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KAPITEL 6 / *CHAPTER 6* [6]
EVOLUTIONARY TECHNOLOGIES AND GENETIC ALGORITHMS IN MACHINE TRANSLATION

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Introduction

In a general sense, genetic algorithms (Genetic Algorithms) are a class of algorithms inspired by the mechanisms of the evolution of living nature – genetics [1], which are applied mainly to complex problems of global optimization and, to some extent, as an auxiliary method within the framework of hybridization for classical data mining methods [2-4]. The genetic algorithm was first proposed in 1975 by John Holland from the University of Michigan (USA). Genetic algorithms are now included in the standard toolkit of supervised and semi-supervised machine learning methods [5-7].

Conceptually, the general scheme of genetic algorithms is quite simple. First, an initial population of individuals (individuals, chromosomes) is generated, that is, a set of solutions to the problem. As a rule, this is done randomly. We must then model reproduction within this population. For this purpose, several pairs of individuals are randomly selected, a crossing is made between the chromosomes in each pair, and the resulting new chromosomes are included in the population of the new generation. The basic principle of natural selection is preserved in the genetic algorithm: the more adapted an individual is (the greater the value of the objective function corresponding to it), the more likely it will participate in crossing. Then, mutations are simulated in several randomly selected individuals of the new generation, that is, some genes are changed. After that, the old population is partially or completely destroyed and we move on to the consideration of the next generation. In most implementations of genetic algorithms, the population of the next generation contains the same number of individuals as the initial one, but due to selection, the fitness (value of the objective function) in it is higher on average. The operation of bringing the number of the current population to the initially determined value is called reduction. The described processes

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of selection, crossing and mutation are repeated already for this new population. In each subsequent generation, the emergence of completely new solutions to the problem will be observed. Among them there will be both bad and good ones, but thanks to the selection procedure, the number of good decisions will increase. Note that there are no absolute guarantees in nature, and even the most adapted tiger can die from a hunter's shot without leaving offspring. By simulating evolution on a computer, you can avoid such undesirable events and always preserve the life of the best individuals of the current generation. Such a technique is called the "elitism strategy", when individuals with the best indicators are selected for the next generation [8].

The described sequence of actions in the implementation of genetic algorithms can be transformed into different software implementations depending on the type of problem being solved and the approaches chosen.

Evolutionary technologies and genetic algorithms are important and relevant technologies within the framework of soft computing, which have already found their application in various fields of scientific and practical activity. In this study, attention was paid to the improvement and further development of the methodology and features of the configuration of evolutionary computing technology in philological sciences. In particular, the authors claim that the optimal configuration and effective use of evolutionary technologies and genetic algorithms can help improve the quality and efficiency of translation, reduce the time required for its execution, and provide more accurate and complete translation, etc.

6.1. Evolutionary technologies and genetic algorithms to improve professional translation in various directions. Here are some examples:

- Improving translation quality: genetic algorithms can be used to automatically improve translation by generating new translation options based on better combinations of words and phrases. In this way, you can improve the accuracy and style of the translation [9].

- Automatic glossary construction: genetic algorithms can be used to automatically build a glossary based on the text to be translated [10].

- Automatic selection of the optimal translation: genetic algorithms can be used to automatically select the best translation option from the list of available translations. This approach improves translation accuracy and reduces the time required to manually check each translation [11].

- Automatic selection of equivalents: genetic algorithms can be used to automatically select equivalents for words and phrases that do not have a direct counterpart in the target language. This allows you to increase the accuracy and style of the translation [12].

- Automatic improvement of translator training: genetic algorithms can be used to automatically improve the training of translators by generating new tasks for exercises and tests, allowing to improve their skills and knowledge.

6.2. The effective application of genetic algorithms and evolutionary technologies.

The effective application of genetic algorithms and evolutionary technologies can improve the efficiency and accuracy of professional translation by automating and optimizing various aspects of this process. To do this, you need to perform several steps:

1. Collect data: In order to use genetic algorithms and evolutionary technologies in the process of improving professional translation, it is necessary to collect a large amount of data, including text corpora of different languages and glossaries. These data must be of good quality and have sufficient data to conduct the study.

2. Create a model: after collecting data, you need to create a model that allows you to automate and optimize the translation process. The model can be created on the basis of genetic algorithms and evolutionary technologies, which will allow to determine the best combinations of words and phrases, as well as to build a glossary and find equivalents for unfamiliar words.

3. Train the model: after creating the model, it needs to be trained on a large amount of data. To do this, you can use training samples of texts in different languages and test the model on new texts.

4. Select the parameters: after training the model, it is necessary to select the parameters to achieve maximum efficiency. This can be achieved by tweaking genetic algorithm parameters and evolutionary technology.

5. Evaluate the results: after selecting the parameters, it is necessary to evaluate the results using metrics that determine the accuracy and efficiency of the translation process. Evaluation of the results allows you to understand which aspects of the process need improvement and improvement.

6. Improve the results: Based on the evaluation of the results, necessary adjustments and improvements can be made to the model and parameters. This can further improve the efficiency and accuracy of the translation process.

6.3. The approaches to improve the results of professional translation using genetic algorithms and evolutionary technologies.

