Machine Translation

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Introduction:

This paper offers a brief but condensed treatment of Machine Translation (MT). It examines these aspects: Types of MT, History of MT, Research Methods, the workstations and the evaluation of MT.

Translation as an art of rendering a work of one language into another is as old as written literature. In this modern civilization of ours the need for translation is ever growing and its importance in the field of business, economics and industrialization can't be ignored. These needs coupled with the modern scientific advancements paved the way to the conception of modern machine translation, which is:

> "An automatic translation of one language into another by means of a computer or another machine that contains a dictionary, along with the programs needed to make logical choices from synonyms, supply missing words and rearrange word order as required for the new language."[1]

With the emergence of Personal Computers (PC) machine translation gained a strong momentum giving birth to commercially available software and hardware with translation tools and powerful dictionaries. But relentless research on the development of MT is going on to tackle problems in the various fields of application.

> "Ideally, machine translation is a batch process which is applied to a given text which produces a perfect translated text which then only needs to be printed out. Although a lot of programs on MT have been introduced to the market since the outset of PC, they can only be applicable to certain situations. Several government- funded research projects came up with a machine which could meet their needs. These projects have shed light on various angles of the machine translation applications and opened the horizon for further studies. Machine translation is not a theoretical science; it is the application of computational linguistics methods and techniques to a practical task. It is a means to an end: the communication of a message or information in a language other than that originally composed; it is a task which has never been and cannot be perfect. There are always the possibilities of multiple translations of the same text of requirements. MT is different; there cannot be a perfect automatic translation. The use of an MT system is contingent upon its cost effectiveness in practical situations."[2]

The development of PC- based MT programs of today is deeply influenced by the theories of two important figures in the history of machine translation. The introduction of computer in the machine translation was advocated by Warren Weaver and the machine translation development based on (Man-Machine) symbiosis, was highly given emphasis by Bar-Hillel. These were the dissenters of the perfectionist tendency in the machine translation research and development. This type of MT is referred to as Machine-Aided Human Translation (MAHT).

> "This is (Human aided) machine translation wherein translation is performed by the computer and humans are involved in pre-editing, post-editing, or answering questions to disambiguate the source text."[3]

There are several approaches which are being adopted by different MT systems in a period of more than 50 years of research and development.

The importance of machine translation in a world of information

Undoubtedly, the role of MT in the world of information can no longer be ignored. This is represented by the system's ability to convey sufficient information so that one can gain necessary information from it.

With the emergence of the world wide web of information channels, millions of users all over the world can gain access to the information superhighway, thereby speakers of different languages will avail themselves of the automatic translation service.

> "MT can be an effective tool for the facilitation of multi-lingual on line discussions allowing users who speak different languages to communicate with one another and promote the globalization of information highway."[4]

As the computer-based translation activities are expanding, they embrace any process which will result in the production of texts, documents in bilingual and multilingual contexts. There is a possibility that MT will be seen as the most significant component in the facilitation of international communication and understanding in the future "information age". And the integration of automatic machine translation technology in the on-line environment is the potent force that initialized its importance in the world of information.

There will be a speedy transfer of comprehensive information between people with different languages through the world wide networks with a considerably fast and competent translation system and in the same way transmit information ranging from political , economic, socio-cultural topics.

> "If we consider the increasing use of international telecommunication networks like Internet, and even if we assume that English will dominate the international information traffic, it is evident that there will be a great need for informative translation, especially from English to other languages and from other languages to English." [5]

This will open more gates and venues for future developments considering the generation of a bulk of multi-lingual data base and power dictionary and tools; the development of powerful PC software and hardware; and more user participation that will serve as a feedback to developers and researchers. These will be a major factor in the development of a more flexible and cost effective translation system.

"When launching MT, Warren Weaver (1949) emphasized the role of translation in global communication. He began his memorandum with the statement:

"There is no need to do more than mention the obvious fact that a multiplicity of languages impedes cultural interchange understanding." In the context of the international network of communication, there will still remain the barriers of language for which computer based translation must play a major part. Is the MT community prepared to rise to the challenge of developing systems for global information society of the next century in which almost anyone anywhere might need translation facilities at any time for a multiplicity of documents, texts and messages?

History of machine translation

MT got off the ground in the late forties right after the World War II and there were several events which led the development of machine translation.

MT was constrained by several factors: limitation of hardware particularly, inadequacy of memories and slow access and unavailability of high level programming language. The linguistic study was not correlated with machine translation research, so researchers relied on the dictionary- based approach and the application of statistical method."

