# Integrating ISA Optimised Random Forest Methods for Building Applications in Digital Accounting Talent Assessment

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***Abstract*—Digital accounting talent assessment in applied undergraduate colleges and universities is an urgent problem of talent assessment construction. In order to solve the problem of digital accounting talent assessment in applied undergraduate colleges, a digital accounting talent assessment method based on improved machine learning algorithm is proposed. Firstly, the digital accounting talent assessment problem in applied undergraduate colleges is analysed, digital accounting talent assessment indicators are extracted, and the index system is constructed; secondly, the digital accounting talent assessment model based on the integrated ISA optimized random forest algorithm in applied undergraduate colleges is constructed by combining the integrated learning technology, the intelligent optimization algorithm, and the random forest; lastly, the digital accounting talent data in applied undergraduate colleges is used to analyse the model. The results show that compared with other algorithms, the accuracy of digital accounting talent assessment in applied undergraduate colleges and universities of Ada-ISA-RF is improved by 3.06 per cent and 7.04 per cent, respectively.**

***Keywords*—Integrated learning; internal renovation algorithms; random forests; digitalisation of applied undergraduate institutions; accounting talent assessment**

## I. INTRODUCTION

With the rapid development of information technology, the demand for digital accounting talents is increasing. Applied undergraduate colleges and universities, as an important base for training accounting talents, need to establish a scientific assessment system to measure the comprehensive quality and ability level of students [1]. Different from research undergraduate colleges and universities, applied undergraduate colleges and universities pay more attention to the improvement of professional practice and application ability of accounting talent students in the process of talent education and training, aiming to cultivate accounting professional and technical application talents for the society [2]. In this context, applied undergraduate colleges and universities need to grasp the progress of the time and the development trend of society, and take a variety of strategies to promote the training of digital accounting talents [3]. At present, the following problems are mainly manifested in the training of digital accounting talents in applied undergraduate colleges and universities [4]: 1) the lagging behind of talent training objectives; 2) the lack of digital technology teaching content in professional courses; 3) the difficulty of faculty to meet the needs of digital accounting talent training; 4) the backwardness of the construction of teaching platforms, which cannot provide support for the training of digital accounting talents. In order to adapt to the rapid development of the digital economy, meet the digital accounting talent cultivation, and improve the construction level of the educational system of digital accounting talents in institutions, it is very necessary to study the accurate and efficient assessment method of digital accounting talents in applied undergraduate colleges and universities [5].

In past studies, scholars have proposed a variety of methods for assessing accounting talent, such as test scores, practical exercises, and internship experiences [6]. However, these methods often have problems such as high subjectivity and inconsistent assessment criteria. In recent years, with the development of machine learning technology, some researchers have begun to try to apply machine learning algorithms to the assessment of accounting talent [7]. For example, some studies have used decision tree algorithms to predict and analyse the academic performance of accounting students, and achieved better results [8]. However, there are still some shortcomings in the current research, such as single assessment index and poor model interpretability [9]. Therefore, this study will further explore the construction and application of digital accounting talent assessment model based on machine learning algorithms in applied undergraduate colleges and universities on the basis of existing research [10].

In order to solve the shortcomings of digital accounting talent assessment in applied undergraduate colleges, this study combines big data technology and machine learning technology to propose a digital accounting talent assessment method based on improved random forest algorithm in applied undergraduate colleges. The main contributions of this study are: 1) analyzing the current situation of digital accounting talent cultivation in applied undergraduate colleges and designing the digital accounting talent assessment method; 2) constructing the digital accounting talent assessment index system in applied undergraduate colleges; 3) investigating the integrated internal search optimization algorithm [11] to improve the Random Forest Algorithm [12] and its application in the problem of digital accounting talent assessment in applied undergraduate colleges ; 4) comparative analyses of the proposed methods are conducted using publicly available online accounting human resources data. The results show that the method proposed in this study solves the current shortcomings of digital accounting talent assessment in applied undergraduate colleges, and improves the level and capability of digital accounting talent assessment.

This study is organized as follows: In Section II, it analyzes the current situation and challenges in digital accounting talent cultivation at applied undergraduate colleges and constructs a relevant indicator system. In Section III, it introduces the methodology, focusing on the integration of the ISA optimization algorithm with the Random Forest model, further enhanced by AdaBoost to develop the ISA-RF assessment model. In Section IV, the model is trained and tested using practical data, and its performance is compared with traditional algorithms. In Section V, experimental results are analyzed to verify the effectiveness and accuracy of the proposed model in improving talent assessment. Finally Section VI presents the conclusion of the study.

## II. Related Work and Theoretical Approaches

### A. Analysis of the Problem

*1) The current state of digital accounting talent assessment:* With the rapid development of information technology, the demand for digital accounting talents is increasing. Applied undergraduate colleges and universities, as an important place to cultivate high-level accounting talents to serve the regional socio-economic development, face challenges in talent cultivation such as unclear target orientation, incomplete cultivation system, insufficient equipment conditions, and lack of faculty capacity [13], as shown in Fig. 1.

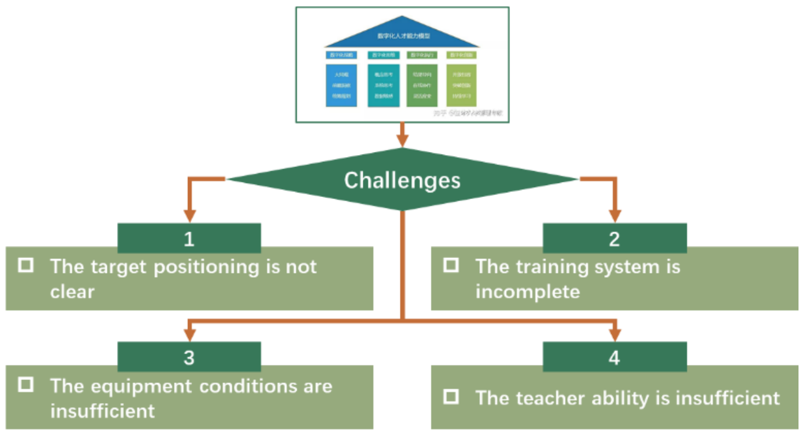



Fig. 1. Problems in the training of accounting personnel.

