses of machine translation systems, this study seeks to help translation students and trainees in choosing the best translation tool to facilitate effective communication across languages.

Key words: Machine Translation, Artificial Intelligence, Translation's quality, Fluency, Arabic- English, Google Translate, Reverso Context, Evaluation.

List of acronyms:

MT: Machine Translation.

IBM: International Business Machines Corporation.

RBMT: Rule-based Machine Translation.

TBMT: Transfer-based Machine Translation.

CBMT: Corpus-based Machine Translation .

EBMT: Example-based Machine Translation.

NMT: Neural Machine Translation.

SMT: Statistical Machine Translation.

SL: Source Language.

TL: Target Language.

AI: Artificial Intelligence.

IT: Information Technology.

ML: Machine Learning

DL: Deep Learning.

TM: Translation Memory

NLP: Natural Language Processing.

NLU: Natural Language Understanding.

NNs: Neural Networks.

List of Tables

List of Figures

Table Of Content

General Introduction

Language acts as a bridge for communication and development among people across the world. Nowadays, there are more than 7000 spoken languages in about 200 country and region. This fast increasing made the translation process challenging for human translators. Through cultural interactions translation start to develop. During the cold war, and as a result of the American Russian conflict the first machine translation appeared to be later the life changing invention ever.

Machines were developed to perform the first limited rule-based translations. By rule-based, we mean translations that rely on built-in linguistic rules and dictionaries for each language pair. Unfortunately, the complexity of the task was far higher than early computer scientists' estimates, requiring enormous data processing power and storage far beyond the capabilities of those machines.

Today, with the advent of Artificial intelligence (AI) which is one of the fascinating and universal fields of computer science that has a great scope in the future. It holds a tendency to cause machines that imitate the human intelligence and perform exactly like them.

Recently, machine translation had a huge breakthrough thanks to the use of AI through the application of neural networks, natural language processing and deep learning. The breakthrough in the processing methods performed by an AI translator has generated several current technologies; such as: translation using text recognition in images or voice recognition. Scientists do not need to pre-program machines to do some work, they can simply create a machine with programmed algorithms which can work with its own intelligence. The purpose of this study is to evaluate the performance of these AI-based machines by analysing the translation quality they offer for users. This investigation will answer this research question: What is the Role of AI in developing machine translation's quality?

To be more precise, these are the following sub-questions discussed in this research:

1. Can machine translation replace human translators?
2. To what extent machine translation is using AI technologies?
3. Will AI help MT equal human translation's quality?

The following hypothesis were determined to answer the stated research questions:

1. Machine translation is threatening human translation's existence.
2. Machine translation is using neural networks to develop its models.
3. Artificial intelligence can help in developing machine translation's quality.

Aims and Objectives of this study:

In this study we attempt to give efficient answers of the research questions and focus on the main following objectives:

- To conduct scientific research as a master degree dissertation.
- To understand the working process of machine translation.
- To investigate the accuracy and efficiency of machine translation comparing to human translation.
- To determine the role of artificial intelligence in the improvement of machine translation's performance and quality.
- To determine the impact of machine translation on human translation.
- To achieve understanding about how AI is transforming the field of translation.

The Research Design:

The current study is divided up into three main chapters. The first chapter represents an introduction of this study which give the reader an overview about the rise of machine translation and its development phases. The second chapter describes artificial intelligence to build understanding about the main purpose of this research. The third chapter is the practical part of this study, which focuses on the analysis of the research corpus (descriptive and expressive texts written in both Arabic and English) and the evaluation of the machine translation's outputs (Google Translate and Reverso Context) comparing to human translation. Finally, a discussion and interpretation of the results.

Chapter One: The Rise of Machine Translation

Chapter One: The Rise of Machine Translation

Introduction

In the everyday life, language is the crucial tool of expression and interaction. All countries nowadays are linked together through politics, economy, tourism and many other partnerships. The interlingual transfer of language that happen through communication is getting complicated, and those multilingual societies require a strong and efficient contact among languages and cultures. This diversity created the need for translation to bridge the gap of connection, since it is impossible for individuals to master all languages existed around the world. The art of translation solved that issue and helped in spreading knowledge to an unlimited audience. This field is known as a fast-growing field, considering the difficulty and the complexity of the process of translation. The use of machines instead of humans to translate text from one language to another has long been a dream. However, the increasingly useful technology made it real. Machine translation is one of the important and hard to implement fields in our daily life. Bar-Hilal stated that machine translation (MT) had become a "multimillion-dollar affair" (1960).

This chapter focuses on the remarkable rise of machine translation, and its transformative development which captured the attention of linguists, researchers, and technologists, exploring its historical phases, breakthrough technologies, and the profound implications it holds for the interconnected world.

1.1. Definition of Machine Translation:

Machine translation (MT) is a sub-field of computational linguistics which refers to the study of designing systems that convert texts from one human language into a meaningfully equivalent text in another language. It is an approach that translation teachers, trainees, and even professional translators should be familiar with.

Grace Hui-chin Lin & Paul Shih Chieh Chien in their PHD defined MT as: "a modern method of translation through computer assistance".

"Machine translation is a branch of computational linguistics which is defined as an automatic process by a computerized system that convert a piece of text (written or spoken) from one natural language referred to as a source language (SL) to another natural language called the target language (TL) with human intervention or not." ***(Benson Kituku , Lawrence Muchemi , Wanjiku Nganga. Review on Machine Translation' approaches).***

MT is an automated translation, by which computer software is used to translate a text from one natural language (such as **English**) to another (such as **Arabic**).

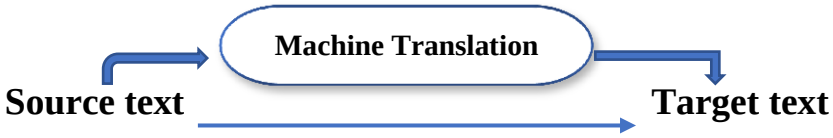

Figure 1: translation process

As examples of the most familiar, and effective machines translation in this domain there are: Google Translate, Microsoft Translator, Yandex, Reverso, and Systran.

The software used in MT can be developed by human intervention. The systems of these machines collect a huge amount of data while getting the access to be connected to smartphones, PCs or any other machine. People can experience that in the new update of social media applications. For example, comments written in Algerian dialect can be easily translated into any target language and this process is happening because of the data collected from the posts being published in Algerian dialects or the captions written in those platforms. The quality of the translation is not as perfect as human translation in this case. However, machines' performances are improving. Each day, a specific way of interpreting is being introduced.

1.2. Brief History of Machine Translation:

Machine translation has always been developing year after year. According to Grace Hui-chin Lin & Paul Shih Chieh Chien, (2009)**,** The concepts of idea of machine translation can be found in the early 17th century. John Hutchins well stated its history in his article "The history of machine translation in a nutshell", separated into different phases:

1.2.1. Before the computer:

In the middle of the 1930s, a Russian **Peter Troyanskii** came up with the concept of automatic bilingual dictionary, and also introduced a schema for coding the interlingual rules and an outline of how to analyse this last. Troyanskii died before finishing his invention and his ideas about the machine were not know until 1950s. By that time the computer was invented.

1.2.2. The Early Years:

The earliest attempts at machine translation were based on simple rules and algorithms that attempted to translate words and phrases between languages.

However, these early experiments were largely unsuccessful, as the complexity and nuance of natural language made it difficult for machines to accurately translate between languages.

- **The Pioneers (1947-1954):** After the invention of the electronic calculator, researchers began to use machines to help in translating natural languages. The British crystallographer Andrew Booth met the researcher Warren Weaver and created numerous proposals toward the existed ideas of using computers as tools of translation. In less than a decade, the most noticeable early machine translation projects happened, and it was the Georgetown-IBM (International Business Machines Corporation) experiment, which was conducted in 1954. This experiment used a computer to translate about 60 Russian sentences into English. The translation wasn't a 100% accurate, too far from perfect translation and the materials were super expensive. Yet, it showed that the miracle of machine translation is possible to happen. (Hutchins, J, 1995,p.6).
- **The ALPAC Report 1964:** researches began to dream big and set high expectations for this project, however the approaches developed were not sufficient to break the language obstacles, and the machines took so much time to learn all the vocabulary, grammar and semantic rules of a particular language. Because of this last issue, the US sponsor created the **Automatic Language Processing Advisory Committee (ALPAC)** and published a report in which he considered the MT research useless, and machine translation with its inaccurate slow translation will only cost more than human translation. This report really put an end to the MT research.
- **After The ALPAC Report:** when all hopes of the MT invention were swept away in the US, other administrations in different parts of the worlds showed their needs for MT, such as Canada, France, and Germany. Researches on machine methods and techniques continued, focusing on the languages structure, the semantic and morphological analysis in order to fill the translation gaps and improve its quality.

The most known experiments that time are the two international multilingual projects: **Eurotra**, supported by the European Communities, and the Japanese CICC project with participants in China, Indonesia and Thailand.

Machine translation in this era witnessed a great increase either in the research activity or in the development of the feasible application. There was a huge evolution in the sale of MT software for the personal use by non-translators. Even the automatic translation through direct internet was popular without caring about the translation quality, these programs made of statistical machine translation which translates the source material based on the most common previous translations that have been previously done. Later the announcement of online MT by Babelfish and then Google Translate made this product a mass market product. (Hutchins, J, 2014, p1-3)

1.2.3. Since 2000:

Globalisation was pushing the need for machine translation like never before, some of the greatest technology companies in the world like Japanese efforts, Google and Microsoft were interested in investing in this project and focused on developing it. More innovations during this time included MOSES, the open-source statistical MT engine (2007), a text/SMS translation service for mobiles in Japan (2008), and a mobile phone with built-in speech-to-speech translation functionality for English, Japanese and Chinese (2009). Researches resulted in the foundation of the Statistical Machine Translation (SMT), and Example-based Machine Translation (EBMT). Different researches were done in different areas of the world. The aim was to move from the limited translation systems to the unlimited translation systems using the statistical methods and the availability of software to function the process of the (SMT).

In 2014, researchers introduced the concept of neural MT, which utilizes deep learning neural networks to directly translate text. The introduction of neural networks brought about a revolution in machine translation. Its models achieved significant improvements in translation quality, fluency, and the ability to handle long-range dependencies.

1.2.4. 2010s -Present:

NMT systems became increasingly practical and were deployed in various online platforms, such as Google Translate and Microsoft Translator. These systems offered instantaneous translation services across multiple languages, benefiting users worldwide. (Bahdanau, D., Cho, K., & Bengio, Y. (2014)).

Ongoing advancements in the present continue to push the boundaries of machine translation, making it more accurate, fluent, and accessible. Its usage continues to increase and expand to new fields of application, (e.g.: movies subtitles, translated websites, translated versions of books, social media networking, instruction booklet).

1.3. Basic features of Machine Translation:

In today's globalized and connected world, automated translation has become a standard tool for every individual or organization. For the numerous advantages that machine translation offer it has become widely used. Some of the key features of machine translation include:

- **Real-Time Translation:** Some machine translation systems can provide real-time translation, allowing for instant communication between people who speak different languages. These systems are commonly used in chat applications, voice assistants, and other real-time communication tools.
- **Customization:** Some machine translation systems allow for customization, where users can train the system on their own specific terminology and language usage to improve the accuracy of the translations.
- **Input Types:** Machine translation systems can work with a variety of input types, including text, speech, images, and videos.
- **Multiple engines:** Many translation engines create a variety of choices for users such as Google Translate, DeepL, Reverso.
- **Training Data:** Machine translation systems require large amounts of training data to work effectively. This data is used to train the algorithms to recognize patterns in the language hence improving the accuracy of the translations and contributing in better translation quality overtime.

1.4. Approaches to Machine Translation:

Machine translation systems developed from just using a simple dictionary-lookup for appropriate words and reordering them after translation to fit the word-order rules of the target language, without taking into account the lexical ambiguity inherent in the source language, to using methods based on linguistic rules which means that words will be translated in a linguistic way through natural language understanding to result a better quality of translation.

There are three basic approaches of MT: Rule-based machine translation (RBMT) approach, Corpus-based machine translation (CBMT) approach, and the Hybrid approach. Each one of them covers its sub approaches.

1.4.1. Rule-based Machine Translation Approach: Rule-based machine translation approach also known as classical approach of MT, or as M. D. Okpor mentioned it in its PHD (Machine Translation Approaches Issues and Challenges) by Knowledge-based MT approach. It was the first exited method of machine translation (first use in 1970s). Its systems are based on linguistic rules which include grammar rules, bilingual and multilingual lexicon, and the semantic, morphological, syntactic structure of a particular language. The RBMT systems tend to analyse input (words, sentences, texts) in the source language (SL), and generate them to output in the target language (TL), taking into consideration the correct grammatical structure, syntax, morphology, and all the linguistic features of both SL and TL.

Rule-based machine translation approach can be divided into two main phases: Direct translation and Indirect translation.

1.4.1.1 Direct Translation: It is a dictionary-based translation, or a word-by-word translation approach. It is the first used approach of MT and the most popular one which requires a structural analysis of the source language to produce the representation in the TL with some grammatical modifications.

Its process happens through:

- Identifying the principal words of the SL, decode them by removing any ambiguity or confusion through the morphological analyser.
- The bilingual dictionary would help in finding the identical word forms of SL in the TL.

- Grammatical analysis to make sure the produced forms in TL are suitable.
- Output in TL is generated.

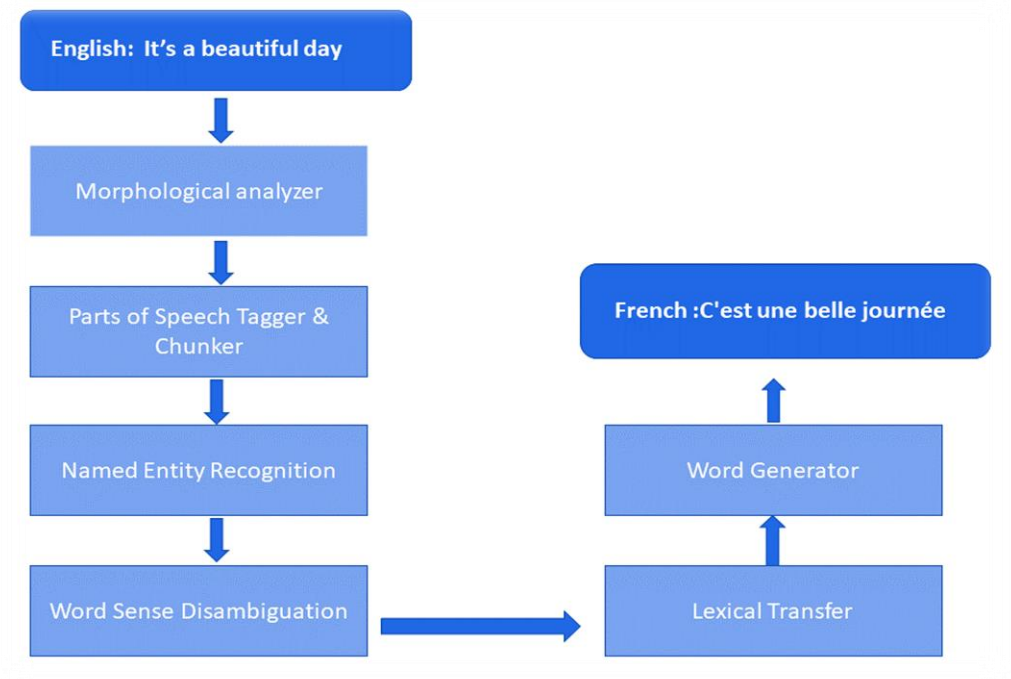

Figure 2: A diagram of a rule-based machine translation system.

(Robert, M. (2021). Machine translation tools: current use and perceptions by French translators.)

1.4.1.2 Indirect Translation: This approach as any other rule-based machine translation approach requires a structural analysis which includes morphological, semantic and syntactic analysis of the SL input. The indirect rule-based machine translation is usually used in multilingual translation since it requires multilingual dictionaries. Two other sub approaches are suggested in this case:

A. Transfer-based Machine Translation Approach: The base of the (TBMT) approach is the structural differences between the source language and the target language. The transfer system can be divided into three different staged: analysis stage, transfer stage, and generation stage. The analysis stage performs lexical, syntactic and semantic analysis of the input text. Morphology compromises identifying the main form of parts of speech, orthography and deconjugation of words. The transfer stage includes the use of bilingual dictionary which consists of

the grammar rules to connect the basic forms of SL and TL. The last stage of this system is generating a correct sentence structure in TL.

B. Interlingua-based Machine Translation Approach: This approach is used to perform the definition of natural languages for translation purposes. Dr. Benson Kituku argued that the interlingual representation of a particular text must be adequate to generate phrases in any language, because this type of approach is mainly used for multilingual translation and considered as the best multilingual approach existed. Naturally, there are some challenges. For example: it is hard sometimes to extract the meaning from the original text in SL to create the intermediate representations in other languages. The steps followed by the IMT approach are:

a. **Analysis:** The source language text is analysed to identify the meaning of each word, phrase, and sentence. This analysis is usually performed using a combination of natural language processing techniques, including part-of-speech tagging, syntactic parsing, and semantic analysis.
b. **Interlingua generation**: Once the meaning of the source language text is identified, it is represented in the interlingua. The interlingua is a language-independent representation of the meaning of the source text that can be used to generate a target language translation.
c. **Synthesis:** The interlingua is then used to generate the target language text. This step involves synthesizing the interlingua into a coherent sentence or passage of text in the target language.

