

CREDIT EVALUATION METHOD, APPARATUS AND DEVICE, AND COMPUTER READABLE STORAGE MEDIUM

This application claims priority to the Chinese Patent Application No. 201711010536.1, filed with the National Intellectual Property Administration, PRC on October 25, 2017, and entitled "CREDIT EVALUATION METHOD, APPARATUS AND DEVICE, AND COMPUTER READABLE STORAGE MEDIUM", which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

This application relates to the field of credit financing, and in particular, to a credit evaluation method, apparatus and device, and a computer readable storage medium.

BACKGROUND

In a conventional credit approval process, a loan request of a loan user is manually reviewed by a staff member of a financial institution. During review, the staff member needs to check a large amount of data of the loan user to determine risk conditions related to a loan transaction, such as how much money the loan user can borrow and whether the loan can be repaid within a loan period. With the development of science and technology, financial institutions begin to use a computer risk control system to evaluate credit requests, where a risk control model is an important part of the entire risk control system, and is mainly configured to identify, analyze and evaluate user data, thereby obtaining an evaluation conclusion.

The current risk control model mainly uses a static rule engine of Drools, and introduces expert rules to evaluate a credit request (that is, human experience is transformed into a logic algorithm of a computer, and then the credit request is identified with the computer). However, the human experience is not necessarily correct. The human experience is susceptible to subjective factors, which affects the accuracy of the risk control model evaluation, making the risk control model unable to give a reasonable loan solution, or even making it difficult to identify an intentional fraud, thereby increasing the rate of bad loans.

SUMMARY

A main objective of this application is to provide a credit evaluation method, apparatus and device, and a computer readable storage medium, which aim to improve the evaluation capability of a risk control model and reduce the rate of bad loans.

To achieve the foregoing objective, this application provides a credit evaluation method, including the following steps:

acquiring historical credit data, and constructing an AI risk control engine according to the historical credit data;

when a loan request is received, acquiring pre-loan user data of a loan user corresponding to the loan request, and inputting the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation; and

acquiring an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine, and generating a corresponding decision and suggestion according to the expert evaluation conclusion and the AI evaluation conclusion.

Optionally, the historical credit data includes historical pre-loan data and historical post-loan data.

The step of acquiring historical credit data, and constructing an AI risk control engine according to the historical credit data includes:

using the historical pre-loan data and the historical post-loan data as an input training set and an output training set respectively, and training an initial machine learning model based on the input training set and the output training set to obtain an AI risk control engine.

Optionally, the initial machine learning model is subjected to a cold start by means of expert rules.

Optionally, input elements in the input training set include a multi-dimensional vector x with a dimension of m , and output elements in the output training set include a non-performing loan ratio y .

The step of training an initial machine learning model based on the input training set and the output training set to obtain an AI risk control engine includes:

combining the input elements with the output elements to define m multi-dimensional training vector groups;

$$\{(x^1, y^1), (x^2, y^2), \dots, (x^m, y^m)\} ;$$

learning a multi-dimensional training vector in the multi-dimensional training vector group based on a Gradient Boosting Decision Tree (GBDT) algorithm to obtain a corresponding decision tree,

$$T(x; \theta_m) ,$$

where θ_m is a parameter of the decision tree;

performing linear combination on the decision trees to obtain a linear combination tree,

$$f_M(x) = \sum_{m=1}^m T(x; \theta_m) ,$$

where a cost function of the linear combination tree is

$$f(x) = l(h(x, D), Y) ,$$

where $h(x, D)$ is a hypothesis function, which is a decision result of the decision tree, and a first-order expansion of a Taylor formula of the cost function $f(x)$ is:

$$l(H(x_{t+1})) = l(H(x_t) + h(x_{t+1})) \approx l(H(x_t)) + \nabla l(H(x_t))h(x_{t+1}) ,$$

where $H(x_t) = \sum_{i=1}^t h(x_i)$ is a weighted sum of the first t decision trees,

$H(x_{t+1}) = H(x_t) - \gamma \nabla l(H(x_t))$ is a steepest descent iterative formula, and

$h(x_{t+1}) = \nabla l(H(x_t))$ is a gradient of the hypothesis function; and

obtaining the AI risk control engine according to the linear combination tree and the cost function.

Optionally, the step of acquiring, when a loan request is received pre-loan user data of a loan user corresponding to the loan request, and inputting the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation includes:

when a loan request is received, generating a corresponding data acquisition request according to a user identifier and an authorization grant included in the loan request, and sending the data acquisition request to a data management system to obtain corresponding pre-loan user data; and

receiving the pre-loan user data fed back by the data management system, and inputting the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation.