Military intelligence needs were the main concern of the translation task in this period. Translating large volumes of technological research gave a boost to the American Industrialization.

Faced with technical constraints, early researchers knew that there could be no perfect high quality translation, and suggested human involvement in the translation process. They also proposed the "development of controlled languages and restriction of systems to specific domains."

Christian Boitet has set the criteria concerning the success and failure of machine translation in its first 50 years of research and development. These criteria are the conceptual, engineering, operational, commercial and communicative criteria.

1. The conceptual level concerns primarily the researchers in processing new interesting concepts and demonstrating their feasibility and advantages in laboratory prototypes.

2. The engineering level primarily engages the developers in implementing innovative architects in using better programming technique to build prototypes or system.

3. The operational level primarily concerns the users in running prototypes or systems in a cost efficient and satisfactory way under operational conditions.

4. The commercial level concerns vendors and should be judged in terms of financial returns not the number of installations or client.

5. The communicative level concerns the image that decision - markers and the general public will form about the field in general.

In March 1947, Warren Weaver, proposed the incorporation of computer in the translation process. This was the beginning of the pioneering period which lasted until the production of the first operational translation system. In 1954 under the collaboration of IBM and a group from Georgetown University, the demonstration was a "big success' and led to the establishment of more MT research centers. It generated a lot of funds from potential sponsors and gained a lot of backing from the general public with the belief that ' a good quality output is achievable,

considering the emergence of the "great development of computer hardware, the programming of language and most of all the development of syntactic analysis" in this period. Though it is not yet known which method would likely succeed, a lot of projects were undertaken and encouraged in US and throughout the world. In the period from 1950's to mid 1960's several approaches were first put forward.

There were also early attempts in Russia. There were several researchers from the associated republics that joined force for the development of MT. These attempts achieved success at the conceptual and engineering level considering the available computer resources and the close cooperation between a brilliant linguist and a mathematician who became computer specialists.

A fully automatic high quality translation was the ambition of MT research. There was a search for theories and methodologies that can achieve a "perfect "translation that is free from human intervention. The proponents of the first operational system did not shoot fort perfectionism. They knew and acknowledged that there were certain limitations of MT in producing a useable translation.

> "This period also can be noted for an almost total neglect of the expertise of professional translators. " There was no consideration on how to use the "less than perfect" systems economically and effectively in practice. This is in contradiction to what the researchers proposed-"that MT systems could progress by the cyclical improvement of imperfect approaches; i.e., an application of the engineering feedback mechanism with which they are familiar."[6]

In 1966 the Automatic language processing Advisory Committee (ALPAC) set up by US research sponsors released a report that Machine translation failed by its own criteria. This put an end to many MT research projects in the US and throughout the world. But there were a few companies in US who insisted on not believing the ALPAC report. Boitet inferred that the first attempt failed only in the communicative level. The reasons for this failure were: researchers were completely unaware of the mockup effect, and made hasty promises that machines would replace humans in the translation task, MT cheaters were diverting funds to more fundamental areas of research; and the ALPAC report itself was distorted that they did not bother to consider the result of the first operational system at military sites in the US and the Ispra European nuclear facility in Italy.

> "Even if the ALPAC report brought to an end many MT projects, it did not banish the public perception of MT research as essential search for fully automatic solutions."[7]

Research in Japan and England started ten years after it had started in the US. Some laboratories in England such as in Cardiff and in Manchester had been established. And in Japan a thesis on a prototype of English- Japanese MT was written by Sugita in 1968. These lines of MT research which were quite interesting died out because of communicative failure in the US and the dependence of the two countries of views of the US at that time.

In France, the CETA system was established in 1960 in Paris and Grenoble, when researchers of the Paris branch estimated that the problem of Fully Automatic High Quality Machine Translation (FAQMT) was insolvable and decided to turn to more fundamental studies. At Grenoble, B. Vauqois persisted and tried to experiment with new techniques to produce a result at least better than the existing systems and conduct evaluation on their ability on large corpora." These systems certainly achieved a big success in the levels of Conceptual, Engineering and Communicative

aspects. This period was noted by the introduction of Ariane- 78 which produced the first complete translation

in 1977. This was also coupled by the availability of computer screens and the emergence of two new paradigms: MT-W for information gathering and MT-R for information dissemination. This time is also noted for the famous congress or overcoming language barrier organized by DG XIII of the Commission of the European Communities and the beginning of anxious efforts by European scientists to produce a European system for EC. There was no operational and commercial success at this time because of the immaturity of the prototypes which were in service.