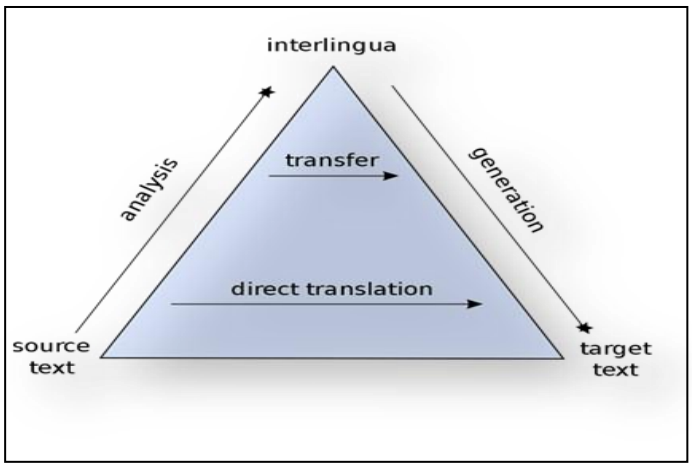

Figure 3: RBMT sub approaches. (Mounier-Kuhn, P. (2016).)

1.4.2. Corpus-based Machine Translation Approach: Corpus-based machine translation approach (also named data-driven machine translation approach). The corpus system uses a model which utilizes a bilingual parallel corpus to acquire data from the forthcoming translations. Parallel corpora are aligned through a process called annotation, followed by the creation of classifiers, using artificial intelligence through supervised, semi-supervised, unsupervised or guided learning methods. The system of this approach is divided into the following two sub-approaches:

1.4.2.1. Statistical Machine Translation (SMT) Approach: This approach is a data driven or corpus-based approach which is characterized by using an inclusive analysis of bilingual text corpora written either in source language (SL) or target language (TL). Its model was first created by **Brown et.al**, however, this approach was taken from the information theory. The programs of the SMT consider every sentence in any language as suitable to be translated in any exiting language, and that is the principle of the system established on this approach.

Statistical Machine Translation approach depends on 03 models, these models see translation as a mathematical case which needs to be solved, it consists of:

- **Language Model:** to count the possibility of the Target language P(t).
- **Translation Model:** to count the possibility of target language output generated from the source language input.
- **Decoder Model:** generates the finest translation possible using computer algorithms.

Statistical machine translation approach can be a word-based SMT, phrase-based SMT, or a hierarchal-based SMT.

a) **Word-based SMT:** The principle of this approach tends to break sentences into smaller unites (words), which are the essential parts of statistical machine translation model. These units are going to be translated from SL to TL, each word on its own.

After the translation the ordering algorithms would set those words in the correct order to form a correct translated sentence. This approach is the first easy to implement MT, yet its translation quality is very low when it comes to idioms, metaphors and complex sentences.

b) **Phrase-based SMT:** This approach depends mainly on sentences as the major units of translation. It divides text corpus into phrases, and the translation process is done sentence by sentence. The output phrased would be reordered appropriately to the SL input. This approach results a better translation quality than the word-based SMT approach.

c) **Hierarchal-based SMT:** The model of this approach consists of two main steps. The first one is done by SMT phrase-based approach which is going to select the unit of translation. The second step is done by Syntax-based translation which generates the translation based on its rules.

1.4.2.2. Example-based Machine Translation (EBMT) Approach: This approach was found by **Makoto Nago** in 1984. It is an approach that is based on the use of analogy translation. The EBMT system contains set of texts that have been already translated. These texts (words, sentences) are going to be taken as references to translate similar ones from source language to target language. From this comparison the system proceeds a new adequate translation. The analogy translation passes through 03 stages:

1) **Matching:** from the corpus exited in EBMT system a set of examples would be proposed to match the input text that needs to be translated. These examples should be close and relevant in meaning to the SL input.

   This operation happens through various methods such as: character-based matching, word-based matching…etc.

2) **Adaptation:** when the examples match perfectly with the SL input, units are combined to form the TL output.

3) **Recombination:** recombining translated units to form a correct text in levels of meaning and grammatical structure.

1.4.3. Hybrid Machine Translation Approach: The Hybrid approach combines both rules and statistics to produce the best quality in the Machine Translation industry. Its system is known for using multiple MT approaches, and that is what explains its proficiency and high coverage. Hybrid systems are the most extensively used in MT systems, integrating both rule-based and statistical machine translation approaches to build a program which processes in different ways like the following:

- **Rule-based MT Guided:** Translations are generated using rule-based engines taken from the parallel corpus (dictionaries, lexicon). And the use of algorithms

helps in pointing out the syntactic, morphology, and grammar rules from the same parallel corpus. (The next step depends in the use statistics, and here comes the concept of combination.)

- **Statistics guided by rules:** In the Hybrid system rules are integrated to post-proceed the statistical output. Statistics have the most power to control the translation process by modifying, deleting, adjusting, and correction the output of this procedure.

1.5. Types of Machine Translation:

Machine Translation systems and approaches are what differentiate each type from another. Four major types of Machine Translation were introduced: Rule-based MT, Statistical MT, Hybrid MT, and Neural MT.

1.5.1. Rule-based Machine Translation (RBMT): This type as stated before is based on linguistic rules, especially the grammatical structure of the text being translated from SL to TL. It requires a full vocabulary to function properly. Programmers with the help of language experts or linguists as in 1957 when Chomsky published Syntactic Structures introducing the idea of generative grammar, which provides better insight of how mainstream linguistics could help MT, they created a library rule of translation using dictionaries. The systems can be updated manually anytime to add new rules or concepts for better results. One advantage of RBMT systems is that they can be highly accurate, especially when translating technical or specialized content.

The capacities of this type of machines are limited because language is changing through time. As a consequence of this last rule-based MT requires the intervention of humans to check on the translated text, delete errors, and simply correct its meaning. This issue made this type useless in so many situations.

1.5.2. Statistical Machine Translation (SMT): This type of machine translation was introduced in the middle of the 1990s, by **Babel Fish.** It is way developed from the rule-based MT. SMT has nothing to do with linguistic rules. It uses computer algorithms to analyse and reference the translated data and suggest millions of alternatives to find the appropriate, suitable one in the target language. It works with statistical models which are based on the investigation of huge volume of content.

The statistical machine translation system processes in the following way:

a. **Training:** The SMT system is trained on a large bilingual corpus, which consists of aligned source and target language texts. The system analyses the corpus and calculates the statistical probability of various translations for each word, phrase, and sentence in the source language.
b. **Translation:** When the system encounters a new sentence in the source language, it applies the statistical models to generate a list of possible translations. The system then selects the translation with the highest statistical probability based on the analysis of the training data.
c. **Post-processing:** Once the system generates a translation, it may apply post-processing techniques to improve the output. These techniques can include smoothing, reordering, and other methods to improve fluency and accuracy.

One of the advantages of SMT is that it is relatively easy to train and implement. However, it has some limitations, including difficulty in handling complex sentence structures, rare or unknown words, and idiomatic expressions. The best example of SMT was Google Translate. But, this last convert in using another type of machine translation approach.

1.5.3. Hybrid Machine Translation (HMT):

The hybrid machine translation tends to combine the strengths of both rule-based and statistical machine translation techniques. It attempts to overcome the limitations of each individual method by combining them in a hybrid system. In an HMT system, the rule-based component may be used to identify the grammatical structure of a sentence and generate a preliminary translation, which is then refined by the statistical component to produce a more natural and accurate translation.

The HMT system usually works like the following:

a. **Pre-processing:** The source text is analysed using rule-based techniques to identify linguistic structures such as parts of speech, named entities, unites and syntactic relationships.
b. **Translation:** SMT system generates a set of possible translations for each sentence based on the pre-processed source text. The translation system also takes into account

the context of the sentence and uses statistical models to estimate the most probable translations for each phrase or sentence.

c. **Post-processing:** The translations generated by the statistical machine translation system are then reiterated using linguistic rules. This step is made to make sure that the translated text is grammatically correct, and conveys the intended meaning of the original text.
d. **Optional:** The system may also incorporate human post-editing to further refine the translation output, especially for specialized or technical content.

HMT has produced better translations than both rule-based and statistical machine translation alone, and it is often used in commercial translation systems. However, it can be more complex and difficult to develop than other machine translation approaches.

1.5.4. Neural Machine Translation (NMT): Neural machine translation is a type of deep learning that uses large amounts of data to train a neural network model that learns to translate text from one language to another. Zong Zhaorong research on the relations between human translation and machine translations showed that NMT is the newest phase of machine translation with the development of AI.

Its theory is based on the theory and techniques of natural language understanding (NLU), natural language processing (NLP), machine translation (MT), translation memory (TM), and statistics-based machine translation (SMT) as well as deep learning (DL).

NMT systems are different from traditional machine translation systems. They do not rely on predefined rules or statistical models. Instead, they rely on deep neural networks to analyse and find relationships between words in different languages. The network goes through a training process in which it learns to encode the meaning of the source input and then decode it into the target output. Because of its efficiency and uniqueness, Google Translate switched to neural machine translation in 2016 after years of using hybrid machine translation.

The basic steps involved in neural machine translation are:

a. **Input Encoding:** The input sentence is first encoded into a sequence of vectors using a neural network called an encoder. Each word in the sentence is represented as a vector, and the sequence of vectors captures the meaning of the input sentence.

b. **Contextual Representation:** The encoder generates a contextual representation of the input sentence that captures the relationships between the words in the sentence.
c. **Output Generation:** The contextual representation of the input sentence is then used as input to another neural network called the decoder, which generates the output sentence word-by-word. The decoder predicts the probability distribution of each word in the output sentence based on the contextual representation of the input sentence and the previously generated words.
d. **Decoding:** During decoding, the most likely word is chosen based on the probability distribution generated by the decoder, and the chosen word is added to the output sentence. This process is repeated until the end-of-sentence token is generated, indicating that the translation is complete.
e. **Training:** The neural network is trained using a large corpus of parallel sentences in the source and target languages. During training, the neural network learns to map the input sentence to the corresponding output sentence by minimizing a loss function that measures the difference between the predicted output and the actual output.

This type of MT is now the dominant machine translation method, and the ideal technology for companies that need to translate content permanently. Because of the significant improvement it offers over traditional machine translation methods in terms of translation quality, efficiency, fluency, and adaptability.

1.6. Significance of Machine Translation:

Nowadays, people are really attached to technology. It suggests the best, easy to do ways of almost everything. Machine translation was invented to minimize time, costs, and efforts, not as a total replacement of human translation, but as a developed tool of translation. This last can be used in so many situations to solve different problems. We mention from them:

- **Global communication:** Dr. Waibel, through his advanced research for speech translation (1991) has demonstrated the power of machine translation in breaking down language barriers and facilitating seamless communication between individuals who speak different languages. He has highlighted the transformative potential of machine translation in areas such as international diplomacy, business negotiations, and cultural exchange. Machine translation has become an essential tool for international businesses, it allows companies to reach out to new markets and communicate with

their clients in their native languages. Also, translating customers' emails or complaints without the integration of human translators. This helps to increase customer satisfaction and expand their customer base. (Davenport, T. H., & Ronanki, R. (2018)).

- **Speed:** Human translators might spend days to translate few texts, taking into consideration the time used to search for vocabulary in dictionaries or word banks, the time used to correct the grammatical structure of the text in target language, reordering the speech parts to match the source language text, and so on…

  Machine translation with the help of the artificial intelligent technology can perform all these tasks using one system only. It translates millions of words constantly, in less than few minutes, and get improved after each translated content. Daniel Gouadec stated this idea in his book "Translation as a profession" when switching from manual to automatic translation.

  He said:

  "Today, with a click or two of the mice, translators can know whether the material has been translated, get all information needed to elucidate the meaning of unknown term or concept or to learn about the subject, check on the validity of their hypothesis, find models and preformatted translations or phrases-and much more. Definitions, drawings, charts, pictures and all kinds of representations…"

  Daniel Gouadec. Translation as a profession (2007). Chapter 14. Page 291.

- **Cost Efficiency:** Human translation can be costly, especially for big projects which provides the use of many languages such as: translating books into different versions. Machine Translation involves the use of highly accurate and fast systems to produce translations at a minimum cost.
- **Flexibility:** Modern machine translation systems can be updated anytime. Considering their ability to manage hundreds of new languages.
- **Information Retrieval:** MT made individuals with their different cultural backgrounds able to get access to information from either documents or online websites in different languages. This information might not be accessible before because of the language barrier. Even social media platforms like: Facebook, Twitter or Instagram, integrate MT (Google Translate) in their systems, by adding the option of translation publications, comments in any selected language.

- **Emergency situations:** MT is characterized by multitasking, which allows individuals to translate any text anywhere. This made MT a crucial tool in emergency cases such as natural disasters or medical emergencies, where communication with people who speak different languages is essential.

1.7. Machine Translation Challenges:

Despite the benefits that machine translation offers, there are still some challenges that researchers and programmers need to work on them to minimize the limitations of this last. Some of the main challenges of MT include:

- **Ambiguity:** Words and phrases often have multiple meanings, and the correct interpretation of a sentence depends on the context in which it was used. Machine translation systems struggle to state the correct meaning of words and phrases, leading to inaccurate translations.
- **Idioms and Dialects:** Machine Translation systems do not understand idiomatic phrases and dialect expressions which usually have a symbolic meaning that is not clear or obvious. So, they generate the literal meaning of the input text only.
- **Cultural Differences**: Machine translation systems do not take into account cultural differences that can affect the meaning of a sentence. For example, the meaning of a word or phrase may be different in different cultural contexts, and this can lead to inaccurate translations.
- **Human Evaluation:** Machine translation systems are typically evaluated using automated metrics, which may not always accurately reflect the quality of the translation. Human evaluation is time-consuming and expensive, making it difficult to get accurate feedback on the quality of translations.

Conclusion:

In conclusion, the chapter on the rise of machine translation has shed light on the evolution, types, approaches, significance, and challenges associated with this ground-breaking technology. Machine translation has witnessed a remarkable growth in recent years, driven by advancements in artificial intelligence and natural language processing technologies which aim to enable computers to understand, interpret, and generate human language in a meaningful and useful way. This growth has been facilitated by the availability of large amounts of data, as well as the development of more sophisticated approaches, algorithms and

machine learning models. The rise of machine translation has had a significant impact on many industries, including e-commerce, travel, and finance (see pages 16,17). While significant challenges persist, the continued progress in machine translation promises a future where language is no longer a barrier to effective global communication.

Chapter Two: Introduction to Artificial Intelligence

Introduction

Anyone can observe what humans have done during the last 50 years. Relying on science and technology humans succeed in building a developed civilisation which never existed before. Artificial intelligence (AI) is one of the life-changing inventions. It has become an essential part of the technology industry, and it will continue to shape the future in profound ways. Its impact is broad and far-reaching to every field existed nowadays: Transportation, Finance, Translation, Healthcare and the list is much longer. As Sundar Pichai, CEO of Google said: "The greatest benefits of artificial intelligence are yet to come", AI will drive the innovation and progress of the world.

This chapter explores the extraordinary rise of AI, tracing its origins, examining its present impact, and pondering the limitless potential it holds for the future.

2.1. Definition Of Artificial Intelligence (AI):

Artificial intelligence (AI) is a branch of computer science which aims of creating machines (computer, computer software) that act intelligently like human mind.
John McCarthy defined Artificial Intelligence in his university article and said:

" It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable."

Artificial intelligence was developed as a special discipline in the information technology (IT). Yet, it combines other disciplines like cognitive science, and decision making. It is achieved by studying the human brain patterns and analysing their cognitive process to develop an intelligent system which preforms exactly like them. AI systems rely on vast amounts of data to learn and upgrade their performance. These systems need to be trained using datasets that contain examples of the task they are designed to perform. The training process generally happens through machine learning techniques. The machine learning (ML) is the first leaning form of artificial intelligence which includes usually a simple computer program. The Second form of leaning is the deep learning (DL) which is the base-method of AI, that deals with the complex tasks to produce an effective insight.

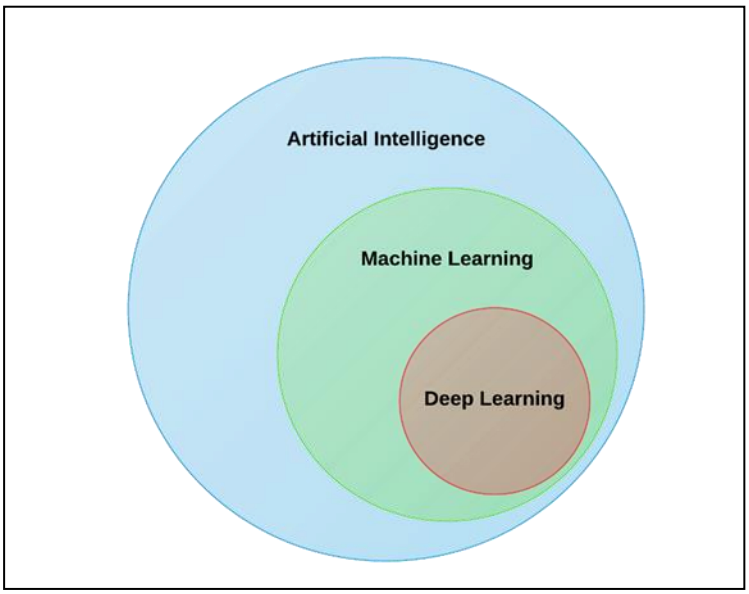

Figure 04: Artificial Intelligence (Van Steenkiste. (2021))

The concept of AI is was defined as how machines can act **"humanly"** by ***Kurzweil (1990):***

"The art of creating machines that perform functions that require intelligence when performed by people."

