

Text Semantic Recognition Method and Apparatus, Computer Device, and Storage Medium

The present application claims priority to Chinese Patent Application No. 201910744603.5, filed to the China National Intellectual Property Administration on August 13, 2019 and entitled "Text Semantic Recognition Method and Apparatus, Computer Device, and Storage Medium", the disclosure of which is hereby incorporated by reference in its entirety.

Technical Field

The present application relates to the technical field of artificial intelligence, and in particular, to a text semantic recognition method and apparatus, a computer device, and a storage medium.

Background

With the development of the Internet, a text semantic recognition technology is more and more widely used. Particularly, in the field of intelligent question answering, in order to accurately answer a question asked by a user, it is usually necessary to convert a voice input by the user into text data, and semantic recognition is further performed on the text data to determine a true meaning expressed by the text data, so as to accurately and quickly answer the question asked by the user.

In terms of network platform, in order to maintain the civilization of Internet language and improve the use experience of the user, a text semantic recognition technology is usually used to perform semantic recognition on a text published on a network, so as to recognize a text with semantic information of violence, vulgarity, sensitive topics, commercial advertisements, etc.

At present, most text semantic analysis technologies adopt a keyword matching method for processing. A keyword database needs to be constructed in advance, and a text to be recognized and a keyword in the constructed database are matched to recognize a sensitive word. The inventor realizes that the semantics of a keyword that is not recorded in the database cannot be recognized, that is to say, the coverage area of the keywords limits the accuracy of text semantic recognition, so that the accuracy of the text semantic recognition is low.

Summary

Based on this, it is necessary to provide a text semantic recognition method and apparatus, a computer device, and a storage medium in view of the abovementioned technical problems.

A text semantic recognition method may include the following steps.

A character vector of each text character and a word vector of each text word segmentation in a target text may be calculated.

The character vector of each text character and the word vector of the text word segmentation that the text character belongs may be spliced to obtain a splicing vector of the corresponding text character.

The character vectors and the splicing vectors corresponding to a plurality of text characters may be input into different hidden layers of a first neural network in order according to a forward appearance order of the text characters in the target text, so as to obtain a first text feature of the target text based on the forward appearance order.

The character vectors and the splicing vectors corresponding to the plurality of text characters may be input into different hidden layers of a second neural network in order according to a reverse appearance order of the text characters in the target text, so as to obtain a second text feature of the target text based on the reverse appearance order.

A comprehensive text feature obtained by splicing the first text feature and the second text feature may be input into a third neural network to obtain a semantic type of the target text.

A text semantic recognition apparatus may include a vector calculation module, a vector splicing module, a first text feature acquisition module, a second text feature acquisition module, and a semantic type acquisition module.

The vector calculation module may be configured to calculate a character vector of each text character and a word vector of each text segmentation in a target text.

The vector splicing module may be configured to splice the character vector of each text character and the word vector of the text word segmentation that the text character belongs to obtain a splicing vector of the corresponding text character.

The first text feature acquisition module may be configured to input the character vectors and the splicing vectors corresponding to a plurality of text characters into

different hidden layers of a first neural network in order according to a forward appearance order of the text characters in the target text, so as to obtain a first text feature of the target text based on the forward appearance order.

The second text feature acquisition module may be configured to input the character vectors and the splicing vectors corresponding to the plurality of text characters into different hidden layers of a second neural network in order according to a reverse appearance order of the text characters in the target text, so as to obtain a second text feature of the target text based on the reverse appearance order.

The semantic type acquisition module may be configured to input a comprehensive text feature obtained by splicing the first text feature and the second text feature into a third neural network to obtain a semantic type of the target text.

A computer device may include a memory and a processor. The processor may be interconnected to the memory. The memory may be configured to store a computer program. The computer program may include a program instruction. The processor is configured to execute the program instruction of the memory.

A character vector of each text character and a word vector of each text word segmentation in a target text may be calculated.

The character vector of each text character and the word vector of the text word segmentation that the text character belongs may be spliced to obtain a splicing vector of a corresponding text character.

The character vectors and the splicing vectors corresponding to a plurality of text characters may be input into different hidden layers of a first neural network in order according to a forward appearance order of the text characters in the target text, so as to obtain a first text feature of the target text based on the forward appearance order.

The character vectors and the splicing vectors corresponding to the plurality of text characters may be input into different hidden layers of a second neural network in order according to a reverse appearance order of the text characters in the target text, so as to obtain a second text feature of the target text based on the reverse appearance order.

A comprehensive text feature obtained by splicing the first text feature and the second text feature may be input into a third neural network to obtain a semantic type of the target text.

A computer-readable storage medium may store a computer program. The

computer program may include a program instruction. The program instruction, when being executed by a processor, may be used to implement the following steps.

A character vector of each text character and a word vector of each text word segmentation in a target text may be calculated.

The character vector of each text character and the word vector of the text word segmentation that the text character belongs may be spliced to obtain a splicing vector of the corresponding text character.

The character vectors and the splicing vectors corresponding to a plurality of text characters may be input into different hidden layers of a first neural network in order according to a forward appearance order of the text characters in the target text, so as to obtain a first text feature of the target text based on the forward appearance order.

The character vectors and the splicing vectors corresponding to the plurality of text characters may be input into different hidden layers of a second neural network in order according to a reverse appearance order of the text characters in the target text, so as to obtain a second text feature of the target text based on the reverse appearance order.

A comprehensive text feature obtained by splicing the first text feature and the second text feature may be input into a third neural network to obtain a semantic type of the target text.

According to the abovementioned text semantic recognition method and apparatus, a computer device, and a storage medium, the character vector corresponding to each text character and the word vector of the text word segmentation that each text character belongs are calculated and spliced to obtain the splicing vector corresponding to the text characters. Vector splicing is performed on the text characters, and the text is represented by a plurality of feature vectors, so that the feature dimension represented by a text language is enhanced. Further, the character vectors and the splicing vectors are input into different hidden layers of different neural networks according to the forward appearance order and the reverse appearance order, so that relevant information of the text characters can be acquired more fully. Context semantics between the text characters is mined, so that the first text feature and the second text feature output through the first neural network are spliced to obtain the comprehensive feature, which can express the semantic features of the target text fully expressed, and improves the accuracy of text

semantic recognition.

Brief Description of the Drawings

Fig. 1 is an application scenario diagram of a text semantic recognition method in an embodiment.

Fig. 2 is a flowchart of the text semantic recognition method in an embodiment.

Fig. 3 is a flowchart of generating a preset file in an embodiment.

Fig. 4 is a structural block diagram of a text semantic recognition apparatus in an embodiment.

Fig. 5 is a structural block diagram of a text semantic recognition apparatus in another embodiment.

Fig. 6 is an internal structure diagram of a computer device in an embodiment.

Detailed Description of the Embodiments

In order to make the purposes, technical solutions and advantages of the present application clearer, the present application will be further described in detail below with reference to the accompanying drawings and embodiments. It is to be understood that specific embodiments described herein are merely illustrative of the present application and are not intended to limit the present application.

The text semantic recognition method provided by the present application may be applied to an application scenario as shown in Fig. 1. The text semantic recognition method is applied to a text semantic system. The text semantic system includes a terminal 102 and a server 104. The terminal 102 communicates with the server 104 through a network. The text semantic recognition method may be completed at the terminal 102 or the server 104. The terminal 102 may collect a target text to be recognized and perform semantic type recognition on the terminal 102 by using the abovementioned text semantic recognition method. Or, the terminal 102 may transmit the target text to the server 104 after acquiring the target text to be recognized, and the server 104 performs the semantic type recognition on the target text by using the abovementioned text semantic recognition method. The terminal 102 may be, but is not limited to, various personal computers, laptops, smartphones, tablet computers, and portable wearable devices. The server 104 may be implemented by using an independent server or a server cluster composed of a plurality of servers.

In an embodiment, as shown in Fig. 2, a text semantic recognition method is provided. Taking the method being applied to the server in Fig. 1 as an example, the method includes the following steps.

At S202, a character vector of each text character and a word vector of each text word segmentation in a target text are calculated.

Text characters are a plurality of independent characters obtained by segmenting the target text. The text characters may specifically be letters, numbers, characters, symbols, or the like. The text word segmentation refers to a process of segmenting the target text into single words, that is, recombining continuous character sequences into word sequences according to certain specifications. The text word segmentation may perform word segmentation by using a characters string matching-based word segmentation method, a semantics-based word segmentation method, and a statistics-based word segmentation method. The character vectors and the word vectors are used to represent a multi-dimensional representation form of the target text.