The systran system was quite successful in MT-W as it has been installed and developed by Latsec. And Logos system which was founded during the time of ALPAC report was abandoned after the Vietnam War. This period was followed by English System by Latsec for Apollo- Soyuz operation and research on English-Chinese at Berkely and German -English at Austin.

> "The subsequent history of MT is in part the story of how this mistaken emphasis of the early system has had to be replaced."[8]

The MT research has turned to be more practical and the involvement of human translators has been accepted as an integral part of translation system. Since the early 1970s development has continued in three main strands: computer -based tools for translators, operational MT systems involving human assistance in various ways, and the pure theoretical research towards the improvement of MT methods.

The mid-seventies is considered to be the revival period which witnessed the installation of Systran in the European community and the success of the Meteo System in Canada. The following were the busy years of research and development of the new approach, the indirect systems, i.e. rule based syntax-oriented stratification with abstract transfer representation. There are some dominant paradigms in this period using the transfer approach like Ariane, Eurotra and Mu systems.

> "There was also an attempt for rule -based interlingual models like DLT, Roseta and at Carnegie- Nellon University and at the same time first commercial systems appeared, including PC -based software."[9]

the ؛BM Candide projectbased I -new approach emerged like the statistic another ،١٩٨٩In based and-constraint lexicalist tendencies in rule-based MT, and systems for monolingual use. At this time also was the commercialization of the transfer approach, indirect MT systems (Metal, Pivot, Atlas/II, Astransac, etc.) and the subsequent development of the user-specific custom built systems based on MT research. The political system in Eastern Europe greatly affected the MT activity in the period and caused some to cease and some have survived until the present time.

In Asia the contribution of multilingual CICC (Center for the International Cooperation for Computerization) project is well known for the collaborative research efforts involving MT group in China, Malaysia and Thailand. Malaysia is one of the main centers of MT activity and its involvement in Machine translation started in the early 80s, with the establishment of its first machine translation center at the University of Malaysia in Penang. The center was established through the collaborative efforts with the University of Grenoble of France to build English- Malay MT. The second Malaysian MT center emerged at the University of Technology (UTM) in Kuala Lumoer. The center is based on research and development laboratory working on natural language processing which started in 1981 and consequently the unit became the secretariat and main

laboratory for KANTA project. KANTA is the Malaysian version of multilingual MT research project and this was being carried out between Japan, Thailand, Indonesia, China and Malaysia. A major research project for several years now is the JEMAH system inspired by Grenoble ARINE approach to MT.

In Korea, a considerable research has been done; some through the cooperation of countries like Japan and the US such as "HESS, KSHALT, & MATES (Machine Aided Translation Environment, and a transfer based system for English Korean Translation developed by Systems Engineering Research Institute "Korean Institute of Science and Technology since 1989."

MT has taken long strides in research and development, but still it has a long way to go. With present computer developments and its viability for integration to Machine Translation, there is a wide horizon for huge developments in all aspects of MT.**MT Approaches:**

Rule-Based MT (RBMT)

This MT approach requires analysis and representation of the meaning of source language texts and the generation of equivalent target language texts. Representation should be unambiguous lexically and structurally. There are two major approaches:

(a) The transfer approach in which translation process operates in three stage-analysis into abstract source language representations, transfer into abstract target language representations and generation or synthesis into target language text.

(b) The two stage 'interlingua' model where analysis into some language-neutral representation starts from this interlingual representation. Ariane and Eurotra are two significant transfer based projects of the 1980's.

These two models incorporate batch processing with post-editing and non- interactive components, essentially-syntax -oriented, with analyses and generation passing through a series of levels (morphological, syntactic, deep syntactic, semantic) and making little use of pragmatic or discourse information.

One of the important contributions of the rule-based interlingua approach has been done at Carnegle Mellon University, where a team worked on Knowledge- Based MT system (KBMT).

Knowledge -based approach is founded on the assumption that translation must go beyond linguistic knowledge and must involve understanding. Japan also had a number of interlingua projects such as NEC's Pivot system.

Constraint-based formalism, which is an approach that includes lexical-functional grammar (LFG), inspired by work of Kay on transformational linguistics. Another one is the functional unification grammar formalism of Kay (1984) which is greatly influenced the current rule-based MT research. The logic of programming which is derived ultimately from Q-system formalism of AUMT project, but is known through Prolong programming language. From this came Definite Clause Grammar and also such formalisms as the Siot Grammar found in LMT (Logic Programming MT). The major attraction of Unification- and constraint- based formalism is their

inherent reversibility- a feature which is assumed to be particularly desirable for bi-directional MT systems.