In simple words, artificial intelligence is created using a combination of computer programs, algorithms, and large datasets that qualify machines to simulate human intelligence. Some researchers aim of putting the human mind into a machine, but this idea seems unreal.

2.2. History of Artificial Intelligence And its Development Phases:

Artificial intelligence (AI) is not a new concept at all. Its history dates back to 1943, which means even before the end of the Second World War. Dr. Maad M. Mijwel specialised in computer science in University of Baghdad demonstrated the history of AI in his PHD paper "History of Artificial Intelligence" and its development phases as presented in the following (chronologically ordered):

- **The Early years (1943/1950):** (before the birth of AI)

In this era, many scientists, mathematicians, and even philosophers started doing researches about AI. In the 1943, McCulloch and Walter Pits suggested a model of artificial neurons (AN).

> **Artificial Neurons (AN):** they are the connection points in the neural network. A single neuron combines so many links and stores a huge amount of data to allow the Artificial Network to deal with complex concepts and mimic the human brain.

This model needed to be updated to match the world's development. So, in the 1949s another researcher named Donald Hebb introduced an updated rule called "Hebbian Learning" to modify this model. By the end of this era, Alan Turing the English mathematician and the founder of computer science suggested "The Turing Test" to review the ability of machines to perform intelligent tasks parallel to human intelligence.

- **The Birth of Artificial Intelligence & its Golden Years (1952/1974):**

This phase was characterized by the production of the first Artificial Intelligent reasoning program by Allen Newell and Herbert A. Simon. The program was called "The Logic Theorist". It had a large effect on the new developing fields of information-processing. Few years later, John McCarthy created the term 'Artificial Intelligence' and had the first AI conference in 1956. The AI project became interesting for investors and researchers who continued developing rules and algorithms to keep the systems updated. In 1966, the first chatbot "ELIZA" was programmed by Joseph Weizenbaum. Six years later, Japanese scientists created the first intelligent robot "Wabot-1". However, some researches denied that information and claimed that the first animated robot was produced at Stanford University in 1966, under the name of "Shakey".

- **The First AI Winter (1974/1980):** AI winter represents the period where no advances were achieved, lack of improvement and no results in the field. The first AI winter happened from 1974 to 1980. Scientists (programmers and developers) lost the passion somehow due to the lack of the outcome and decided to leave it as it is.

- **The Back of AI 1980/1987):** First winter duration was finished by the foundation the "Expert System". It is a knowledge-based program or a computer software which uses artificial intelligent services to imitate the human expert behaviour. This system is known for its high-performance level and its simplicity.
- **The Second AI Winter (1987/1993):** Once again, another winter arrived. The government stopped the investments of the project and many companies and institutions reduced their budget. The project seemed unworthy because of its high costs and low improvement with no results.
- **The Boom of AI (1993/ Present):** After the invention of the first personal computer in 1981, The International Business Machine Cooperation **(IBM)** continued to impress the world by designing a supercomputer called **"Deep Blue"** in 1997, to be the first computer player that defeated the world champion chess player in a match. It was such a great achievement in the field. This machine was an inspiration to other developers that in 2002 the first vacuum cleaner machine was created. Not only that but social media platforms also started using AI. The beginning by Facebook company in 2004, to Twitter. By that Artificial Intelligence entered the business world. Lately, it was integrated in all domains (Translation for example, Google company developed an artificial translation machine in 2006 called "Google Translate", which benefits from AI technologies to translate millions of words anytime anywhere). Mentioning the development of new approaches like deep learning which enables AI to solve complex problems and understand natural language to perform tasks like human mind.

  In 2011, The first initial release of **"Apple Siri".** The virtual assistant for IOS smartphones which is fully powered by Artificial Intelligent and utilizes the voice recognition feature. This assistant exists till now and it's always updated to match any changes in this field.

  Two years later, **"Alexa"** the developed version of Siri was programmed by Amazon to be a voice-controlled assistant which can offer many services like: controlling the user's smartphone or smart house by getting access to his/her data, answering all kinds of question, playing music…etc. It is known to be safe and available in 6 languages other than English.

The latest achievement of AI in 2022 is **"ChatGPT"**. The program allows the user to have human like conversations with a robot assistant. This model is trained to answer questions and help individuals with all types of tasks.

The success of Artificial Intelligence can be seen from the examples of accomplishments described above, and they only explain how much the world has changed and individuals' need for AI has increased.

2.3. Types of Artificial Intelligence:

Based on its functions, artificial intelligence is classified into four types**,** according to "Karin Kelley" the content marketing professional who spent more than a decade writing about emerging enterprise and cloud technologies. These four types are:

a. Purely Reactive AI: Reactive AI is a type that does not rely on stored data or pre-existed experiences. It reacts to the current situation and produce an output based on a set of predefined rules. Reactive machine works with present data and performs the way it has been trained, its system uses a combination of sensors, processors, and actuators to interact with its environment and carry out only specific chosen tasks. The suitable example for this type is the IBM's Deep Blue, the reactive machine that defeated the world champion chess player. The Deep Blue was only capable of identifying the pieces position and analyse the flow of the game to decide the rational move to do based on the chess rules in its system. Each move was considered real, new and totally separate from other movements in other matches. This type is also used by the spam filter and social media recommendation. Reactive machines cannot improve through time, but they can be highly effective in certain applications, such as robotics, where quick, accurate reactions are necessary.

b. Limited Memory AI: Limited memory is a type of AI which refers to its capacity to store previous data. Its systems are designed to perform a limited amount of memory same as mobile devices. Unlike the reactive AI, the limited memory AI can improve by time depending on the previous generated experiences. The significant approaches realized in this type are:

- **Reinforcement Learning:** In the model of this approach, AI agent learn how to make predictions after interacting with the system environment, based on

previous operations and range of trials and errors. This model has been used successfully in many applications like: game apps, and recommendation systems.

- **Incremental Learning:** This approach allows AI system to update its existing models based on new data, without having to retrain or reorganize the dataset. This approach is useful in applications where the data is permanently changing like in online learning where data is added continuously.

c. Theory of Mind AI: theory of mind AI represents the advanced type of Artificial Intelligence, which refers to the development of AI systems to the level they can understand mental states of other agents (humans, Ai systems). This theory involves the capacity to reason desires, beliefs, emotional states, and intentions. By analysing the psychological situation of agents, AI systems tend to predict their behaviour. This theory existed only as a concept, because of many challenges:

- Lack of data.
- Complexity: the mental state requires a deep understanding of human psychology.
- Privacy: ethical concerns have been raised around its safety.

However, the theory of mind was implemented in **"Sophia"** from Hanson robotics. It is a developed robot combined with computer algorithms which gave it the ability to see (using cameras in its eyes), recognize faces and follow them using sensory recognition.

d. Self-awareness AI: This type of artificial intelligence cannot be achieved unless the theory of mind is realized. Self-awareness AI is considered as the future of AI, where machines are capable to be self-aware and processes human consciousness. It allows systems to understand their own thoughts, their feelings, and the environment they exist in. The machines will be able to perform human tasks and improve their performance as well. Yet, the development of the self-awareness AI is highly complex, there are no theories or approaches existed at present to guide the development of this type. Lately, some researchers used biologically inspired neural networks and hybrid models to combine symbolic reasoning with machine learning. But, the implementation of this type

of AI in the society is not seen safe and ethically legal yet. It is important for researchers to carefully ensure the safety of its application.

2.4. Approaches of Artificial Intelligence:

Artificial intelligence (AI) is a broad field encompassing different approaches and techniques. Here are some of the most common AI approaches:

- **Rule-Based System:** In this approach, a set of rules are programmed into the system so that it can make decisions based on the inputs it receives.
  These rules can be simple "if-then" statements or more complex decision trees.
- **Machine Learning:** Machine learning is a subset of artificial intelligence that trains a model based on data so that it can make predictions or decisions. There are different types of machine learning, including supervised learning, unsupervised learning, and reinforcement learning.
- **Neural Network:** A neural network is a machine learning algorithm inspired by the structure and function of the human brain. They consist of interconnected nodes that process information and learn from data.
- **Genetic Algorithm:** A genetic algorithm is an optimization algorithm based on the principles of natural selection and evolution. They use genetic operators such as mutation and crossover to generate new candidate solutions to problems.
- **Fuzzy Logic:** Fuzzy logic is a mathematical framework for dealing with uncertain or inaccurate information. It allows for degrees of truth rather than traditional true/false binary numbers.
- **Expert Systems:** Expert systems are computer programs that are designed to copy the decision-making capabilities of human specialists in a specific domain. They often use a combination of rule-based and knowledge-based techniques.
- **Natural Language Processing:** Natural language processing (NLP) enables computers to understand human language and interpret it for the machine to understand it, developers use it in applications such as chatbots, virtual assistants, and speech voice recognition.

2.5. Application of Artificial Intelligence:

Artificial intelligence is used in various fields that the machine use on it is going to help reduce the time and facilitate the process. Ai is applied in E-commerce, visual perception, speech recognition, decision-making, and language translation, some of the most common uses are:

- **Natural Language Processing:** AI-powered natural language processing is utilized to automate multiple tasks such as chatbots for customer service, analysis of sentiment, translation of languages, and recognition of speech.
- **Image and Video processing:** AI-based technology for computer vision is employed for various functions such as recognition of faces, identification of objects, categorization of images and videos, and self-driving vehicles.
- **Fraud Prevention:** AI-based systems for fraud detection are utilized to recognize fraudulent activities in financial transactions like banking and insurance.
- **Healthcare:** AI is used in healthcare for medical diagnosis, individualized treatment plans, and discovery of drugs.
- **Education:** AI-based systems for education are employed to provide individualized learning experiences, assess student performance, and enhance teaching efficiency.
- **Robotics:** AI-based robotics technology is utilized in the manufacturing, logistics, and agricultural sectors to automate various tasks.
- **Gaming:** AI is used in gaming to provide opponents that are realistic and challenging and to create dynamic game environments.
- **Cybersecurity:** AI-based cybersecurity systems are employed to detect and prevent cyberattacks, protect networks and data, and automate security operations.
- **Marketing and Advertising:** Ai is used for analyzing customer data, predicting consumer behavior, and providing personalized marketing and advertising experiences.

Ashlyn S Pothen argued that AI applications and their benefits are growing in popularity in a variety of fields. With the emergence of competent models using AI approaches, it is certain that artificial intelligence will take all fields in the near future (2022).

2.6. Concepts of Artificial Intelligence:

To fully understand how AI works, it is necessary to know its basic concepts, these concepts are broken down from AI and they represent the basics of it. They include:

2.6.1. Machine Learning: Artificial Intelligence (AI) subset known as Machine Learning (ML) emphasizes the software's capability to adapt to new data. Unlike AI's typical imitation approach, ML concentrates solely on the learning aspect. ML software can improve decision-making without the need for additional coding by the programmer. It is similar to algebraic equations, where one starts with specific use cases and discovers their broader applications. The fundamental objective of machine learning is to teach software enough to enable it to teach itself. Machine learning includes 4 types:

- **Supervised Learning:** This approach acquires knowledge by utilizing a significant amount of labeled training data to enable generalization in new scenarios.
- **Unsupervised Learning:** This method acquires knowledge by directly identifying, comprehending, and abstracting patterns from the data, similar to human thought processes.
- **Semi-supervised Learning:** This technique acquires knowledge from both labeled and unlabeled training data, with the amount of unlabeled data usually being greater.
- **Reinforcement Learning:** This approach learns through experience via a process of trial-and-error and reward-punishment. It is currently receiving extensive attention as it does not necessitate vast amounts of data.

The machine learning process typically involves the following steps:

- **Problem Definition:** the first step to take is defining the problem needed to be solved and identifying the business or research question needed to be answered.
- **Data Collection:** collecting the data that will be used to train the machine model. The developer or programmer can obtain data from various sources such as public datasets, user-generated data, and web scraping.

- **Data Pre-processing:** This step is important. It is known as the cleaning stage where the developer transforms, and prepares the data for use in the machine learning model. This can involve tasks such as removing missing values, handling outliers, and normalizing the data.
- **Feature Engineering:** It includes selecting the relevant features from the data and create new features that can help improve the performance of the machine model.
- **Model Selection:** This step depends on the developer's selection of the appropriate machine learning model based on the type of problem he/she is trying to solve and the characteristics of the data.
- **Model Evaluation:** After training the model, the developer evaluates its performance using evaluation metrics such as accuracy, precision, and recall.
- **Deployment:** When reaching this step, the model is ready to be deployed in a production environment where it can be used to make predictions on new data.
- **Monitoring and Maintenance**: Observing the performance of the model in the production environment and make necessary updates to maintain its accuracy and efficiency.

2.6.2. Neural Network: Neural network is a set of machine learning algorithms that model an artificial intelligence as interconnected nodes. This representation technique is inspired by the interconnectivity of neurons in the human brain. Therefore, the term "neural networks," represents rudimentary digital brain. For instance, observing a feature in a smartphone's photo app that sorts photos based on the individuals in each photo. This is possible through a neural network designed to recognize faces, a task that usually requires human intervention. This "digital brain" may not be capable of holding a conversation because of its limited capacity. However, it can perform adaptive recognition, which is something that conventional computer programs cannot do.

There are several types of neural networks, each with its own architecture and characteristics, some of them are:

- **Feedforward neural networks:** These are the simplest type of neural network and consist of an input layer, one or more hidden layers, and an output layer.
  Information flows through the network in one direction, from the input layer to the

output layer, without any feedback loops. This type is mostly used for image and speech recognition.

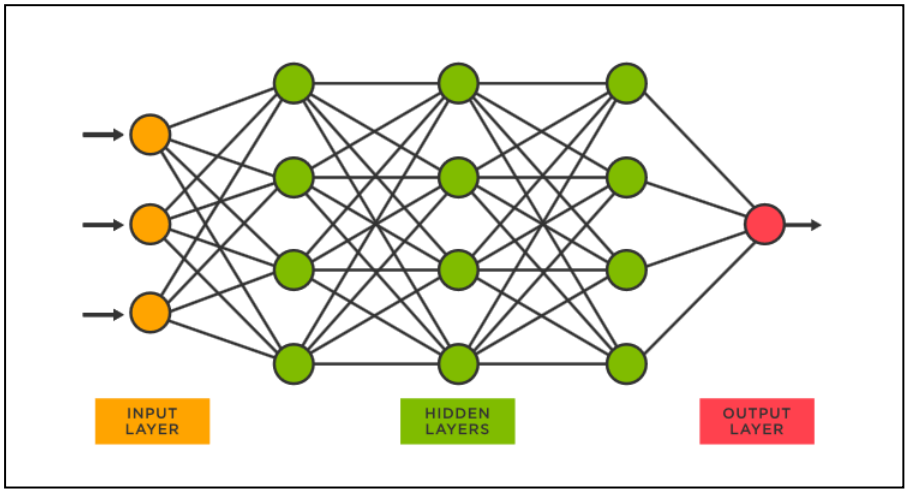

Figure 05: A diagram of a Simple Artificial Neural Network

(Coulibaly, P., Anctil, F., & Bobée, B. (1999).)

- **Generative adversarial networks (GANs):** These networks consist of two neural networks that are trained together to generate new data that is related to the training data. This type is generally used for tasks like: generating realistic images and videos.
- **Deep Belief Networks (DBNs):** This type depends on the use of unsupervised learning to learn a hierarchical representation of the input data. It is often used for tasks such as image and speech recognition.

Each type of neural network has its own strengths and weaknesses, and the choice of network depends on the specific task being performed.

2.6.3. Deep Learning: Deep learning is a subset of machine learning that employs multiple neural networks layers instead of a single one. Each layer of the network applies a set of mathematical operations to the input data, transforming it into a more useful form. To simplify this, there are five vertical lines: I I I I I. The first line represents the input layer, where the deep learning software receives data. The second layer, utilizes an algorithm to learn something about the data. The third layer does the same using a different algorithm, enabling the software to learn a second thing about the data. The fourth layer does the same with yet another algorithm, providing the deep learning software with three insights about the initial input. In the fifth and final

layer, the software outputs what it has learned. The layers between the first and last layers are known as "hidden" layers, and most deep learning applications have more than three hidden layers. However, the concept is to perform several operations with a piece of data to provide the software with a deeper comprehension of the data, rather than just one. Deep learning has several advantages over traditional machine learning approaches. First, deep learning models can learn more complex representations of the input data, allowing them to perform better on tasks such as image and speech recognition. Second, its models can learn from raw data, without the need for manual feature engineering. And they can be trained using large amounts of data, making them well-suited for big data applications.

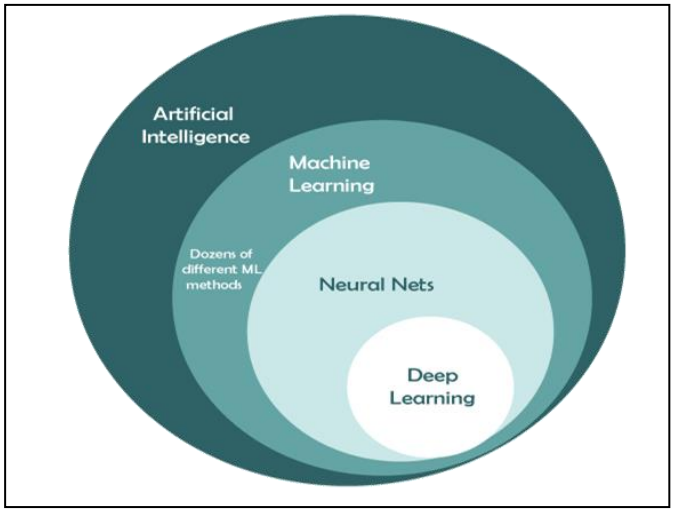

Figure 06: Concepts of AI (Laurence Trutin)

2.6.4. Natural language processing: Natural language processing (NLP) is a subfield of artificial intelligence (AI) that deals with the interaction between computers and humans in natural language. NLP involves the processing and understanding of human language by computer systems, including speech recognition, natural language understanding, natural language generation, and machine translation.