Optionally, the step of acquiring an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine, and generating a corresponding decision and suggestion according to the expert evaluation conclusion and the AI evaluation conclusion includes:

acquiring an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine, and performing a weighted computation based on the expert evaluation conclusion and the AI evaluation conclusion to obtain a credit line of the loan user; and

generating a corresponding loan suggestion according to the credit line, where the loan suggestion includes a loan limit and a loan period.

Optionally, after the step of acquiring an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine, and generating a corresponding decision and suggestion according to the expert evaluation conclusion and the AI evaluation conclusion, the method further includes:

acquiring post-loan user data of the loan user, and combining the pre-loan user data and the post-loan user data to obtain an iterative training sample; and

performing iterative training on the AI risk control engine through the iterative training sample to adjust the AI risk control engine.

In addition, to achieve the foregoing objective, this application further provides a credit evaluation apparatus, including:

an engine construction module, configured to acquire historical credit data, and construct an AI risk control engine according to the historical credit data;

a credit evaluation module, configured to acquire, when a loan request is received, pre-loan user data of a loan user corresponding to the loan request, and input the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation; and

a suggestion generation module, configured to acquire an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine, and generate a corresponding decision and suggestion according to the expert evaluation conclusion and the AI evaluation conclusion.

In addition, to achieve the foregoing objective, this application further provides a credit evaluation device, including a processor, a memory, and a credit evaluation program stored on the memory and executable by the processor, where when the credit evaluation program is executed by the processor, the following steps are implemented:

acquiring historical credit data, and constructing an AI risk control engine according to the historical credit data;

when a loan request is received, acquiring pre-loan user data of a loan user corresponding to the loan request, and inputting the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation; and

acquiring an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine, and generating a corresponding decision and suggestion according to the expert evaluation conclusion and the AI evaluation conclusion.

In addition, to achieve the foregoing objective, this application further provides a computer readable storage medium having a credit evaluation program stored thereon, where when the credit evaluation program is executed by a processor, the following steps are implemented:

acquiring historical credit data, and constructing an AI risk control engine according to the historical credit data;

when a loan request is received, acquiring pre-loan user data of a loan user corresponding to the loan request, and inputting the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation; and

acquiring an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine, and generating a corresponding decision and suggestion according to the expert evaluation conclusion and the AI evaluation conclusion.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a schematic diagram of a hardware structure of a credit evaluation device involved in a solution of an embodiment of this application;

FIG. 2 is a schematic flowchart of a credit evaluation method according to a first embodiment of this application;

FIG. 3 is a schematic flowchart of a detailed process of FIG. 2 in which when a loan request is received, pre-loan user data of a loan user corresponding to the loan request is acquired, and the pre-loan user data is input to a pre-set expert engine and the AI risk control engine respectively for credit evaluation;

FIG. 4 is a schematic flowchart of a credit evaluation method according to a second embodiment of this application; and

FIG. 5 is a schematic diagram of functional modules of a credit evaluation apparatus according to a first embodiment of this application.

The implementation, functional features and advantages of this application will be further described by combining embodiments with reference to the accompanying drawings.

DESCRIPTION OF EMBODIMENTS

It should be understood that the specific embodiments described herein are merely illustrative of this application and are not intended to limit this application.

A credit evaluation method according to an embodiment of this application is mainly applied to a credit evaluation device. Referring to FIG. 1, illustrated is a schematic diagram of a hardware structure of a credit evaluation device involved in a solution of an embodiment of this application. The credit evaluation device in the embodiment of this application may include a processor 1001 (such as a CPU), a communication bus 1002, a user interface 1003, a network interface 1004, and a memory 1005. The communication bus 1002 is configured to implement connection communication among these components. The user interface 1003 may include a display and an input unit such as a keyboard. The network interface 1004 may optionally include a standard wired interface and a wireless interface (such as a Wi-Fi interface). The memory 1005 may be a high-speed RAM or a stable memory (a non-volatile memory), such as a disk memory. The memory 1005 may optionally further be a storage device independent of the foregoing processor 1001. It will be understood by

those skilled in the art that the hardware structure of the credit evaluation device shown in FIG. 1 does not constitute a limitation on the credit evaluation device, and may include more or fewer components than those illustrated, or combine some components, or different component arrangements.

Still referring to FIG. 1, the memory 1005 as a computer readable storage medium in FIG. 1 may include an operating system, a network communication module, and a credit evaluation program. The network communication module is mainly configured to connect to a database for data communication with the database, and the processor 1001 can call the credit evaluation program stored in the memory 1005 and execute credit evaluation methods according to various embodiments of this application.

This application provides a credit evaluation method.

Referring to FIG. 2, illustrated is a schematic flowchart of a credit evaluation method according to a first embodiment of this application.

In this embodiment, the credit evaluation method includes the following steps.

Step S10: Acquire historical credit data, and construct an AI risk control engine according to the historical credit data.