Specifically, the server determines each text character included in the target text and the text word segmentation that each text character belongs according to the acquired target text, and matches to obtain the character vector corresponding to each text character and the word vector corresponding to the text word segmentation in the target text through a pre-trained character vector library or word vector library. The server may also perform encoding on the obtained text characters and the text word segmentations to obtain corresponding character vectors and word vectors through a preset vector encoding rule.

In one of the embodiments, a specific step that the target text is acquired includes: the terminal acquires the target text, herein, there may be a plurality of target texts, the target text may be a recognized text obtained through voice recognition, or a text that is directly input by a user at the terminal. The terminal transmits the acquired target text to the server. The target text may also be acquired from a network platform, and a related target text is acquired from the network through a crawler technology.

In one of the embodiments, the step that each text character and the text word segmentation that each text character belongs included in the target text are determined include: the server performs character segmentation processing on the characters according to the received target text, so as to obtain the text characters

included in the target text; all obtained text characters are arranged according to the order in which the text characters appear in the target text to obtain a character sequence of the target text, and a text character which belongs to a stop word list is deleted from the character sequence, so as to obtain a pre-processed character sequence. Stop words refer to words or characters that need to be filtered and have no processing value in a natural language processing task. The stop words include English characters, numbers, mathematical characters, punctuation marks, single Chinese characters with high use frequency, etc.

The server detects each character in the character sequence, performs character identification on the same character to distinguish different words corresponding to the same character, and performs word segmentation processing on the character sequence with a character identifier to obtain a word sequence with the character identifier by using a pre-constructed word segmentation library. The server determines the text word segmentation that each character belongs from the word sequence on the basis of the pre-processed character sequence.

In one of the embodiments, the segmentation word library may be constructed on the basis of *Xinhua Dictionary* or other similar published books, or may also be constructed according to an intelligent customer service scenario. The constructed word segmentation library may be stored in a database of the server or sent to a cloud.

In one of the embodiments, the target text may also be acquired through the server. For example, the server may acquire required text data as the target text from a web page, and further determine each text character and the text word segmentation that each text character belongs of the target text.

For example, an acquired target text is “shen zhen shi de shi zheng fu zai shi min zhong xin”. First, a server performs character segmentation processing on the target text to obtain a character sequence “shen/zhen/shi/de/shi/zheng/fu/zai/shi/min/zhong/xin/”. Characters that belong to a stop word list in the character sequence are deleted to obtain a preprocessed character sequence “shen/zhen/shi/shi/zheng/fu/shi/min/zhong/xin”. Further, character identification is performed on the same character, so as to obtain the character sequence with character identifiers “shen/zhen/shi 01/shi 02/zheng/fu/shi 03/min/zhong/xin”. Word segmentation is performed on the character sequence to obtain a word sequence “shen zhen shi 01/shi 02 zheng fu/shi 03 min zhong xin”.

Although the text character “shi” corresponds to three words, the text word segmentation that the text character belongs may be distinguished according to the character identifiers.

At S204, the character vector of each text character and the word vector of the text word segmentation that the text character belongs are spliced to obtain a splicing vector of the corresponding text character.

The splicing vector is a vector formed by splicing a plurality of text vectors according to a preset rule, and the splicing vector represents the representation dimension of the plurality of vectors.

Specifically, on the basis of the character vectors and the word vectors of the acquired target text, the server splices the character vector corresponding to each text character and the word vector that the text character belongs to obtain a splicing vector corresponding to the text character, so as to obtain the splicing vectors of all text characters included in the target text. The splicing sequences of the character vectors and the word vectors are not required.

In one of the embodiments, the server adds or multiplies the character vector of each text character and the word vector of the text word segmentation that the text character belongs to obtain a splicing vector of the corresponding text character.

At S206, the character vectors and the splicing vectors corresponding to the plurality of text characters are input into different hidden layers of a first neural network in order according to a forward appearance order of the text characters in the target text, so as to obtain a first text feature of the target text based on the forward appearance order.

The first neural network is mainly configured to generate a feature carrying context semantics of the target text based on the forward appearance order according to the features included in the target text input in the forward appearance order of the text characters in the target text. The first neural network includes a plurality of hidden layers. Each hidden layer may have the same or different neuron nodes. The first neural network is a recurrent neural network, which may be a Long and Short-Term Memory (LSTM) and a Recurrent Neural Network (RNN).

Specifically, the target text includes a plurality of text characters. The server calculates the character vector and the splicing vector corresponding to each text character, orders the calculated character vectors and splicing vectors according to the forward appearance order of the text characters in the target text, further, inputs

the character vectors and the splicing vectors ordered according to the forward appearance order into different hidden layers of the first neural network in order to perform feature extraction, and acquires mutual information of different text characters, so as to obtain a first text feature based on the forward appearance order.

In one of the embodiments, the character vectors, the word vectors, and the splicing vectors corresponding to the plurality of text characters may be input into different hidden layers of the first neural network in order to obtain the first text feature of the target text based on the forward appearance order.

At S208, the character vectors and the splicing vectors corresponding to the plurality of text characters are input into different hidden layers of a second first neural network in order according to a reverse appearance order of the text characters in the target text, so as to obtain a second text feature of the target text based on the reverse appearance order.

The second neural network is mainly configured to generate a feature carrying context semantics of the target text based on the reverse appearance order according to the features included in the target text input in the reverse appearance order of the text characters in the target text. The second neural network includes a plurality of hidden layers. Each hidden layer may have the same or different neuron nodes. The second neural network is a recurrent neural network, which may be an LSTM and an RNN.

Specifically, the word vectors and the splicing vectors corresponding to the text characters are input into different hidden layers of the second neural network in order according to the reverse appearance order of the text characters in the target text on the basis of the character vectors and the splicing vectors respectively corresponding to all text characters in the obtained target text, and feature extraction is performed on the input character vectors and splicing vectors through the second neural network, so as to obtain a second text feature based on the reverse appearance order.

In one of the embodiments, the maximum number of the text characters that may be input into the first neural network and the second neural network may be set in advance. If the number of the text characters of the target text input currently is less than the maximum number of the text characters, then a character vector matrix formed by the target text is supplemented with a zero vector, and the supplemented character vector serves as an input of the first neural network or the second neural

network.

At S210, a comprehensive text feature obtained by splicing the first text feature and the second text feature is input into a third neural network to obtain a semantic type of the target text.

The comprehensive text feature is a text feature formed by splicing an output of the first neural network and an output of the second neural network according to a preset rule. The third neural network is mainly configured to classify the comprehensive text feature corresponding to an input target text according to the semantic type, so as to obtain the semantic type of the target text. The semantic type refers to the type that the target text belongs determined according to a semantic relationship of the target text.

Specifically, the server splices the first text feature and the second text feature to obtain the comprehensive text feature of the target text on the basis of the first text feature and the second text feature of the obtained target text. Further, the comprehensive text feature of the target text is transmitted to the third neural network. The comprehensive text feature is classified according to a semantic category through the third neural network, so as to obtain the semantic type of the target text. The semantic understanding of a context and implied vocabulary of the text is fully considered. For example, when dirty words and polite expressions in the target text are recognized, the semantic type may be correspondingly set into two categories, i.e., category 1: the text is dirty words, and category 0: the text is polite words.

In the abovementioned embodiment, the character vector corresponding to each text character and the word vector of the text word segmentation that each text character belongs are calculated and spliced to obtain a splicing vector corresponding to the text character. Vector splicing is performed on text characters, and the text is represented by a plurality of feature vectors, which enhances the feature dimension represented by a text language. Further, the character vectors and the splicing vectors are input into different hidden layers of different neural networks according to the forward appearance order and the reverse appearance order, so that relevant information of the text characters can be acquired more fully. Context semantics between the text characters is mined, so that the first text feature and the second text feature output through the first neural network are spliced to obtain the comprehensive feature, which can express the semantic features of the target text more fully, and improves the accuracy of text semantic recognition.

In an embodiment, as shown in Fig. 3, the abovementioned method further includes the following steps of generating a preset file.

At S302, a sample text is acquired.

At S304, character vectors and word vectors of the sample text are extracted on the basis of a pre-trained first neural network.

At S306, character numbering is performed on the character vectors and the word vectors.

At S308, the character vectors, the word vectors, and respective corresponding character numbers are written into the preset file.