NLP algorithms and techniques are used to analyze and interpret large volumes of human language data such as text, speech, and social media posts. With the recent advancements in machine learning and AI, NLP has become an increasingly important field

and has a wide range of practical applications in various industries, including healthcare, finance, and customer service.

2.6.4.1. Brief History of NLP:

The history of Natural language processing (NLP) dates back to the 1950s when computer scientists and linguists began exploring the possibilities of machine translation. Since then, NLP has evolved into a multidisciplinary field that combines computer science, linguistics, mathematics, and psychology. Some of the key milestones in the history of NLP include:

- In 1950, Alan Turing proposed the "Turing Test" as a measure of a machine's ability to exhibit intelligent behavior equivalent to, or indistinguishable from, that of a human.
- In the 1960s, researchers developed rule-based systems for machine translation, which used hand-crafted grammatical rules to translate text from one language to another.
- In the 1970s and 1980s, researchers began exploring statistical methods for NLP, including the use of Hidden Markov Models (HMMs) and probabilistic context-free grammars.
- In the 1990s, researchers developed machine learning algorithms for NLP, including Support Vector Machines (SVMs) and decision trees.
- In the 2000s and 2010s, deep learning algorithms such as Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) revolutionized NLP, enabling computers to perform tasks such as speech recognition, language translation, and sentiment analysis with greater accuracy.

2.6.4.2. Levels of NLP:

There are generally five levels of NLP based on the complexity of the processing required to analyze and understand natural language:

a) **Phonological level NLP:** The phonological level of natural language processing (NLP) deals with the analysis and understanding of the sound patterns of

language. At this level, NLP focuses on the acoustic properties of speech and the ways in which speech sounds are organized to form words and sentences. Phonological processing involves several subtasks, including speech recognition, speech segmentation, and phonetic transcription. Speech recognition is the process of converting spoken language into text, while speech segmentation involves identifying the boundaries between words in spoken language. Phonetic transcription is the process of representing spoken language using a standardized set of symbols that correspond to speech sounds. Phonological processing is essential for many NLP tasks, including speech recognition, speaker identification, and speech synthesis. For example, speech recognition systems use phonological processing to convert spoken language into text, while speech synthesis systems use phonological processing to generate spoken language from text. Phonological processing also plays a role in natural language understanding, particularly in tasks that involve processing spoken language, such as dialog systems and virtual assistants. By analyzing the sound patterns of spoken language, phonological processing can help to disambiguate words with similar sounds, identify the intended speaker, and detect emotional cues in speech.

b) **Morphological level NLP:** Morphology has been a part of mainstream linguistics for sixty years or more. The morphological level of linguistic processing deals with the study of word structures and word formation, focusing on the analysis of the individual components of words. According to the classical approach in linguistics, words are formed of morphemes, which are the minimal (that is, non-decomposable) linguistics units that carry meaning. Many language processing applications need to extract the information encoded in the words – parsers which analyze sentence structure need to know/check agreement between subjects and verbs, adjectives and nouns. Information retrieval systems benefit from know what the stem of a word is and machine translation systems analyze words to their components and generate words with specific features in the target language In Information Retrieval, document and query terms can be stemmed to match the morphological variants of terms between the documents and query; such that the singular form of a noun in a query will match even with its plural form in the document, and vice versa, thereby increasing recall.

c) **Syntax Level NLP:** This level of NLP deals with the grammatical structure of language, such as identifying parts of speech, parsing sentences into a structured representation, and identifying the relationships between words. Syntax-level processing is useful for tasks such as text normalization, named entity recognition, and text classification.

d) **Semantics Level NLP:** This level of NLP goes beyond the grammatical structure of language and focuses on the meaning of words and sentences. Semantics-level processing involves identifying word meanings and their relationships with other words, recognizing synonyms and antonyms, and disambiguating word senses. This level of processing is useful for tasks such as sentiment analysis, topic modeling, and question answering.

e) **Pragmatics Level NLP:** This level of NLP involves understanding the context and purpose of language. Pragmatics-level processing includes identifying the speaker's intentions, inferring meaning from non-literal language such as idioms and metaphors, and understanding discourse structure. Pragmatics-level processing is useful for tasks such as language generation, machine translation, and natural language understanding in dialog systems.

Each level of NLP builds on the previous level, with pragmatics-level processing being the most complex and challenging. However, recent advancements in machine learning and deep learning have enabled significant progress in all three levels of NLP, leading to a wide range of practical applications in various industries.

2.6.4.3. NLP Applications:

Natural language processing (NLP) has an extensive variety of packages throughout numerous industries. Some not unusual place packages of NLP include:

- **Virtual Assistants:** NLP is used to broaden shrewd digital assistants inclusive of Apple's Siri, Amazon's Alexa, and Google Assistant. These digital assistants use NLP strategies to apprehend herbal language queries and offer applicable responses.
- **Machine Translation:** NLP is used to broaden system translation structures that could translate textual content from one language to another. Machine translation

structures use statistical techniques and deep studying algorithms to enhance translation accuracy.

- **Sentiment Analysis:** NLP is used to investigate social media posts and client comments to decide the sentiment of the textual content. Sentiment evaluation is utilized in marketing, client service, and logo recognition management.
- **Text Summarization:** NLP is used to broaden textual content summarization structures that could generate summaries of lengthy documents. Text summarization is utilized in information aggregation, report summarization, and prison report evaluation.
- **Speech Recognition:** NLP is used to broaden speech popularity structures that could convert spoken language into textual content. Speech popularity structures are utilized in digital assistants, dictation software, and voice-enabled devices.
- **Named Entity Recognition:** NLP is used to broaden named entity popularity structures that could perceive and extract entities inclusive of people, places, and agencies from textual content. Named entity popularity is utilized in facts extraction and textual content classification.
- **Question Answering:** NLP is used to broaden query answering structures that could offer solutions to herbal language questions. Question answering structures are utilized in chatbots, client support, and seek engines.

Conclusion:

In conclusion, the chapter on introduction to artificial intelligence has highlighted the remarkable progress, diverse approaches, and wide-ranging applications of this transformative technology which has had a profound impact on the world, revolutionizing industries and changing the way people live and work. From self-driving cars and virtual assistants to personalized medicine and deep learning models which leverage techniques to achieve state-of-the-art performance. Understanding its key concepts discussed before (see page 28) is crucial for unlocking the full potential of AI and developing sophisticated intelligent systems which enables it to analyze and understand human language and perform human tasks properly.

Chapter Three: Evaluation of Machine Translation's Quality

Introduction

Artificial intelligence (AI) has emerged as a powerful force in enhancing machine translation (MT) quality, revolutionizing the way translations are conducted. With its ability to learn from vast amounts of data, analyze complex linguistic patterns, and adapt to diverse language contexts, AI has elevated machine translation to new levels of accuracy, fluency, and contextual understanding. Its effect is not limited to linguistic proficiency alone. But its sophisticated models can handle idiomatic and cultural expressions also. This chapter discusses the profonde impact of AI on the enhancement of machine translation quality, exploring the various techniques, approaches used by different types of machines. We will deal with the practical side of this study, analyzing both machine and human translations to measure the degree of advancement reached by those machines and to what extent they are using developed technologies which enable them to challenge human translation.

3.1. Data gathering tool:

The significant objective of this study is to investigate the role of Artificial Intelligence in developing machine translation quality. To reach this goal, we selected some expressive and descriptive texts which represent the research corpus, and translated that corpus using both: online machine translation applications (Google Translate and Reverso), and human translator. When translating the texts from the source language (SL) to the target language (TL), we evaluated the quality of the translation according to the linguistic environment or the context.

3.1.1. Description of the Machine Translation applications used:

3.1.1.1. Google Translate:

Google Translate is an online machine translation service, and the most used one (Darija Lunić, 2022). It was introduced in 2006, as a Statistical machine translation, supported by few languages only. The quality of its translations was not that much relevant and accurate, but the SMT approach which analyzes large number of bilingual texts helps in generating a more reliable translations for users.

The boom of Google Translate was in 2016, when Google company implemented the neural machine translation approach to Google Translate (United Language Group, 2017).

This last uses artificial neural networks which allowed it to perform fluency and improve the translation quality.

Google Translate nowadays made a significant breakthrough in its history by combining machine learning and human volunteers who are going to correct the translations and suggest new words. This will only make sure the translation generated is a 100% accurate, taking into consideration the contextual environment and the cultural differences. According to Google Blog (Unlocking zero resources MT to support new languages in Google Translate, May 2022), Google Translate now includes more than 100 languages, adding Kurdish, Frisian (the Netherlands and Germany), and Pashto (Afghanistan and Pakistan).

3.1.1.2. Reverso:

Reverso is an online translation platform that provides translation services and dictionaries. It was launched in 2011 as a multilingual online dictionary and language tool to users worldwide ("Reverso Context - Innovative Translations in Context", 2020).

In 2012, the company Softissimo Inc introduced "Reverso Context" which provides translations in the context of sentences, and suggests translations based on real-life example from bilingual texts. It uses advanced algorithms and machine learning techniques to provide accurate and relevant translations ("Reverso Context - Innovative Translations in Context", 2020).

Reverso continues to evolve and improve its services by incorporating user feedback and integrating new technologies. It regularly updates its dictionary database, expands language coverage (50 languages), and adds new features to enhance the translation and language learning experience.

3.1.2. Research Corpus:

- A passage from **"The Raven"** the title work in the collection of twelve short stories and poems that is widely regarded as the most famous of Edgar Allan Poe's writings.
- A literary text from the novel **"Kafka on The Shore"**, by the Japanese author Haruki Murakami (2002).
- A descriptive text of Damascus.
- The Fall of Seville – A Poem by Abu al-Baqa' al-Rundi.

3.1.2.1. Describing the Evaluation method of the corpus:

To evaluate the translation generated by a machine, there must be a list of norms, principles, and standards that professional translators follow to ensure the quality and accuracy of their translations. These norms help maintain consistency, clarity, and faithfulness to the original text while adapting it to the target language and culture. Some of them are:

- **Accuracy:** Translations should accurately convey the meaning of the source text. The translator must understand the content, context, and intent of the original text and faithfully reproduce it in the target language. (Nord Christiane, 1991. "Text Analysis in Translation").
- **Fluency:** Translations should capture the meaning, the tone, and the same style of the original text, while being linguistically and culturally appropriate for the target audience. Translator should follow logical structures, maintain proper sentence flow, and avoid ambiguity or confusion.
- **Cultural Adaptation:** Translations should consider the cultural context of the target audience. The translator should adapt expressions, idioms, and cultural references to ensure they are meaningful and appropriate in the target language and culture.

The machine translation does not consider these norms in so many cases, so it mistranslates the source text and make different types of errors. The goal of our study is to conduct a linguistic analysis of the Machine Translation to give the exact evaluation of its quality.

❖ **Types of errors:** By conducting an inclusive linguistic analysis of a translation, we identify potential errors, inconsistencies, or areas where the translation may deviate from the intended meaning of the source text. According to the linguist J.C. Catford (1917), translation errors are classified as the following:

1. **Grammatical Errors**: These errors involve mistakes in sentence structure, verb conjugation, word order, agreement between subject and verb, or the use of articles and prepositions.
2. **Semantic errors**: A semantic error in translation refers to a mistake or discrepancy in the meaning or semantic content between the original text and its translated version. It occurs when the intended meaning of the original text is not accurately conveyed or when there is a misunderstanding of the context or linguistic environment of the source language.

3. **Lexical Errors:** Lexical errors occur when the translator chooses an incorrect word or phrase that does not accurately convey the meaning of the original text. It can be due to a lack of vocabulary knowledge or misunderstanding the context. Lexical errors include the omissions and additions also.

   Sometimes, translators might omit or add information that was present or absent in the source text. This can lead to the loss or distortion of the original meaning.
4. **Idiomatic Errors:** Idiomatic expressions are phrases or figures of speech that have a different meaning than the literal interpretation of their individual words. Translating idioms word-for-word can result in errors or awkward phrasing if the equivalent idiom is not used in the target language.
5. **Cultural Errors:** Cultural errors occur when a translation does not consider the cultural nuances, references, or specific context of the source language. These errors can lead to misunderstandings or offensive statements in the target language.
6. **Stylistic Errors:** Stylistic errors involve deviations from the appropriate style or tone of the original text. Translations should maintain the same level of formality, register, and tone to accurately convey the author's intended message.
7. **Ambiguity:** Translations can introduce ambiguity if the meaning of a word, phrase, or sentence is unclear or can be interpreted in different ways. Unclear translations can cause confusion for readers.
8. **Terminology Errors:** In technical or specialized translations, inaccurate or inconsistent usage of terminology can be a problem. It's important to maintain consistency and use the correct terminology within the specific field.
9. **Syntax Errors:** Syntax errors involve mistakes in sentence structure or syntax rules of the target language. These errors can make the translation sound unnatural or confusing.

3.2. Data Analysis:

3.2.1. Analysis of The Corpus:

Our data consists of 4 texts (two of them in Arabic and two in English) translated using the online applications: Google Translate and Reverso Context. The human translation plays the role of the accepted form of translation of the source language, and also according to it we judge the translation performed by a machine tool.

Table 1.1: Analysis of a descriptive passage from "The Raven" Collection. (Google Translate)

Examples	Machine Translation	Type of Errors	Human Translation
1) While I pondered, weak and weary;	بينما كنت أفكر، ضعيفًا ومرهقًا،	lexical error: wrong choice of words. "ضعيفًا ومرهقًا" does not accurately capture the meaning of the original phrase "weak and weary."	في غمرة إنهاكي وضَجَري،
2) Over many a quaint and curious Volume of forgotten lore—	على العديد من غريبة وفضولية حجم المعرفة المنسية	Ambiguity	على كتبٍ طريفةٍ غريبةٍ عن المَعارفِ المنسية،
3) While I nodded, nearly napping.	بينما أومأت برأسي، أوشكت على القيلولة	Syntactic error: the sentence is not well structured Lexical error: wrong choice أوشكت	مالَ رأسي، كِدتُ أغفو
4) Suddenly there came a tapping, As if someone gently rapping, Rapping at my chamber door.	فجأة سمع صوت نقر، كما لو أن شخصًا ما يغني بلطف، قرع على باب غرفتي.	Semantic error: the translation of the word "rapping" should reflect the tapping or knocking sound.	فجأة تناهى لسمعي صَوتُ دَق، كأن أحداً برِفقٍ على بابِ حُجرَتي يطرُق
5) "'This some visitor," I muttered, "Tapping at my chamber door Only this, and nothing more."	"تمتمت: "هذا زائر ما، النقر على باب غرفتي" هذا فقط وليس أكثر	Lexical error: Omission of word	قلتُ مُتمتماً: "إنه زائر ما، على بابِ حُجرتي يَدُق ".هذا فقط، ولا شيء أكثر

Table 1.2: Analysis of a descriptive passage from "The Raven" Collection.