This embodiment provides a credit evaluation method, which uses a dual-core risk control engine to evaluate and make a decision on a loan request, reduces adverse influence of limitations of human thought on a risk control model, and improves the accuracy of a risk control system, thereby reducing the rate of bad loans.

In this embodiment, it is first necessary to construct an AI risk control engine, which is different from a conventional expert engine. With respect to the expert engine, a risk control expert or related staff analyzes a large amount of loan data and then make experience (rule) summaries, and then convert these experience summaries into a logic algorithm of a computer, thereby forming evaluation rules (also called expert rules) of the expert engine. However, the human experience is not necessarily correct. The human experience is susceptible to subjective factors, which makes the expert rules have certain flaws, reducing the evaluation capability of the risk control engine using the expert rules. Therefore, the AI risk control engine construction process in this embodiment does not completely use the expert rules, but constructs the AI risk control engine by means of machine learning. The

machine learning means not relying on humans to sum up experience and input logic. Humans only need to input a large amount of sample data (including input sample data and output sample data) to a computer, and then the computer itself summarizes data conversion logic or mapping conversion relationship therein, and sums up corresponding logic codes, thereby obtaining a data conversion rule to form a corresponding evaluation engine. Specifically, in this embodiment, a database is first queried to acquire historical credit data, and the historical credit data is a historical lending record of a financial institution, including behavior data provided by a user before a loan (such as credit status, personal financial resources, bank transaction records, social security payment status, and call data), as well as post-loan repayment records and post-loan behavior data of the user; then the behavior data of the user before the loan is used as an input training set, the post-loan repayment records and the post-loan behavior data are used as an output training set, and the input training set and the output training set are input to an initial machine learning model; the initial machine learning model is trained based on the input training set and the output training set, and a computer automatically makes a comparison and analysis on the two data structure forms and data contents and the like, summarizes conversion rules, and sums up conversion logic to construct an AI risk control engine.

Further, since machine learning often requires a large amount of training data to demonstrate excellent learning ability, but for credit data (especially in the evaluation of personal credit), the number of users is limited and effective information acquired on the users is more limited, expert rules can be used as a cold start zero point of the initial machine learning model; that is, the expert rules can be used as initial logic of the initial machine learning model, and then the initial machine learning model is continuously trained by using the historical credit data, to construct an AI risk control engine.

It should be noted that the AI risk control engine construction process in this embodiment uses algorithms, including, but not limited to, logistic regression, a decision tree, a GBDT, SVM, and the like. For example, for the GBDT, a sample set includes real estate, income, age, education, and the like, and a combination thereof can be used to define m vector groups, where x is a multi-dimensional vector and y is a non-performing loan ratio, namely,

$$\{(x^1, y^1), (x^2, y^2), \dots, (x^m, y^m)\} \quad (1)$$

According to different combinations, different weak models (short decision trees) can be learned and then linearly combined into a function:

$$f_M(x) = \sum_{m=1}^m T(x; \theta_m) \quad (2)$$

in formula (2), $T(x; \theta_m)$ represents a decision tree and can be seen as a regression tree;

where θ_m is a parameter of the decision tree; and

m is the number of the decision trees.

A cost function of the GBDT is:

$$f(x) = l(h(x, D), Y) \quad (3)$$

in formula (3), $h(x, D)$ is a hypothesis function that is a decision result of the decision tree;

a first-order expansion of a Taylor formula of the $f(x)$ is:

$$l(H(x_{t+1})) = l(H(x_t) + h(x_{t+1})) \approx l(H(x_t)) + \nabla l(H(x_t))h(x_{t+1})$$

(4)

In formula (4), $H(x_t) = \sum_{i=1}^t h(x_i)$ is a weighted sum of the first t decision trees;

$H(x_{t+1}) = H(x_t) - \gamma \nabla l(H(x_t))$ is a steepest descent iterative formula; and

$h(x_{t+1}) = \nabla l(H(x_t))$ is a gradient of the hypothesis function.

It can be seen from the above that the idea of the loss function of the GBDT is similar to the logistic regression, except that a base function of the latter uses a bijective sigmoid function, while this embodiment uses CART herein. It can be seen that a method for calculating a GBDT parameter is similar to the logistic regression, and the gradient descent method can also be used. According to the above, a linear combination tree GBDT (as shown in formula (2)) with CART as a base function and a corresponding cost function (as shown in formula (3)), namely, an AI risk control engine, can be obtained.

Certainly, the staff can manually adjust the AI risk control engine obtained by training, to improve the AI risk control engine.

Step S20: When a loan request is received, acquire pre-loan user data of a loan user corresponding to the loan request, and input the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation.

In this embodiment, after the AI risk control engine is obtained by training, the AI risk control engine can be used for loan evaluation. It should be noted that, in this embodiment, not just the AI risk control engine is used for evaluation, the AI risk control engine and a pre-set expert engine are used simultaneously to perform credit evaluation by using a dual-core risk control method. The meaning of the pre-set expert engine is as above, and is that a risk control expert or related staff analyze a large amount of loan data and then make experience (rule) summaries, and then convert these experience summaries into a logic algorithm of a computer, thereby forming evaluation rules of the expert engine.

