Computer Aided Online Translation Teaching System

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Abstract. In the process of machine translation, similarity threshold is an important factor restricting retrieval and translation. When the fuzzy interval similarity threshold is low, the translation effect of the traditional online translation teaching system is poor, but if the threshold is too high, it will lead to retrieval difficulties and affect the translation progress. In view of this situation, a computer-aided online translation teaching system is designed. In the hardware design of the system, the content addressed memory is mainly studied to provide space for data storage and facilitate address search for the partition of translation cache package; In the software design, firstly, the neural loop network is established for deep learning, the natural language feature vector is extracted, and the source sentence is encoded to obtain the sentence vector with a certain length. After adding some algorithms and constraints, the decoding is completed with the help of neural network to eliminate the gradient imbalance in the process of translation ambiguity; Optimize the translation training model, reorder the extracted feature vectors, and optimize the translation results. In order to verify the effectiveness of the designed system, experiments are designed. The results show that when the fuzzy interval is less than 0.5, the performance of the designed system is significantly better than the traditional system. With the increase of similarity threshold, the performance gap between the two methods gradually narrows.

Keywords: Computer-aided · Online translation · Teaching system

1 Introduction

With the continuous progress of science and technology and Internet technology, more and more computers have entered people's life, especially in the field of higher education. Computer teaching has become an important symbol of the modernization of higher education and the trend of educational development. As an extension of traditional teaching, the role of computer information teaching has been gradually valued by people. More and more schools have begun to build campus computers and digital campuses. On this basis, the computer-aided teaching system has the possibility of development and implementation, which better makes up for the shortcomings of classroom teaching [1, 2]. With the development of computer and multimedia technology, computer information teaching system will have more development space.

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In the network environment, the teaching assistance platform can not only "enrich both voice and emotion", but also make full use of and share teaching resources, realize the communication between teachers and students, and turn the traditional one-way teaching mode into a multi-directional communication and interactive virtual learning community. It has been scientifically proved that timely and high-quality information interactive transmission can effectively improve learning efficiency. After entering the system, teachers can upload their class videos, lesson plans, courseware, reference materials and assignments to the database, and students can download them at any time to facilitate the further development of teaching activities [3, 4]. In addition to the functions of random questions, online Q & A, online test and online review, the teaching auxiliary platform can also communicate and interact with students, understand the teaching effect and improve teaching methods in time. Students can learn in a differentiated environment through the online translation function provided by the system, make full use of the resources in the database and enhance their learning consciousness.

Reference [5] believes that under the background of the wide popularization of smart phones, more and more people in teachers and students begin to use smart phones for mobile teaching or learning. With the continuous development of hardware conditions, many PC translation systems begin to support smart phones. Users can easily translate and learn foreign languages on mobile phones and other mobile devices. Based on the existing mobile translation software, this paper expounds the implementation of English translation on smart phones, and puts forward corresponding solutions to the problems existing in the current translation software, which provides a new idea for the construction of English learning system. Reference [6] constructs the structural level of English translation system, including translation data collection module, information feature extraction module and analysis model construction module. The language model of the English translation system is established, the probability distribution of the specific sentence sequence or word sequence of the translation is counted by using the model, and the information features of the user's English translation documents and the information features of the translation training set are extracted. According to the feature extraction results, the similarity of feature keywords is calculated, and the BP network optimized by particle swarm optimization is used for fitting calculation. Finally, the teaching of English translation is realized. However, the performance of the above traditional system is poor when the fuzzy interval similarity threshold is low. However, in practical applications, the threshold of similarity is too high, which will lead to difficulties in retrieval and affect the progress of translation.

In view of this situation, this paper designs a computer-aided online translation teaching system. Computer aided translation technology can help translators complete translation tasks quickly and efficiently. This technology is based on database driver. In a broad sense, computer tools that can assist translation can be classified as computer-aided translation tools, such as the integrated use of computers and related application software, grammar checking tools and network resources; In the narrow sense, computer-aided translation tools refer to special software and related technologies developed to improve the translation process. The core technology of computer-aided translation software is translation memory technology and database technology. Its core modules are translation memory system, corpus management system, translation alignment tool, translation project management tool and so on. It is a bold attempt to apply it to the online translation teaching system.