The step that the character vector of the text character and the word vector corresponding to a text word segmentation are calculated includes: character numbering is performed on each text character and each text word segmentation; and the character vector corresponding to each text character and the word vector corresponding to each text word segmentation are read from the preset file on the basis of the character numbers.

The preset file is a pre-constructed text with indexes, which includes character vectors and indexes thereof, and word vectors and indexes thereof.

Specifically, a preset file including index queries of the character vectors and the word vectors needs to be constructed before the character vectors of the text characters and the word vectors corresponding to the text word segmentations are calculated. The server acquires the sample text and a corresponding known semantic type from a terminal or a web page, extracts the character vectors and the word vectors of the sample text on the basis of a pre-trained first neural network, and performs character numbering on the extracted character vectors and word vectors respectively to obtain a mapping relationship between the character vectors and the numbers, and a mapping relationship between the word vectors and the numbers. The server writes the character vectors, the word vectors, and respective corresponding character numbers into the preset file, so as to form the character vectors and the word vectors with character number indexes.

On the basis of each text character and the text word segmentation that the text character belongs included in the obtained target text, the server performs character numbering on each text character and each text word segmentation to obtain a mapping relationship between the text characters and the character numbers and the mapping relationship between the text word segmentations and the character

numbers. The character vector of the corresponding text character is queried from the preset file according to the character number of each text character, and the character vector of the corresponding text character is queried from the preset file according to the character number of each text word segmentation.

In one of the embodiments, the character number may include a number type. Character numbering is performed on the character vectors and the word vectors respectively according to the number type, and the number types of the character vectors and the word vectors may be the same or different. For example, the character numbering is performed on the character vectors according to natural numbers. The word vectors may also be numbered according to the natural numbers, and may also be numbered according to English letters.

For example, the target text is “shen zhen shi”, and if the character number of the text character “shen” is 01, the word vector corresponding to the character number 01 queried from the preset file is $(1,1,2,2)$.

In the present embodiment, through the pre-constructed preset file including the character vectors and the word vectors, when the character vectors and the word vectors of the target text are calculated, respective corresponding character vectors and word vectors are queried from the preset file according to respective corresponding character numbers of the text characters and the text word segmentations, so that the character vectors of the text characters and the word vectors of the text word segmentations may be obtained accurately and quickly, thereby improving the speed and accuracy of obtaining the semantic type of the target text.

In an embodiment, the step that the character vectors and the splicing vectors corresponding to a plurality of text characters are input into different hidden layers of a first neural network in order according to a forward appearance order of the text characters in the target text, so as to obtain a first text feature of the target text based on the forward appearance order includes: the character vector and the splicing vector corresponding to a current-order text character are input into a current hidden layer of the first neural network according to the forward appearance order of the text characters in the target text; the character feature output by the current hidden layer and the character vector and the splicing vector corresponding to a next-order text character are input into a next hidden layer of the first neural network; and iteration is

performed by taking the next hidden layer as the current hidden layer until a last-order text character, so as to obtain the first text feature of the target text based on the forward appearance order.

Specifically, the server inputs a character vector and a splicing vector corresponding to a first-order text character into the first hidden layer of the first neural network according to the forward appearance order of the text characters in the target text, and the first hidden layer performs projection on the input character vector and splicing vector to obtain a character feature corresponding to the text character. Herein, the first-order text character refers to the text character located at a first position after all text characters in the target text are ordered according to a preset appearance order. A last-order text character refers to the text character located at a last position after all text characters in the target text are ordered according to the preset appearance order.

The server takes the first hidden layer as a current hidden layer, and obtains a character vector and a splicing vector corresponding to the current hidden layer according to the forward appearance order of the text characters in the target text. Weights of all neuron nodes in the current hidden layer are set in advance. The weights of all neuron nodes may be the same or different. Then, the server performs nonlinear mapping on the feature input into the current hidden layer according to the weights of all neuron nodes set in advance, so as to obtain a character feature output by the current hidden layer. The nonlinear mapping may adopt activation functions, such as a sigmoid (S-type) function, a tanh (hyperbolic tangent) function, a relu (rectified linear unit) function.

The server inputs the character feature output by the current hidden layer and the character vector and the splicing vector corresponding to a next-order text character into a next hidden layer of the first neural network, takes the next hidden layer as the current hidden layer, and cyclically executes the following step: the character vector and the splicing vector corresponding to the current hidden layer are obtained according to the forward appearance order of the text characters in the target text. The weights of all neuron nodes in the current hidden layer are set in advance. The server performs nonlinear mapping to obtain a character feature output by the current hidden layer according to the character vector and the splicing vector corresponding to the current hidden layer, the weight of the neuron node corresponding to the current hidden layer, and the character feature output by a

previous hidden layer. That is, the server inputs the character feature output by the previous hidden layer, and the character vector and the splicing vector corresponding to the current hidden layer into the current hidden layer, and performs nonlinear mapping on the input feature according to the weights of all neuron nodes set in advance, so as to obtain a character feature of the next hidden layer. The next hidden layer is taken as the current hidden layer, iteration is performed repeatedly, the abovementioned steps are executed until the character vector and the splicing vector corresponding to the last-order text character are input into the current hidden layer to obtain a character feature output by the current hidden layer, and the output character feature is taken as the first text feature of the target text based on the forward appearance order.

In one of the embodiments, the current hidden layer includes a first sub-hidden layer and a second sub-hidden layer. The step that the character vector and the splicing vector corresponding to the current-order text character are input into the current hidden layer of the first neural network includes: the character vector and the output of the previous hidden layer are taken as an input of the first sub-hidden layer, and the first sub-hidden layer is configured to perform projection on the character vector to obtain a first sub-character feature according to the weight of each neuron node corresponding to the first sub-hidden layer. The first sub-character feature and the splicing vector are taken as an input of the second sub-hidden layer, and the second sub-hidden layer is configured to perform projection on the splicing vector to obtain a second sub-character feature as an output of the current hidden layer according to the weight of each neuron node corresponding to the second sub-hidden layer.

Specifically, the current hidden layer includes a first sub-hidden layer and a second sub-hidden layer. The server inputs the character vector corresponding to the text character which appears in a first order into the first sub-hidden layer, and performs projection on the character vector through the weight of each neuron node set in the first sub-hidden layer in advance, so as to obtain the first character feature output by the first sub-hidden layer. Further, the server takes the first character feature and the splicing vector corresponding to the text character which appears in the first order as an input of the second sub-hidden layer, and performs nonlinear mapping on the input feature according to the weight of each neuron node set in the second sub-hidden layer in advance, so as to obtain the character feature output by

the second sub-hidden layer, as the output of the first hidden layer.

In one of the embodiments, the current hidden layer includes a first sub-hidden layer and a second sub-hidden layer. The step that the character vector and the splicing vector corresponding to the current-order text character are input into the current hidden layer of the first neural network includes: the server takes the splicing vector and the output of the previous hidden layer as an input of the first sub-hidden layer, the first sub-hidden layer being configured to perform projection on the character vector to obtain a first sub-character feature according to the weight of each neuron node corresponding to the first sub-hidden layer, and takes the first sub-character feature and the character vector as an input of the second sub-hidden layer, the second sub-hidden layer being configured to perform projection on the splicing vector to obtain a second sub-character feature as an output of the current hidden layer according to the weight of each neuron node corresponding to the second sub-hidden layer.

In one of the embodiments, the server inputs character vectors, word vectors, and splicing vectors corresponding to a plurality of text characters into different hidden layers of a first neural network in order according to a forward appearance order of the text characters in a target text, so as to obtain a first text feature of the target text based on the forward appearance order.

Specifically, the server inputs a character vector, a word vector, and a splicing vector corresponding to a current-order text character into a current hidden layer of the first neural network according to the forward appearance order of the text characters in the target text, and adopts nonlinear mapping to obtain a character feature output by the current hidden layer according to the character vector, the word vector, and the splicing vector corresponding to the current hidden layer, the weight of each neuron node corresponding to the current hidden layer, and the character feature output by the previous hidden layer. The server inputs the character feature output by the current hidden layer and the character vector, the word vector, and the splicing vector corresponding to a next-order text character into a next hidden layer of the first neural network, takes the next hidden layer as the current hidden layer, repeats the step of inputting the character feature output by the current hidden layer, and the character vector, the word vector, and the splicing vector corresponding to the next-order text character into the next hidden layer of the first neural network until the last-order text text character, so as to obtain the first text character of the target

text based on the forward appearance order.

