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**К вопросу о переводе терминов искусственного интеллекта
(на материале научно-популярного пособия
«Создаем нейронную сеть» Т. Рашида)**

Аннотация: Статья посвящена особенностям перевода терминов искусственного интеллекта. В качестве материала для анализа было выбрано научно-популярное пособие «Создаем нейронную сеть» Т. Рашида, в котором подробно описывается процесс создания нейронной сети, ее устройство и функционирование. Данное пособие было выбрано в связи с доступностью изложения тематики искусственного интеллекта для неспециалиста в данной области.

Искусственный интеллект является стремительно развивающейся областью, в связи с чем терминологическое поле данной науки также расширяется и видоизменяется. Одной из отличительных черт искусственного интеллекта как научной области является пересечение с другими научными областями, а именно математикой, физикой, робототехникой, а также с понятиями из биологии и медицины. В ходе исследования термины были разделены на две крупных группы: термины, непосредственно относившиеся к области искусственного интеллекта, и термины, заимствованные из других областей. Затем термины были разделены по принципу наличия одного, двух и более или отсутствия эквивалентов с целью выявления закономерности при выборе эквивалента в языке перевода и трудностей, возникающих при отсутствии необходимого варианта. Нередко ввиду новизны терминов искусственного интеллекта переводчик не обнаруживает эквивалента в языке перевода, в связи с чем прибегает к кальке, транслитерации, транскрипции или их гибриду. В данной статье автор предлагает свои варианты перевода терминов, вызвавших наибольшее затруднение при переводе, которые, как нам кажется, будут больше соответствовать требованиям термина как лексической единицы.

Ключевые слова: искусственный интеллект, нейронная сеть, перевод, термин, терминосистема, эквивалент

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**On Translation of Artificial Intelligence Terms:
A Study of the Manual “Make Your Own Neural Network” by T. Rashid**

Abstract: The article is devoted to the issue of translation of artificial intelligence terms. The manual “Make Your Own Neural Network” by T. Rashid, which describes in

detail the process of creating a neural network, its design and functioning, was chosen as the material for analysis due to the accessibility of the information for a non-specialist in this field.

Artificial intelligence is a rapidly developing field, and therefore the terminological field of this science is also expanding and diversifying. One of the distinctive features of artificial intelligence as a scientific field is its cross-disciplinary nature as it deals with mathematics, physics, robotics as well as biology and medicine. The terms were divided into two major groups: terms directly related to the field of artificial intelligence and terms borrowed from adjacent fields. The terms were then categorized according to whether they had one, two or more equivalents or no equivalents in order to identify the pattern of equivalence in the target language and the difficulties encountered when the required variant was not available. Often, due to the novelty of AI terms, the translator does not find an equivalent in the target language and therefore resorts to calque, transliteration, transcription or their hybrid. In this article, the author suggests the variants of translation of the terms that have caused the greatest difficulty in translation, which, in our opinion, will better meet the requirements of the term as a lexical unit.

Key words: artificial intelligence, neural network, translation, term, terminological system, equivalent

Artificial intelligence is one of the most rapidly growing fields. According to the handbook by K. Frankish and W. Ramsey, “artificial intelligence (AI) is a cross-disciplinary approach to understanding, modeling, and replicating intelligence and cognitive processes by invoking various computational, mathematical, logical, mechanical, and even biological principles and devices”¹.

For the purposes of analysis, the manual “Make your own neural network” by T. Rashid was chosen. It is devoted to the functioning of neural networks. One might assume that such a strategy would be helpful in terms of future studies of the terminological system as it includes terms in use. Within the text of the manual a more systematic approach to usage of terms would be traceable and, as a result, the analysis might be more appropriate.

One of the distinctive features of this field, noted in its definition, is its cross-disciplinary nature. The terminosystem of artificial intelligence includes not only terms directly related to the field, but also terms from related fields such as mathematics, programming, as well as biology and medicine as well as terms of advanced mathematics such as designations of mathematical processes (*multiplication* – умножение, *calculus* – дифференциальное исчисление, дифференцирование), designations of functions (*logical function* – логическая функция, *step function* – ступенчатая функция, *sigmoid function* – сигмоидная функция, сигмоида, *logistic function* – логистическая функция etc.) and mathematical units (*square root* – квадратный корень, *constant* – константа, *slope* – наклон, *matrix* – матрица, *whole number* – целое число, *decimal digits* – десятичные знаки, *sum* – сумма, *power* – степень, *logic gate* – логический вентиль), biology (*neuron* – нейрон, *neural network* – нейронная сеть, *saturate* – насыщать), physics (*gradient* – градиент, *inner product*, *dot product* – скалярное произведение, *cross product* – векторное произведение), programming (*integer* – целое число, *real* – дробное число, *update* – обновить, обновление, поправки, *install* – установить, *programming language* – язык программирования, *extension* –

¹ Frankish K., Ramsey W.M. The Cambridge Handbook of Artificial Intelligence. Cambridge, 2014. P. 1.