Principles- Based MT. A third one is Principles- Based MT which concerns the MT research in the framework of the principles and parameters approach, manifested in syntax as the Government-Binding Theory. The basic premise is that there are universal principles which hold across all languages. Distinction between languages is accounted for by different settings of the parameters, syntactic and lexical- semantic. The best known example is the UNITRAN, an interlingua-based system which has two processing components: syntactic processing for the acceptance and production of grammatically correct sentences, and lexical-semantic processing for deriving an underlying conceptual representation and for matching this to appropriate target language structures. The advantage claimed for this approach is that separate analysis and generation processors do not have to be written for each language.

Lexicalist approach, the essence of the lexicalist approach in MT design is to reduce transfer rules to simple billingual lexical equivalencies. The requirement for structural representations -common to both transfer and interlingua approaches is abandoned in favor of sets of semantic, synthetic constraints on lexical items. Translation involves the identification of the target language lexical items which satisfy the semantic constraints attached to the source language lexical equivalents. The bag of target lexical items is then shaken to generate the output text conforming to the syntax and semantics of the target language.

CORPUS-BASED MT (CBMT)

This is considered as the approach of the new era for machine translation. Among the corpus-based approaches we should distinguish between:

(a) The direct use of information derived from corpora for the analysis, transfer and generation of translations.

(b) The indirect use of copora as sources of information for deriving or compiling lexical, grammatical and knowledge databases, and as sources of statistical information about source and target language.

The first group comprises the statistic-based, example-based and connectionist approaches to MT system design. Within second group falls the range of activities concerned with databases compilation, lexical and knowledge acquisition and the use of statistical information in otherwise rule-based systems.

Statistical -based MT. A striking feature is the use of stochastic methods as virtually the sole means of analysis and generation. One of the best examples is the IBM Candide research project which is based on a large corpus of the Canadian Hansard which records parliamentary debates in both English and French. The essence of the method is the alignment of sentences in the two languages and the calculation of the probabilities that any one word is a sentence of one language corresponds to two, one or zero words in he translated sentence in the other language. Alignment is established by a technique widely used in speech recognition. The probabilities are estimated by matching bigrams (two consecutive words) in each English sentence against bigrams in equivalent French sentence.

Example-based MT. This method was first proposed in the mid 1980's (Nagao 1984). The basic argument is that translation is often a matter of finding or recalling analogous examples, discovering and remembering how particular source language expression or something similar has been translated before. The development of larger databases with faster access made the computational implementation of the idea feasible. In essence, the method relies on a bilingual database of example phrases derived from a large corpus of texts and their translation. The concrete example of this kind of approach was extensively demonstrated by the ATR project known as transfer driven MT.

Connectionist Approach. Connectionism, parallel to computation, are significant developments in the computational modeling of cognition. A distinctive feature is the computation of the strengths of links between nodes of networks and the adjustment of the weightings as a result of actual analyses, i.e. the network learns about the links and their strengths for later use. Another attractive feature is the possibility of computing alternative analysis in parallel. Researchers at CMU concerned with speech translation have made preliminary exploration (Jain et al 1991); Mclean of UMIST (1992) put forward a connectionist method to compute-based MT prototype. In this, all possible analyses of noun modification structures are computed in parallel. The syntactic relationships and level control rules, link control rules defining semantic and syntactic relationships and level control rules defining precedence of alternatives (e.g. of modifying phrases to verbs). The weights of these links are computed by spreading activation across network nodes, and the preferred analyses are calculated.

The development of machine translation is geared towards commercialization of a practical MT system. In the advent of computer revolution there are possibilities for integration of various types of approaches and from there the MT community will be able to carve another unique paradigm of MT for the future.

Types of Machine Translation

The development of machine translation had employed different types of methodology and approaches since the Automatic language processing Advisory Committee report (ALPAC). This report ended many MT projects throughout the world. Though the report became a setback, there was still an undying impetus that gave the boost for the search of a more realistic and practical machine translation.

In more than five decades of research and development, machine translation has evolved into a truly practical system which is now beginning to build its foundation in the world market. The analysis of machine translation's 50 years of history reveals several factors in its success and failures which are determined at several levels such as Conceptual level, engineering level, Operational level, Commercial level. Communicative level which concerns specifically researchers, developers, users, and fund agencies respectively.