(Reverso Context)

Examples	Machine Translation	Type of Errors	Human Translation
1) While I pondered, weak and weary;	بينما كنت أتأمل، ضعيفة ومرهقة،	Grammatical error: gender agreement Lexical error: choice of vocabulary	في غمرة إنهاكي وضَجَري،
2) Over many a quaint and curious Volume of forgotten lore—	أكثر من الكثير من الغرابة والفضول حجم التقاليد المنسية	Semantic error: mistranslation Syntax error: unstructured sentence Ambiguity	على كتبٍ طريفةٍ غريبةٍ عن المَعارفِ المنسية،
3) While I nodded, nearly napping.	بينما أومأت برأسي، على وشك القيلولة،	Grammatical error: wrong words order Use of noun instead of a verb "napping"	مالَ رأسي، كِدتُ أغفو
4) Suddenly there came a tapping, As if someone gently rapping, Rapping at my chamber door.	فجأة جاء هناك التنصت، بالنسبة لشخص يغني بلطف، الراب على باب غرفتي	Lexical error: wrong word choice Semantic error: mistranslation Grammatical error: wrong part of speech Syntax error	فجأة تناهى لسمعي صَوتُ دَق، كأن أحداً برِفقٍ على بابِ حُجرَتي يطرُق
5) "'This some visitor," I muttered, "Tapping at my chamber door Only this, and nothing more."	هذا بعض الزائر تمتمت، النقر على باب غرفتي فقط هذا، ولا شيء أكثر من ذلك	Grammatical errors: wrong words order Wrong speech parts Syntax error: unstructured sentence Ambiguity	قلتُ مُتمتماً: "إنه زائر ما، على بابِ حُجرتي يَدُق هذا فقط، ولا شيء أكثر

Table 2.1: Analysis of a literary text from the novel "Kafka on The Shore"

(Google Translate)

Examples	Machine Translation	Types of Errors	Human Translation
1) Over and over, you play this out, like some ominous dance with death just before dawn.	مرارا تلعب هذا، مثل بعض الرقص المشؤوم مع الموت في الفجر	Grammatical error: the sentence order is wrong+ Inaccurate preposition في. Lexical error : omission « and over »	تلعب معها هكذا مرارًا وتكرارًا، كرقصة مشؤومة مع الموت قبل الفجر
2) This storm isn't something that blew in from far away, something that has nothing to do with you. This storm is you. Something inside of you.	هذه العاصفة ليست شيئًا ينفجر من بعيد، شيء لا علاقة له بك. هذه العاصفة هي أنت. شيء بداخلك	Lexical error: wrong choice of Vocabulary "ينفجر" Semantic error: weak expression. Stylistic error	لأن هذه العاصفة ليست شيئاً يهب فجأة من بعيد، ليست شيئاً لا يمت لك بصلة، إنها أنت. إنها شيء ما في داخلك
3) So, all you can do is give in to it, step right inside the storm, closing your eyes and plugging up your ears so the sand doesn't get in, and walk through it, step by step.	وكل ما يمكنك فعله هو الاستسلام لها، والخطوة مباشرة داخل العاصفة، وإغلاق عينيك وسد أذنيك حتى لا تدخل الرمال، والمشي عبرها، خطوة بعد خطوة	Grammatical errors: Noun phrase instead of verbal phrase+ omission of the pronouns. إليهما + wrong preposition.	لذا، كل ما عليك فعله هو ان تستسلم لها. أدخل إليها مباشرة. أغمض عينيك، وسد أذنيك حتى لا تتسلل الرمال إليهما، وسر في العاصفة، خطوة بخطوة
4) There's no sun there, no moon, no direction, no sense of time.	لا توجد شمس هناك، ولا قمر، ولا اتجاه، ولا معنى للوقت	Semantic error: Inaccurate translation of the word "sense"	ليس من شمس هناك، ولا قمر، ولا اتجاهات، ولا إحساس بالزمن

5) Just fine white sand swirling up into the sky like pulverized bones.	مجرد رمل أبيض ناعم يحوم في السماء مثل العظام المطحونة	Syntax error: word order. Idiomatic error: The translation misses the metaphorical aspect of the original sentence.	فقط دوامة من الرمال البيضاء الناعمة تصعد إلى السماء كعظام مسحوقة
6) And you really will have to make it through that violent, metaphysical, symbolic storm.	وسيكون عليك حقًا اجتياز تلك العاصفة العنيفة الميتافيزيقية الرمزية	Lexical error: word choice. "اجتياز" Semantic error Lack of the idiomatic nature and sense of challenge conveyed by the original phrase.	وعليك حقًا أن تنجو من وسط تلك العاصفة العاتية الميتافيزيقية الرمزية
7) No matter how metaphysical or symbolic it might be, make no mistake about it: it will cut through flesh like a thousand razor blades.	بغض النظر عن مدى كونه ميتافيزيقيًا أو رمزيًا، لا تخطئ في ذلك: سوف يقطع اللحم مثل ألف شفرة حلاقة.	Grammatical error Lexical error: choice of word. Semantic error: inaccurate translation " شفرة حلاقة" + luck of idiomatic sense.	بغض النظر عن مدى ميتافيزيقيتها أو رمزيتها. الخطأ ممنوع: ستقطع العاصفة الجلد كآلاف الأنصال
8) People will bleed there, and you will bleed too. Hot, red blood. You'll catch that blood in your hands, your own blood and the blood of others.	سوف ينزف الناس هناك، وسوف تنزف أيضًا. دم أحمر حار. سوف تلتقط تلك الدماء في يديك ودمك ودم الآخرين.	Lexical errors: omission of the pronoun "you" + Addition "و" Semantic error: inaccurate translation	سينزف الناس هناك، وستنزف أنت أيضاً، ستنزفون جميعاً دماً أحمر حاراً. ستمسك أنت هذا الدم بيديك، دمك، ودم الآخرين

9) And once the storm is over you won't remember how you made it through, how you managed to survive.	وبمجرد أن تنتهي العاصفة، لن تتذكر كيف نجحت، وكيف تمكنت من البقاء على قيد الحياة	Semantic error: inaccurate translation. Lexical: omission + wrong choice of vocabulary "نجحت" "البقاء على قيد الحياة"	ولحظة انتهاء العاصفة، لن تتذكر كيف نجوت منها، لن تتذكر كيف تدبرت أمرك لتنجو
10) But one thing is certain. When you come out of the storm you won't be the same person who walked in.	ولكن شيء واحد مؤكد. عندما تخرج من العاصفة لن تكون نفس الشخص الذي دخل	Lexical errors: addition « و » + Omission of the preposition "in" Semantic errors: inaccurate translation of the word "certain" + weak expression.	لكن ستكون متيقناً من أمر واحد فقط: حين تخرج من العاصفة، لن تكون الشخص نفسه الذي دخلها
11) That's what this storm's all about	هذا ما تدور حوله هذه العاصفة	Grammatical error Semantic error: inaccurate translation.	لهذا السبب وحده، وجدت العاصفة

Table 2.2: Analysis of a literary text from the novel "Kafka on The Shore" (Reverso Context)

Examples	Machine Translation	Type of Errors	Human Translation
1)Over and over, you play this out, like some ominous dance with death just before dawn.	مرارًا وتكرارا تلعب هذا مثل بعض الرقصات المشؤومة مع الموت قبل الفجر بقليل	Lexical errors: wrong word choice. Grammatical error Syntax error: sentence unstructured	تلعب معها هكذا مرارًا وتكرارًا، كرقصة مشؤومة مع الموت قبل الفجر

2) This storm isn't something that blew in from far away, something that has nothing to do with you. This storm is you. Something inside of you.	لأن هذه العاصفة ليست شيئًا انفجر من بعيد، شيء لا علاقة له بك. هذه العاصفة هي أنت شيء ما بداخلك	Lexical errors: omission Semantic error: inaccurate translation of the word "blew" Grammatical errors	لأن هذه العاصفة ليست شيئاً يهب فجأة من بعيد، ليست شيئاً لا يمت لك بصلة، إنها أنت. إنها شيء ما في داخلك
3) So, all you can do is give in to it, step right inside the storm, closing your eyes and plugging up your ears so the sand doesn't get in, and walk through it, step by step.	كل ما يمكنك فعله هو الاستسلام لها، والخطوة مباشرة داخل العاصفة، وإغلاق عينيك وتوصيل أذنيك حتى لا تدخل الرمال، والمشي من خلالها، خطوة بخطوة.	Lexical errors: omission "so" + inaccurate choice of words Semantic error: mistranslation of the word "plugging" Grammatical errors: Wrong preposition+ the use of noun instead of a verb.	لذا، كل ما عليك فعله هو ان تستسلم لها. أدخل إليها مباشرة. أغمض عينيك، وسد أذنيك حتى لا تتسلل الرمال إليهما، وسر في العاصفة، خطوة بخطوة
4) There's no sun there, no moon, no direction, no sense of time.	لا توجد شمس هناك، ولا قمر، ولا اتجاه، ولا إحساس بالوقت	Stylistic error	ليس من شمس هناك، ولا قمر، ولا اتجاهات، ولا إحساس بالزمن
5) Just fine white sand swirling up into the sky like pulverized bones.	مجرد رمال بيضاء ناعمة تدور في السماء مثل العظام المسحوقة.	Lexical error: omission+ wrong choice of vocabulary "swirling" Grammatical error	فقط دوامة من الرمال البيضاء الناعمة تصعد إلى السماء كعظام مسحوقة
6) And you really will have to make it through that violent, metaphysical, symbolic storm.	وسيتعين عليك حقًا تجاوز تلك العاصفة العنيفة والميتافيزيقية والرمزية	Semantic error: mistranslation of the word "violent Lexical errors: addition+ omission.	وعليك حقًا أن تنجو من وسط تلك العاصفة العاتية الميتافيزيقية الرمزية

7) No matter how metaphysical or symbolic it might be, make no mistake about it: it will cut through flesh like a thousand razor blades.	مهما كانت ميتافيزيقية أو رمزية، فلا تخطئ في ذلك: ستقطع اللحم مثل ألف شفرة حلاقة	Lexical errors: omission+ wrong choice of words. Semantic error: inaccurate translation Idiomatic error Grammatical error	بغض النظر عن مدى ميتافيزيقيتها أو رمزيتها. الخطأ ممنوع: ستقطع العاصفة الجلد كآلاف الأنصال
8) People will bleed there, and you will bleed too. Hot, red blood. You'll catch that blood in your hands, your own blood and the blood of others.	سوف ينزف الناس هناك، وسوف تنزف أيضًا. دم أحمر ساخن. سوف تمسك ذلك الدم في يديك، دمك ودماء الآخرين	Grammatical error: wrong preposition. Lexical error: omission	سينزف الناس هناك، وستنزف أنت أيضاً، ستنزفون جميعاً دماً أحمر حاراً. ستمسك أنت هذا الدم بيديك، دمك، ودم الآخرين
9) And once the storm is over you won't remember how you made it through, how you managed to survive.	وبمجرد انتهاء العاصفة، لن تتذكر كيف نجحت في ذلك، وكيف تمكنت من البقاء على قيد الحياة	Lexical errors: wrong choice of words+ omission. Semantic error: mistranslation of "made it through" Grammatical errors.	ولحظة انتهاء العاصفة، لن تتذكر كيف نجوت منها، لن تتذكر كيف تدبرت أمرك لتنجو
10) But one thing is certain. When you come out of the storm you won't be the same person who walked in.	لكن هناك شيء واحد مؤكد. عندما تخرج من العاصفة لن تكون نفس الشخص الذي دخل	Both translations are correct.	لكن ستكون متيقناً من أمر واحد فقط: حين تخرج من العاصفة، لن تكون الشخص نفسه الذي دخلها
11) That's what this storm's all about	هذا ما تدور حوله هذه العاصفة	Stylistic error	لهذا السبب وحده، وجدت العاصفة

Table 3.1: Analysis of a descriptive text of Damascus: (Reverso Translation)

Examples	Machine Translation	Types of Errors	Human Translation
1) دمشق هي بلدٌ قد وَهَبَتْها الطبيعة جمالًا فائقًا، فتراها كثيرةَ الأنهار وافِرَةَ الجنان	Damascus is a country that nature has endowed with a superior beauty, which is seen by many rivers and abundant jinns	Semantic error: inaccurate translation of the word "بلدٌ" +" الجنان" " Grammatical error	Damascus is a city that nature awarded it with a superb beauty, it has many rivers and abundant gardens
2) قَلَّ أن تمرَّ بحائط إلَّا والماء يخرجُ منه في أنبوب إلى حوضٍ يُشْرَب منه ويَسْتَقِي الوارِدُ والصادر،	You said to go through a wall, and the water came out of it in a tube to a basin from which it would be drunk and the incoming and outgoing would soak	Lexical error: omission "قلَّ" Grammatical errors Semantic errors: inaccurate translations "الوارِدُ والصادر" Syntactic error: not well structured	You can hardly pass by a wall without water flowing from it through a pipe into a basin from which people drink and the comer and goer waters from it.
3) وما رأيت بها مسجدًا ولا مدرسةً ولا خانقاهًا إلَّا والماءُ يجري في بركة في صحن هذا المكان ويسبح في منصته	and what I saw was a mosque, no school, no suffocation, but water running in a pool in the plate of this place and swimming in its platform.	Lexical error: addition + wrong choice of words. Semantic errors: inaccurate translation. Grammatical errors: Wrong tense Syntax error: unstructured sentence	I have never seen a mosque, school, or Khanqah in Damascus without water flowing in a pool in the courtyard of that place and all over it.

4) وهي نضيرة البقاع تحيط بها مِنْ جميع جهاتها الجبالُ وأشهرها جبل قاسيون	Bekaa's freshness surrounds her from all sides of the mountain, the most famous being Mount Cruel	Lexical errors: wrong choice of word "freshness" + omission Grammatical errors: wrong tense+ wrong pronoun "her" Semantic error: inaccurate translation of the mountain's name.	Its fresh Bekaa surrounds it from all sides of the mountain, the most famous of which is Mount Qasioun
5) وتمتاز بكثرة الفواكه، حتى إنها تُحْمَل إلى مصر وحران	It has a lot of fruits, even being carried to Egypt and Haran.	Semantic error: Inaccurate interpretation. Grammatical error Lexical error: wrong choice of verb + Omission. إنها	It's known for the plenty of fruits that even get exported to Egypt and Haran.
6) ويصف المقدسي دمشق فيذكر شيئًا عن أحوال اجتماعها فيقول: «دمشق هي مصرُ الشام ودارُ الملك أيامَ بني أمية وثَمَّ قصورهم وآثارهم	Al-Qudsi describes Damascus and says something about the conditions of its meeting, saying: "Damascus is the embassy of Al-Sham and the King's House are illiterate and then their palaces and monuments"	Lexical errors: wrong choice of words "conditions" + Addition. Semantic errors: inaccurate interpretations. "embassy" Syntactic error: the words are not well arranged.	Al-Maqdisi describes Damascus and describes its society, saying: "Damascus is the Egypt of Al-Sham and the Khalifa's House in the days of Ummaya and their palaces and monuments.

7) بنيانهم خشبٌ وطينٌ أكثر أسواقها مُغَطَّاة ولهم سوقٌ على طول البلد مكشوفٌ حَسَنٌ	Their structure is wooden and mud, their most covered market and they have a market along the country well exposed.	Lexical errors: inaccurate choice of the word "structure" + omission. Grammatical errors Syntactic error: the sentence is not well structured.	Their buildings are made of wood and mud, most of its markets are covered and they have a market along the country beautiful and exposed
8) وهو بلدٌ قد خرقته الأنهار وأَحْدَقَتْ به الأشجار وكَثُرَتْ به الثمار مع رخصِ أسعار	It is a country that has been burned by rivers, thrown by trees and many fruits with price cheaps	Lexical errors: wrong choice of words. Semantic errors: vocabulary chosen is not relevant to the context "burned, thrown". Grammatical errors	It is a city that has many of rivers, surrounded by trees and plenty of fruits with cheap prices
9) لا ترى أحسن من حماماتها ولا أعجب من فواراتها ولا أجزم من أهلها	That sees no better than its bathrooms, no admiration for its blowouts, and no assurance from its people	Lexical errors: Omission+ Inaccurate word choice. "No admiration, blowouts." Grammatical error: noun instead of verb "assurance"	That sees no better than its bathrooms, there is no more fantastic than its fountains, and no People more assuring than its people.
10) وهي طيّبة جدًّا غير أن في هوائها يبوسة	She's very kind, but she's in her air.	Grammatical errors: "she, her" instead of "it, its" + wrong preposition "in". Semantic error: inaccurate interpretation.	It's very pure but its air is dry

11) ولحومها عاصية ومنازلها ضيقة وأزقّتها غامة وأخبازها ردية، والمعايش بها ضيقة	Their meat is rough, their homes are tight, their tears are cloudy their bakes are pink, and their lives are tight	Lexical errors: inaccurate choice of words: "rough, tight" Semantic error: inaccurate interpretation "pink" "cloudy"	its meat is rough, its homes are tight, its alleys are narrowed, its bakes are lousy, and its lifestyle is joyless

Table 3.2: Analysis of a descriptive text of Damascus: (Google Translate)

Examples	Machine Translation	Types of Errors	Human Translation
1) دمشق هي بلدٌ قد وَهَبَتْها الطبيعة جمالًا فائقًا، فتراها كثيرةَ الأنهار وافِرَةَ الجنان	Damascus is a country that nature has endowed with extraordinary beauty, so you see it with many rivers abundant in paradise.	Semantic error: incorrect translation of the words "بلدٌ" "الجنان" Lexical error: wrong choice of word	Damascus is a city that nature awarded it with a superb beauty, it has many rivers and abundant gardens
2) قَلَّ أن تمرَّ بحائط إلَّا والماء يخرجُ منه في أنبوب إلى حوضٍ يُشْرَب منه ويَسْتَقِي الواردُ والصادر،	Say that you pass through a wall except that the water comes out of it in a pipe into a basin from which it drinks and draws the incoming and the outgoing	Semantic error: incorrect translation of the word "قَلَّ" Lexical error: omission + inaccurate choice of words.	You can hardly pass by a wall without water flowing from it through a pipe into a basin from which people drink and the comer and goer waters from it.
3) وما رأيت بها مسجدًا ولا مدرسةً ولا خانقاهًا إلَّا والماءُ يجري في بركة في صحن هذا المكان ويسبح في منصته	In the plateau of this place and swimming in its platform	Lexical error: omission + wrong choice of words Semantic errors: incorrect translations "platform"	I have never seen a mosque, school, or Khanqah without water flowing in a pool in the courtyard of that place and all over it.