In order to cope up with these challenges, applied undergraduate colleges are exploring a suitable path for themselves, including repositioning the objectives of accounting talent cultivation in the context of digitalisation, reorganising the content of the curriculum (teaching materials), teaching methods, competency frameworks and evaluation standards, and re-designing the practical teaching system, etc. [14]. The digital accounting talent cultivation path is shown in Fig. 2.

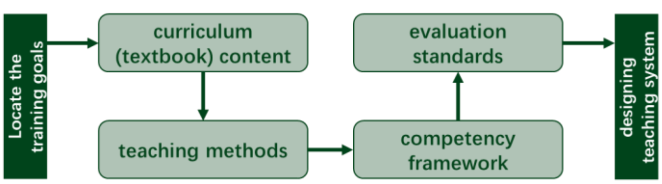



Fig. 2. Digital accounting talent cultivation pathway.

In assessing digital accounting talents, the Chinese Society of Business Accounting compiled the Digital Accounting Professional Competency Framework, which classifies digital accounting into four levels: beginner, intermediate, advanced, and extraordinarily (Fig. 3), and precisely describes digital accounting in five dimensions: digital strategic competency, digital competency in accounting, digital competency in business, digital leadership, and digital technological competency [15], and precisely describes the digital accounting competency requirements. The embodiment of digital accounting talent competency dimensions is shown in Fig. 4.

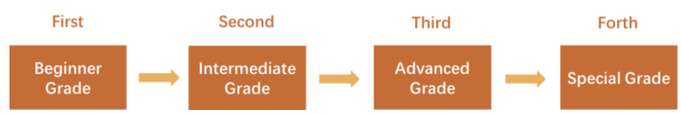



Fig. 3. Digital accounting talent segmentation levels.


Fig. 4. Digital accounting talent competency dimensions.

In summary, applied undergraduate colleges and universities are making efforts to improve the education level of accounting majors and the employability of students to meet the requirements of the era of digital economy through the development of competency frameworks and the conduct of assessment activities on the issue of digital accounting talent assessment [16].

*2) Design of digital accounting talent assessment programme:* As a powerful data analysis tool, machine learning algorithms can provide new ideas and methods for the assessment of digital accounting talent. In this study, we will explore the construction and application of digital accounting talent assessment model based on machine learning algorithm in applied undergraduate colleges, as shown in Fig. 5. Firstly, analyse the current situation of digital accounting talent cultivation in applied undergraduate colleges, analyse the digital accounting talent assessment indexes, and construct the assessment system; secondly, take the digital accounting talent assessment index data as input, and take the assessment value as output, and use machine learning algorithms to construct the digital accounting talent assessment model in applied undergraduate colleges; lastly, use the internal renovation algorithm and integration algorithms to carry out the constructed model for optimisation evaluation. The specific optimisation structure is shown in Fig. 6.

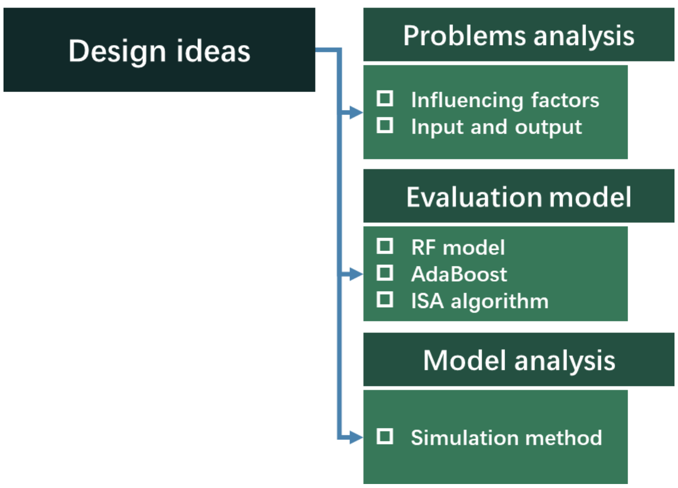



Fig. 5. Design of digital accounting talent assessment programme.

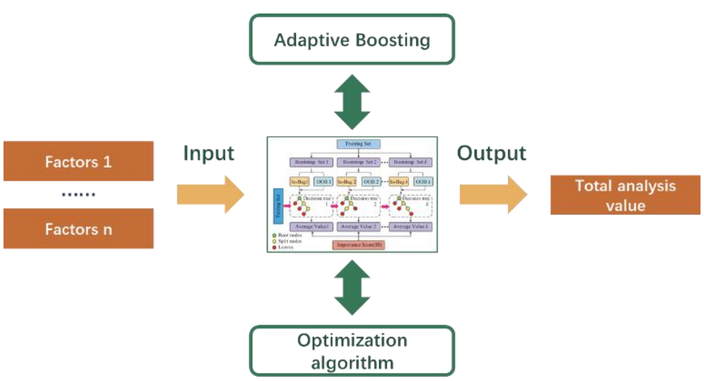



Fig. 6. Model optimised structural design.

## B. Theoretical Approach

*1) Integrated learning technologies:* AdaBoost (Adaptive Boosting) [17] is an iterative algorithm whose core idea is to train different classifiers (weak classifiers) for the same training set, and then ensemble these weak classifiers to form a stronger final classifier (strong classifier). The specific principle is shown in Fig. 7. AdaBoost is an integrated learning technique that is able to enhance weak learners with only slightly higher prediction accuracy than random guessing into strong learners with high prediction accuracy, which provides an effective new idea and method for the design of learning algorithms when it is very difficult to construct strong learners directly [18].