The application of genetic algorithms and evolutionary technologies to improve professional translation can be useful in many cases. For example, it can help reduce translation time, improve translation quality, and help ensure more accurate results. However, it is worth remembering that the use of these technologies does not replace a professional translator, but only helps him in performing his work. A variety of approaches can be used to improve the results of professional translation using genetic algorithms and evolutionary technologies. Example:

- Application of genetic algorithms to select the most optimal translations: the genetic algorithm can be used to select the most optimal translations from several possible options. This can help reduce translation time and improve the quality of the result.

- Using the evolutionary technology of "mutation" to ensure a more accurate

translation: mutation can be used to modify the source text in order to ensure a more accurate translation. For example, if the translator made a mistake in choosing a word or misunderstood the meaning of some words, mutation can help correct this error.

- Use of genetic algorithms to improve translation quality: genetic algorithm can be used to improve translation quality by selecting the most optimal translation parameters, such as choosing the appropriate word or phrase to translate.

- Using genetic algorithms to select the optimal set of words and phrases for translation: the genetic algorithm can be used to select the most optimal set of words and phrases for text translation. For example, if the translator cannot find a suitable word or phrase to translate some part of the text, a genetic algorithm can be used to select the most optimal option

- Using the evolutionary technology of "crossover" to improve translation: Crossover can be used to combine two or more translations in order to create a new translation that is more accurate and complete. For example, if two different translations of the same text have some overlapping phrases, crossover can be used to combine them and create a more complete translation.

- Using evolutionary algorithms to improve translation into different languages: evolutionary algorithms can be used to select the most optimal translations into different languages. For example, if a text needs to be translated into several languages, evolutionary algorithms can be used to select the most accurate and complete translations for each of the languages.

- Using evolutionary algorithms to improve translation for specialized terms: evolutionary algorithms can be used to select the most optimal translations for specialized terms that may be difficult to translate in a normal context. For example, if the text contains specialized medical terms, evolutionary algorithms can be used to select the most accurate and complete translations of these terms.

6.4. Optimal stages in the development of evolutionary technologies and genetic algorithms to improve professional translation.

Next steps in the development of evolutionary technologies and genetic algorithms to improve professional translation may include:

- Use of more complex genetic algorithms that are able to work with more factors and provide more accurate results.

- Use of additional data sources to ensure a more accurate assessment of translation quality and improve the learning process.

- Introducing additional features to machine translation systems that will allow translators to use genetic algorithms and evolutionary technologies in a more efficient way.

- Development of special tools and software to ensure faster and more efficient application of genetic algorithms and evolutionary technologies in the translation process.

- Development of automatic translation improvement systems that will be able to learn and adapt to different linguistic contexts and user requirements.

- Development of new metrics for evaluating the quality of translation, which will take into account the effectiveness of the application of genetic algorithms and evolutionary technologies.

- Using artificial intelligence and reinforcement learning to optimize the parameters of genetic algorithms and evolutionary technologies.

- Implementation of genetic algorithms and evolutionary technologies in a wider range of applications, such as automatic text analysis and information retrieval.

- Using genetic algorithms and evolutionary technologies in combination with other technologies such as neural networks and statistical models to achieve better results.

- Development of new data collection and processing methods that will allow more effective use of genetic algorithms and evolutionary technologies in professional translation.

- Implementation of evolutionary technologies and genetic algorithms in various fields such as finance, medicine, law and others to improve decision processes and optimize results.

- The use of evolutionary technologies and genetic algorithms in professional translation is becoming more and more popular, and developers continue to work on the improvement and development of these technologies.

Summary and conclusions.

In general, the application of evolutionary technologies and genetic algorithms in professional translation is a promising direction of development.

Overall, the application of evolutionary technologies and genetic algorithms can help improve the translation process and provide more accurate and complete translations. In general, the use of evolutionary technologies and genetic algorithms is an important stage in the development of professional translation and helps to improve the quality of translation and reduce the time required for its execution.

However, the use of genetic algorithms and evolutionary technologies should be balanced with other machine learning & mathematical programming & soft computing approaches to maximum improve translation (such as the use of hybrid machine learning, the creation soft LLM, fuzzy inference engine for translation & interpretation etc. [13-15]) and depend on the specific requirements and needs of users.

In general, the use of evolutionary technologies and genetic algorithms is a promising innovative direction for improving the quality and efficiency of professional translation, especially in the conditions of streaming semi-structured Big Data [16-18].

Genetic algorithms and evolutionary technologies cannot completely replace human expertise and the performance of tasks by professional translators, but only help them perform their work more efficiently and quickly [19]. Such technologies allow translators to focus on more complex aspects of translation, such as understanding and conveying shades of meaning, while using the support of computer technology to

improve translation speed and accuracy.

In particular, genetic algorithms can help in solving the problem of choosing the most optimal translation option from a large number of possible options. Also, evolutionary technologies make it possible to improve the quality of translation by automatically adapting the translation to a specific text and its context.

It should be noted that the use of evolutionary technologies and genetic algorithms has its limitations and drawbacks. For example, they may be less efficient in solving some types of tasks and require a significant amount of computing resources.

Research and development in this field continues, and we can expect new innovative solutions and technologies that will allow even more accurate and efficient translation of texts of different levels of complexity and style.