расширение, *string* – строка, *open source* – программное обеспечение с открытым кодом доступа).

After the division of terms into the groups of their origin, we have singled out cases where terms have only one equivalent. They included such terms as *recognition* – распознавание, *backpropagation* – обратное распространение ошибок, *feed forward* – прямая связь, *deep learning* – глубокое обучение, *software* – программное обеспечение, *data* – данные, *layer* – слой, *to train* – обучать, *node* – узел, *database* – база данных, *dataset* – набор данных, *hidden layer* – скрытый слой, *separator* – разделительный знак, *keyboard* – клавиатура, *output* – выходные данные, *input* – входные данные, *value* – значение, *variable* – переменная, *cell* – ячейка, *loop* – цикл, *weight* – вес, *весовой коэффициент*, *spreadsheet* – электронная таблица *etc.*

Then we were to examine the terms with several equivalents in the target language. Such were *learning rate* – скорость обучения, *интервал*, *link* – сайт, *адрес*, *связь*, *pattern* – закономерность, *изображение*, *distribution* – дистрибутив, *распределение*, *range* – диапазон, *интервал*, *calculus* – дифференциальное исчисление, *дифференцирование*, *etc.* In some cases, two or more equivalents coexisted within the same translation. For example, *computer language* – компьютерный язык, *язык программирования*, *shortcut* – комбинация клавиш, *ярлык*, *plot* – графически отобразить, *отобразить массив*, *построить график*, *notebook* – ноутбук, *блокнот*, *computer* – операционная система, *компьютер*, *электронное вычислительное устройство*, *компьютерные системы*, *gradient calculus*, *gradient* – градиент, *gradient* – градиент, *градиентный спуск*, *угловой коэффициент*, *update* – обновить, *обновление*, *поправки*, *printout* – вывод данных на печатающее устройство, *отпечаток* *etc.*

The opposite situation, however, also took place: *monitor*, *screen* – экран, *folder*, *directory*, *catalogue* – папка, *electrical input*, *electric signal* – электрический сигнал, *gradient*, *slope* – наклон, *configuration*, *shape* – конфигурация, *notebook*, *laptop* – ноутбук, *whole number*, *interger* – целое число, *value*, *amount*, *quantity* – величина, *string*, *line*, *row* – строка.

Yet we believe that the choice of the equivalent in the first case was not incorrect as the term *monitor* has various meanings, which include not only a device consisting of many details, but also a screen itself, especially in the colloquial discourse. These examples show the instability of the nearly new field of science where not all the terminological units have proper equivalents. Moreover, in the case of *electrical input*, *electric signal* both terms are interchangeable. The term *input* refers to an incoming signal or information that was given to the neural network for training and as a result may also be used to indicate a signal. Another cases of interchangeable terms were *string*, *line*, *row* – строка and *folder*, *directory*, *catalogue* – папка. In the first case all three terms designate a straight line of words or other objects that could be perceived by a human. The differences between them are insignificant. However, the term *string* in specific contexts may refer to a function in programming, thus becoming a nomenclature unit. In the case of *folder*, *directory*, *catalogue* the difference lies only in the words themselves. Naturally, all three refer to storage of documents on a hard disk memory displayed on the screen for a user, sorted under specific conditions from name to the last date of changing a document.

In some cases, an original multi-word term was narrowed down to one-word translation. *Gradient calculus* and *gradient* were both rendered as *градиент*. One may consider this a better option than the original choice of terms as the ideal term strives

to shortening itself. And here the translator did not distort the meaning of the original term, but only improved its form. The same situation occurred with such terms as *error backpropagation* and *computer software*. It is possible that these are cases of pleonasm, because the term *backpropagation* already presupposes that it is a backward propagation of errors. As well as that, usually, only computers require software to function. The translation of the terms, however, was proper. The equivalents chosen for these terms were *обратное распространение ошибок* and *программное обеспечение* accordingly.