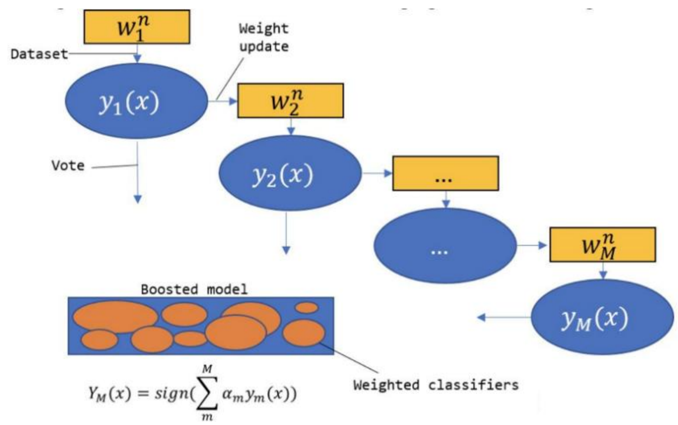



Fig. 7. AdaBoost technique.

The workflow of AdaBoost algorithm is shown in Fig. 8 with the following steps:

- Initialise weights: initialise the weights of the first weak classifier by initialising all its weights to the same probability;
- Training weak classifiers: for each weak classifier perform the following:
  - The weak classifier results are obtained by training the training set containing the weight distribution;
  - Calculate the classification error rate of the weak classifier on the current weighted training set;
  - Calculate the weight coefficients of the current weak classifier based on the classification error rate;
  - Adjust the next training set weight distribution;
- Construct a linear combination of T weak classifiers: combine all weak classifiers into one strong classifier, and obtain the final classification result by weighted summation.

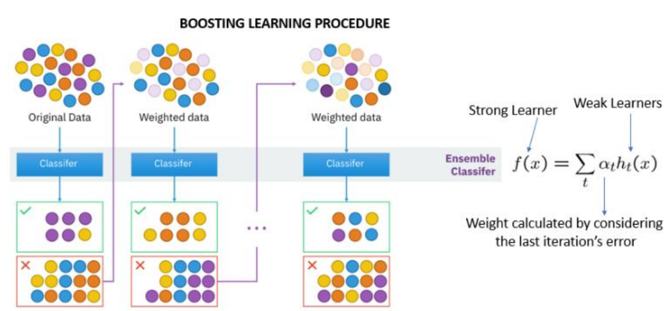



Fig. 8. Steps of AdaBoost algorithm.

*2) ISA optimisation algorithm:* The algorithm breaks through the framework of traditional meta-heuristics and provides an innovative solution to global optimisation problems. The effectiveness of the ISA algorithm has been demonstrated on standard mathematical and engineering problems, and its performance outperforms other known optimisation algorithms. In addition, the ISA algorithm has a simple structure and requires only one parameter to be tuned, greatly simplifying its implementation and use.

The algorithm proposed by ISA, inspired by architectural design, searches for a better viewpoint by dividing the elements into compositional and mirroring groups, and except for the most adapted element, the other elements are recombined or mirrored to find a better viewpoint. The algorithm first randomly determines the element location and evaluates the adaptation, and then the elements are randomly grouped based on the parameter α to explore the optimal viewpoints, this parameter α is key to balance the depth and breadth of the search, the specific principle is shown in Fig. 9.

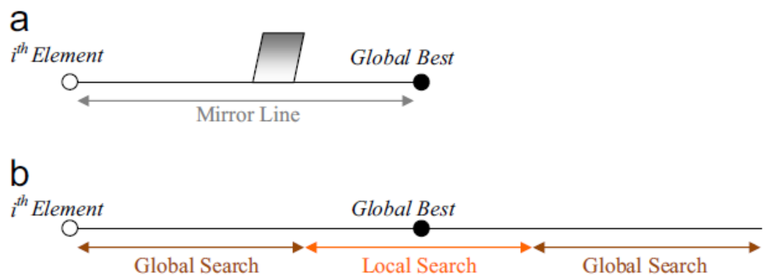



Fig. 9. Principle of ISA algorithm.

The specific principle steps of the ISA algorithm are as follows:

- Randomly generate the element positions of the ISA algorithm and the fitness value is calculated;
- Based on the definition of the problem, find the individual with the optimal fitness value, listed as $x_{gb}^{j}$ ;
- Randomly divide the elements into two groups, i.e. composition group and mirror group. If $r_1 \le \alpha$ , perform mirror group; otherwise perform composition group;
- For composition groups, each element is randomly generated in a finite space:

$$x_i^j = LB^j + r_2 \times \left(UB^j - LB^j\right) \quad (1)$$

where, $x_i^j$ denotes the i-th element of the j-th iteration, $UB$ and $LB$ denote the upper and lower bounds of the problem search space, respectively, and $r_2$ denotes a random number.

- For mirror groups, the algorithm operates by randomly placing mirrors between each element and the most adapted element (global optimum):

$$x_{m,i}^j = r_3 x_i^{j-1} + \left(1 - r_3\right) x_{gb}^j \quad (2)$$

where, $r_3$ denotes a random number.

The image or virtual position of the element depends on the position of the mirror:

$$x_i^j = 2x_{m,i}^j - x_i^{j-1} \quad (3)$$

- For globally optimal elements, their positions are slightly adjusted by the randomised wandering method:

$$x_{gb}^j = x_{gb}^{j-1} + r_n \times \lambda \quad (4)$$

where, $r_n$ denotes the random number and $x_{gb}^j$ denotes the globally optimal element.

- Calculate the fitness value of the new position and update the element position information:

$$x_i^j = \begin{cases} x_i^j & f\left(x_i^j\right) < f\left(x_i^{j-1}\right) \\ x_i^{j-1} & else \end{cases} \quad (5)$$

- If the maximum number of iterations is reached, repeat (2).

The ISA algorithm pseudo-code is shown in Table I.