> "Christian Boitet, during the Fifth MT Summit in Luxemburg, July 1995, stated that Machine Aided Translation (MAT) should be the correct term to cover all techniques and systems aiming at automating the translation process, whether the bulk of the translation process is done by a machine or by man." [10]

The following are four types of Machine Translation:

1. **MT for Watcher** (MT-W) - This is intended for readers who wanted to gain access to some information written in foreign language who are also prepared to accept possible bad 'rough' translation rather than nothing. This was the type of MT envisaged by the pioneers. This came in with the need to translate military technological documents. This was almost the dictionary- based translation far away from linguistic based machine translation. (e.g. Systran).

2. **MT for revisors (MT-R).** This type aims at producing raw translation automatically with a quality comparable to that of the first drafts produced by human. The translation output can be considered only as brush-up so that the professional translator freed from that very boring and time consuming task can be promoted to revisers" (e.g. Logos system).

The prominent MT-R in the history of machine translation was the one developed by A. Colmerauer. A simple but very powerful rule based specialized language which was used by Canadian Meteorological office to translate the weather bulletin into French. And the result was the first version of TAUM-METRO.

3. **MT for translators (MT-T).** This aims at helping human translators do their job by providing on-line dictionaries, thesaurus and translation memory. This type of machine translation system is usually incorporated into the translation work stations and the PC based translation tools. "Tools for individual translators have been available since the beginning of office automation." And those systems running on standard platforms and integrated with several text processors are the ones that attained operational and commercial success. Some examples of this type of system are SISKEP (English-Malay) and the TWS and MTX both produced by Linguatech. Some tools for professional teams are now available in the market, such as Translation Manager by IBM, Eurolang Optimizer by Site Eurolang and TWB by Trados.

4. **MT for Authors (MT-A).** This aims at authors wanting to have their texts translated into one or several languages and accepting to write under control of the system or to help the system disambiguate the utterance so that satisfactory translation can be obtained without any revision. This is an "interactive MT" which has long been envisaged around 1967 by Kay and Kaplan in the MIND System. "The interaction was however done both during analysis and during transfer, and not by authors, but by specialists of the system and language(s)." TITUS [31] a system which is operationally used in the Textile institute of France, relied on a controlled language and interactive input. N-Tran is another system for writing Japanese. "The implementation was being done on work stations and dialogues were both modal (the user is under the control of the system and must answer) and use specialized linguistic terminology. "ITS-2 and LIDIA are also research products that intended to show how to build disambiguated dialogues for the user to understand. Presently only the JET MT-A system for natural texts can be put into operational use.' In short, there have been no operational successes yet in MT-A, but the designs are becoming increasingly user-oriented and geared towards the right kind of potential users, people users, people needing to produce translations, preferably into several languages.

Research methods for machine translation

The whole history of MT has been based on research. From a mere concept to the generation of complex methods, procedures and integration of several systems, research has extended to the latest discoveries in MT

In MT research systems have often been developed without any idea of how they might be used or who the users might be the main focus of research on machine translation whiles it was still in its infancy was the production of a perfect automatic translation. Linguistics was not even deeply associated with the research process. Many had forgotten that 'machine translation was not a theoretical science; it was the application of computational, linguistic, etc.methods and techniques to a practical task. It is a means to an end: the communication of a message or information in a language other than that which was originally composed.

Though machine translation continues to incorporate new theories and methods side by side with the modern computer technology, there is still a lot of research to be done. As the complex science of machine translation is little by little being subdued by theories and applications, inconsistencies emerge and such inconsistencies should be adapted, modified in the process and used as a key to develop the current system.

The role of research is to simplify the complex process involved in machine translation so as to give a clear picture about the problem. In cases where prototypes have been developed and tested, evaluation of such prototypes shall be used to identify and study the underlying problems and attempt to efficiently solve them.

MT nowadays has achieved a considerably long experience. It has undergone an evolution from information theories of the 60's to the statistical methods of the 90's. It has gone through a lot of phases with accompanying successes and failures in different aspects of the translation process.