4) وهي نضيرة البقاع تحيط بها مِنْ جميع جهاتها الجبالُ وأشهرها جبل قاسيون	It is the lushness of the Bekaa surrounded on all sides by mountains, the most famous of which is Mount Qasioun,	Grammatical errors: Wrong use of verb Wrong preposition	Its fresh Bekaa surrounded from all sides by mountains, the most famous of which is Mount Qasioun
5) وتمتاز بكثرة الفواكه، حتى إنها تُحْمَل إلى مصر وحران	And it is distinguished by the abundance of fruits, so that it is carried to Egypt and Harran.	Lexical error: wrong choice of words Semantic error: mistranslation of the word "تُحْمَل"	It's known for the plenty of fruits that even get exported to Egypt and Haran.
6) ويصف المقدسي دمشق فيذكر شيئًا عن أحوال اجتماعها فيقول: «دمشق هي مصرُ الشام ودارُ الملك أيامَ بني أمية وثَمَّ قصورهم وآثارهم	Al-Maqdisi describes Damascus, and he mentions something about the conditions of its assembly, saying: "Damascus is Egypt, the Levant, and the king's house in the days of the Umayyads, then their palaces and monuments.	Lexical errors: wrong choice of word + omission. Semantic errors: inaccurate translations	Al-Maqdisi describes Damascus and describes its society, saying: "Damascus is the Egypt of Al-Sham and the Khalifa's House in the days of Ummaya and their palaces and monuments.
7) بنيانهم خشبٌ وطينٌ أكثر أسواقها مُغَطَّاة ولهم سوقٌ على طول البلد مكشوفٌ حَسَنٌ	their buildings are made of wood and mud, most of their markets are covered, and they have a market throughout the country that is well exposed.	Lexical error: omission+ wrong choice of words Grammatical error: wrong pronoun	Their buildings are made of wood and mud, most of its markets are covered and they have a market along the city beautiful and exposed

8) وهو بلدٌ قد خرقته الأنهار وأَحْدَقَتْ به الأشجار وكَثُرَتْ به الثمار مع رخصِ أسعار	It is a country pierced by rivers, surrounded by trees, abundant with fruits, with cheap prices	Lexical error: wrong choice of words Semantic error: mistranslation "بلدٌ"	It is a city that has many of rivers, surrounded by trees and plenty of fruits with cheap prices
9) لا ترى أحسن من حماماتها ولا أعجب من فواراتها ولا أجزم من أهلها	You do not see anything better than its baths, nor more amazing than its fountains, and I am not certain of its people	Semantic error: mistranslation of the word "أجزم" Lexical error: addition	That sees no better than its bathrooms, there is no more fantastic than its fountains, and no People more assuring than its people.
10) وهي طيّبة جدًّا غير أن في هوائها يبوسة	It is very good, except that its air is dry	Lexical error: wrong choice of vocabulary	It's very pure but its air is dry
11) ولحومها عاصية ومنازلها ضيقة وأزقّتها غامة وأخبازها ردية، والمعايش بها ضيقة	Its meat is disobedient, its houses are narrow, its alleys are cloudy, its bread is bad, and its living conditions are cramped	Lexical errors: wrong choice of vocabulary Semantic error: inaccurate translations "cloudy, cramped"	its meat is rough, its homes are tight, its alleys are narrowed, its bakes are lousy, and its lifestyle is joyless

Table 4.1: The Fall of Seville – A Poem by Abu al-Baqa' al-Rundi Analysis. (Reverso Translation)

Examples	Machine Translation	Type of Errors	Human Translation
1) فاسأل بلنسية ما شأن مرسية * * * وأين شاطبة أم أين جيانُ	Ask Valencia what Marsi * * * is and where Shatiba or where Jian is	Lexical error: omission "ما شأن" Semantic error: inappropriate translation of the propre noun "مرسية" Syntactic error: sentence not structured.	Therefore, ask Valencia what is the state of Murcia; and where is Jativa, and where is Jaen?
2) وأين قرطبةُ دار العلوم فكم * * * من عالم قد سما فيها له شأنُ	And where the Dar Al-Science Cordopus is how much * * * of a world it has been named after.	Lexical error: omission Semantic error: wrong translation of the propre noun "قرطبةُ" "دار" Grammatical error: the parts of speech aren't ordered.	Where is Cordoba, the home of the sciences, and many a scholar whose rank was once lofty in it?
3) وأين حمصُ وما تحويه من نزهٍ * * * ونهرها العذب فياض وملآنُ	Where is Homs and its picnic * * * and its fresh river is white and burning	Lexical errors: Omission "العذب" "وملآنُ" Semantic error: inaccurate translation "White and burning" + mistranslation of the propre noun " حمصُ	Where is Seville and the pleasures it contains, as well as its sweet river overflowing and brimming full?

4) قواعد كن أركان البلاد فما * * * عسى البقاء إذا لم تبق أركانُ	The rules of be the pillars of the country.	Lexical error: omission Grammatical errors: incorrect word order. + wrong tense. Ambiguity	[They are] capitals which were the pillars of the land, yet when the pillars are gone, it may no longer endure!
5) تبكي الحنفيةُ البيضاءُ من أسفٍ * * * كما بكى لفراقِ الإلف هيمانُ	The white tap cries from the regret of * * * as it cried to the teams of a thousand dominant	Lexical error: omission + wrong choice of vocabulary. Semantic error: inaccurate translation. Grammatical error: wrong preposition + wrong words order.	The tap of the white ablution fount weeps in despair, like a passionate lover weeping at the departure of the beloved
6) على ديارٍ من الإسلامِ خاليةٌ * * * قد أقفرت ولها بالكفر عمرانُ	On the houses of Islam are empty * * * has been forgiven and has disbelief Omran	Grammatical errors: wrong preposition "On" + wrong tense "has been". Lexical errors: wrong choice of words. "houses" Semantic error: inaccurate translation "Omran"	Over dwellings emptied of Islam that were first vacated and are now inhabited by unbelief.
7) حيث المساجدُ صارت كنائس * * * ما فيهنَّ إلا نواقيسٌ وصلبانُ	Where mosques have become churches * * * in which there are only bows and crosses	Grammatical errors: wrong pronouns + wrong prepositions+ the sentence is not complete Lexical error: Omission.	In which the mosques have become churches wherein only bells and crosses may be found.

8) حتى المحاريب تبكي وهي جامدةٌ * * * حتى المنابرُ تبكي وهي عيدانُ	Even the warriors are crying and they're rigid.	Semantic error: inaccurate translation "المحاريب" Lexical error: omission	Even the mihrabs weep though they are solid; even the pulpits mourn through they are wooden!
9) يا غافلاً وله في الدهرِ موعظةٌ * * * إن كنت في سنةٍ فالدهرُ يقظانُ	O heedless, and he has an admonition in time * * * If you are in a year, then time is alert	Lexical error: wrong word choice "time, alert" + Omission Grammatical error: wrong verb tense. Stylistic error	O you who remain heedless though you have a warning in Fate: if you are asleep, Fate is always awake!
10) وماشياً مرحاً يلهيه موطنهُ * * * أبعد حِمصٍ تغرُّ المرءُ أوطانُ	And with a fun walk, his home * * * farthest roasts tempt one's homelands.	Lexical errors: wrong choice of words+ omission. Semantic errors: mistranslation "حِمصٍ" Grammatical errors Syntax error: unstructured sentence + no coherence	And you who walk forth cheerfully while your homeland diverts you [from cares], can a homeland beguile any man after [the loss of] Seville?
11) تلك المُصيبةُ أنست ما تقدمها * * * ومالها من طوالِ الدهرِ نسيانُ	That hit you forgot what a * * * and her money is so long.	Semantic errors: inaccurate translation "hit, money" Lexical error: omission "الدهرِ نسيانُ" Grammatical errors: wrong pronoun "her" wrong verb tense. Syntax error: no coherence.	This misfortune has caused those that preceded it to be forgotten, nor can it ever be forgotten for all the time!

12) يا راكبين عتلق الخيل ضامرة * * * كأنها في مجال السبقِ عقبانُ	Hey, two riders. Horses are dumped.	Lexical errors: omission كأنها في مجال السبقِ عقبانُ Semantic errors: wrong addressing + inappropriate translation "dumped" Stylistic error: unformal language. Syntax error.	O you who ride lean, thoroughbred steeds which seem like eagles in the racecourse;
13) وحاملين سيوف الهند مرهفةً * * * كأنها في ظلام النقع نيرانُ	And holding India's swords is as cumbersome as it is in the darkness of soaking fire.	Lexical errors: omission+ wrong choice of vocabulary. Grammatical error: "is, holding" Semantic error: mistranslation Syntax error: no coherence, the sentence is not well structured.	And you who carry slender, Indian blades which seem like fires in the darkness caused by the dust cloud [of war],
14) وَرَاتِعِين وراء البحر في دَعَةٍ * * * لَهُم بأوطانهم عزٌّ وسلطانُ	They have their homelands and authority behind the sea.	Lexical errors: omission "عزٌّ وسلطانُ" Omission of the addressing. "You, you who have…" Grammatical error: wrong preposition	And you who are living in luxury beyond the sea enjoying life, you who have the strength and power in your homelands

15) أعندكم نبأٌ من أهلِ أندلُسٍ * * * فقد سرى بحديثِ القومِ ركبانُ	I'm telling you the people of Andalusia.	Lexical errors: omission Grammatical error: question not structured! + wrong verb tense. Syntax error: no coherence. Semantic error: mistranslation "Andalusia"	Have you known news of the people of Andalus, for riders have carried forth what men have said [about them]?
16) كم يستغيثُ بنا المُستضعفُونَ وهم * * * قتلى وأسرى فما يهتزَّ إنسانُ	How vulnerable are we, who are dead and prisoners of human shaking.	Grammatical errors: question not structured, wrong verb tense. Semantic error: incorrect translation "human shaking" Lexical error: omission	How often have the weak, who were being killed and captured while no man stirred, asked our help?
17) لمثلِ هذا يبكي القلب من كمدٍ * * * إن كان في القلبِ إسلامٌ وإيمانُ	For example, the heart cries as much as * * if it is in the heart Islam and faith	Lexical errors: wrong choice of vocabulary. Semantic translation: inaccurate translation "لمثلِ هذا" Grammatical error: wrong word order. Syntax error: Sentence not structured, no coherence.	The heart melts with sorrow at such [sights], if there is any Islam or belief in that heart!

Table 4.2: Analysis of The Fall of Seville – A Poem by Abu al-Baqa' al-Rundi. (Google Translate)

Examples	Machine Translation	Type of Errors	Human Translation
1) فاسأل بلنسية ما شأن مرسية * * * وأين شاطبة أم أين جيانُ	Ask Valencia what is the matter with Murcia * * * and where is Xtiva or where is Gian	Lexical error: omission	Therefore, ask Valencia what is the state of Murcia; and where is Jativa, and where is Jaen?
2) وأين قرطبةُ دار العلوم فكم * * * من عالم قد سما فيها له شأنُ	And where is Cordoba, the House of Sciences? How many * * * scholars have been eminent in it	Semantic error: mistranslation "دار" Grammatical error: wrong tense Lexical error: wrong choice of vocabulary	Where is Cordoba, the home of the sciences, and many a scholar whose rank was once lofty in it?
3) وأين حمصُ وما تحويه من نزهٍ * * * ونهرها العذب فياض وملآنُ	And where is Homs, and what it contains of promenades * * * and its sweet river is overflowing and full	Semantic error: inaccurate translation Lexical error: wrong choice of vocabulary	Where is Seville and the pleasures it contains, as well as its sweet river overflowing and brimming full?
4) قواعد كن أركان البلاد فما * * * عسى البقاء إذا لم تبق أركانُ	Rules Be the pillars of the country, so what * * * may it survive if there are no pillars left	Grammatical errors: wrong verb tense+ wrong words order Syntax error: unstructured sentence Lexical error: omission	[They are] capitals which were the pillars of the land, yet when the pillars are gone, it may no longer endure!

5) تبكي الحنفيةُ البيضاءُ من أسفٍ * * * كما بكى لفراقِ الإلف هيمانُ	The white tap is crying out of sorrow * * * As he cried for the separation of Alf Heyman	Lexical error: wrong choice of vocabulary + Omission Semantic error: mistranslations Grammatical error	The tap of the white ablution fount weeps in despair, like a passionate lover weeping at the departure of the beloved
6) على ديارٍ من الإسلامِ خاليةٌ * * * قد أقفرت ولها بالكفر عمرانُ	On an empty land of Islam * * * it has been desolate, and it has Imran in disbelief	Grammatical error: wrong preposition + wrong verb tense Lexical error: omission+ wrong word choice. Semantic error: mistranslation "Imran"	Over dwellings emptied of Islam that were first vacated and are now inhabited by unbelief.
7) حيث المساجدُ صارت كنائس * * * ما فيهنَّ إلا نواقيسٌ وصلبانُ	Where mosques have become churches * * * There are only bells and crosses in them	Grammatical errors: wrong pronouns+ wrong preposition+ wrong verb tense.	In which the mosques have become churches wherein only bells and crosses may be found.
8) حتى المحاريب تبكي وهي جامدةٌ * * * حتى المنابرُ تبكي وهي عيدانُ	Even the mihrabs weep while they are rigid * * * Even the pulpits weep while they are sticks	Lexical errors: incorrect word choice. "rigid" "sticks" "weep"	Even the mihrabs weep though they are solid; even the pulpits mourn though they are wooden!

9) يا غافلاً وله في الدهرِ موعظةٌ * * * إن كنت في سنةٍ فالدهرُ يقظانُ	O heedless, and he has an admonition in time * * * If you are in a year, then time is alert	Stylistic error: informal language. Semantic error: inaccurate translation "يقظانُ" Grammatical errors Lexical error: omission	O you who remain heedless though you have a warning in Fate: if you are asleep, Fate is always awake!
10) وماشياً مرحاً يلهيه موطنهُ * * * أبعد حِمصٍ تغرُّ المرءُ أوطانُ	Walking merrily, distracted by his homeland * * * The farthest hummus deceives a person from homelands	Lexical error: wrong choice of vocabulary Grammatical error: question structure Semantic error: mistranslation of the propre name Seville	And you who walk forth cheerfully while your homeland diverts you [from cares], can a homeland beguile any man after [the loss of] Seville?
11) تلك المُصيبةُ أنست ما تقدمها * * * ومالها من طوالِ الدهرِ نسيانُ	That calamity has forgotten what it has presented * * * and its money has been oblivion for all eternity	Lexical errors: wrong words choice Grammatical error: wrong demonstrative pron+ wrong V tense Semantic error: mistranslation of the word "ومالها"	This misfortune has caused those that preceded it to be forgotten, nor can it ever be forgotten for all the time!
12) يا راكبين عتلق الخيل ضامرة * * * كأنها في مجال السبقِ عقبانُ	O riders, the horses hang lean * * * as if they were eagles in the field of racing	Stylistic errors: informal language Lexical error: omission + wrong word choice.	O you who ride lean, thorough bred steeds which seem like eagles in the racecourse;

13) وحاملين سيوف الهند مرهفةً * * * كأنها في ظلام النقع نيرانُ	And carrying slender swords of India * * * As if in the darkness of soaking fires	Lexical error: omission Stylistic error: lack of figurative lge Idiomatic error Syntax error: unstructured phrase	And you who carry slender, Indian blades which seem like fires in the darkness caused by the dust cloud [of war],
14) وَرَاتِعِين وراء البحر في دَعَةٍ * * * لَهُم بأوطانهم عزٌّ وسلطانُ	And they graze beyond the sea in peace * * * They have glory and power in their homelands	Semantic error: incorrect translation of the word "دَعَةٍ" Stylistic error	And you who are living in luxury beyond the sea enjoying life, you who have the strength and power in your homelands
15) أعندكم نبأٌ من أهلِ أندلُسٍ * * * فقد سرى بحديثِ القومِ ركبانُ	Do you have news from the people of Andalus * * * The story of the people was conveyed by riders	Lexical error: word choice Stylistic error: loss of poetic imagery	Have you known news of the people of Andalus, for riders have carried forth what men have said [about them]?
16) كم يستغيثُ بنا المُستضعفُونَ وهم * * * قتلى وأسرى فما يهتزَّ إنسانُ	How often the oppressed cry out to us while they are * * * dead and prisoners, so no one is shaken	Lexical error: wrong choice of words Grammatical errors: wrong v. tense Semantic error: incorrect translation	How often have the weak, who were being killed and captured while no man stirred, asked our help?
17) لمثلِ هذا يبكي القلب من كمدٍ * * * إن كان في القلبِ إسلامٌ وإيمانُ	For such a person, the heart cries from grief * * * if there is Islam and faith in the heart	Lexical error: omission+ wrong words choice Grammatical error: question structure Syntax error: unstructured phrase	The heart melts with sorrow at such [sights], if there is any Islam or belief in that heart!

3.2.2. Analysis of The Machine Translation's outputs

A. Table-1 Google Translate:

Type of Errors	Number of Errors	Percentage
Semantic errors	28	30,10%
Lexical errors	35	37,63%
Syntax errors	05	05,37%
Grammar errors	16	17,20%
Style errors	06	06,45%
Idiomatic errors	02	02,15%
Ambiguity	01	01,075%
Total	93	100%

B. Table-2 Reverso Context:

Type of Errors	Number of Errors	Percentage
Semantic errors	28	23,72 %
Lexical errors	36	30,50%
Syntax errors	14	11,86%
Grammar errors	32	27,11%
Style errors	04	3,38%
Idiomatic errors	01	0,84%
Ambiguity	03	02,54%
Total	118	100%

- **Interpretation and Discussion of the Results:**

In an attempt to evaluate the MT performance, we did qualitatively and quantitively analyse both of their outcomes. The analysis presented in **Table-1** represents the first Machine Translation's output "Google Translate" which revealed a total of 93 errors in the translations generated. The errors encompass semantic, lexical, syntax, grammar, style, and idiomatic aspects.

28 semantic errors were identified which account for 30.10% of the total errors. Semantic errors in this case refer to mistakes in capturing the intended meaning of the source text accurately which result in a translation that conveys a different and incorrect meaning compared to the original text. The case in example n=04 in the analysis of the descriptive passage from "The Raven" Collection

There were 35 lexical errors identified which represent the type of errors the most repeated making up 37.63% of the total errors. This only shows that Google Translate failed in making the right choice of words and inappropriate usage of some vocabulary selected in the previous examples leading to a less accurate or less natural translation. As in example n=06 from the analysis of the quoted text from the novel "Kafka on The Shore".

The analysis detected 05 syntax errors, representing 05.37% of the total errors. This percentage represents issues with the arrangement and structure of words and phrases within a sentence leading to a grammatically incorrect translation.

Talking about the grammatical mistakes a total of 16 grammar errors were identified, accounting for 17.20% of the total errors. These errors involve incorrect verb forms and use of tenses. The analysis found about 06 stylistic errors, which represent 06.45% of the total errors. Style errors refer to violations of stylistic conventions, such as inconsistencies in tone and inappropriate language as in example n=12 from the analysis of "The Fall of Seville" poem. The machine in that example failed in generating a formal target language as the source language. And we see this type of errors repeated in the cases of translating poems only.