TABLE I. ISA ALGORITHM PSEUDO-CODE

| ***Algorithm 1: Internal Search Optimisation Algorithm*** |
|---|
| Initialise ISA algorithm parameters; |
| While the iteration stop condition is satisfied |
| Calculate the fitness value and find the optimal solution; |
| For i=1:n |
| If xgb |
| Minor adjustments through the randomised wandering method; |
| Else if rl<=a |
| Use mirror operation to update elements; |
| Else |
| Update elements using composition group operations; |
| End if |
| Check for transgressions; |
| End for |
| A greedy strategy is used to update the element position information; |
| End while |

*3) Random forest:* Random Forest (Fig. 10) [18] is an integrated learning approach that makes predictions by constructing multiple decision trees and combining their results. Each tree is trained on a different subset of the data and a subset of the features, thus reducing the risk of overfitting and improving the generalisation of the model [19].

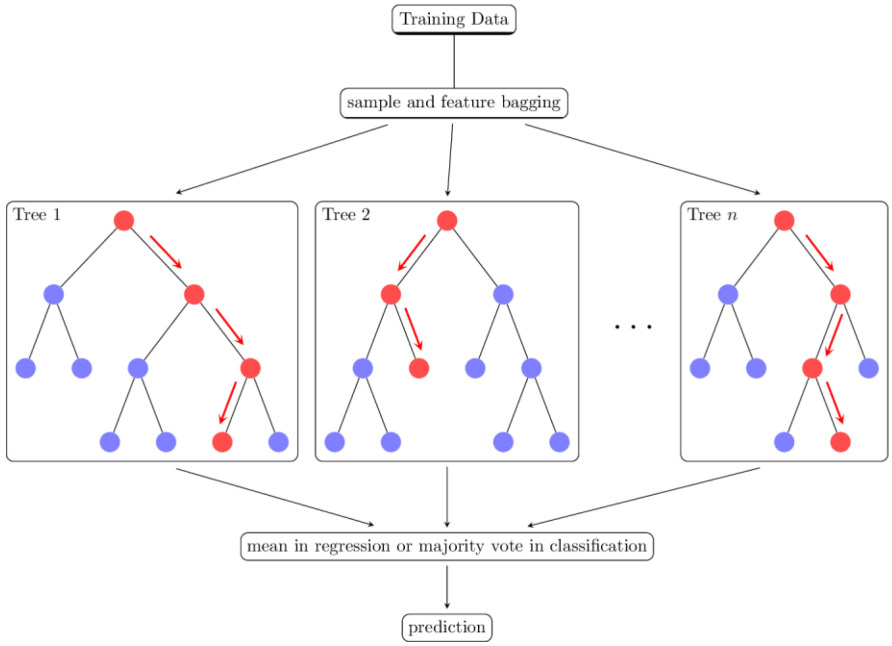



Fig. 10. Random forest principle.

Based on the analysis of the working principle of Random Forest, the specific steps of RF algorithm are as follows (Fig. 11):

*a)* Data sampling: Multiple sample subsets are randomly selected from the original training dataset with putback.

*b)* Feature selection: At each splitting node, some features are randomly selected for optimal splitting.

*c)* Constructing a decision tree: A decision tree is constructed on each subset of samples until a predetermined depth or other stopping condition is reached.

*d)* Integrated prediction: Voting or averaging the prediction results of all the decision trees to get the final prediction result.

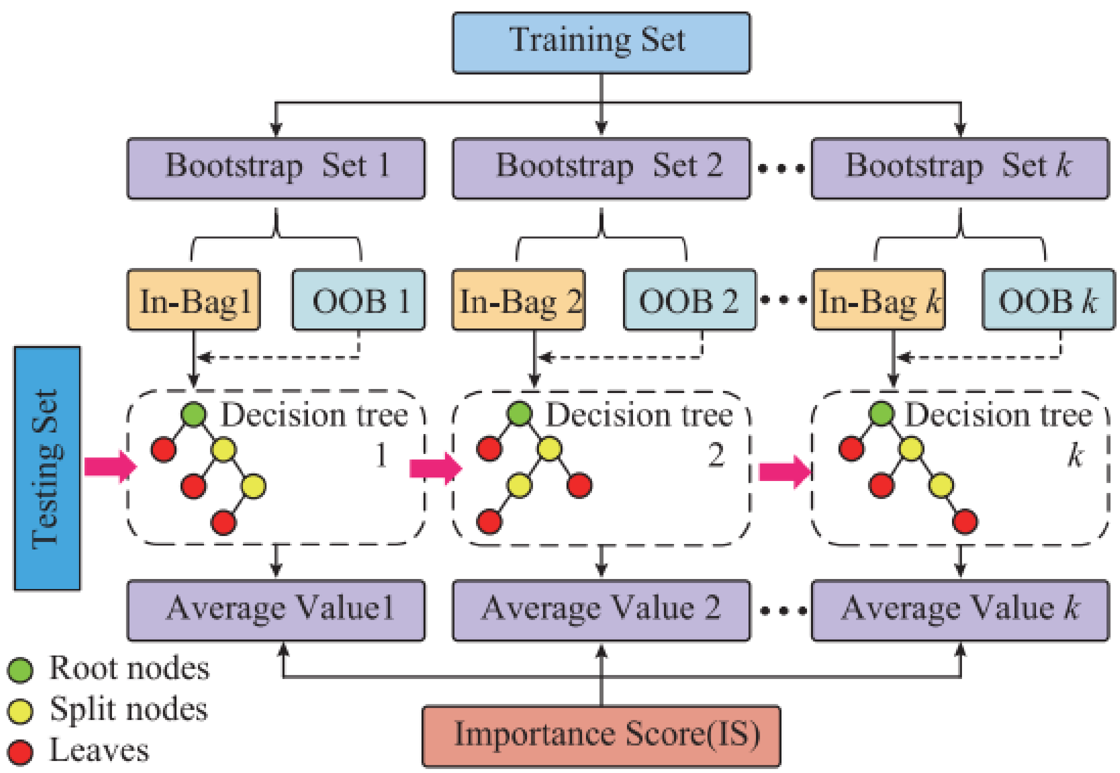



Fig. 11. Random forest steps.