2 Computer-Aided Online Translation Teaching System

2.1 Hardware Design

In the online translation teaching system designed in this paper, the memory module is the basis of computer-aided translation. In the hardware design, content addressable memory is first introduced, which is a memory to realize associative translation on the basis of traditional memory technology. Content addressable memory has a large number of storage units [7, 8], which can provide space for the storage of translation data. The data is stored in a specific location, and the current location can be searched through the stored data content to get the storage address of the data. The memory is equipped with a hardware clock cycle. In this cycle, the keyword matching can be completed once (Fig. 1):

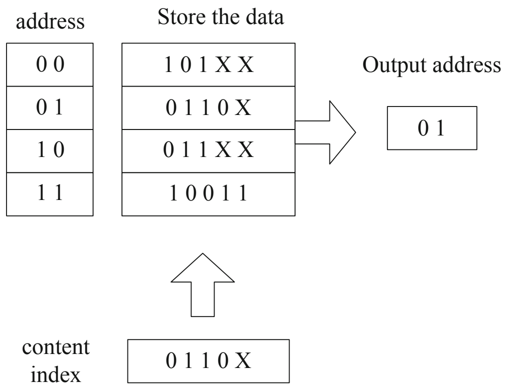

Fig. 1. Schematic diagram of content-addressable memory operation

After inputting the key words in the memory, the input key words are compared with all the table items in the memory, and finally all the matching table items are returned in the corresponding address in the memory. In the returned address, it will be used in an associated table to complete addressing and partitioning, and return the corresponding content. In content addressable memory, there are only two display states of bits in each unit, namely "0" and "1", which are used to reflect the two states of "match" and "mismatch". Therefore, content addressable memory can realize accurate matching search. The translation cache address is generally used as a subnet address or a prefix address, and the length of the prefix address is also called the bit length. In the classification application subset, the matched prefix has the maximum prefix length. If there are redundant translation cache packages, they need to be implemented by classification. In order to meet the longest prefix matching rule, to ensure that each possible address prefix length in the network transmission process can be equipped with a separate search matching chip, so a uniform length translation cache prefix set needs to be reserved in the chip. There are as many kinds of prefix lengths as there are as many memory chips as needed. So far, the system hardware design is completed.

2.2 Software Design

Establish a Recurrent Neural Network

In the online translation teaching system, the main idea is to rely on computer to complete the online translation conversion of the teaching system. In the software design, it mainly relies on the deep learning of recurrent neural network to complete the extraction of natural language feature vector. The neural network is composed of a large number of neurons. The neuron structure in the artificial cyclic neural network is similar to that of biological neurons. When the neuron is stimulated by the external environment, the artificial cyclic neural network will behave abstractly after being stimulated. As a mathematical language, the structure of neurons when they are stimulated is shown in the figure below (Fig. 2):

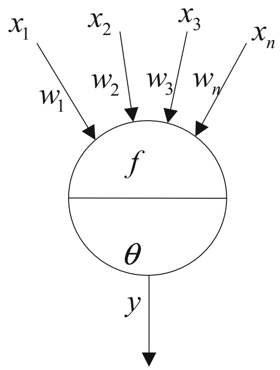

Fig. 2. Schematic diagram of external stimulation of neurons

In the above figure, $X = (x_1, x_2..., x_n)$ represents the external input received by the neuron, $W = (w_1, w_2..., w_n)$ represents the weight corresponding to the external input, θ represents the threshold in the neuron, which can be set manually, and y represents the output of the neuron. The above relationship can be expressed for:

$$y = f(\sum_{i=1}^{n} w_i x_i - \theta)x_1 \tag{1}$$

In the structure of artificial circulation neural network composed of neurons, it is mainly divided into three layers: input layer, hidden layer and output layer. In the traditional machine translation process, the whole sentence is decomposed into separate words and phrases for translation, but this translation method will lead to the lack of context semantic relevance. After the cyclic neural network is established, the source sentence can be encoded, processed to obtain a sentence vector of a certain length, and certain algorithms and constraints are added to complete the decoding with the aid of the neural network to achieve accurate online translation. And training is performed on the established recurrent neural network. The schematic diagram of translation training is as follows (Fig. 3):