In one of the embodiments, the first hidden layer includes a first sub-hidden layer, a second sub-hidden layer, and a third sub-hidden layer. The step that the character vector, the word vector, and the splicing vector corresponding to the current-order text character are input into the current hidden layer of the first neural network includes: the character vector and the output of the previous hidden layer are taken as an input of the first sub-hidden layer, and the first sub-hidden layer is configured to perform projection on the character vector to obtain a first sub-character feature according to the weight of each neuron node corresponding to the first sub-hidden layer; the first sub-character feature and the word vector are taken as an input of the second sub-hidden layer, and the second sub-hidden layer is configured to perform projection on the splicing vector to obtain a second sub-character feature according to the weight of each neuron node corresponding to the second sub-hidden layer; and the second sub-character feature and the splicing vector are taken as an input of the third sub-hidden layer, the third sub-hidden layer is configured to perform projection on the splicing vector to obtain a third sub-character feature as an output of the first hidden layer according to the weight of each neuron node corresponding to the third sub-hidden layer. The order of projecting the character vector, the word vector, and the splicing vector corresponding to the text character is not specified, and may be set arbitrarily. For example, the word vector may be projected to obtain a first sub-character feature corresponding to the first sub-hidden layer.

In one of the embodiments, the step that the server adopts the nonlinear mapping to obtain the character feature of the next hidden layer according to the character vector and the splicing vector corresponding to the current hidden layer, the weight of each neuron node corresponding to the current hidden layer, and the character feature output by the previous hidden layer may be described by the following examples.

For example, it is assumed that each neuron node corresponding to the current hidden layer is recorded as W_f , the character vector corresponding to the current hidden layer is x_t , the splicing vector corresponding to the current hidden layer is y_t , the character feature output by the previous hidden layer is h_{t-1} , and the nonlinear function is $\tanh$, then the character feature f_t output by the next hidden layer may be calculated by the formula as follows.

$f_t = \tanh(W_c [h_{t-1}, x_t, y_t] + b_f)$, herein, b_f is a bias of the current hidden layer.

In one of the embodiments, the first neural network further includes a random dropout layer. The method further includes: a first text feature is taken as an input of the random dropout layer. The random dropout layer is configured to perform projection on each piece of data in the first text feature according to a preset sparse probability, so as to obtain a sparse feature vector, as an output of the first neural network.

The random dropout layer is mainly configured to performing sparse processing on the input first text feature, and performing zeroing performing on part elements of the first text feature, so as to prevent over-fitting of the neural network, and meanwhile, reduce the calculation amount of a neural network.

Specifically, the server inputs the first text feature to the random dropout layer. The random dropout layer performs sparse processing on the first text feature according the set sparse probability, and performs projection on each piece of data of the first text feature according to the sparse probability, so as to obtain a sparse feature vector. Herein, the sparse probability refers to the probability of data after projection. For example, the first text feature is a one-dimensional sequence $[1, 2, 3, 4]^T$, the sparse probability is set to be 0.5. The probability of appearance of each number in the corresponding one-dimensional sequence after projection is 0.5, i.e., the result output by the random dropout layer may be $[0, 2, 0, 4]^T$, or may also be $[0, 0, 0, 4]^T$.

In an embodiment, the step that the character vectors and the splicing vectors corresponding to a plurality of text characters are input into different hidden layers of a second neural network in order according to a reverse appearance order of the text characters in the target text, so as to obtain a second text feature of the target text based on the reverse appearance order includes: the first text feature and a character vector and a splicing vector corresponding to a first-order text character are input into a first hidden layer of the second neural network according to the reverse appearance order of the text characters in the target text, so as to obtain a character feature output by the first hidden layer; the second hidden layer of the second neural network is taken as a current hidden layer, and a second-order text character is taken as a current-order text character; the character feature output by a previous hidden

layer and the character vector and the splicing vector corresponding to the current-order text character are input into the current hidden layer of the second neural network; and iteration is performed by taking the next hidden layer as the current hidden layer until the last-order text character, so as to obtain a second text feature of the target text based on the reverse appearance order.

Specifically, the first neural network is connected to the second neural network in series. An output of the first neural network is taken as an input of the second neural network. The character vector and the splicing vector corresponding to the first-order text character are obtained according to the reverse appearance order of the text characters in the target text. The server inputs the obtained first text feature output by the first neural network, and the character vector and the splicing vector into the first hidden layer of the second neural network, so as to obtain character feature output by the first hidden layer. The second hidden layer of the second neural network is taken as the current hidden layer, and a second-order text character is taken as a current-order text character. Further, the character feature output by the previous hidden layer, and the character vector and the splicing vector corresponding to the current-order text character are input into the current hidden layer of the second neural network, and nonlinear mapping is performed on the input feature through the weight of each neuron set in the current hidden layer, so as to obtain a character feature output by the current hidden layer. The server inputs the character feature output by the current hidden layer and the character vector and the splicing vector corresponding to the next-order text character into the next hidden layer of the second neural network, and iteration is performed by taking the next hidden layer as the current hidden layer until the last-order text character, so as to obtain a second text feature of the target text based on the reverse appearance order.

In one of the embodiments, the current hidden layer of the second neural network includes a first sub-hidden layer and a second sub-hidden layer. The step that the character feature output by the previous hidden layer, and the character vector and the splicing vector corresponding to the current-order text character are input into the current hidden layer of the second neural network includes: the character vector and the character feature output by the previous hidden layer are taken as an input of the first sub-hidden layer, and the first sub-hidden layer is configured to perform projection on the character vector to obtain a first sub-character feature according to the weight of each neuron node corresponding to

the first sub-hidden layer; the first sub-character feature and the splicing vector are taken as an input of the second sub-hidden layer, and the second sub-hidden layer is configured to perform projection on the splicing vector to obtain a second sub-character feature as an output of the current hidden layer according to the weight of each neuron node corresponding to the second sub-hidden layer.

In one of the embodiments, the step that the second text feature is input into a third neural network to obtain a semantic type of the target text includes: the second text feature is taken as an input of an attention mechanism layer, and the attention mechanism layer is configured to perform weighting processing on each piece of data in the second text feature to obtain a weighted feature; the weighted feature is taken as an input of the random dropout layer, and the random dropout layer is configured to perform projection on each piece of data in the weighted feature according to a preset sparse probability to obtain a sparse feature; the sparse feature is taken as an input of a fully connected layer, and the fully connected layer is configured to perform a classification operation on the sparse feature to obtain a predicted probability corresponding to each semantic type; and the semantic type with the greatest predicted probability is selected as the semantic type of the target text.

In one of the embodiments, the server inputs character vectors, word vectors, and splicing vectors corresponding to a plurality of text characters into different hidden layers of a second neural network in order according to a reverse appearance order of the text characters in a target text, so as to obtain a second text feature of the target text based on the reverse appearance order.

In one of the embodiments, the second neural network further includes a random dropout layer. The method further includes: the server takes a second text feature as an input of the random dropout layer. The random dropout layer is configured to perform projection on each piece of data in the second text feature according to a preset sparse probability, so as to obtain a sparse feature vector, as an output of the second neural network.

Hereinbelow, a process of processing the target text by the first neural network and the second neural network is described by a specific embodiment. For example, for the target text of “shen zhen shi”, the character vector corresponding to the text character “shen” is $(1,1,2,2)$, the splicing vector is $(1,1,1,1)$, the text character “zhen” corresponds to $(1,2,3,4)$, the splicing vector is $(2,1,1,1)$, the text character

“shi” corresponds to $(0,0,2,5)$, and the splicing vector is $(3,1,1,1)$.

According to the forward appearance order of the text characters in the target text, the character vector of the formed target text is $\begin{pmatrix} 1,1,2,2 \\ 1,2,3,4 \\ 0,0,2,5 \end{pmatrix}$, and the splicing

vector is $\begin{pmatrix} 1,1,1,1 \\ 2,1,1,1 \\ 3,1,1,1 \end{pmatrix}$.

A character vector and a splicing vector corresponding to a first-order text character are input into a first hidden layer, and the first hidden layer is taken as the current hidden layer. The current hidden layer includes a first sub-hidden layer and a second sub-hidden layer. That is, the character vector $(1,1,2,2)$ is input into the first sub-hidden layer of the current hidden layer, so as to obtain a first sub-character feature output by the first sub-hidden layer. Further, the first sub-character feature and the splicing vector $(1,1,1,1)$ are input into the second sub-hidden layer, and nonlinear mapping is performed on the input feature according to the weight of each neuron node set in the second sub-hidden layer in advance, so as to obtain a character feature output of the second hidden layer, as an output of the current hidden layer.