## III. Construction of Digital Accounting Talent Assessment Indicator System

### A. Analysis of Digital Accounting Talent Assessment Indicators

In Fig. 12, in order to comprehensively assess the digital accounting talents in applied undergraduate colleges and universities, this study establishes a scientific and reasonable assessment index system [20], which mainly includes the following aspects:

*1) Level of professional knowledge:* including accounting basics, financial statement analysis, and tax regulations.

*2) Practical skills:* including accounting software operation, financial data processing, and auditing practice.

*3) Data analysis capabilities:* including data mining, data visualisation, statistical analysis, etc.

*4) Information system application capabilities:* including ERP systems, financial sharing platforms, etc.

*5) Comprehensive quality:* including communication skills, teamwork, and innovative thinking.

### B. System Construction

According to the principles of practicability and operability, this study constructs an assessment index system that meets the characteristics of applied undergraduate colleges and the market demand from the aspects of professional knowledge level, practical operation ability, data analysis ability, information system application ability, and comprehensive quality [20], as shown in Fig. 13.

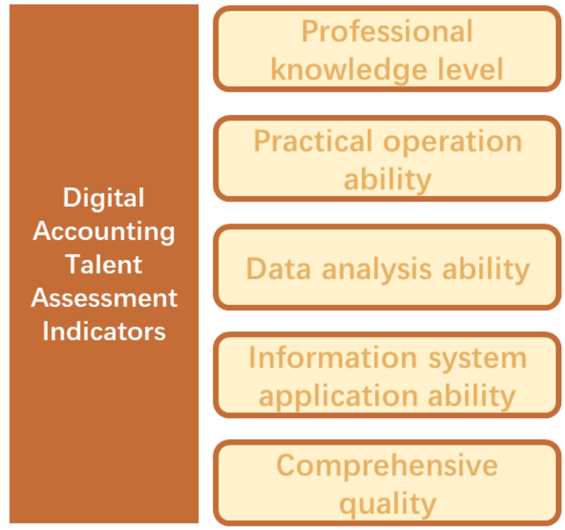



Fig. 12. Assessment of indicator aspects.

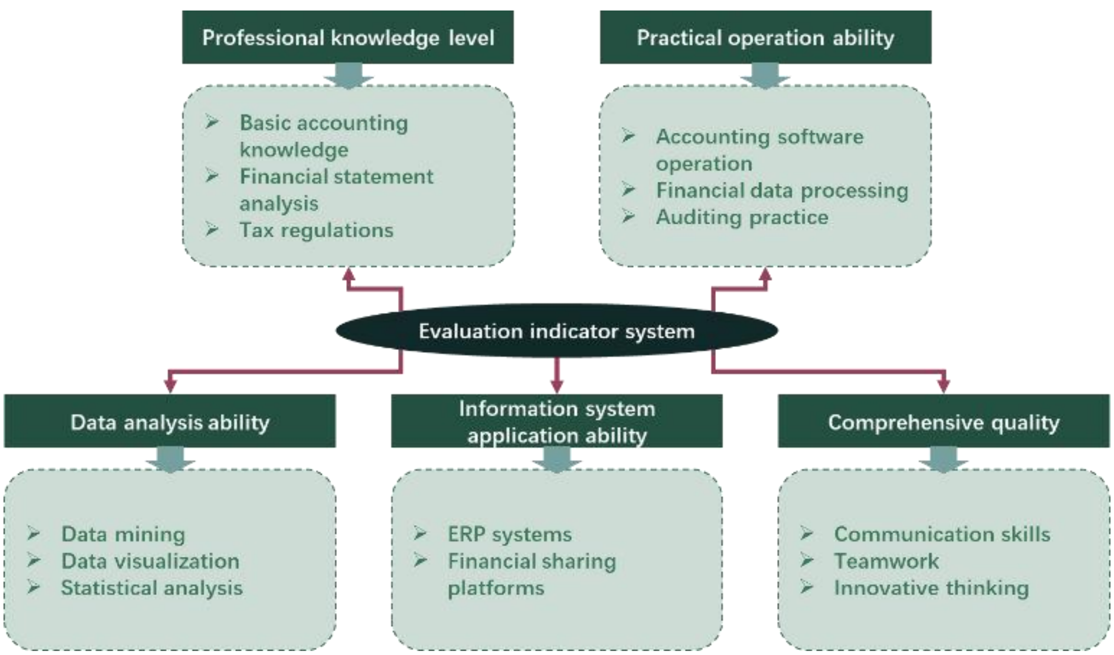



Fig. 13. Construction of the assessment indicator system.

## IV. Integration of ISA Optimised Random Forest Algorithm and Applications

### A. ISA Optimisation of Random Forests

In order to improve the evaluation accuracy of the RF algorithm, this study takes the number of RF algorithm decision trees and the minimum number of leaf points as the ISA algorithm optimisation decision variables, and the error objective function as the fitness value [21], and in Fig. 14, the specific steps are as follows: 1) Initialise the ISA algorithm optimisation RF model parameter population, and compute the fitness value; 2) Update the RF model parameter population using the ISA algorithm optimisation strategy; 3) Iteratively update until the maximum number of iterations is satisfied, output the optimal RF model hyperparameters, and construct the ISA-RF model.

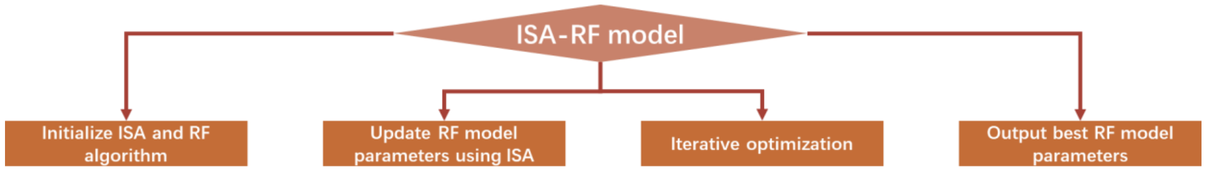



Fig. 14. ISA-RF Model construction and steps.