> 'The lesson to be derived from such fluctuating fortunes is that no old or fashionable theory or approach should be disregarded simply because it has been found inadequate. Before applying some new approach to MT on a large scale, researchers and the funding agencies should assure themselves that previous work is not about to be replicated." [11]

> "The advantage of this long experience is that there are many old wheels which do not have to be reinvented. There are large areas of morphological and syntactic analysis which can be adopted successfully by any new system. Indeed the success of many custom-built systems in recent years demonstrates that methods of machine translation and of computational linguistics are becoming ideally known outside the narrow research community and can be applied with success in working MT system."[12]

Pre-Editing and Post- Editing of Text

Pre and post editing of text stems from the principles of MT development advocated by the well known dissenter of perfectionist principles, Bar-Hillel. He advocated the development of systems specifically designed on the basis of what he called "Man- Machine- systems."[13]

> "Machine translation research has turned increasingly to the development of realistic practical machine translation system where the necessity for human involvement at different stages of the process is fully accepted as an integral component of the design. "Be it machine aided translation or human aided machine translation, the involvement of human translators, revisers in pre-editing

> and post editing of text is essential to attain a completely usable machine translation."[14]

MT outputs are raw translated texts which must be edited of publishable quality. This is true in the business community where proper and acceptable translation plays an important role in product marketing.

The modern concept of pre- and post- editing of the text stems from the fact that the linguistic or contextual meaning of the text is beyond the machines recognition.

> "Different texts can be translated to different formats of different situations."[15]

Pre -editing is conducted to disambiguate points of a text, to simplify the flow of thought and to conduct syntactic and semantic analysis so as to arrive at an acceptable raw translation which can be post edited by revisers and /or translators. Post-editing is an extensive task done by revisers/ translators to a given text, such as cleaning up the language, adjusting format and reviewing for technical accuracy, editing for accuracy especially in fields which require very high quality translation (e.g. subtitles of T.V. broadcast, insurance contracts, and publication).

The pre- editing is done by examining various grammatical constructions, specifying parts of speech, giving the range of a given phrases, inserting a mark to break up sentences, specifying parts of speech in a sentence.

Likewise post -editing removes actual errors made by the machine and produces a grammatically acceptable text.

Translation Workstations

The concept of translator workstation has been introduced within the framework of Machine - aided human translation. (MAHT)" [16] "These translator workstations are designed to provide a computer- based environment for professional translators integrating a range of facilities. These facilities include automated access to dictionaries terminology /databanks and other information sources (online remote access, CD -ROM, or stored on a local network, etc.); tools for managing terminological resources; multilingual word processing facilities; optical character recognition devices; electronic receipt and transmission of texts and concordance software.

One of the systems of translation is machine aided human translation (MAHT), where translation is performed by a human and the computer offers supporting tools. There are specific software environments designated for professional translators working in teams linked through a local network. The term "workstations" is under stood to be "any configuration of hardware and software tools used by an individual performing translation tasks and working either alone or in a team." [17] The user translate on a microcomputer, using online service such as bilingual dictionaries terminological data bases, collection of "bi-texts" (tests in parallel with their transitions) etc. accessed directly from under a text processor.

This translator's workstation offers tools to access a bilingual terminology, translation memory which have to be integrated in the text processor, and submit parts of the text to an MT server. The software will perform automatic analysis to the source text and will attach keyboard short cuts to the terms and sentences found in terminological database and in translation memory.

There are several translation tools which are commercially viable. To mention some are Trados, IBM Translation manager, and site Eurolang. These are all avialable on PC/windows, PS./OS2, o Unix base workstations. With the break through of powerful soft ware and hardware with different capacities. developers introduced several software combinations and dynamic features.

When a document has to be translated it is pre processed on the server and sent back to the translator's workstation with an associated "kit" which contains the corresponding subsets of the dictionary and translation memory as well as proposals coming from a batch Machine Translation system.

Evaluation of Machine Translation Systems

Progress has been made towards a more complex and practical realistic MT systems, since the advent of the computer development. Enough

Systems and PC-based translation aids have been introduced to the market and more approaches are being applied. Of course, there also have been some considerable successes in the operation of machine translation in a particular domain in most parts of EC, the US and Southeast Asia, particularly Japan. In short, MT has become a necessity in this modern information system. The questions that arise are: How will a user be able to determine which of the systems available would likely meet his requirements? Are there any guidelines to be followed in determining the suitability of a certain system in a particular requirement? With ample systems introduced to the market designed for different types of translation tasks, employing different functionalities, the difficulties have become clear. For the sake of credibility of the MT community it is important that potential users can discover exactly what they may expect.

"As MT systems become widely used, as the attractions of PC-based translation software group, the need for standards of performance become ever more urgent. Evaluation of MT systems has emerged as a key issue particularly in the few years; many would say the concern is long over due. As far as the MT community is concerned the milestones of this activity have been the workshops on evaluation at MT conferences, notably at the 1990 TMI conference. The prime mover has been Margaret King (ISSCO) who chaired the sessions and who subsequently organized an important seminar in April 1991. In November 1992, a sub-committee of the Japan Electronic Industry Development Association Published a set of criteria for economic and technical evaluation of systems by users and out lined guidance to developers for evaluating their systems (JEIDA).