Further, the text character is moved to obtain a corresponding character vector $(1,2,3,4)$ and a corresponding splicing vector $(2,1,1,1)$ according to a forward appearance order, and the second hidden layer is taken as the current hidden layer. The output of the previous hidden layer and the character vector $(1,2,3,4)$ are input into a first sub-hidden layer of the current hidden layer, so as to obtain an output of the first sub-hidden layer of the current hidden layer. The output of the first sub-hidden layer of the current hidden layer and the splicing vector $(2,1,1,1)$ are input into the second sub-hidden layer of the current hidden layer, and nonlinear mapping is performed on the input feature according to the preset weight of each neuron node in the second sub-hidden layer of the current hidden layer, so as to obtain a character feature output by the second sub-hidden layer of the current

hidden layer, as an output of the current hidden layer. Until the output of the previous hidden layer, and the character vector $(0,0,2,5)$ and the splicing vector $(3,1,1,1)$ corresponding to a last-order text character are input into the current hidden layer, an output of the current hidden layer is obtained. The output result is taken as a first text feature of the output of the first neural network.

In one of the embodiments, the first neural network is connected to the second neural network in series. The second text feature output by the second neural network is input into a third neural network. An output of the first neural network is taken as an input of the second neural network.

Based on the reverse appearance order of the text characters in the target text,

the character vector of the formed target text is $\begin{pmatrix} 0,0,2,5 \\ 1,2,3,4 \\ 1,1,2,2 \end{pmatrix}$, and the splicing vector is

$$\begin{pmatrix} 3,1,1,1 \\ 2,1,1,1 \\ 1,1,1,1 \end{pmatrix}.$$

According to the reverse appearance order of the text characters, the first text feature, and the character vector and the splicing vector corresponding to a first-order text character are input into a first hidden layer of the second neural network, so as to obtain a character feature output by the first hidden layer. The first hidden layer of the second neural network is taken as the current hidden layer, and a second-order text character is taken as a current-order text character. That is, the first text character and the character vector $(0,0,2,5)$ are input into the first sub-hidden layer, so as to obtain an output of the first sub-hidden layer of the current hidden layer. The output of the first sub-hidden layer of the current hidden layer and the splicing vector $(3,1,1,1)$ are input into a second sub-hidden layer of the current hidden layer, and nonlinear mapping is performed on the input feature according to the preset weight of each neuron node in the second sub-hidden layer of the current hidden layer, so as to obtain a character feature output by the second sub-hidden layer of the current hidden layer, as an output of the current hidden layer.

The text character is moved to obtain a corresponding character vector

$(1,2,3,4)$ and a corresponding splicing vector $(2,1,1,1)$ according to a reverse appearance order, and the second hidden layer is taken as the current hidden layer. The output of the previous hidden layer and the character vector $(1,2,3,4)$ are input into a first sub-hidden layer of the current hidden layer, so as to obtain an output of the first sub-hidden layer of the current hidden layer. The output of the first sub-hidden layer of the current hidden layer and the splicing vector $(2,1,1,1)$ are input into the second sub-hidden layer of the current hidden layer, and nonlinear mapping is performed on the input feature according to the preset weight of each neuron node in the second sub-hidden layer of the current hidden layer, so as to obtain a character feature output by the second sub-hidden layer of the current hidden layer, as an output of the current hidden layer. Until the output of the previous hidden layer, and the character vector $(1,1,2,2)$ and the splicing vector $(1,1,1,1)$ corresponding to a last-order text character are input into the current hidden layer, so as to obtain an output of the hidden layer. The output result is taken as a second text feature of the output of the first neural network. The second text feature is input into a third neural network to obtain a semantic type of the target text. The output of the first neural network is taken as an input of the second neural network by connecting the first neural network to the second neural network in series, that is, the first text feature based on the forward appearance order, the character vector and the splicing vector based on the reverse appearance order are input into the second neural network together, so that mutual information between text characters can be mined more fully, particularly, context information between characters can be obtained well when the text characters are far apart from each other.

In one of the embodiments, the first neural network is connected to the second neural network in parallel. The first text feature output by the first neural network and the second text feature output by the second neural network are spliced and input into a third neural network. The rate of data processing can be improved by performing parallel processing on the target text through the first neural network and the second neural network.

In the present embodiment, a plurality of features, such as the character vector, the word vector, and the splicing vector, corresponding to the text character are input into the first neural network and the second neural network, and the input features

are cyclically calculated through various hidden layers in the first neural network and the second neural network, so as to obtain the first text feature and the second text feature that represent target text semantics. Through cyclic calculation of the neural networks, the correlation between the text characters can be captured better, especially for text characters with long character spacing. That is to say, when the text character spacing is large, relevant information of a predicted position can be acquired very well. The relevant information does not decay with the increase of the number of cycles.

In one of the embodiments, the third neural network layer includes an attention mechanism layer and a fully connected layer. The step that the first text feature and the second text feature are spliced and input into the third neural network to obtain a semantic type of the target text includes: the first text feature and the second text feature are spliced to obtain a comprehensive text feature of the target text; the comprehensive text feature is taken as an input of the attention mechanism layer, and the attention mechanism layer is configured to perform weighting processing on each piece of data in the comprehensive text feature to obtain a weighted feature; the weighted feature is taken as an input of a random dropout layer, and the random dropout layer is configured to perform projection on each piece of data in the weighted feature according to a preset sparse probability to obtain a sparse feature; the sparse feature is taken as an input of a fully connected layer, and the fully connected layer is configured to perform a classification operation on the sparse feature to obtain a predicted probability corresponding to each semantic type; and the semantic type with the greatest predicted probability is selected as the semantic type of the target text.

Specifically, the server splices the first text feature and the second text feature of the target text, so as to obtain the comprehensive text feature of the target text. Further, the server inputs the obtained comprehensive text feature into the attention mechanism layer. The attention mechanism layer calculates each piece of data in the comprehensive text feature to obtain a coefficient sequence according to a pre-trained coefficient weight parameter. The coefficient sequence is activated by using a nonlinear activation function, so as to obtain an activated coefficient sequence. Normalization processing is performed on the activated coefficient sequence through a logistic regression (softmax) function, so as to obtain the coefficient probability corresponding to each piece of data in the comprehensive text

feature. Herein, the coefficient probability ranges between [0, 1]. The obtained coefficient probability is multiplied with respective data of the comprehensive text feature to obtain weighted features after weighting processing, as an output of the attention mechanism layer.

Further, the server inputs the weighted features output by the attention mechanism layer into the random dropout layer. The random dropout layer performs sparse processing on the weighted features according the set sparse probability, and performs projection on each piece of data of the weighted features according to the sparse probability, so as to obtain a sparse feature. Herein, the sparse probability refers to the probability of data after projection.

Further, the server inputs the sparse feature into the fully connected layer, and a classification operation is performed on the sparse feature through the fully connected layer. The predicted probability corresponding to each semantic type is calculated according to the weight parameters of the trained fully connected layer. Herein, the each predicted probability output by the fully connected layer corresponds to one semantic type. The server selects the semantic type with the maximum predicted probability as a semantic type of the target text.

In one of the embodiments, the third neural network layer further includes a logistic regression layer (softmax layer), and the method specifically includes: the predicted probability corresponding to each semantic type is taken as an input of the softmax layer. Herein, the softmax layer is configured to perform the normalization processing on each predicted probability to obtain a probability corresponding to each semantic type, and select the semantic type with the maximum probability as the semantic type of the target text.

For example, the predicted probability output by the fully connected layer is $\begin{bmatrix} a \\ b \end{bmatrix}$,

the semantic type corresponding to a is 1, and the semantic type corresponding to b is 0. After normalization is performed by using a softmax function, the probability output after the normalization of the each semantic type is obtained as

$\begin{bmatrix} e^a / (e^a + e^b) \\ e^b / (e^a + e^b) \end{bmatrix}$. The semantic type corresponding to the maximum probability is

selected as the semantic type of the target text.