### B. Integration of the ISA-RF Algorithm

In order to make the training process less prone to overfitting phenomenon and improve RF accuracy, the integrated ISA-RF algorithm is constructed based on the ISA optimisation to improve RF algorithm by combining with AdaBoost technology. From Fig. 15, the specific algorithm is described as follows: 1) Initialise the weight distribution of the samples; 2) Train the base evaluator $h_t = f_{ISA-RF}(X, D_t)$; 3) Calculate the prediction error of the base evaluator $h_t$ on the training sample set; 4) Calculate the weight coefficients of the base evaluator $a_t$; 5) Update the sample distribution until it meets the maximum number of iterations; 6) Combine the $T$ base evaluators linearly to obtain the strong evaluator integrated ISA-RF model.

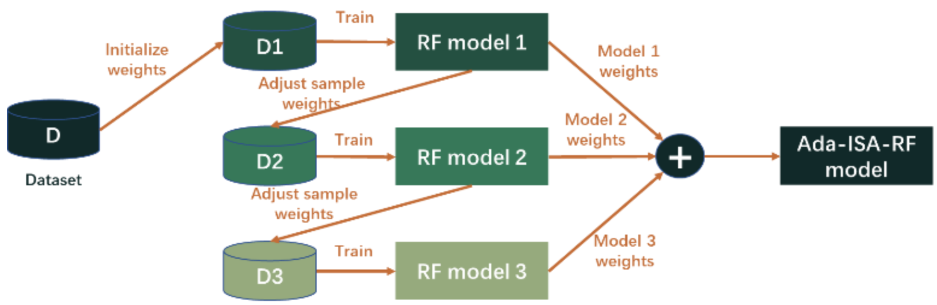



Fig. 15. Integrated ISA-RF model construction and steps.

### C. Application of Algorithms

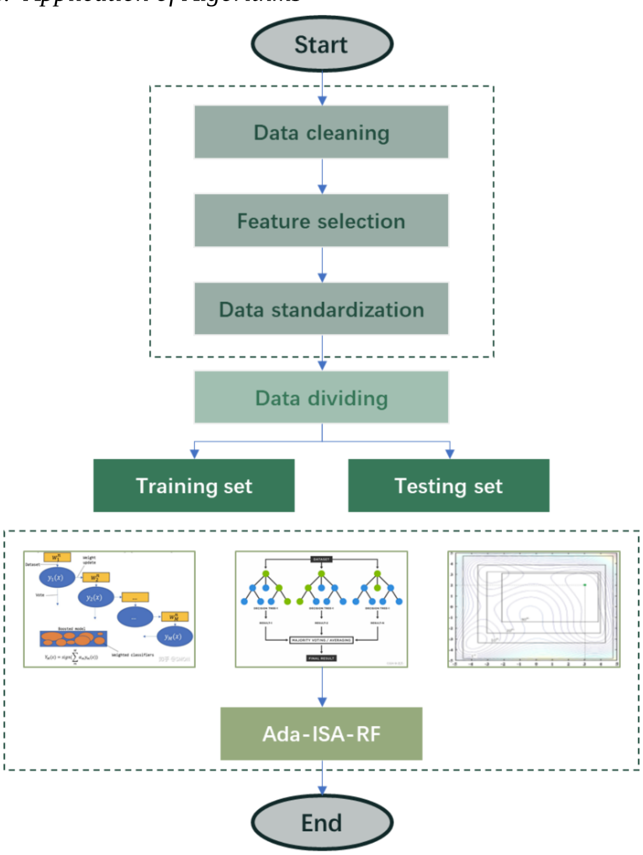



Fig. 16. Integrated ISA-RF model application flow.

From Fig. 16, after selecting the algorithm, the data needs to be pre-processed, including data cleaning, feature selection, data standardisation, etc. Then, the dataset is divided into a training set and a test set, and the model is trained using the training set and validated and optimised on the test set. Finally, the trained model is used to assess and predict the comprehensive quality of students.

## V. Effectiveness Analysis

### A. Environmental Settings

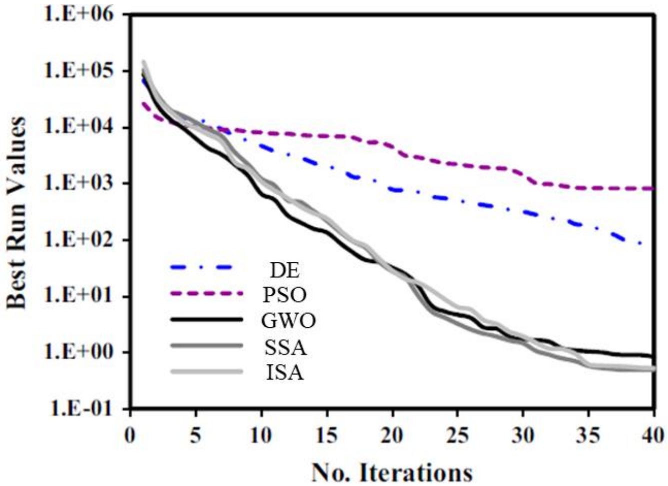
In order to further validate the performance of the integrated ISA-RF algorithm proposed in this study, and the improvement of the performance of digital accounting talent assessment, this study does training and testing on selected samples in Matlab2019a simulation environment. The parameter settings of the algorithm are shown in Table II.