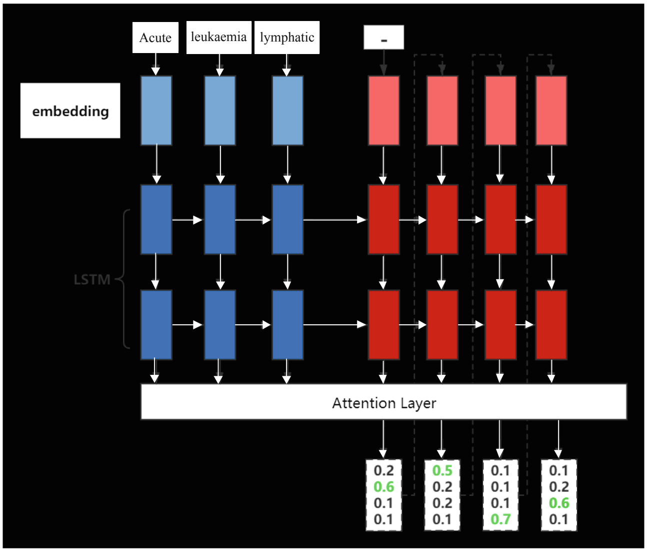

Fig. 3. Schematic diagram of translation training based on neural network

In the process of translation training as shown in the figure above, it can effectively reduce the engineering design involved in the translation work, and encode and decode through the encoder and decoder in the recurrent neural network. The encoder can process the word vector and the hidden unit in the upper layer to get the hidden unit at a certain time by the following formula:

$$h_t = f(x_t, h_{t-1}) \tag{2}$$

In the above formula, h_t represents the hidden unit, f represents the non-linear activation function, t represents a certain time, and x_t represents the input sequence vector at time t. As the length of sentences and the number of iterations increase, the established artificial recurrent neural network can solve the shortcomings of the original method and eliminate the "gradient imbalance" problem that occurs in the online translation process.

Optimizing Translation Training Model

Although the phrase-based machine translation system does not require the characteristics of the language in the bilingual corpus, any two languages can be trained as a machine translation system [9, 10]. However, due to the characteristics of the language itself, specific analysis needs to be carried out for specific language types when building language models and translation models. Therefore, in the process of building machine translation system software, the main goal of model training is to complete simple sorting between words. In the process of translation, for a given source statement e, there is $e = e_1, ..., e_n$. In simple sorting, for each unit that needs to be reordered, there is the following formula:

$$scroe_L(e_i) = \theta \cdot \phi(e, i) \tag{3}$$

In the above formula, ϕ represents the feature vector, θ represents the corresponding weight, and $scroe_L$ represents the scoring function of the re-ranking model. Simple reordering will sort all the basic units that need to be reordered according to $scroe_L$:

$$\pi^* = sort(e1, ..., en, scroe_L) \tag{4}$$

At present, some machine translation systems can only receive one sentence or one article, that is, pure text data. However, in the modern information processing industry, the demand for machine translation system as a component of a large-scale information processing system is growing [11, 12]. The information obtained by this large-scale system is no longer pure text data, but may be any other kind of data, such as the output of character recognition or speech recognition. This output result is generally data that has not been proofread, and it is no longer a single data, but an output with multiple errors or multiple possibilities. Hybrid network decoding can receive this multi-possibility input, and obtain better translation results through its algorithm. Under the above theoretical guidance, the training and reordering process of the obtained model is shown in the following figure (Fig. 4):

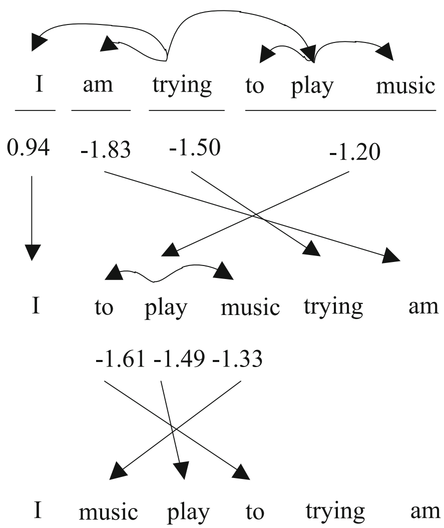

Fig. 4. Training based reordering

This simple sorting method can complete inference in a certain time complexity during model training, which has certain advantages for improving system performance. So far, the design of computer-aided online translation teaching system has been completed.