Specifically, when a risk control model of a financial institution receives a loan request of a loan user (the loan request includes a loan amount, a loan period, and the like), relevant pre-loan data of the loan user (the pre-loan data includes credit status, personal financial resources, bank transaction records, social security payment status, call data, and the like of a borrower) is acquired, and the risk control data is input to the pre-set expert engine and the AI risk control engine respectively, and the loan request is evaluated through the pre-set expert engine and the AI risk control engine.

Step S30: acquire an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine, and generate a corresponding decision and suggestion according to the expert evaluation conclusion and the AI evaluation conclusion.

In this embodiment, after the loan request is evaluated by the pre-set expert engine and the AI risk control engine respectively, the corresponding expert evaluation conclusion and the corresponding AI evaluation conclusion are obtained, and the decision and suggestion (such as the loan amount and the loan period) can be obtained by combining the expert evaluation conclusion with the AI evaluation conclusion.

In specific implementation, the expert evaluation conclusion and the AI evaluation conclusion may be represented in the form of a score, and the score ranges from 0 to 100. The higher the score is, the lower the rate of bad loans for the loan request of the loan user is. When the loan request is

respectively evaluated by means of the preset expert engine and the AI risk control engine to obtain two evaluation cores, i.e., an expert score and an AI score, it is also necessary to perform weighted computation on the expert score and the AI score to obtain a comprehensive evaluation value. The meaning of the comprehensive evaluation value is similar to the evaluation score obtained by the single-core evaluation, and the range is also between 0 and 100. The higher the score is, the lower the rate of bad loans for the loan request of the loan user is. Different score segments correspond to different credit lines, the credit line represents the recommended maximum amount and maximum loan period for lending to the loan user. The credit line of the loan user can be determined by calculating the comprehensive evaluation value of the loan user, thereby generating a corresponding loan suggestion (including the loan limit and the loan period).

Certainly, in specific implementation, for the expert evaluation conclusion and the AI evaluation conclusion, the evaluation conclusion can be divided into two points (namely agreeing the loan and rejecting the loan), and a decision and suggestion generation process can also be implemented in other ways. The foregoing examples do not constitute a limitation on the credit evaluation method of this embodiment.

Further, in this embodiment, after the decision and suggestion are generated, the risk control model may also generate a corresponding credit evaluation report. The credit evaluation report includes pre-loan data of a loan user used in the evaluation process, and further includes an expert evaluation conclusion and an AI evaluation conclusion obtained by evaluating the loan user, a final decision and suggestion, and the like. In the credit evaluation report, as a large amount of data is involved, the way the data is displayed can be customized. For example, the pre-loan data includes a total expenditure of the loan user in the first three months, and the monthly expenditure includes water and electricity expenditure, telephone service expenditure, credit card consumption, and the like. The monthly expenditure can be displayed in a pie chart, so that a decision maker can understand the loan user's monthly investment in different things. The three-month total expenditure situation can be displayed with a bar chart, so that the decision maker can understand the monthly expenditure trend of the loan user. Certainly, methods for displaying different types of data can be configured by the decision maker according to the actual situations.

In this embodiment, historical credit data is acquired, and an AI risk control engine is constructed according to the historical credit data; when a loan request is received, pre-loan user data of a loan user corresponding to the loan request is acquired, and the pre-loan user data is input to a pre-set expert engine and the AI risk control engine respectively for credit evaluation; an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine are acquired, and a corresponding decision and suggestion are generated according to the expert evaluation conclusion and the AI evaluation conclusion. In the above way, this embodiment constructs the AI risk control engine by using a machine learning method, and the loan request is evaluated by means of the AI risk control engine and an expert rule engine simultaneously; a credit decision and suggestion are acquired by means of double-engine evaluation, which greatly reduces adverse influence of limitations of human thought on engine construction and a credit evaluation process, improving the evaluation capability of a risk control model and effectively reducing the rate of bad loans.

Referring to FIG. 3, illustrated is a schematic flowchart of a detailed process of FIG. 2 in which when a loan request is received, pre-loan user data of a loan user corresponding to the loan request is acquired, and the pre-loan user data is input to a pre-set expert engine and the AI risk control engine respectively for credit evaluation.

Based on the embodiment shown in FIG. 2 above, in this embodiment, step S20 includes:

Step S21: When a loan request is received, generate a corresponding data acquisition request according to a user identifier and an authorization grant included in the loan request, and send the data acquisition request to a data management system to obtain corresponding pre-loan user data; and

Step S22: Receive the pre-loan user data fed back by the data management system, and input the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation.