TABLE II. Parameter Settings of the Algorithm

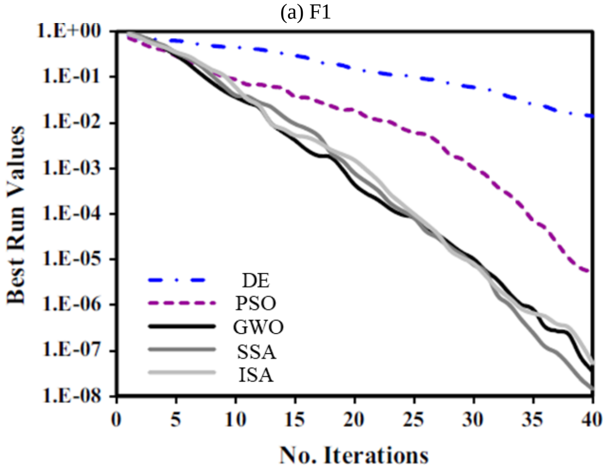
| *Arithmetic* | *Parameterisation* |
|---|---|
| Decision tree[22] | A maximum depth of 4 is used to specify that the minimum number of samples required at the leaf node is 10 |
| RF | The number of decision trees is 7, the maximum number of features is 5 and the maximum depth is 4 |
| ISA-RF | The number of decision trees, maximum number of features, and maximum depth are obtained by optimising the ISA algorithm with a population size of 20 and an iteration number of 40 |
| Ada-ISA-RF | The number of decision trees, maximum number of features, and maximum depth are obtained by optimising the ISA algorithm with 20 populations, 40 iterations, and 10 base evaluators |

### B. Optimising Performance Analysis

In order to analyse the optimization performance of the ISA algorithm, this study uses DE, PSO, GWO, SSA, and ISA to compare the optimization of the F1 and F2 functions, and the results are shown in Fig. 17. From Fig. 17, it can be seen that the ISA algorithm convergence accuracy is better than other algorithms.




(a) F1



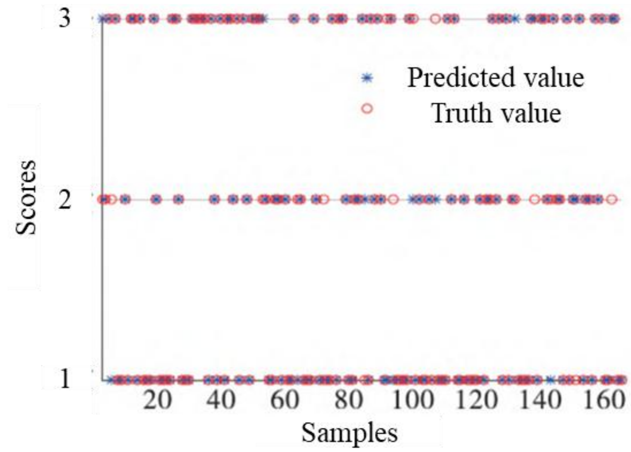

(b) F12

Fig. 17. Performance analysis of ISA algorithm optimisation.

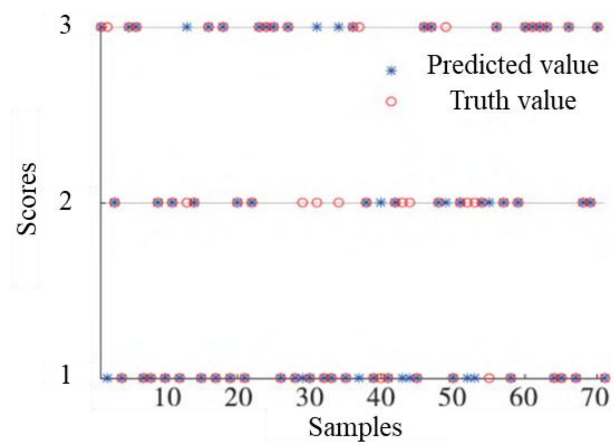
### C. Effectiveness Evaluation Analysis

In order to analyse the effect of integrated ISA-RF (Ada-ISA-RF) in digital accounting talent assessment in applied undergraduate colleges and universities, this study adopts Decision tree, RF, ISA-RF, Ada-ISA-RF to analyse and discuss the digital accounting talent assessment data in applied undergraduate colleges and universities. The digital accounting talent assessment data in applied undergraduate colleges is divided into training set and prediction set, and its sample size is 160 and 70, respectively, and the specific assessment effects are shown in Fig. 18 to Fig. 21, and Table III.

Figs. 18 to 21 give the assessment results of different talent assessment algorithms on the training and prediction sets. From Figs. 18 to 21, it can be seen that the digital accounting talent assessment results of applied undergraduate colleges and universities based on the integrated ISA-RF (Ada-ISA-RF) algorithm agree better with the real results than other algorithms, indicating that the algorithms proposed in this study favourably solve the problem of improving prediction accuracy; ISA-RF is better than RF, indicating that the ISA algorithm can improve the assessment accuracy of random forests; Ada- ISA-RF is better than ISA-RF, indicating that the integration technique can prevent ISA-RF from overfitting.

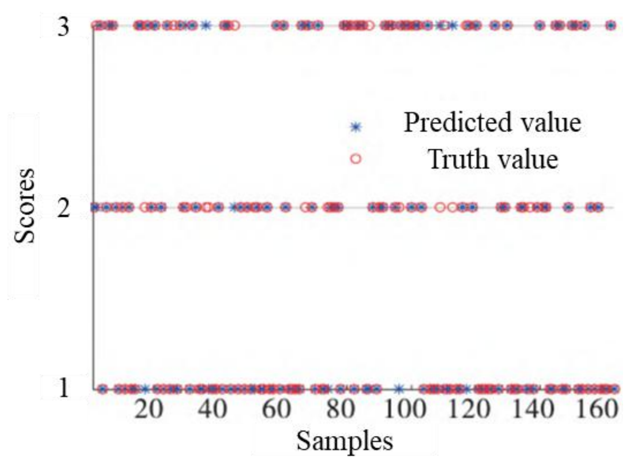



(a) Training set

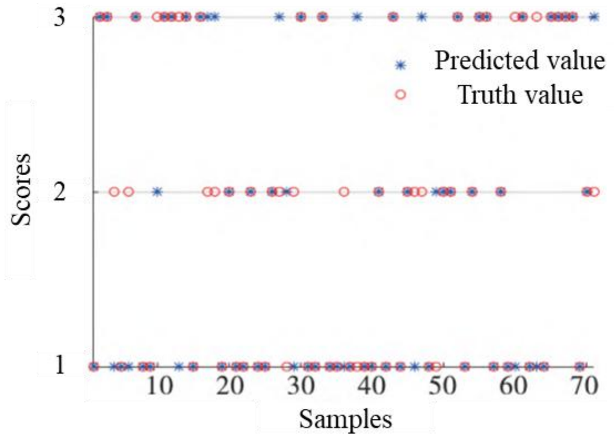



(b) Prediction sets

Fig. 18. Decision tree effect evaluation results.