Finally, there were 2 idiomatic errors identified, also accounting for 02.15% of the total errors. Idiomatic errors occurred when idiomatic expressions or phrases were not translated accurately, leading to a loss of meaning and cultural nuances in the target language. Which shows that machines have some sort of challenges when it comes to the

figurative language. (Example n=5 from the analysis of the quoted text from "Kafka on The Shore"

The analysis presented in **Table-2** of the second Machine Translation's output "Reverso Context" which revealed a total of 80 errors in the translations generated.

28 semantic errors were identified representing 23.72% of the total errors. Semantic errors involve mistakes in the understanding or meaning of the language used, and inaccurate interpretation of the context which results in 2.54% of ambiguity of the target text. As in example n=3 from the analysis of "The Fall of Seville" poem

The lexical errors were the most repeated ones in the previous translations. About 26 errors were found accounting for 32.5% of the total errors. These involve omissions and additions, incorrect vocabulary selection, and usage words that do not convey the intended meaning which affect the precision and appropriateness of the target text. As in example n= 6 from the analysis of the descriptive text "Damascus".

The analysis identified 14 syntax errors, representing 11.86% of the total errors. They were related to the structure and arrangement of words within a sentence. Most of Reverso generated sentences were unstructured because of the improper use of grammar rules

A total of 32 grammatical errors were found, making up 27.11% of the total errors. They encompass a range of mistakes in the use of incorrect verb forms, subject-verb agreement issues, improper use of verb tenses, resulting in sentences that do not conform to the target language's syntactic rules. (Example n=8 from the analysis of quoted text from "Kafka on The Shore".

The analysis revealed 4style errors, representing 03.38% of the total errors effecting the tone of the text by using unformal language as in example n=9 from the analysis of "The Fall of Seville – A Poem by Abu al-Baqa' al-Rundi."

Finally, only one idiomatic error was found, making up 0.84% of the total errors leading to a loss of meaning and cultural nuances in the target language. (Example n=7 from the analysis of the quoted text from "Kafka on The Shore".

3.3. General Analysis:

Machine translation models rely on large amounts of data to learn patterns and make accurate translations. The quality and diversity of the training data play a crucial role in the

performance of the system. From the analysis of the machine translation performance, we realized its usefulness and limitations.

Google Translate for instance, struggles with understanding context, which can lead to inaccurate translations. It often translates words and phrases literally without considering the broader meaning or the specific context in which they are used. This limitation explains the statistics introduced previously (30.10% semantic errors and 37.63% lexical errors) which can result in misinterpretations and misleading translations, especially in content where context is crucial. The case of the previous translated texts from English to Arabic (Descriptive text from "The Raven" and expressive quote from the novel "Kafka on The Shore") which results in a total of 27% of linguistic errors. And about 66% of linguistic errors in the previous translated texts from Arabic to English (Descriptive text of Damascus and the expressive text of The Fall of Seville).

On the other hand, Reverso Context attempts to provide translations in context by offering sentence examples. However, the contextual examples do not cover all possible meanings of a word or a phrase in a specific context. It relies on dictionary-based translation, without paying taking the linguistic rules into consideration. This only results in total 80% of linguistic errors in the previous translated texts from Arabic to English (Descriptive text of Damascus and the expressive text of The Fall of Seville). And making up 38% of linguistic errors when translating from English to Arabic (Descriptive text from "The Raven" and expressive quote from the novel "Kafka on The Shore"). As explained below:

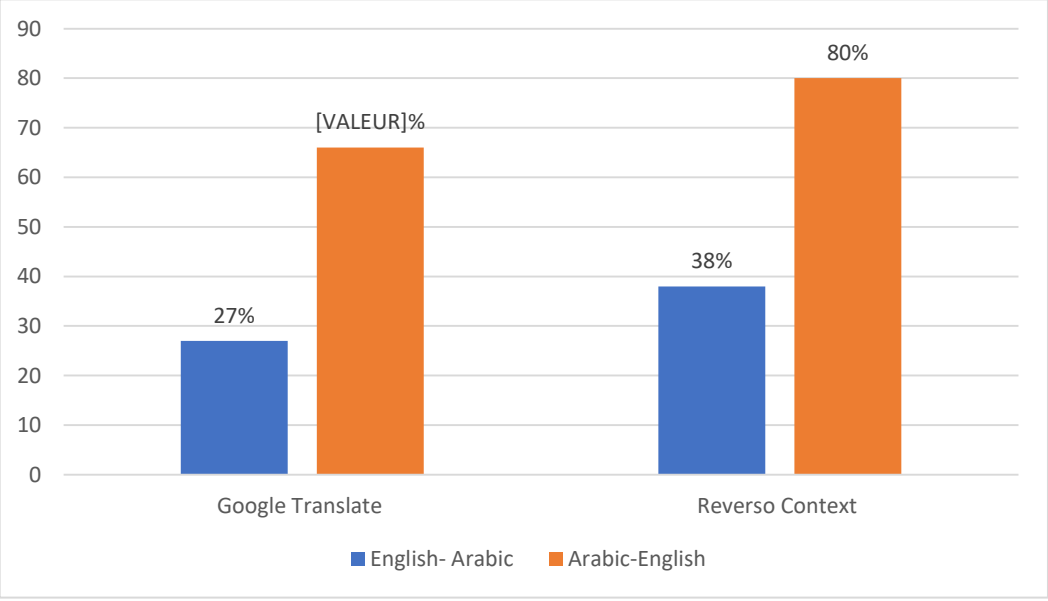

Figure 07: Evaluation of Google Translate and Reverso Context outputs.

Both Google Translate and Reverso have generated acceptable quality of translation. However, Google Translate tends to perform better with more common and widely used phrases, thanks to the neural machine translation approach it relays on. While Reverso often failed in handling idiomatic expressions and context-specific translations because its system relays on the statistical machine translation approach. This difference in underlying translation technologies can impact the performance and accuracy of the translations provided by each system.

The diacritical marks (vowel signs) used in Arabic, known as "Tashkeel," play a significant role in translation. They help clarify the meanings of words and sentences since they are considered as vowels, providing a higher level of accuracy, by differentiating between sounds. From the Arabic texts translated before we can say that Google Translate and Reverso Context systems succeeded in decoding and understanding these marks in some cases. However, they generated wrong translations and caused confusion and ambiguity in the most of the examples (as in: example n=2 in the analysis of the descriptive text of Damascus). Omitting or neglecting the diacritical marks can result in a change in meaning.

3.4. Human Translation Vs Machine Translation:

While Machine Translation has made significant advancements in recent years, it still falls short of human translation in terms of accuracy, contextual understanding, fluency, and domain-specific knowledge. It still faces certain limitations in capturing nuanced meanings and idiomatic expressions, often resulting in inaccurate or nonsensical translations. Additionally, machine translation heavily relies on available training data, making it less effective for languages with limited resources. Ambiguous or polysemous words pose a challenge, as machines struggle to accurately determine the intended meaning without sufficient context. Its systems are sensitive to errors and inconsistencies in the input, and even minor mistakes can propagate throughout the translation.

Human translation, performed by professional translators have a deep understanding of both the source and target languages, allowing them to accurately convey the intended meaning of the text, and offers a higher level of quality, capturing the nuances and subtleties of the source text accurately. They are more likely to reflect the appropriate tone, style, and register of the original content. However, it is important to note that human translation is more time-consuming and costly compared to machine translation.

Machine translation can be suitable for quick and basic understanding like traveling for instance, while human translation is essential for content that requires a high level of accuracy, fluency, cultural adaptation, and domain-specific expertise.

Conclusion:

In this chapter, we attempt to evaluate the MT quality by analysing English-Arabic and Arabic-English descriptive and expressive texts. This evaluation was done based on the translation norms (linguistic criteria). The quantitative analysis results in a percentage of 54% of MT accuracy.

The statistics introduced before (see page 64) shows that translation carried out by humans is generally more precise and accurate than machine generated translation. Human translators possess a profound understanding of the source and target languages. They have extensive knowledge of grammar, vocabulary, idiomatic expressions, and cultural nuances. This enables them to accurately interpret the meaning of the original text and convey it effectively in the target language. They have the ability to detect mistakes without requiring guidance, the precision of machine translation has always been a significant issue when compared to that of a professional translator.

This study showed that the two MT systems evaluated did not generate a high qualified translation compared to the human translation.

General Conclusion

This research was conducted to investigate the role of Artificial Intelligence (AI) in developing Machine Translation (MT) quality. The findings of this study can be explained as the following:

- The development of MT quality is significantly influenced by artificial intelligence (AI). AI has contributed to improving machine translation in many key aspects including: neural machine translation (NMT), training on large corpora, contextual understanding, domain Adaptation, continuous learning and improvement, and post-editing assistance. AI, particularly deep learning techniques, has transformed machine translation through the creation of neural machine translation models. It allows MT systems to be trained on vast amounts of bilingual and multilingual data (the case of Google Translate).
- By using AI algorithms, translation models can process and analyse extensive text corpora. This data-driven approach helps improve translation accuracy, fluency, and context sensitivity.
- AI techniques, such as deep learning and natural language processing, enable machine translation systems to better understand the contextual meaning of words and phrases.
- AI empowers machine translation systems to learn and improve over time. Its algorithms can analyse user interactions and incorporate user feedback to make iterative improvements to the translation quality.
- AI-powered machine translation tools can assist human translators by providing suggestions (the case of Reverso Context) and options during the post-editing process. This collaboration between human translators and AI tools can enhance productivity and ensure high-quality translations.

Although the evolvement of these developed technologies, and based on the data we have gathered machine translation cannot reach the level of human translation accuracy. The human mind operates with logic, emotions, and perception that can result in an exact translation, whereas MT has its own thought process that frequently produces imprecise outcomes for human understanding. This is a primary reason why humans are superior to machine translation.

Machine translation cannot replace human translation. But, the collaboration between human translators and MT systems has become increasingly important in the translation industry. While MT systems provide efficiency and speed, human translators contribute their

linguistic skilfulness, cultural understanding, and creativity to refine and improve the translation output. This collaboration leads to high-quality translations that balance the advantages of AI technology with human linguistic capabilities.

The findings of this study are quite limited by the nature of the research corpus and the type of MT systems used (Google Translate and Reverso Context). However, this study would add a significant insight to the field of translation in general, and would help perfectional translators, trainees and language learners in specific. It is important also to individuals who have a keen interest in understanding and acquiring knowledge about artificial intelligence, machine translation and online technologies.

Further studies mentioned in the last part of this dissertation would complete our study and can provide valuable insights into improving the role of AI in MT quality and contribute to the ongoing development of AI-aided machine translation.

Appendices

Appendix 01

“Sometimes fate is like a small sandstorm that keeps changing directions. You change direction but the sandstorm chases you. You turn again, but the storm adjusts. Over and over, you play this out, like some ominous dance with death just before dawn. Why? Because this storm isn’t something that blew in from far away, something that has nothing to do with you. This storm is you. Something inside of you. So, all you can do is give in to it, step right inside the storm, closing your eyes and plugging up your ears so the sand doesn’t get in, and walk through it, step by step. There’s no sun there, no moon, no direction, no sense of time. Just fine white sand swirling up into the sky like pulverized bones. That’s the kind of sandstorm you need to imagine.

And you really will have to make it through that violent, metaphysical, symbolic storm. No matter how metaphysical or symbolic it might be, make no mistake about it: it will cut through flesh like a thousand razor blades. People will bleed there, and you will bleed too. Hot, red blood. You’ll catch that blood in your hands, your own blood and the blood of others.

And once the storm is over you won’t remember how you made it through, how you managed to survive. You won’t even be sure, in fact, whether the storm is really over. But one thing is certain. When you come out of the storm you won’t be the same person who walked in. That’s what this storm’s all about.” **– Haruki Murakami, Kafka on The Shore.**

Human Translation

القدر أحياناً كعاصفة رملية صغيرة لا تنفك تغير اتجاهاتها. وأنت تغير اتجاهاتك، لكنها تلاحقك. تراوغها مرة بعد أخرى، لكنها تتكيف وتتبعك. تلعب معها هكذا مراراً، كرقصة مشؤومة مع الموت في الفجر.

لماذا؟ لأن هذه العاصفة ليست شيئاً يهب فجأة من بعيد، ليست شيئاً لا يمت لك بصلة، إنها أنت. إنها شيء ما في داخلك. وكل ما عليك فعله هو ان تستسلم لها. أدخل إليها مباشرة. أغمض عينيك، وسد أذنيك حتى لا تتسلل الرمال إليهما، وسر في العاصفة، خطوة بعد خطوة. ليس من شمس هناك، ولا قمر، ولا اتجاهات، ولا إحساس بالزمن. فقط دوامة من الرمال البيضاء الناعمة تصعد إلى السماء كعظام مطحونة، هذه هي العاصفة التي عليك أن تتخيلها

وعليك حقًا أن تنجو من وسط تلك العاصفة العاتية الميتافيزيقية الرمزية، بغض النظر عن مدى ميتافيزيقيتها أو رمزيتها. الخطأ ممنوع: ستقطع العاصفة الجلد كآلاف الأنصال. سينزف الناس هناك، وستنزف أنت أيضاً، ستنزفون جميعاً دماً أحمر حاراً. وستمسك أنت هذا الدم بيديك، دمك، ودم الآخرين

ولحظة انتهاء العاصفة، لن تتذكر كيف نجوت منها، لن تتذكر كيف تدبرت أمرك لتنجو. ولن تدرك هل انتهت العاصفة أم لا. لكن ستكون متيقناً من أمر واحد فقط: حين تخرج من العاصفة، لن تكون الشخص نفسه الذي دخلها، لهذا السبب وحده، وجدت العاصفة

Machine Translation:

- **Google Translate**

"القدر أحيانًا يشبه عاصفة رملية صغيرة تستمر في تغيير الاتجاهات. أنت تغير الاتجاه لكن العاصفة الرملية تطاردك. تستدير مرة أخرى، لكن العاصفة تتكيف. مرارا، تلعب هذا، مثل بعض الرقص المشؤوم مع الموت قبل الفجر. لماذا؟ لأن هذه العاصفة ليست شيئًا ينفجر من بعيد، شيء لا علاقة له بك. هذه العاصفة هي أنت. شيء بداخلك. وكل ما يمكنك فعله هو الاستسلام لها، والخطوة مباشرة داخل العاصفة، وإغلاق عينيك وسد أذنيك حتى لا تدخل الرمال، والمشي عبرها، خطوة بخطوة. لا توجد شمس هناك، ولا قمر، ولا اتجاه، ولا معنى للوقت. مجرد رمل أبيض ناعم يحوم في السماء مثل العظام المسحوقة. هذا هو نوع العاصفة الرملية التي يجب أن تتخيلها.

وسيكون عليك اجتياز تلك العاصفة العنيفة الميتافيزيقية الرمزية. بغض النظر عن مدى كونه ميتافيزيقيًا أو رمزيًا، لا تخطئ في ذلك: سوف يقطع اللحم مثل ألف شفرة حلاقة. سوف ينزف الناس هناك، وسوف تنزف أيضًا. دم أحمر حار. سوف تلتقط تلك الدماء في يديك ودمك ودم الآخرين.

وبمجرد أن تنتهي العاصفة، لن تتذكر كيف نجحت، وكيف تمكنت من البقاء على قيد الحياة. لن تكون متأكدًا، في الواقع، ما إذا كانت العاصفة قد انتهت حقًا. ولكن شيء واحد مؤكد. عندما تخرج من العاصفة لن تكون نفس الشخص الذي دخل. هذا ما تدور حوله هذه العاصفة

- **Reverso Context**

"أحيانًا يكون القدر مثل عاصفة رملية صغيرة تستمر في تغيير الاتجاهات. أنت تغير الاتجاه لكن العاصفة الرملية تطاردك. تستدير مرة أخرى، لكن العاصفة تتكيف. مرارًا وتكرارًا، تلعب هذا، مثل بعض الرقصات المشؤومة مع الموت قبل الفجر بقليل. لماذا ؟ لأن هذه العاصفة ليست شيئًا انفجر من بعيد، شيء لا علاقة له بك. هذه العاصفة هي أنت شيء ما بداخلك لذا، كل ما يمكنك فعله هو الاستسلام لها، والخطوة مباشرة داخل العاصفة، وإغلاق عينيك وتوصيل أذنيك حتى لا تدخل الرمال، والمشي من خلالها، خطوة بخطوة. لا توجد شمس هناك، ولا قمر، ولا اتجاه، ولا إحساس بالوقت. مجرد رمال بيضاء ناعمة تدور في السماء مثل العظام المسحوقة. هذا هو نوع العاصفة الرملية التي تحتاج إلى تخيلها.

وسيتعين عليك حقًا تجاوز تلك العاصفة العنيفة والميتافيزيقية والرمزية. مهما كانت ميتافيزيقية أو رمزية، فلا تخطئ في ذلك: ستقطع اللحم مثل ألف شفرة حلاقة. سوف ينزف الناس هناك، وسوف تنزف أيضًا. دم أحمر ساخن. سوف تمسك ذلك الدم في يديك، دمك ودماء الآخرين.

وبمجرد انتهاء العاصفة، لن تتذكر كيف نجحت في ذلك، وكيف تمكنت من البقاء على قيد الحياة. لن تكون متأكدًا، في الواقع، مما إذا كانت العاصفة قد انتهت حقًا. لكن هناك شيء واحد مؤكد. عندما تخرج من العاصفة لن تكون نفس الشخص الذي دخل. هذا ما تدور حوله هذه العاصفة."