In this embodiment, the pre-loan data of the loan user often involves the privacy of the loan user, and the pre-loan data needs to be obtained from other data sources. For example, bank card consumption records of the loan user need to be acquired from a banking system; and phone bill data of the loan user needs to be acquired from a telecommunications company. If a risk control model

needs to acquire the pre-loan data, an authorization grant of the loan user need to obtained first. Specifically, when the loan user sends the loan request, the loan request includes an identity of the loan user (such as ID number and other identity information), and authorization grant information of the loan user (such as an electronic signature) to indicate that the loan user allows the risk control model (the financial institution) to obtain own relevant pre-loan data for credit evaluation. When receiving the loan request, the risk control model generates a corresponding data acquisition request according to a user identifier and an authorization grant, and sends the data acquisition request to a relevant data management system (such as a banking system and a telecommunications company). When receiving the data acquisition request, the data management system first acquires a user identifier therein and determines the data acquisition request for acquiring relevant data of which user; and then verifies the authorization grant to determine the authenticity of the authorization grant, thereby determining whether the risk control model requesting to acquire the data is a legal acquirer. When the authorization grant are passed, the data management system queries the corresponding pre-loan user data, and returns the data to the risk control model. When receiving the pre-loan user data fed back by the data management system, the risk control model can input the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation.

Referring to FIG. 4, illustrated is a schematic flowchart of a credit evaluation method according to a second embodiment of this application.

Based on the embodiment shown in FIG. 2 above, in this embodiment, after step S30, the method further includes:

Step S40: Acquire post-loan user data of the loan user, and combine the pre-loan user data with the post-loan user data to obtain an iterative training sample; and

Step S50: Perform iterative training on the AI risk control engine through the iterative training sample to adjust the AI risk control engine.

In this embodiment, considering the development of time, different economic cycles and social factors may affect AI rules (evaluation logic) of the AI engine, so that an effective interval of some factors generates a swing. For example, for a monthly income of 6,000 RMB, under different price conditions, the weight factor of the data is different. In order to make the AI engine adapt to the

economic cycle and the actual situation of the society, it is necessary to correct and adjust the AI engine constantly. Specifically, after determining the loan to the loan user, the risk control model further continuously acquires post-loan data of the loan user (such as repayment records and consumption records); and then the pre-loan data obtained in step S20 is combined with the post-loan data to obtain an iterative training sample, and the AI engine is continuously modified and adjusted by means of the iterative training sample. The adjusted content includes changing a threshold of a parameter, changing the priority of some risk control data or evaluation factors, changing the weight of the data, and the like. For example, in a strategy algorithm of the AI engine, the data weight level is 1 to 5. For the data provided during user loan, the weight level of data A is 5, which means that the data A is of great reference value for determining whether the user can repay the loan on time. However, it is found through some post-loan data that the reference value of the data A is not as big as expected. In this case, the AI engine corrects the original strategy algorithm and reduces the weight level of the data A. After the AI engine is adjusted, the possibility that loans are overdue or bad for the loan user is given in the new loan period, and then actual post-loan data of the new period is used for feedback and correction. Through this iterative training method, the AI engine is continuously improved, and the evaluation accuracy is gradually improved.

In addition, this application further provides a credit evaluation apparatus.

Referring to FIG. 5, illustrated is a schematic diagram of functional modules of a credit evaluation apparatus according to a first embodiment of this application.

In this embodiment, the credit evaluation apparatus includes an engine construction module 10, a credit evaluation module 20, and a suggestion generation module 30.

The engine construction module 10 is configured to acquire historical credit data, and construct an AI risk control engine according to the historical credit data.

The credit evaluation module 20 is configured to acquire, when a loan request is received, pre-loan user data of a loan user corresponding to the loan request, and input the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation.

The suggestion generation module 30 is configured to acquire an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine, and

generate a corresponding decision and suggestion according to the expert evaluation conclusion and the AI evaluation conclusion.

Further, the historical credit data includes historical pre-loan data and historical post-loan data. The engine construction module 10 is further configured to use the historical pre-loan data and the historical post-loan data as an input training set and an output training set respectively, and train an initial machine learning model based on the foregoing input training set and the foregoing output training set to obtain an AI risk control engine.

Further, the initial machine learning model is subjected to a cold start by means of expert rules.

Further, input elements in the input training set include a multi-dimensional vector x with a dimension of m , and output elements in the output training set include a non-performing loan ratio y .