In the US the ARPA (Advanced Research Project Agency) a part of the Human Language Technologies Program began in 1991. A great challenge faced ARPA program "because the systems participating differ radically in the linguistic approach, their level of maturity, and the languages translated. The systems participating were IBM Candide, using statistical modeling approach, Pangloss, Using knowledge-based approaches and Lingstat using modeling and conducted and there were also a several production systems participated, such as METAL, PIVOT, GLOBALINK POWER, SPANAM, SYSTRAN (French- Japanese; Spanish- English), SOCATRA XLT System. The main mission of ARPA MT evaluation program provides a useful set of evaluation process for a general standard.

The evaluation methods of ARPA are

> "based on human judgments because assessment of the correctness of any translation even by professional humans will vary widely among experts and novices alike. The best approach to handle this highly variable subjectively is to use it as a basis for measurement decomposing these judgments into relatively small units, focused and controlled by separate evaluations for adequacy, fluency and informativeness of outputs."[18]

In March 1995, JEIDA's test-sets for quality evaluation of MT systems has been formulated in Japan with three criteria for evaluating MT systems namely, technical, financial evaluations for users and technical evaluation for developers.

> "The method proposed is entirely dependent of the MT design so that system developer can use this method regardless of his /her system type, e.g. whether the relevant MT system is rule-based or example -based. Conversely, in this method, it becomes clear that specific linguistic phenomenon cannot be processed by the relevant MT system, no solution common to the various system types is indicated, and so the solution is entrusted to the developer according to the specific system type."[19]

> "In the test sets, it gives no information on how often the linguistic phenomenon in each text -sets appears in general usage. This is because the frequency of appearance of the relevant linguistic phenomenon may differ according to the type of document to be translated. If specific linguistic phenomenon regularly appears in the documents handled on a specific MT system, the evaluator needs only to select the test -sets which correspond to the linguistic phenomenon in question. Wrong evaluation could be made if accruing was based merely on the frequency of individual linguistic phenomenon."[20]

> "To sum up the evaluation method is designed in such a way that the system developers, irrespective of their system type, can precisely understand linguistic phenomena which cannot be handled by their systems and thus should be taken into account when improving the system performance."[21]

In Europe the Eagles group on Evaluation and assessment was sponsored by European Commission. The group distinguishes three types of evaluation, the following are:

Progress evaluation- assessing the actual state of a system with respect to some desired state of the same system, as when progress of a project towards some goal is assessed. This kind of evaluation is typically used to compare measuring system performance against some pre-established criterion. We can therefore further distinguish the choice of criteria, the measure used and the method employed. This kind of evaluation tends to make large demands on resources in the form of test collections or annotated corpora, for example, which must be established and distributed.

Adequacy Evaluation- assessing the state of system with respect to some intended use of that system, as exemplified by a customer investigating whether a system in its current state will do what he requires, how well it will do it and at what cost. This kind of evaluation may involve comparison between two or more systems. This kind of evaluation is very much oriented towards specific requirements, and may therefore require considerable work to establish the potential customer's needs."[22]

Diagnostic Evaluation- assessing the state of system with the intention of discovering where it fails and why, has been exemplified by a research group examining their own system. Typically, this kind of evaluation requires intimate knowledge of the system examined, and is not done comparatively although there may be comparative studies of the effects of alternative versions of some system component. This involves production of a system performance profile with respect to some texonomisation of the possible inputs."[23]

In the light of the evaluation methods described above it is quite clear that the processes involved aims at determining flexibility, reliability and cost effectiveness of a machine translation. Every leading developer of MT had developed their evaluation methods to uplift the status of their machine translation system in all respects of the translation process.

Discussions of machine translation evaluation has to be approached from several standpoints: First, technology concerning multi-lingua; processing relating to all issues on design and developing actual machine translation systems based on the current technology; thus involving issues on lexicon, grammar, term bank, parsing and generation, system integration, human interface, etc. This is to check whether available data and technology have been well encoded into the MT system and is functioning well so that it can provide the most powerful but economic MT system to each user. The second point concerns guidelines for user selection of a MT system among candidates when purchasing, by which the user can expect the most cost saving translation business. The third point is to find future technical problems on machine translation which will help researchers and developers recognize what task to be collaborated.