3 Experiment

3.1 Experiment Preparation

In order to verify the effectiveness of the designed system, the universal verification methodology (UVM) is used as the development library of verification environment, and the designed system is carried on the verification platform. The framework of UVM verification platform is shown in the following figure (Fig. 5):

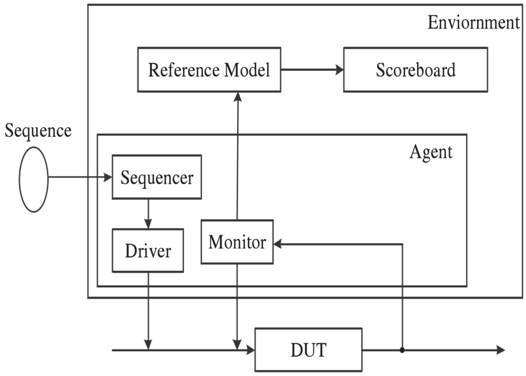

Fig. 5. Typical UVM verification platform structure

For the management partition system of translation cache, its performance can be judged by the miss rate of online translation block and the efficiency of partition exception instruction location. In the above verification platform, the cache partition based on fuzzy clustering analysis is verified. According to the generation frequency of the target code block, the transition of translation set partition management is detected. The following figure is the state chart of the algorithm used to detect the partition management transition of online translation set in this system performance test (Fig. 6):

According to the generation frequency characteristics of the target translation block, the threshold value 1 is set to 60% and the threshold value 2 is set to 40% during the performance test. The profile is used to count the frequency of generation, and a statement is added to the target code block to count the frequency of generation. The program just started running at S1, once the generation frequency is greater than the threshold 1, enter S2, which means that the working set is being constructed. At this

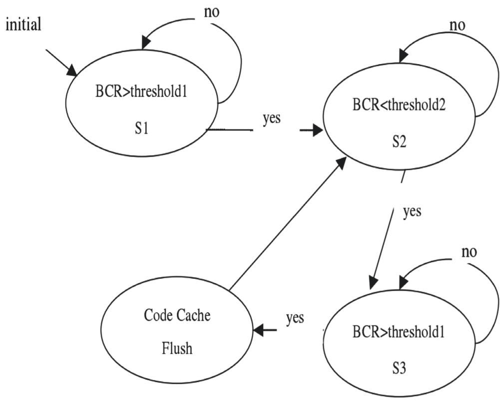

Fig. 6. Schematic diagram of the algorithm for detecting changes in the translation set

time, if it is detected that the generation frequency is less than the threshold 2, then enter S3, indicating that the working set has been constructed. When S3 detects that the generation frequency is greater than threshold 1, it means that the new working set is started to be built, the translation cache will be emptied immediately and the previous working set will be emptied from the translation cache.

The performance test of this system simultaneously compares the BLUE value of the traditional online translation teaching system and the system designed in this paper under the similarity threshold in different fuzzy intervals, so as to compare and analyze the performance.

3.2 Parameters and Experimental Process Settings

In order to make the results more stable without oscillation, the experimental system needs to perform three trainings to obtain three different sets of n-best translation results, and conduct experiments on the basis of these three sets of results and take the average value. In order to prevent over-fitting, this article uses the CNTK training ranking model, taking the default average distribution parameters as the initialization parameters, the range of the random number is [−0.5,0.5], and the activation function is as follows:

$$\alpha(n) = \begin{cases} 0 \ \ if\ n < 0.03 \\ 1 \ \ else \end{cases} \tag{5}$$

The state of hidden layer in deep neural network determines the number of parameters needed in the experiment. The larger the hidden layer is, the more complex the task can be solved. Therefore, in this paper, according to the data of the development set, the training set and the test set, we set the relevant super parameters of the system (Table 1).

Table 1. Hyperparameter settings

Parameter	Symbol	Numerical value
Feature vector	d	50
Hidden layer	d_h	800
Regularization rate	λ	10^{-8}
Adagrad's initial learning rate	α	0.01
Mini-batch size	b	10000
Word vector size	d_{rnn}^{w}	25
Embedded distance size	d_{rnn}^{d}	25
Regularization parameter	λ_{rnn}	10^{-4}
Margin loss rate	κ	0.2
Correction factor	f	8

In the online translation teaching system of this article, a random reordering correction result is selected for analysis. The correct word order of the sentence is "French leaders have made speeches". In the reordering system, the top 10 candidate sentences of the original recognition are as follows (Table 2):

Table 2. Translation candidates

Ranking	Result	Score
1	The eight leaders spoke in succession	−275.415154
2	The German leaders have delivered speeches one after another	−225.454152
3	The heads of state of the Republic of China made speeches one after another	−283.141212
4	Leaders of major powers have made speeches one after another	− 293.450231
5	The leaders of all countries have made speeches	−284.115451
6	The heads of state of Pakistan made speeches one after another	−305.417521
7	Leaders of major powers have made speeches one after another	−2645.145541
8	Foreign heads of state have made speeches one after another	−281.521252
9	French leaders have made speeches one after another	−263.545841
10	The heads of state of Pakistan made speeches one after another	−284.504241