In one of the embodiments, the neural network includes a first neural network, a second neural network, and a third neural network. A training process of a neural network model includes: a sample text and a known label are acquired; a sample text character and a sample text word segmentation that each sample text character belongs included in the sample text are determined; a sample character vector corresponding to the sample text character and a sample word vector corresponding to the sample text word segmentation are calculated, and the sample character vector corresponding to each sample text character and the sample word vector of the sample text word segmentation that the sample text character belongs are spliced, so as to obtain a sample splicing vector of the corresponding sample text character; the sample character vectors and the sample splicing vectors corresponding to a plurality of sample text characters are input into a first neural network to be trained in order according to a forward appearance order of the sample text characters in the sample text, so as to obtain a sample first text feature; and the sample character vectors and the sample splicing vectors corresponding to the plurality of sample text characters are input into a second neural network to be trained in order according to a reverse appearance order of the sample text characters in the sample text, so as to obtain a sample second text feature.

A sample comprehensive text feature obtained by splicing the sample first text feature and the sample second text feature is input into a third neural network to be trained, so as to obtain a predicted semantic type of the sample text. A loss value is calculated according to the predicted semantic type and the known label, and loss value is transmitted to each layer of the neural network model by a reverse gradient propagation method, so as to obtain the gradient of parameters of each layer. The parameters of each layer in the neural network model are adjusted according to the gradient until the determined loss value reaches a training stop condition.

Herein, the step that the parameters of each layer in the neural network model are adjusted includes: the weight parameters of the fully connected layer, and the weighting parameters and bias parameters of each hidden layer in the first neural network and the second neural network are adjusted. A function for calculating the loss value may be a cross entropy loss function. The reverse gradient propagation method may be a Batch Gradient Descent (BGD) method, a Mini-Batch Gradient Descent (MGBD) method, and a Stochastic Gradient Descent (SGD) method.

In the present embodiment, the attention mechanism layer of a third neural network layer performs weighting processing on the comprehensive text feature, which highlights the features of high mutual information between the text characters and weakens the features of low mutual information. Further, the random dropout layer performs sparse processing on the weighted features to obtain sparse features after the sparse processing, and the fully connected layer performs the classification operation on the sparse features to obtain the predicted probability corresponding to each semantic type, and selects the semantic type with the maximum predicted probability as the semantic type of the target text. The semantic feature of the target text is represented by using the comprehensive text feature, and weighting and sparse processing are performed, which enhances the Context semantics of the text characters, reduces the amount of calculation of computer devices, and improves the classification accuracy of target samples.

It should be understood that, although various steps in the flowcharts of Figs. 2-3 are shown in order as indicated by the arrows, these steps are not necessarily executed sequentially in the order indicated by the arrows. Unless explicitly stated herein, there is no strict order restriction on the execution of these steps, and these steps may be executed in other orders. In addition, at least part of the steps in Figs. 2-3 may include a plurality of sub-steps or a plurality of stages. These sub-steps or stages are not necessarily completed at the same time, but may be executed at different times. These sub-steps or stages are not necessarily executed in order, instead, may be executed in turn or alternately with other steps or at least part of sub-steps or stages of other steps.

In an embodiment, as shown in Fig. 4, a text semantic recognition apparatus 400 is provided, including: a vector calculation module 402, a vector splicing module 404, a first text feature acquisition module 406, a second text feature acquisition module 408, and a semantic type acquisition module 410.

The vector calculation module 402 is configured to calculate a character vector of each text character and a word vector of each text segmentation in a target text.

The vector splicing module 404 is configured to splice the character vector of each text character and the word vector of the text word segmentation that the text character belongs to obtain a splicing vector of the corresponding text character.

The first text feature acquisition module 406 is configured to input the character vectors and the splicing vectors corresponding to a plurality of text characters into

different hidden layers of a first neural network in order according to a forward appearance order of the text characters in the target text, so as to obtain a first text feature of the target text based on the forward appearance order.

The second text feature acquisition module 408 is configured to input the character vectors and the splicing vectors corresponding to the plurality of text characters into different hidden layers of a second neural network in order according to a reverse appearance order of the text characters in the target text, so as to obtain a second text feature of the target text based on the reverse appearance order.

The semantic type acquisition module 410 is configured to input a comprehensive text feature obtained by splicing the first text feature and the second text feature into a third neural network to obtain a semantic type of target text.

In an embodiment, the first neural network inputs a character vector and a splicing vector corresponding to a current-order text character into a current hidden layer of the first neural network according to the forward appearance order of the text characters in the target text, inputs the character feature output by the current hidden layer and the character vectors and the splicing vectors corresponding to the text characters in a next order into a next hidden layer of the first neural network, performs iteration by taking the next hidden layer as the current hidden layer until a last-order text character, so as to obtain the first text feature of the target text based on the forward appearance order.

In an embodiment, as shown in Fig. 5, the abovementioned apparatus further includes a preset sample generation module 412, configured to extract character vectors and word vectors of a sample text on the basis of a pre-trained first neural network layer, perform character numbering the character vectors and the word vectors respectively, write character numbers respectively corresponding to the character vectors and the word vectors into a preset file, and calculate the character vectors of the text characters and the word vector corresponding to text word segmentation, including: character numbering is performed on each text character and text word segmentation, and the character vector corresponding to each text character and the word vector corresponding to each text word segmentation are read from the preset file on the basis of the character numbers.

In an embodiment, the abovementioned first text feature acquisition module is further configured to the character vectors and the splicing vectors corresponding to text characters in a current order into a current hidden layer of the first neural network

according to the forward appearance order of the text characters in the target text, inputs the character feature output by the current hidden layer and the character vectors and the splicing vectors corresponding to the text characters in a next order into a next hidden layer of the first neural network, takes the next hidden layer as the current hidden layer, and returns to the step of inputting the character feature output by the current hidden layer and the character vectors and the splicing vectors corresponding to the text characters in the next order into the next hidden layer of the first neural network until the text character in the last order, so as to obtain a first text feature of the target text based on the forward appearance order.

In an embodiment, the abovementioned second text feature acquisition module is further configured to input the first text feature and a character vector and a splicing vector corresponding to a first-order text character into a first hidden layer of the second neural network according to the reverse appearance order of the text characters in the target text, inputs the output of the first hidden layer, and a character vector and a splicing vector corresponding to a current-order text character into the current hidden layer of the second neural network, inputs the character feature of the current hidden layer and the character vector and the splicing vector corresponding to a next-order text character into a next hidden layer of the second neural network, performs iteration by taking the next hidden layer as the current hidden layer, and returns to the step that the character feature of the current hidden layer and the character vector and the splicing vector corresponding to the next-order text character into the next hidden layer of the second neural network until the last-order text character, so as to obtain a second text feature of the target text based on the reverse appearance order.

In an embodiment, the abovementioned first text feature acquisition module is further configured to take the character vector and the output of the previous hidden layer as an input of a first sub-hidden layer, the first sub-hidden layer being configured to perform projection on the character vector to obtain a first sub-character feature according to the weight of each neuron node corresponding to the first sub-hidden layer, and take the first sub-character feature and the splicing vector as an input of the second sub-hidden layer, the second sub-hidden layer being configured to perform projection on the splicing vector to obtain a second sub-character feature as an output of the current hidden layer according to the weight of each neuron node corresponding to the second sub-hidden layer.

In an embodiment, the abovementioned first text feature acquisition module is further configured to take the first text feature as an input of a random dropout layer. The random dropout layer is configured to perform projection on each piece of data in the first text feature according to a preset sparse probability, so as to obtain a sparse feature vector, as an output of the first neural network.

In an embodiment, the abovementioned semantic type acquisition module is further configured to: splice the first text feature and the second text feature to obtain a comprehensive text feature of the target text; take the comprehensive text feature as an input of an attention mechanism layer, the attention mechanism layer being configured to perform weighting processing on each piece of data in the comprehensive text feature to obtain a weighted feature; take the weighted feature as an input of the random dropout layer, the random dropout layer being configured to perform projection on each piece of data in the weighted feature according to a preset sparse probability to obtain a sparse feature; take the sparse feature as an input of a fully connected layer, the fully connected layer being configured to perform a classification operation on the sparse feature to obtain a predicted probability corresponding to each semantic type; and select the semantic type with the greatest predicted probability as the semantic type of the target text.

In the abovementioned embodiments, the character vector corresponding to each text character and the word vector of the text word segmentation that each text character belongs are calculated and spliced to obtain the splicing vector corresponding to the text characters, and vector splicing is performed on the text characters, and the text is represented by a plurality of feature vectors, so that the feature dimension represented by a text language is enhanced. Further, the character vectors and the splicing vectors are input into different hidden layers of different neural networks according to the forward appearance order and the reverse appearance order, so that relevant information of the text characters can be acquired more fully. Context semantics between the text characters is mined, so that the first text feature and the second text feature output through the first neural network are spliced to obtain the comprehensive feature, the semantic features of the target text can be fully expressed, and the accuracy of text semantic recognition is improved.