There were a lot of views and approaches presented in the search for an effective evaluation methods for machine translation. There is a sense of cooperation between major economic blocks; North America (US and Canada), Southeast Asia under the leadership of Japan and the European Community. This cooperation should be encouraged so as to speed up the development of an evaluation procedure that can benefit all the MT systems all over the world.

An Outlook to the Future

The current present state of MT can be attributed to the R&D made by its pioneers. The unabating input for the need to translation was the one that triggered off the search for theories and methodologies which can be used to produce prototypes that would eventually prove the viability of automatic machine translation.

So far machine translation has emerged in the midst of varying degrees of ideas, concepts, and approaches. But it also has evolved into a more realistic, practical and cost effective type of machine translation.

Today, the "second generation" of MT system is generally being used commercially with the integration of various translation tools. The concept of machine -aided human translation (MAHT) and human aided machine translation as expounded by Boitet is attaining an operational success. The introduction of translation workstations and the accompanying translation tools and the emergence of the worldwide network created a state of the art of MT system.

> "The current MT projects are both pure and hybrid, both predominantly technology oriented and scientific art single engine projects, capable of one particular type of source text analysis, (e.g. weather report, financial news article, scientific abstract

> and for a particular end use- e.g. assimilation or dissimulation of information. It has been developed for a particular text type, one particular method of finding target language correspondences for source language elements and one prescribed method of finding target language text. While such projects can be quite useful, we believe that it is time to make the nest step in the design of machine translation systems and to move toward adaptive multi-engine systems."[24]

> "In this new era, we are likely to see the emergence of a 'third generation' of MT system design. It will combine the essentials of the rule- based approach of the 'second generation' with the corpus- based methods which have come to the fore since 1990. The rule- based will be less ambitious than that of the indirect models: syntactic analysis may well be restricted to surface constituency and dependency relation; semantic analysis will probably be limited to identification of sentence and clause roles (agents, patients, etc.) and broad Semitic features (human, animal etc.) for initial disambiguation; and the lexical information will be derived primarily from standard dictionary sources with 'crude' on lower level 'surface' representations. Systems will combine use of example-based methods (using large bilingual text corpora aligned by simple syntactic category analysis and statistical method, use of statistical data about lexical collocation and vocabulary frequencies, use of domain-specific knowledge bases (comprising both linguistic and subject knowledge) and the statistical 'feedback' from the interactions and revisions of actual users." [25]

In the last decade, research on spoken translation has developed into a major MT activity. It is possible that the ambition ATR, CMU, VERBMOBIL research project may be forerunners of the 'third generation' design. "At the same time there will be a much greater emphasis on discourse and text stylistic aspects- the shift towards production of idiomatic high quality output is already strong. On the technical side, the 'third generation' is likely to be integrated more closely into documentation and publishing systems, is already under way in the development of translators' workstations.

As MT research and all commercial MT have concentrated on major international languages: English, French, German, Spanish, Japanese and Russian, the languages of the less developed countries have been largely ignored. Yet it can be argued that the need for MT in those countries is as great and sometimes greater that the more developed countries. The future challenge for the MT community must be the development of translation tools and working MT systems for these neglected languages.

As it is already evident, the rapid expansion of computer-based translation activities would develop to embrace

> "Any process which results in the production or generation of texts and document in bilingual and multilingual context. And machine translation will be seemed as the most significant component in the facilitation of international communication and understanding in the future information age."[26]

ABBREVIATIONS:

MT = Machine Translation.
PC = Personal computers
MAHT = Machine-Aided Human Translation
RBMT = Rule-Based Machine Translation
KBMTS = Knowledge- Based Machine Translation System
PBMT = Principles- Based Machine Translation
CBF = Constraint-Based Formalism
CBMT = Corpus-Based Machine Translation
SBMT = Statistical Based Machine Translation
EBMT = Example-Based Machine Translation
ALPAC = Automatic Language Processing Advisory Committee
MT-W = Machine Translation for Watcher
MT-R = Machine Translation for revisers
MT-T = Machine Translation for translators
MT-A = Machine Translation for Authors
MAHT = Machine - Aided Human Translation
AST = Automatic Speech Translation
CFG = Context Free Grammar
SR = Speech Recognition
HMM = Hidden Markov Model
SSS = Successively State Splitting
VFS = A vector Field Smoothing
PD = Phrases Definition
CVC = consonant-Verbal-Consonant
ARPA = Advanced Research Project Agency

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