The engine construction module 10 is further configured to:

combine the input elements and the output elements to define m multi-dimensional training vector groups;

$$\{(x^1, y^1), (x^2, y^2), \dots, (x^m, y^m)\} ;$$

learn a multi-dimensional training vector in the multi-dimensional training vector group based on a gradient boosting decision tree (GBDT) algorithm to obtain a corresponding decision tree,

$$T(x; \theta_m) ,$$

where θ_m is a parameter of the decision tree;

perform linear combination on the decision trees to obtain a linear combination tree,

$$f_M(x) = \sum_{m=1}^m T(x; \theta_m)$$

where a cost function of the linear combination tree is

$$f(x) = l(h(x, D), Y) ,$$

where $h(x, D)$ is a hypothesis function, which is a decision result of the decision tree, and a first-order expansion of a Taylor formula of the cost function $f(x)$ is:

$$l(H(x_{t+1})) = l(H(x_t) + h(x_{t+1})) \approx l(H(x_t)) + \nabla l(H(x_t))h(x_{t+1}) ,$$

where $H(x_t) = \sum_{i=1}^t h(x_i)$ is a weighted sum of the first t decision trees,

$H(x_{t+1}) = H(x_t) - \gamma \nabla l(H(x_t))$ is a steepest descent iterative formula, and $h(x_{t+1}) = \nabla l(H(x_t))$ is a gradient of the hypothesis function; and

obtain the AI risk control engine according to the linear combination tree and the cost function.

Further, the credit evaluation module 20 includes a data acquisition unit and a credit evaluation unit.

The data acquisition unit is configured to generate, when a loan request is received, a corresponding data acquisition request according to a user identifier and an authorization grant included in the loan request, and send the data acquisition request to a data management system to obtain corresponding pre-loan user data.

The credit evaluation unit is configured to receive the pre-loan user data fed back by the data management system, and input the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation.

Further, the suggestion generation module 30 includes a weighted computation unit and a suggestion generation unit.

The weighted computation unit is configured to acquire an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine, and perform a weighted computation based on the expert evaluation conclusion and the AI evaluation conclusion to obtain a credit line of the loan user.

The suggestion generation unit is configured to generate a corresponding loan suggestion according to the credit line, where the loan suggestion includes a loan limit and a loan period.

Further, the credit evaluation apparatus further includes a data combination module and an iterative training module.

The data combination module is configured to acquire post-loan user data of the loan user, and combine the pre-loan user data with the post-loan user data to obtain an iterative training sample.

The iterative training module is configured to perform iterative training on the AI risk control engine through the iterative training sample to adjust the AI risk control engine.

The modules in the foregoing credit evaluation apparatus correspond to the steps in the foregoing credit evaluation method embodiment, and functions and implementation processes thereof are not repeated herein.

In addition, this application also provides a computer readable storage medium.

The computer readable storage medium of this application stores a credit evaluation program, where when the credit evaluation program is executed by a processor, the steps of the foregoing credit evaluation method are implemented.

The method implemented when the credit evaluation program is executed can refer to various embodiments of the credit evaluation method of this application, and details are not described herein again.

The above are only preferred embodiments of this application, and are not intended to limit the patent scope of this application. Any equivalent structure or equivalent process transformation made using the specification and the accompanying drawings of this application may be directly or indirectly applied to other related technical fields and similarly falls within the patent protection scope of this application.

CLAIMS

1. A credit evaluation method, comprising the following steps:

acquiring historical credit data, and constructing an AI risk control engine according to the historical credit data;

when a loan request is received, acquiring pre-loan user data of a loan user corresponding to the loan request, and inputting the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation; and

acquiring an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine, and generating a corresponding decision and suggestion according to the expert evaluation conclusion and the AI evaluation conclusion.

2. The credit evaluation method according to claim 1, wherein the historical credit data comprises historical pre-loan data and historical post-loan data,

the step of acquiring historical credit data, and constructing an AI risk control engine according to the historical credit data comprises:

using the historical pre-loan data and the historical post-loan data as an input training set and an output training set respectively, and training an initial machine learning model based on the input training set and the output training set to obtain an AI risk control engine.

3. The credit evaluation method according to claim 2, wherein the initial machine learning model is subjected to a cold start by means of expert rules.

4. The credit evaluation method according to claim 2, wherein input elements in the input training set comprise a multi-dimensional vector x with a dimension of m , and output elements in the output training set comprise a non-performing loan ratio y ,

the step of training an initial machine learning model based on the input training set and the output training set to obtain an AI risk control engine comprises:

combining the input elements with the output elements to define m multi-dimensional training vector groups;

$$\{(x^1, y^1), (x^2, y^2), \dots, (x^m, y^m)\} ;$$

learning a multi-dimensional training vector in the multi-dimensional training vector group based on a Gradient Boosting Decision Tree (GBDT) algorithm to obtain a corresponding decision tree,

$$T(x; \theta_m) ,$$

wherein θ_m is a parameter of the decision tree;

performing linear combination on the decision tree to obtain a linear combination tree,

$$f_M(x) = \sum_{m=1}^m T(x; \theta_m) ,$$

wherein a cost function of the linear combination tree is

$$f(x) = l(h(x, D), Y) ,$$

wherein the $h(x, D)$ is a hypothesis function, which is a decision result of the decision tree, and a first-order expansion of a Taylor formula of the cost function $f(x)$ is:

$$l(H(x_{t+1})) = l(H(x_t) + h(x_{t+1})) \approx l(H(x_t)) + \nabla l(H(x_t))h(x_{t+1})$$

$$H(x_t) = \sum_{i=1}^t h(x_i)$$

wherein $H(x_t)$ is a weighted sum of the first t decision trees,

$$H(x_{t+1}) = H(x_t) - \gamma \nabla l(H(x_t))$$

is a steepest descent iterative formula, and

$$h(x_{t+1}) = \nabla l(H(x_t))$$

is a gradient of the hypothesis function; and

obtaining the AI risk control engine according to the linear combination tree and the cost function.

5. The credit evaluation method according to claim 1, wherein the step of acquiring, when a loan request is received, pre-loan user data of a loan user corresponding to the loan request, and inputting the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation comprises:

when a loan request is received, generating a corresponding data acquisition request according to a user identifier and an authorization grant comprised in the loan request, and sending the data acquisition request to a data management system to obtain corresponding pre-loan user data; and

receiving the pre-loan user data fed back by the data management system, and inputting the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation.

6. The credit evaluation method according to claim 1, wherein the step of acquiring an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine, and generating a corresponding decision and suggestion according to the expert evaluation conclusion and the AI evaluation conclusion comprises:

acquiring an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine, and performing a weighted computation based on the expert evaluation conclusion and the AI evaluation conclusion to obtain a credit line of the loan user; and

generating a corresponding loan suggestion according to the credit line, wherein the loan suggestion comprises a loan limit and a loan period.

7. The credit evaluation method according to claim 1, wherein after the step of acquiring an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine, and generating a corresponding decision and suggestion according to the expert evaluation conclusion and the AI evaluation conclusion, the method further comprises:

acquiring post-loan user data of the loan user, and combining the pre-loan user data and the post-loan user data to obtain an iterative training sample; and

performing iterative training on the AI risk control engine through the iterative training sample to adjust the AI risk control engine.

8. A credit evaluation apparatus, comprising:

an engine construction module, configured to acquire historical credit data, and construct an AI risk control engine according to the historical credit data;

a credit evaluation module, configured to acquire, when a loan request is received, pre-loan user data of a loan user corresponding to the loan request, and input the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation; and

a suggestion generation module, configured to acquire an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine, and generate a

corresponding decision and suggestion according to the expert evaluation conclusion and the AI evaluation conclusion.

9. The credit evaluation apparatus according to claim 8, wherein the historical credit data comprises historical pre-loan data and historical post-loan data, and

the engine construction module is further configured to use the historical pre-loan data and the historical post-loan data as an input training set and an output training set respectively, and train an initial machine learning model based on the input training set and the output training set to obtain an AI risk control engine.

10. The credit evaluation apparatus according to claim 9, wherein the initial machine learning model is subjected to a cold start by means of expert rules.

11. The credit evaluation apparatus according to claim 9, wherein input elements in the input training set comprise a multi-dimensional vector x with a dimension of m , and output elements in the output training set comprise a non-performing loan ratio y ,

the engine construction module is further configured to combine the input elements and the output elements to define m multi-dimensional training vector groups;

$$\{(x^1, y^1), (x^2, y^2), \dots, (x^m, y^m)\} ;$$

learn a multi-dimensional training vector in the multi-dimensional training vector group based on a Gradient Boosting Decision Tree (GBDT) algorithm to obtain a corresponding decision tree,

$$T(x; \theta_m) ,$$

wherein θ_m is a parameter of the decision tree;

perform linear combination on the decision trees to obtain a linear combination tree

$$f_M(x) = \sum_{m=1}^m T(x; \theta_m) ,$$

wherein a cost function of the linear combination tree is

$$f(x) = l(h(x, D), Y) ,$$

wherein the $h(x, D)$ is a hypothesis function, which is a decision result of the decision tree, and a first-order expansion of a Taylor formula of the cost function $f(x)$ is:

$$l(H(x_{t+1})) = l(H(x_t) + h(x_{t+1})) \approx l(H(x_t)) + \nabla l(H(x_t))h(x_{t+1}),$$

wherein $H(x_t) = \sum_{i=1}^t h(x_i)$ is a weighted sum of the first t decision trees,

$H(x_{t+1}) = H(x_t) - \gamma \nabla l(H(x_t))$ is a steepest descent iterative formula, and

$h(x_{t+1}) = \nabla l(H(x_t))$ is a gradient of the hypothesis function; and

obtain the AI risk control engine according to the linear combination tree and the cost function.