Appendix 02

“The Raven” by Edgar Allan Poe

Once upon a midnight dreary,

While I pondered, weak and weary,

Over many a quaint and curious

Volume of forgotten lore—

While I nodded, nearly napping,

Suddenly there came a tapping,

As of someone gently rapping,

Rapping at my chamber door.

'"This some visitor," I muttered,

"Tapping at my chamber door

Only this, and nothing more."

Human translation

في مُنتصفِ ليلةٍ كئيبة،

في غمرة إنهاكي وضَجَري،

أثناءَ انكبابي على كتبٍ طريفةٍ غريبةٍ عن المَعارفِ المنسية،

.مالَ رأسي، كِدتُ أغفو

فجأة تناهى لسمعي صَوتُ دَق،

.كأن أحداً برِفقٍ على بابِ حُجرَتي يطرُق

- قلتُ مُتمتماً: "إنه زائر ما، على بابِ حُجرتي يَدُق

".هذا فقط، ولا شيء أكثر

Machine translation:

- **Google Translate**

ذات مرة في منتصف الليل كئيب،

بينما كنت أفكر، ضعيفًا ومرهقًا،

على العديد من غريبة وفضولية

- حجم المعرفة المنسية

بينما أومأت برأسي ، أوشكت على القيلولة ،

فجأة سمع صوت نقر،

اعتبارًا من شخص يغني بلطف،

.قرع على باب غرفتي

"تمتمت: "هذا زائر ما،

النقر على باب غرفتي"

." هذا فقط وليس أكثر

- **Reverso Context**

ذات مرة في منتصف الليل كئيب،
بينما كنت أتأمل، ضعيفة ومرهقة،
أكثر من الكثير من الغرابة والفضول
- حجم التقاليد المنسية
بينما أومأت برأسي، على وشك القيلولة،
فجأة جاء هناك التنصت،
بالنسبة لشخص يغني بلطف،
.الراب على باب غرفتي
هذا بعض الزائر،» تمتمت،»
النقر على باب غرفتي"
." فقط هذا، ولا شيء أكثر من ذلك

Appendix 03

A Descriptive Text of Damascus

دمشق هي بلدٌ قد وَهَبَتْها الطبيعة جمالًا فائقًا، فتراها كثيرةَ الأنهار وافِرَةَ الجنان، قال ياقوت: «قَلَّ أن تمرَّ بحائط إلَّا والماء يخرجُ منه في أنبوب إلى حوضٍ يُشْرَب منه ويَسْتَقِي الواردُ والصادر، وما رأيت بها مسجدًا ولا مدرسةً ولا خانقاهًا إلَّا والماءُ يجري في بركة في صحن هذا المكان ويسبح في منصته»، وهي نضيرة البقاع تحيط بها مِنْ جميع جهاتها الجبالُ وأشهرها جبل قاسيون، وتمتاز بكثرة الفواكه، حتى إنها تُحْمَل إلى مصر وحران، ويصف المقدسي دمشق فيذكر شيئًا عن أحوال اجتماعها فيقول: «دمشق هي مصرُ الشام ودارُ الملك أيامَ بني أمية وثَمَّ قصورهم وآثارهم، بنيانهم خشبٌ وطينٌ، أكثر أسواقها مُغَطَّاة ولهم سوقٌ على طول البلد مكشوفٌ حَسَنٌ ... وهو بلدٌ قد خرقته الأنهار وأَحْدَقَتْ به الأشجار وكَثُرَتْ به الثمار مع رخصِ أسعار، لا ترى أحسن من حماماتها ولا أعجب من فواراتها ولا أجزم من أهلها ... وهي طيّبة جدًّا غير أن في هوائها يبوسة ... ولحومها عاصية ومنازلها ضيقة وأَزقَّتها غامة وأخبازها ردية، والمعايش بها ضيقة».

Human translation

Damascus is a city that nature awarded it with a superb beauty, it has many rivers and abundant gardens, Yakut said: " You can hardly pass by a wall without water flowing from it through a pipe into a basin from which people drink and the comer and goer waters from it. And every mosque, school, or Khanqah you will see water running in a pool in the yard of the place and all over it», its fresh Bekaa surrounded from all sides by mountains, the most famous of which is Mount Qasioun. it's known the plenty of fruits that even get exported to Egypt and Harran. Al-Maqdisi describes Damascus and describes its society, saying: "Damascus is the Egypt of Al-Sham and the Khalifa's House in the days of Ummaya and their palaces and monuments, their buildings are made of wood and mud, most of its markets are covered and they have a market along the country beautiful and exposed... It is a city that has many of rivers, surrounded by trees and plenty of fruits with cheap prices, that sees no better than its bathrooms, there is no more fantastic than its fountains, and no People more assuring than its people... it’s very pure but its air is dry... its meat is rough, its homes are tight, its alleys are narrowed, its bakes are lousy, and its lifestyle is joyless.

Machine Translation:

- **Reverso Context**

Damascus is a country that nature has endowed with a superior beauty, which is seen by many rivers and abundant jinns, Yakut said: "You said to go through a wall, and the water came out of it in a tube to a basin from which it would be drunk and the incoming and outgoing would soak. and what I saw was a mosque, no school, no suffocation, but water running in a pool in the plate of this place and swimming in its platform ", 3 Bekaa's freshness surrounds her from all sides of the mountain, the most famous being Mount Cruel. It has a lot of fruits, even being carried to Egypt and Haran.

Al-Qudsi describes Damascus and says something about the conditions of its meeting, saying: "Damascus is the embassy of Al-Sham and the King's House are illiterate and then their palaces and monuments, their structure is wooden and mud, their most covered market and they have a market along the country well exposed... It is a country that has been burned by rivers, thrown by trees and many fruits with price cheaps, that sees no better than its bathrooms, no admiration for its blowouts, and no assurance from its people... She's very good, but in her air, she's just... Their meat is rough, their homes are tight, their tears are cloudy, their bakes are pink, and their lives are tight.

- **Google Translate**

Damascus is a country that nature has endowed with extraordinary beauty, so you see it with many rivers abundant in paradise. Yaqut said: “Say that you pass through a wall except that the water comes out of it in a pipe into a basin from which it drinks and draws the incoming and the outgoing. In the plateau of this place and swimming in its platform.” It is the lushness of the Bekaa surrounded on all sides by mountains, the most famous of which is Mount Qasioun, and it is distinguished by the abundance of fruits, so that it is carried to Egypt and Harran. Al-Maqdisi describes Damascus, and he mentions something about the conditions of its assembly, saying: “Damascus is Egypt, the Levant, and the king’s house in the days of the Umayyads, then their palaces and monuments. The days of the Umayyads, and then their palaces and monuments, their buildings are made of wood and mud, most of their markets are covered, and they have a market throughout the country that is well exposed…It is a country pierced by rivers, surrounded by trees, abundant with fruits, with cheap prices. You do not see anything better than its baths, nor more amazing than its fountains, and I am not certain of its people... It is very good, except that its air is dry... Its meat is disobedient, its houses are narrow, its alleys are cloudy, its bread is bad, and its living conditions are cramped.

Appendix 04

The Fall of Seville – A Poem by Abu al-Baqa' al-Rundi

فاسأل بلنسية ما شأن مرسية * * * وأين شاطبة أم أين جيانُ

وأين قرطبةُ دار العلوم فكم * * * من عالم قد سما فيها له شأنُ

وأين حمصُ وما تحويه من نزهٍ * * * ونهرها العذب فياض وملآنُ

قواعد كن أركان البلاد فما * * * عسى البقاء إذا لم تبق أركانُ

تبكي الحنفيةُ البيضاءُ من أسفٍ * * * كما بكى لفراقِ الإلف هيمانُ

على ديارٍ من الإسلامِ خاليةٌ * * * قد أقفرت ولها بالكفر عمرانُ

حيث المساجدُ صارت كنائس * * * ما فيهنَّ إلا نواقيسٌ وصلبانُ

حتى المحاريب تبكي وهي جامدةٌ * * * حتى المنابرُ تبكي وهي عيدانُ

يا غافلاً وله في الدهرِ موعظةٌ * * * إن كنت في سنةٍ فالدهرُ يقظانُ

وماشياً مرحاً يلهيه موطنهُ * * * أبعد حِمصٍ تغرُّ المرءُ أوطانُ

تلك المُصيبةُ أنست ما تقدمها * * * ومالها من طوالِ الدهرِ نسيانُ

يا راكبين عتلق الخيل ضامرة * * * كأنها في مجال السبقِ عقبانُ

وحاملين سيوف الهند مرهفةً * * * كأنها في ظلام النقع نيرانُ

وَرَاتِعِين وراء البحر في دَعَةٍ * * * لَهُم بأوطانهم عزٌ وسلطانُ

أعندكم نبأٌ من أهلِ أندلُسٍ * * * فقد سرى بحديثِ القومِ ركبانُ

كم يستغيثُ بنا المُستضعفُونَ وهم * * * قتلى وأسرى فما يهتزَّ إنسانُ

لمثلِ هذا يبكي القلب من كمدٍ * * * إن كان في القلبِ إسلامٌ وإيمانُ

Human translation

Therefore, ask Valencia what is the state of Murcia; and where is Jativa, and where is Jaen?

Where is Cordoba, the home of the sciences, and many a scholar whose rank was once lofty in it?

Where is Seville and the pleasures it contains, as well as its sweet river overflowing and brimming full?

[They are] capitals which were the pillars of the land, yet when the pillars are gone, it may no longer endure!

The tap of the white ablution fount weeps in despair, like a passionate lover weeping at the departure of the beloved,

Over dwellings emptied of Islam that were first vacated and are now inhabited by unbelief;

In which the mosques have become churches wherein only bells and crosses may be found.

Even the mihrabs weep though they are solid; even the pulpits mourn through they are wooden!

O you who remain heedless though you have a warning in Fate: if you are asleep, Fate is always awake!

And you who walk forth cheerfully while your homeland diverts you [from cares], can a homeland beguile any man after [the loss of] Seville?

This misfortune has caused those that preceded it to be forgotten, nor can it ever be forgotten for the length of all time!

O you who ride lean, thoroughbred steeds which seem like eagles in the racecourse;

And you who carry slender, Indian blades which seem like fires in the darkness caused by the dust cloud [of war],

And you who are living in luxury beyond the sea enjoying life, you who have the strength and power in your homelands,

Have you known news of the people of Andalus, for riders have carried forth what men have said [about them]?

How often have the weak, who were being killed and captured while no man stirred, asked our help?

The heart melts with sorrow at such [sights], if there is any Islam or belief in that heart!

Translation by: Olivia Remie (1997). http://lostislamichistory.com/about/

Machine translation

- **Reverso Context**

Ask Valencia what Marsi * * * is and where Shatiba or where Jian is

And where the Dar Al-Science Cordopus is how much * * * of a world it has been named after.

Where is Homs and its picnic * * * and its fresh river is white and burning

The rules of be the pillars of the country.

The white tap cries from the regret of * * * as it cried to the teams of a thousand dominant

On the houses of Islam are empty * * * has been forgiven and has disbelief Omran

Where mosques have become churches * * * in which there are only bows and crosses

Even the warriors are crying and they're rigid.

O heedless, and he has an admonition in time * * * If you are in a year, then time is alert

And with a fun walk, his home * * * farthest roasts tempt one's homelands.

That hit you forgot what a * * * and her money is so long.

Hey, two riders. Horses are dumped.

And holding India's swords is as cumbersome as it is in the darkness of soaking fire.

They have their homelands and authority behind the sea.

I'm telling you the people of Andalusia.

How vulnerable are we, who are * * * dead and prisoners of human shaking.

For example, the heart cries as much as * * if it is in the heart Islam and faith

- **Google Translate**

Ask Valencia what is the matter with Murcia * * * and where is Xtiva or where is Gian

And where is Cordoba, the House of Sciences? How many * * * scholars have been eminent in it

And where is Homs, and what it contains of promenades * * * and its sweet river is overflowing and full

Rules Be the pillars of the country, so what * * * may it survive if there are no pillars left

The white tap is crying out of sorrow * * * As he cried for the separation of Alf Heyman

On an empty land of Islam * * * it has been desolate, and it has Imran in disbelief

Where mosques have become churches * * * There are only bells and crosses in them

Even the mihrabs weep while they are rigid * * * Even the pulpits weep while they are sticks

O heedless, and he has an admonition in time * * * If you are in a year, then time is alert

Walking merrily, distracted by his homeland * * * The farthest hummus deceives a person from homelands

That calamity has forgotten what it has presented * * * and its money has been oblivion for all eternity

O riders, the horses hang lean * * * as if they were eagles in the field of racing

And carrying slender swords of India * * * As if in the darkness of soaking fires

And they graze beyond the sea in peace * * * They have glory and power in their homelands

Do you have news from the people of Andalus * * * The story of the people was conveyed by riders

How often the oppressed cry out to us while they are * * * dead and prisoners, so no one is shaken

For such a person, the heart cries from grief * * * if there is Islam and faith in the heart

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Recommendations

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الملخص

الترجمة الآلية، التي تعتمد على الذكاء الاصطناعي غيّرت طريقة تجاوز حواجز اللغة في عالمنا اليوم المترابط سيكشف هذا البحث الدور الذي يلعبه الذكاء الاصطناعي في تحسين جودة الترجمة الآلية. من خلال استخدام خوارزميات متطورة برامج مدعمة حديثة، حيث حققت أنظمة الترجمة الآلية التي تعتمد على الذكاء الاصطناعي تقدمًا كبيرًا في الدقة والطلاقة والسياق، والتحقيق في التقنيات الرئيسية المستخدمة في الترجمة الآلية القائمة على الذكاء الاصطناعي. يركز هذا البحث على تقييم جودة الترجمة الآلية من خلال مقارنتها بالترجمة البشرية، بهدف توفير رؤى حول نقاط القوة والصعوبات التي تواجه أنظمة الترجمة الآلية. تستخدم الدراسة نهج التحليل المقارن، حيث تضع النصوص المترجمة آليًا في مقابل النصوص المترجمة بشريًا. يتم فحص مجموعة متنوعة من الميزات اللغوية والنصية، بما في ذلك الدقة والطلاقة والقواعد اللغوية لقياس فعالية مخرجات الترجمة الآلية في استخراج المعنى المقصود. لإجراء التقييم، تم اختيار مجموعة من النصوص التعبيرية والوصفية المكتوبة باللغتين العربية والإنجليزية. تتضمن عملية الترجمة مترجمًا محترفًا ونوعين مختلفين من تطبيقات الترجمة الآلية عبر الإنترنت: ترجمة جوجل وReverso Context .

لقياس مدى استخدام هذه الآلات لتقنيات الذكاء الاصطناعي المطورة لتحسين جودة الترجمة يقدم التحليل المقارن فكرة حول الصراع بين الترجمات البشرية والآلية ويحدد المجالات التي يمكن تحسين الترجمة الآلية فيها. كما أنه يحدد قيود الترجمة الآلية، لا سيما في التقاط التعبيرات السياقية وفهم الصور البيانية والمعنى المجازي. من خلال تحديد نقاط القوة والضعف في أنظمة الترجمة الآلية، تسعى هذه الدراسة إلى مساعدة طلاب الترجمة والمتدربين في اختيار أفضل أداة ترجمة تسهل عليهم التواصل الفعال عبر اللغات.

الكلمات المفتاحية: الترجمة الالية، الذكاء الاصطناعي، جودة الترجمة، ترجمة غوغل، ترجمة ريفيرسو كونتيكست، تقويم الترجمة.

Résumé

La traduction automatique, propulsée par l'intelligence artificielle (IA), a révolutionné de manière spectaculaire la façon de surmonter les barrières linguistiques dans notre monde interconnecté. Cette étude explore le rôle crucial joué par l'IA dans l'amélioration décisive de la qualité de la traduction automatique. Grâce à des algorithmes sophistiqués et à des réseaux neuronaux de pointe, les systèmes de traduction automatique ravitaillés par l'IA ont réalisé des progrès considérables en termes d'exactitude, de fluidité et de prise en compte du contexte, en étudiant les composantes clés et les techniques utilisées dans la traduction automatique basée sur l'IA. Cette recherche se concentre sur l'évaluation de la qualité de la traduction automatique en la comparant à la traduction humaine, dans le but de fournir des informations sur les forces et les limites des systèmes de traduction automatique. Une approche d'analyse comparative est adoptée, comparant des textes traduits par des machines à des textes traduits par des humains. Diverses caractéristiques linguistiques et textuelles, telles que l'exactitude, la fluidité et la grammaire, sont examinées afin de mesurer l'efficacité des résultats de traduction automatique dans la

saisie du sens voulu. Pour mener l'évaluation, un corpus de textes expressifs et descriptifs rédigés en arabe et en anglais a été sélectionné. Le processus de traduction implique un traducteur humain professionnel et deux types différents d'applications de traduction automatique en ligne : Google Translate et Reverso Context, ceci permet de déterminer dans quelle mesure ces machines utilisent des technologies développées par l'IA pour améliorer la qualité de la traduction. L'analyse comparative offre des perspectives précieuses sur la différence entre les traductions humaines et automatiques, et identifie les domaines dans lesquels la traduction automatique peut encore être améliorée. Elle met également en évidence les limites de la traduction automatique, notamment en ce qui concerne la compréhension des expressions contextuelles, idiomatiques et des références spécifiques à une culture. En identifiant les forces et les faiblesses des systèmes de traduction automatique, cette étude vise à aider les étudiants et les stagiaires en traduction à choisir le meilleur outil de traduction pour faciliter une communication efficace entre les langues.

Mots clés : Traduction automatique, Intelligence artificielle, Qualité de la traduction, Google Translate, Reverso Context, Evaluation.