A peculiar situation took place in the case of *computer language*. There are two equivalents in English language that refer to *язык программирования*: *computer language* and *programming language*. Both were found in the source text. But only the *computer language* was rendered as both *компьютерный язык* and *язык программирования*, which was accomplished through the use of calquing. Even though this translation does not quite refer to the terminological units registered in the dictionaries, we believe that the reason for such choice was contextual translation. Still, one might choose the dictionary-registered equivalent rather than introduce an unjustified calque or another unregistered and not quite significant newborn term.

Sometimes contextual translation did not considerably distort the meaning of the original term. For example, the term *computer* has multiple equivalents suggested by the translator such as *операционная система*, *компьютер*, *электронное вычислительное устройство*. The term *операционная система* is usually rendered as *operation system* and is a separate term. However, in the context, that translation was even more proper than the direct meaning of the term given, so the translator replaced it with a metonymy. Another example is the term *diagram* which also had two equivalents: *иллюстрация*, *диаграмма*. We believe that in such cases a strict adherence to terminology is not required, as these terms are not that important to the artificial intelligence field. Finally, the term *learning rate* was translated not only as *скорость обучения*, but also as *интервал*. However, as it has already been observed with the term *diagram*, the translation was not materially incorrect.

Another peculiar case arises along with *whole number* and *interger*. Both terms are rendered as *целое число*, however, each refers to a different sphere of knowledge. *Whole number* comes from mathematics and indicates a type of numbers (there can be a fraction, which refers to a part of a number¹, or a whole number), and the second term refers to a type of primitive data in programming which consists of whole numbers only. Another type of numbers which also belong to the same group is *real*. These refer to fractional numbers. It is possible that both types possess same features so that they have the same equivalent in the target language, but differ in English and in specific situations such as the fields where they originate from.

Some of the translations were derived from the core term. As an example, the term *to plot* originally refers to a graphical depiction of a diagram. But in some contexts it has acquired an additional meaning. Thus, it turned out to have several equivalents: *графически отобразить*, *отобразить массив*, *построить график*. One may point out that *построить график* is the core definition and the other equivalents are derivational.

¹ “A fraction may be used to name part of an object or part of a collection of objects, to compare two quantities, or to represent division” (*Bell M. Everyday Mathematics Teacher’s Reference Manual. The McGraw-Hill Companies et al., 2012. P. 248*).

Then terms with no equivalents in the target language were singled out. In the case of lacunae the translator most often resorted to the use of calquing: *machine intelligence* – *машинный интеллект*, *machine learning* – *машинное обучение*, *artificial intelligence* – *искусственный интеллект*, *deep learning* – *глубокое обучение*; and transliteration, transcription or partial assimilation of transliterated and transcribed words: *iteration* – *итерация*, *web browser* – *веб браузер*, *site* – *сайт*, *command* – *команда*, *notation* – *нотация*, *transcendental* – *трансцендентные*, *transpose* – *транспонировать*, *notebook* – *ноутбук*, *algorithm* – *алгоритм*, *gigabytes* – *гигабайты*, *terabytes* – *терабайты*, *machine* – *машина*, *robot* – *робот функция* – *function*, *constant* – *константа*, *code* – *код*, *кодировать*, *to test* – *тестировать*, *recombine* – *рекомбинировать*, *visualize* – *визуализировать*, *generate* – *генерировать*, *import* – *импортировать*, *vectorise* – *векторизировать*, *version* – *версия*, *signal* – *сигнал*, *smartphone* – *смартфон* etc.

Within this group, two types of terms have been singled out: those that could be replaced by commonly used target terms: *notation* – *обозначение*, *iteration* – *повтор*, *transpose* – *перемещать*, and those that cannot be replaced by terms in the target language because they have no counterparts capable of conveying their meaning most accurately and concisely: *initialize*, *smartphone*, *import*, *generate*, *notebook (computer)*, *constant*, *robot*, *distribution*, *web browser*, *configuration*, *code (n)*, *code (v)*.