Specific definition of the text semantic recognition device may refer to the definition of the text semantic recognition method hereinabove, which will not be elaborated here. Various modules in the abovementioned semantic recognition

apparatus may be implemented in whole or in part by software, hardware, and combinations thereof. Each of the above modules may be embedded in or independent of a processor in a computer device, or may be stored in a memory in the computer device in a software form, so that the processor invokes operations corresponding to the above modules.

In an embodiment, a computer device is provided. The computer device may be a server, and an internal structure diagram thereof may be as shown in Fig. 6. The computer device includes a processor, a memory, a network interface, and a database connected by a system bus. The processor of the computer device is configured to provide calculation and control capabilities. The memory of the computer device includes a non-volatile storage medium and an internal memory. The non-volatile storage medium stores an operating system, a computer program, and a database. The internal memory provides an environment for operation of the operating system and the computer program in the non-volatile storage medium. The database of the computer device is used to store a preset file and the character vectors corresponding to the text characters and the word vectors corresponding to the text word segmentations included in the target text. The network interface of the computer device is configured to communicate with an external terminal via a network connection. The computer program is executed by the processor to implement a text semantic recognition method.

It will be understood by those skilled in the art that the structure shown in Fig. 6 is only a block diagram of a part of the structure related to the solution of the present application, and does not constitute a limitation of the computer device to which the solution of the present application is applied. The specific computer device may include more or fewer components than those shown in the figures, or combine some components, or have different component arrangements.

A computer device includes a memory and a processor. The memory stores a computer program. The processor, when executing the computer program, implements the steps of the text semantic recognition method provided by any embodiment of the present application.

A computer-readable storage medium stores a computer program thereon. The computer program, when being implemented by the processor, implements the steps of the text semantic recognition method provided by embodiment of the present application.

Those skilled in the art can understand that all or part of the processes in the above method embodiments may be implemented by a computer program to instruct related hardware, and the computer program may be stored in a computer-readable storage medium. The computer-readable storage medium may be nonvolatile or volatile. The computer program, when being executed, may include flowcharts of the embodiments of the methods described above. Any reference to a memory, storage, database, or other media used in various embodiments provided by the present application may include nonvolatile and/or volatile memories. The nonvolatile memory may include a Read Only Memory (ROM), a Programmable ROM (PROM), an Electrically Programmable ROM (EPROM), an Electrically Erasable Programmable ROM (EEPROM), or a flash memory. The volatile memory may include a Random Access Memory (RAM) or an external cache memory. As an illustration rather than a limitation, the RAM is available in various forms, such as a Static RAM (SRAM), a Dynamic RAM (DRAM), a Synchronous DRAM (SDRAM), a Dual Data Rate SDRAM (DDRSDRAM), an Enhanced SDRAM (ESDRAM), a Synchlink DRAM (SLDRAM), a Rambus Direct RAM (RDRAM), a Direct Memory Bus Dynamic RAM (DRDRAM), a Memory Bus Dynamic RAM (RDRAM), etc.

The foregoing descriptions are merely specific implementations of this application, but are not intended to limit the protection scope of this application. Any variation or replacement readily figured out by a person skilled in the art within the technical scope disclosed in this application shall fall within the protection scope of this application. Therefore, the scope of protection of the present application shall be subject to the scope of protection of the claims.

What is claimed is:

1. A text semantic recognition method, comprising:

calculating a character vector of each text character and a word vector of each text word segmentation in a target text;

splicing the character vector of each text character and the word vector of the text word segmentation that the text character belongs, to obtain a splicing vector of the corresponding text character;

inputting the character vectors and the splicing vectors corresponding to a plurality of text characters into different hidden layers of a first neural network in order according to a forward appearance order of the text characters in the target text, so as to obtain a first text feature of the target text based on the forward appearance order;

inputting the character vectors and the splicing vectors corresponding to the plurality of text characters into different hidden layers of a second neural network in order according to a reverse appearance order of the text characters in the target text, so as to obtain a second text feature of the target text based on the reverse appearance order; and

inputting a comprehensive text feature obtained by splicing the first text feature and the second text feature into a third neural network to obtain a semantic type of the target text.

2. The method as claimed in claim 1, further comprising:

acquiring a sample text;

extracting character vectors and word vectors of the sample text on the basis of a pre-trained first neural network;

performing character numbering the character vectors and the word vectors;

writing the character vectors, the word vectors, and respective corresponding character numbers into a preset file;

the calculating a character vector of the text character and a word vector corresponding to a text word segmentation comprises:

performing character numbering on each of the text characters and the text word segmentations; and

reading in the preset file to obtain the character vector corresponding to each text character and the word vector corresponding to each text word segmentation.

3. The method as claimed in claim 1, wherein the inputting the character vectors

and the splicing vectors corresponding to a plurality of text characters into different hidden layers of a first neural network in order according to a forward appearance order of the text characters in the target text, so as to obtain a first text feature of the target text based on the forward appearance order comprises:

inputting a character vector and a splicing vector corresponding to a current-order text character into a current hidden layer of a first neural network according to the forward appearance order of the text characters in the target text;

inputting a character feature output by the current hidden layer and the character vector and the splicing vector corresponding to a next-order text character into a next hidden layer of first neural network; and

performing iteration by taking a next hidden layer as the current hidden layer until a last-order text character, so as to obtain a first text feature of the target text based on the forward appearance order.

4. The method as claimed in claim 3, wherein the current hidden layer comprises a first sub-hidden layer and a second sub-hidden layer; the inputting a character vector and a splicing vector corresponding to a current-order text character into a current hidden layer of a first neural network comprises:

taking the character vector and an output of a previous hidden layer as an input of the first sub-hidden layer, and the first sub-hidden layer being configured to perform projection on the character vector to obtain a first sub-character feature according to the weight of each neuron node corresponding to the first sub-hidden layer; and

taking the first sub-character feature and the splicing vector as an input of the second sub-hidden layer, and the second sub-hidden layer being configured to perform projection on the splicing vector to obtain a second sub-character feature as an output of the current hidden layer according to the weight of each neuron node corresponding to the second sub-hidden layer.

5. The method as claimed in claim 3, wherein the first neural network further includes a random dropout layer, and the method further comprises:

taking the first text feature as an input of a random dropout layer, and the random dropout layer being configured to perform projection on each piece of data in the first text feature according to a preset sparse probability, so as to obtain a sparse feature vector, as an output of the first neutral network.

6. The method as claimed in claim 1, wherein the inputting the The character

vectors and the splicing vectors corresponding to a plurality of text characters into different hidden layers of a second neural network in order according to a reverse appearance order of the text characters in the target text, so as to obtain a second text feature of the target text based on the reverse appearance order comprises:

inputting the first text feature, and a character vector and a splicing vector corresponding to a first-order text character into a first hidden layer of the second neural network according to a reverse appearance order of the text characters in the target text, so as to obtain a character feature output by the first hidden layer;

taking a second hidden layer of the second neural network as a current hidden layer, and taking a second-order text character as a current-order text character;

inputting the character feature output by a previous hidden layer, and the character vector and the splicing vector corresponding to the current-order text character into the current hidden layer of the second neural network; and

performing iteration by taking the next hidden layer as the current hidden layer until a last-order text character, so as to obtain a second text feature of the target text based on the reverse appearance order.

7. The method as claimed in claim 1, wherein the third neural network comprises an attention mechanism layer and a fully connected layer; the inputting a comprehensive text feature obtained by splicing the first text feature and the second text feature into a third neural network to obtain a semantic type of the target text comprises:

splicing the first text feature and the second text feature to obtain a comprehensive text feature;

taking the comprehensive text feature as an input of the attention mechanism layer, and the attention mechanism layer being configured to perform weighting processing on each piece of data in the comprehensive text feature;

taking a weighted feature as an input of the random dropout layer, and the random dropout layer being configured to perform projection on each piece of data in the weighted feature according to a preset sparse probability, so as to obtain a sparse feature vector;

taking the sparse feature as an input of the fully connected layer, and the fully connected layer being configured to perform a classification operation on the sparse feature to obtain a predicted probability corresponding to each semantic type; and

selecting a semantic type with the maximum predicted probability as a semantic

type of the target text.