12. The credit evaluation apparatus according to claim 8, wherein the credit evaluation module comprises:

a data acquisition unit, configured to generate, when a loan request is received, a corresponding data acquisition request according to a user identifier and an authorization grant comprised in the loan request, and send the data acquisition request to a data management system to obtain corresponding pre-loan user data; and

a credit evaluation unit, configured to receive the pre-loan user data fed back by the data management system, and input the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation.

13. The credit evaluation apparatus according to claim 8, wherein the suggestion generation module comprises:

a weighted computation unit, configured to acquire an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine, and perform a weighted computation based on the expert evaluation conclusion and the AI evaluation conclusion to obtain a credit line of the loan user; and

a suggestion generation unit, configured to generate a corresponding loan suggestion according to the credit line, wherein the loan suggestion comprises a loan limit and a loan period.

14. The credit evaluation apparatus according to claim 8, further comprising:

a data combination module, configured to acquire post-loan user data of the loan user, and combine the pre-loan user data with the post-loan user data to obtain an iterative training sample; and

an iterative training module, configured to perform iterative training on the AI risk control engine through the iterative training sample to adjust the AI risk control engine.

15. A credit evaluation device, comprising a processor, a memory, and a credit evaluation program stored on the memory and executable by the processor, wherein when the credit evaluation program is executed by the processor, the following steps are implemented:

acquiring historical credit data, and constructing an AI risk control engine according to the historical credit data;

when a loan request is received, acquiring pre-loan user data of a loan user corresponding to the loan request, and inputting the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation; and

acquiring an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine, and generating a corresponding decision and suggestion according to the expert evaluation conclusion and the AI evaluation conclusion.

16. The credit evaluation device according to claim 15, wherein the historical credit data comprises historical pre-loan data and historical post-loan data, and

the step of acquiring historical credit data, and constructing an AI risk control engine according to the historical credit data comprises:

using the historical pre-loan data and the historical post-loan data as an input training set and an output training set respectively, and training an initial machine learning model based on the input training set and the output training set to obtain an AI risk control engine.

17. The credit evaluation device according to claim 16, wherein the initial machine learning model is subjected to cold start by means of expert rules.

18. The credit evaluation device according to claim 16, wherein input elements in the input training set comprise a multi-dimensional vector x with a dimension of m , and output elements in the output training set comprise a non-performing loan ratio y ,

the step of training an initial machine learning model based on the input training set and the output training set to obtain an AI risk control engine comprises:

combining the input elements with the output elements to define m multi-dimensional training vector groups;

$$\{(x^1, y^1), (x^2, y^2), \dots, (x^m, y^m)\} ;$$

learning a multi-dimensional training vector in the multi-dimensional training vector group based on a Gradient Boosting Decision Tree (GBDT) algorithm to obtain a corresponding decision tree,

$$T(x; \theta_m) ,$$

wherein θ_m is a parameter of the decision tree;

perform linear combination on the decision trees to obtain a linear combination tree,

$$f_M(x) = \sum_{m=1}^m T(x; \theta_m) ,$$

wherein a cost function of the linear combination tree is

$$f(x) = l(h(x, D), Y) ,$$

wherein the $h(x, D)$ is a hypothesis function, which is a decision result of the decision tree, and a first-order expansion of a Taylor formula of the cost function $f(x)$ is:

$$l(H(x_{t+1})) = l(H(x_t) + h(x_{t+1})) \approx l(H(x_t)) + \nabla l(H(x_t))h(x_{t+1}) ,$$

wherein $H(x_t) = \sum_{i=1}^t h(x_i)$ is a weighted sum of the first t decision trees,

$H(x_{t+1}) = H(x_t) - \gamma \nabla l(H(x_t))$ is a steepest descent iterative formula, and

$h(x_{t+1}) = \nabla l(H(x_t))$ is a gradient of the hypothesis function; and

obtaining the AI risk control engine according to the linear combination tree and the cost function.

19. The credit evaluation device according to claim 15, wherein the step of acquiring, when a loan request is received, pre-loan user data of a loan user corresponding to the loan request, and inputting the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation comprises:

when a loan request is received, generating a corresponding data acquisition request according to a user identifier and an authorization grant comprised in the loan request, and sending the data acquisition request to a data management system to obtain corresponding pre-loan user data; and

receiving the pre-loan user data fed back by the data management system, and inputting the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation.

20. A computer readable storage medium, having a credit evaluation program stored thereon, wherein when the credit evaluation program is executed by a processor, the following steps are implemented:

acquiring historical credit data, and constructing an AI risk control engine according to the historical credit data;

when a loan request is received, acquiring pre-loan user data of a loan user corresponding to the loan request, and inputting the pre-loan user data to a pre-set expert engine and the AI risk control engine respectively for credit evaluation; and

acquiring an expert evaluation conclusion of the pre-set expert engine and an AI evaluation conclusion of the AI risk control engine, and generating a corresponding decision and suggestion according to the expert evaluation conclusion and the AI evaluation conclusion.