Such terms usually pose great difficulty due to the lack of proper equivalents in the target language. What is peculiar is that most of them have either Romanic origin (*algorithm*, *visualize*, *generate*, *gigabytes*, *terabytes*, *machine*, *constant*, *recombine*, *vectorise*, *transcendental* etc.), or belong solely to the relatively new field of science called artificial intelligence (*web browser*, *code*, *feed forward*, *backpropagation*, *deep learning*, *machine learning*). It is possible that some of them do not require equivalents in the target language as it would only distort the understanding of the terms proper and may produce unnecessary and redundant equivalents. In such case the terminological system of artificial intelligence may become overloaded and could eventually require purification from excessive non-terminological units. Furthermore, even though these terms might seem to stagnate the translation process, eventually they are beneficial for progress of the system itself and as a result it would be helpful in terms of translation. One more important feature of terms with no equivalents is their international value. Such a revolution was achieved in the field of medicine when Latin became an official language of medical terminology so that all people who spoke Latin could perceive the terminology.

Finally, there are a number of cases, where the scope of meaning of the suggested term in the target language does not quite correspond to the source one. Some of the cases were already overviewed in the previous subsections, but in this subsection we observe the cases of terms that did not have any proper equivalents to render their meaning in the target language.

The term *epoch* is translated as *эпоха*, therefore it has two equivalents in the target language. According to *lingvo live* dictionary, *эпоха* relates to general lexis and refers to a period of time which possesses specific features and includes specific events¹, while *период дискретизации* is a specific term that belongs to computing sphere and refers to “an iteration in a procedure”². As well as that, in *multitran*³ dictionary *epoch*

¹ <https://www.ldoceonline.com/dictionary/>

² Raynor W.J. Jr. The International Dictionary of Artificial Intelligence. New York, 1999. P. 96.

³ <https://www.multitran.com>

as *период дискретизации* is marked as *IT, comp., net.*, meaning that it relates to computing sphere only.

Both refer to a period of time, but the definition of a net working process is narrower and includes a term of programming – *iteration*, which also refers to a repetitive action of a program and which may have become the source of the confusion. Thus, it is probable that the translator decided to introduce a new term on the basis of its English counterpart. Such a decision might be considered as a contribution in linguistics. However, one assumes that such change of terminological units is not proper in the situation. The book chosen for the analysis is a study guide for future network programmers and developers. And the confusion at the start of the learning process might lead to further misunderstandings.

Another case was related to the term *shortcut*. We have previously mentioned that the term chosen for the analysis possesses two meanings: *клавиши быстрого доступа* and *ярлык*. In the *lingvo live* dictionary there are several translations for this term. It can be rendered as *клавишная комбинация быстрого вызова; сокращенная клавиатурная команда* and *ярлык* which refer to a pictogram used for a quick access to a program or a document¹. In the context of the book both meanings were introduced. However, what attracted our attention was the second context, where the term was rendered as *значки*. We suppose that even though such a replacement might be close to the original meaning *ярлык*, it should not only correlate with the meaning itself, but also with the terminology proper. In other words, in the context of a manual one assumes that the usage of terminological units would more proper than the use of general lexis.

Finally, a term *fraction* is supposedly translated as *дробь, дробная часть (числа), мантисса, доля*². However, the translator suggested *выражение* instead. We believe that such translation did not quite render the meaning of the original term. To prove our point, let us turn to the definitions of the terms. Dictionary of computing suggests that *fraction* is “a part of a whole unit, expressed as one figure above another, or a figure after a decimal point”. *Выражение*, on the other hand, is usually referred to as *expression*³ and is defined as “a mathematical formula or relationship”⁴. In the context of the book the term *fraction* referred to a specific kind of mathematical expression. Thus, we believe that a more proper variant of translation would be either *дробь* or *дробное выражение*, as both terms correlate with the dictionary equivalent of the analyzed term and render its meaning fully.

To sum up, it is possible to state that AI is a rapidly developing cross-disciplinary field which consists of terms belonging not only to this area, but also to adjacent fields. Its terminological system is quite unstable due to the fact that it is an emerging science. As for the challenges in translation of the terms, they consisted in the choice of proper equivalents in cases of terms having multiple translations in the target language and vice versa. Research has shown that sometimes it is impossible to find a proper equivalent in the target language, thus the translator is to use calquing or transcription and transliteration to render the new term. As well as that, difficulties arise due to the attempts of the translator to find a non-terminological synonym in the target language.

¹ <https://www.lingvolive.com/ru-ru/translate/en-ru/>

² <https://www.lingvolive.com/ru-ru/translate/en-ru/>

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⁴ Collin S.M.H. Dictionary of Computing. London, 2004. P. 130.

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