8. A text semantic recognition apparatus, comprising:

a vector calculation module, configured to calculate a character vector of each text character and a word vector of each text segmentation in a target text;

a vector splicing module, configured to splice the character vector of each text character and the word vector of the text word segmentation that the text character belongs to obtain a splicing vector of the corresponding text character;

a first text feature acquisition module, configured to input The character vectors and the splicing vectors corresponding to a plurality of text characters into different hidden layers of a first neural network in order according to a forward appearance order of the text characters in the target text, so as to obtain a first text feature of the target text based on the forward appearance order;

a second text feature acquisition module, configured to input the character vectors and the splicing vectors corresponding to the plurality of text characters into different hidden layers of a second neural network in order according to a reverse appearance order of the text characters in the target text, so as to obtain a second text feature of the target text based on the reverse appearance order; and

a semantic type acquisition module, configured to input a comprehensive text feature obtained by splicing the first text feature and the second text feature into a third neural network to obtain a semantic type of the target text.

9. A computer device, comprising a memory and a processor, wherein the processor is interconnected to the memory, the memory is configured to store a computer program, the computer program comprises a program instruction, and the processor is configured to execute the program instruction of the memory to:

calculate a character vector of each text character and a word vector of each text word segmentation in a target text;

splice the character vector of each text character and the word vector of the text word segmentation that the text character belongs to obtain a splicing vector of a corresponding text character;

input the character vectors and the splicing vectors corresponding to a plurality of text characters into different hidden layers of a first neural network in order according to a forward appearance order of the text characters in the target text, so as to obtain a first text feature of the target text based on the forward appearance order;

input the character vectors corresponding to the plurality of text characters and the splicing vector into different hidden layers of a second neural network in order according to a reverse appearance order of the text characters in the target text, so as to obtain a second text feature of the target text based on the reverse appearance order; and

input a comprehensive text feature obtained by splicing the first text feature and the second text feature into a third neural network to obtain a semantic type of the target text.

10. The computer device as claimed in claim 9, wherein the processor is configured to:

acquire a sample text;

extract character vectors and word vectors of the sample text on the basis of a pre-trained first neural network;

perform character numbering the character vectors and the word vectors;

write the character vectors, the word vectors, and respective corresponding character numbers into a preset file; wherein

the calculating a character vector of the text character and a word vector corresponding to a text word segmentation comprises:

performing character numbering on each of the text characters and the text word segmentations; and

reading in the preset file to obtain the character vector corresponding to each text character and the word vector corresponding to each text word segmentation.

11. The computer device as claimed in claim 9, wherein the processor is configured to:

input a character vector and a splicing vector corresponding to a current-order text character into a current hidden layer of a first neural network according to the forward appearance order of the text characters in the target text;

input a character feature output by the current hidden layer and the character vector and the splicing vector corresponding to a next-order text character into a next hidden layer of first neural network; and

perform iteration by taking a next hidden layer as the current hidden layer until a last-order text character, so as to obtain a first text feature of the target text based on the forward appearance order.

12. The computer device as claimed in claim 11, wherein the current hidden

layer comprises a first sub-hidden layer and a second sub-hidden layer; the processor is configured to:

take the character vector and an output of a previous hidden layer as an input of the first sub-hidden layer, wherein the first sub-hidden layer is configured to perform projection on the character vector to obtain a first sub-character feature according to the weight of each neuron node corresponding to the first sub-hidden layer; and

take the first sub-character feature and the splicing vector as an input of the second sub-hidden layer, wherein the second sub-hidden layer is configured to perform projection on the splicing vector to obtain a second sub-character feature as an output of the current hidden layer according to the weight of each neuron node corresponding to the second sub-hidden layer.

13. The computer device as claimed in claim 11, wherein the processor is configured to:

take the first text feature as an input of a random dropout layer, wherein the random dropout layer is configured to perform projection on each piece of data in the first text feature according to a preset sparse probability, so as to obtain a sparse feature vector, as an output of the first neural network.

14. The computer device as claimed in claim 9, wherein the processor is configured to:

input the first text feature, and a character vector and a splicing vector corresponding to a first-order text character into a first hidden layer of the second neural network according to a reverse appearance order of the text characters in the target text, so as to obtain a character feature output by the first hidden layer;

take a second hidden layer of the second neural network as a current hidden layer, and take a second-order text character as a current-order text character;

input the character feature output by a previous hidden layer, and the character vector and the splicing vector corresponding to the current-order text character into the current hidden layer of the second neural network; and

perform iteration by taking the next hidden layer as the current hidden layer until a last-order text character, so as to obtain a second text feature of the target text based on the reverse appearance order.

15. The computer device as claimed in claim 9, wherein the third neural network comprises an attention mechanism layer and a fully connected layer; the processor is configured to:

splice the first text feature and the second text feature to obtain a comprehensive text feature;

take the comprehensive text feature as an input of the attention mechanism layer, wherein the attention mechanism layer is configured to perform weighting processing on each piece of data in the comprehensive text feature;

take a weighted feature as an input of the random dropout layer, wherein the random dropout layer is configured to perform projection on each piece of data in the weighted feature according to a preset sparse probability, so as to obtain a sparse feature vector;

take the sparse feature as an input of the fully connected layer, wherein the fully connected layer is configured to perform a classification operation on the sparse feature to obtain a predicted probability corresponding to each semantic type; and

select a semantic type with the maximum predicted probability as a semantic type of the target text.

16. A computer-readable storage medium, storing a computer program, wherein the computer program comprises a program instruction, and the program instruction, when being executed by a processor, is used to implement the following steps:

calculating a character vector of each text character and a word vector of each text word segmentation in a target text;

splicing the character vector of each text character and the word vector of the text word segmentation that the text character belongs to obtain a splicing vector of a corresponding text character;

inputting the character vectors and the splicing vectors corresponding to a plurality of text characters into different hidden layers of a first neural network in order according to a forward appearance order of the text characters in the target text, so as to obtain a first text feature of the target text based on the forward appearance order;

inputting the character vectors and the splicing vectors corresponding to the plurality of text characters into different hidden layers of a second neural network in order according to a reverse appearance order of the text characters in the target text, so as to obtain a second text feature of the target text based on the reverse appearance order; and

inputting a comprehensive text feature obtained by splicing the first text feature and the second text feature into a third neural network to obtain a semantic type of

the target text.

17. The computer-readable storage medium as claimed in claim 16, wherein the program instruction, when being executed by the processor, is further used to implement the following steps:

- acquiring a sample text;

- extracting character vectors and word vectors of the sample text on the basis of a pre-trained first neural network;

- performing character numbering the character vectors and the word vectors;

- writing the character vectors, the word vectors, and respective corresponding character numbers into a preset file;

the calculating a character vector of the text character and a word vector corresponding to a text word segmentation comprises:

- performing character numbering on each of the text characters and the text word segmentations; and

- reading in the preset file to obtain the character vector corresponding to each text character and the word vector corresponding to each text word segmentation.

18. The computer-readable storage medium as claimed in claim 16, wherein the program instruction, when being executed by the processor, is further used to implement the following steps:

- inputting a character vector and a splicing vector corresponding to a current-order text character into a current hidden layer of a first neural network according to the forward appearance order of the text characters in the target text;

- inputting a character feature output by the current hidden layer and the character vector and the splicing vector corresponding to a next-order text character into a next hidden layer of first neural network; and

- performing iteration by taking a next hidden layer as the current hidden layer until a last-order text character, so as to obtain a first text feature of the target text based on the forward appearance order.

19. The computer-readable storage medium as claimed in claim 18, wherein the current hidden layer comprises a first sub-hidden layer and a second sub-hidden layer; the program instruction, when being executed by the processor, is further used to implement the following steps:

- taking the character vector and an output of a previous hidden layer as an input of the first sub-hidden layer, and the first sub-hidden layer being configured to

perform projection on the character vector to obtain a first sub-character feature according to the weight of each neuron node corresponding to the first sub-hidden layer; and

taking the first sub-character feature and the splicing vector as an input of the second sub-hidden layer, and the second sub-hidden layer being configured to perform projection on the splicing vector to obtain a second sub-character feature as an output of the current hidden layer according to the weight of each neuron node corresponding to the second sub-hidden layer.

20. The computer-readable storage medium as claimed in claim 18, wherein the program instruction, when being executed by the processor, is further used to implement the following steps:

taking the first text feature as an input of a random dropout layer, wherein the random dropout layer is configured to perform projection on each piece of data in the first text feature according to a preset sparse probability, so as to obtain a sparse feature vector, as an output of the first neural network.