By dividing the results in the above table, the candidate sentences in the above table can be realized in the form of lattice, as shown in the following figure (Fig. 7):

As can be seen from the figure above, there are many candidates for each tone in lattice structure, and the recognition result is affected not only by the language model,

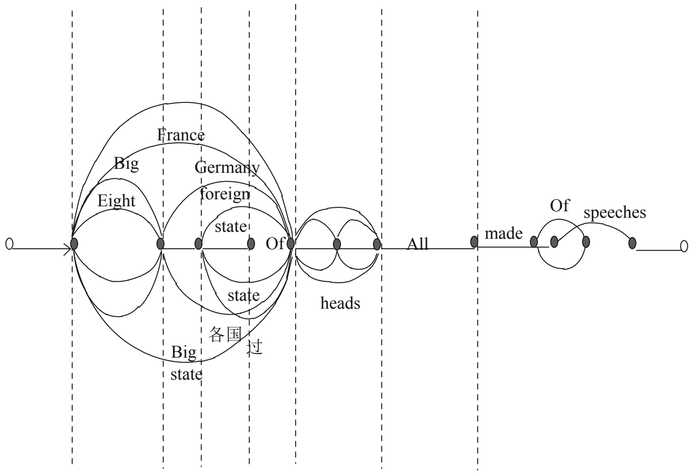

Fig. 7. Schematic diagram of the translated lattice structure

but also by decoding algorithm and other factors. Therefore, in the process of system performance test, the system designed in this paper and the traditional system are used for performance test, and the performance test results are counted and analyzed, and the blue value method is used for performance judgment.

3.3 Experimental Results and Comparison

In this paper, the performance of the two methods is compared by setting different fuzzy interval similarity thresholds. 100 experiments are carried out under each fuzzy interval similarity threshold, and the average experimental results under each threshold are taken to show the performance. The experimental results are shown in the table below (Table 3):

Table 3. Performance comparison under different fuzzy interval similarity thresholds

Fuzzy interval similarity threshold	Traditional system	Text system
[0.0,0.1)	0.221	53.41
[0.1,0.2)	4.85	55.38
[0.2,0.3)	6.13	56.81
[0.3,0.4)	8.37	59.31
[0.4,0.5)	13.94	62.84
[0.5,0.6)	24.87	63.97
[0.6,0.7)	42.64	66.31
[0.7,0.8)	57.31	67.29
[0.8,0.9)	65.87	68.34
[0.9,1.0]	70.35	69.51

It can be seen from the experimental results in the above table that the higher the threshold of fuzzy interval similarity, the higher the similarity between the test set data and the training set data, and the closer to the correct answer, whether in this system or in the traditional system. This paper designs a computer-aided online translation teaching system. In the previous translation fuzzy retrieval process, only when the threshold similarity threshold between the dialogue to be translated and the reference translation segment is the closest, the final translation result will be affected by the similarity threshold of the translation memory retrieval module. Therefore, the results from the above table are analyzed. When the output unit in the retrieval process is only the same as the sentence to be translated, the translation unit in the traditional method will participate in the translation process of the translator, and it is not output as the final translation result. Therefore, the traditional system performance is slightly lower among the fuzzy regions. The data in the table above can be seen that when the fuzzy interval is below 0.5, the performance of the system designed in this paper is obviously better than that of the traditional method. With the increase of similarity threshold, the performance gap between the two methods is gradually reduced. However, it is important to note that in practical applications, too high threshold of similarity will cause difficulty in retrieval and affect the progress of translation. In the case of reasonable setting of similarity threshold, the system designed in this paper has more advantages than traditional systems, which can improve the translation results.

4 Conclusion and Outlook

This topic is based on the actual needs of computer-assisted translation courses, combined with the current situation of course teaching and the current research status of computer-assisted teaching systems at home and abroad, using existing campus network resources, and using neural networks and translation memory technology in accordance with software engineering development methods. And computer-aided technology developed and designed a computer-assisted online translation teaching system suitable for the teaching and practice of computer-assisted translation courses in local colleges and universities. However, the time-consuming translation teaching of this article system still needs to be further optimized. In the follow-up research work, in-depth research will be conducted on this issue.

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