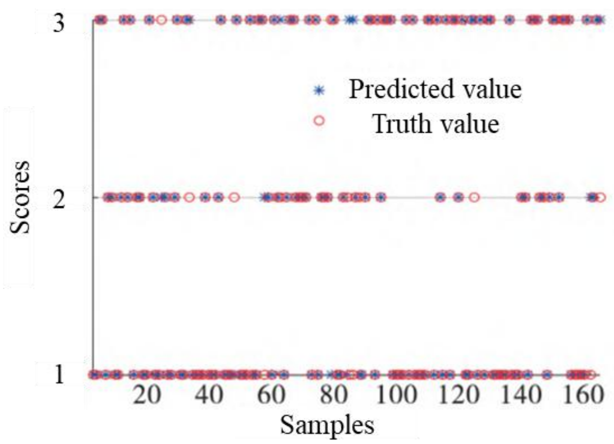



(a) Training set

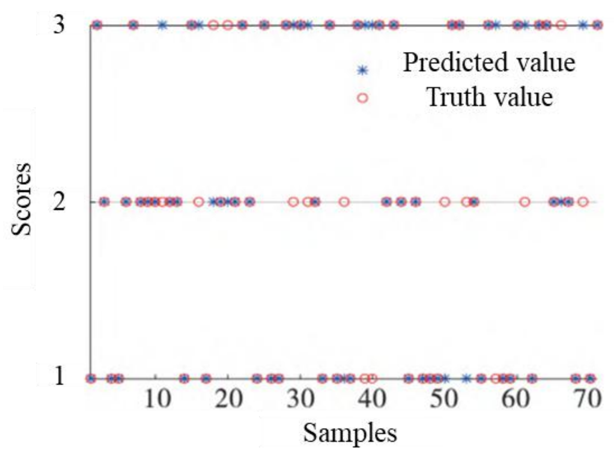



(b) Prediction sets

Fig. 19. RF Effectiveness evaluation results.

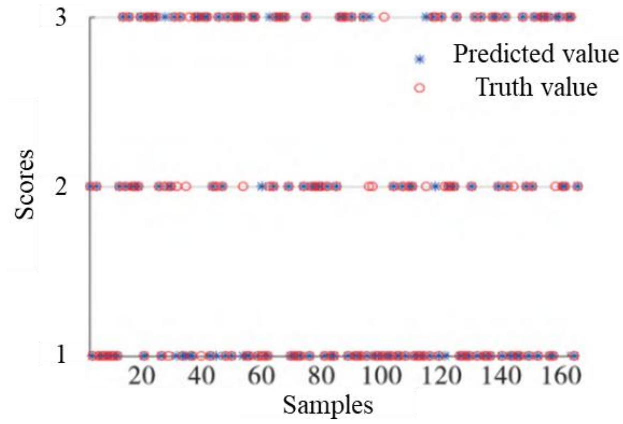



(a) Training set.

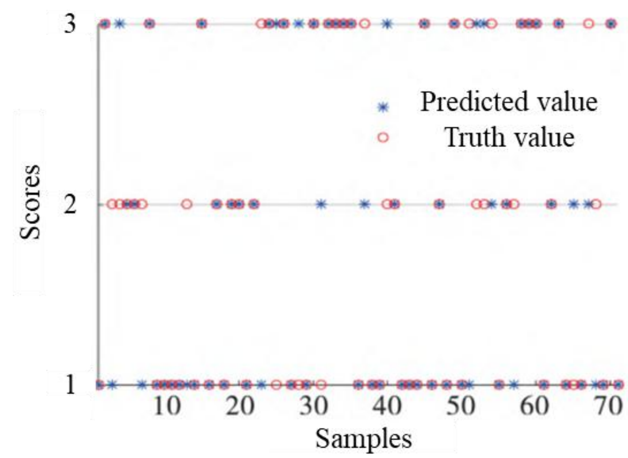



(b) Prediction sets.

Fig. 20. ISA-RF Effectiveness evaluation results.




(a) Training set.




(b) Prediction sets.

Fig. 21. Ada-ISA-RF Effectiveness assessment results.

Table III presents the results of Decision tree, RF, ISA-RF, and Ada-ISA-RF algorithms in assessing digital accounting talent in applied undergraduate colleges and universities on the training and prediction sets. From Table III, it can be seen that the accuracy of Ada-ISA-RF is 92.02 per cent and 81.69 per cent respectively, which is better than Decision tree, RF, and ISA-RF. Compared with the decision tree model alone, the accuracy of digital accounting talent assessment in applied undergraduate colleges and universities of Ada-ISA-RF is improved by 3.06 per cent and 7.04 per cent, which indicates that Ada- ISA-RF can effectively improve the accuracy of digital accounting talent assessment in applied undergraduate colleges.

TABLE III. EVALUATION RESULTS OF DIFFERENT ALGORITHMS

| ***Arithmetic*** | ***Training set per cent*** | ***Forecast set per cent*** |
|---|---|---|
| Decision tree | 88.96 | 74.65 |
| RF | 89.57 | 76.06 |
| ISA-RF | 90.80 | 78.87 |
| Ada-ISA-RF | 92.02 | 81.69 |

## VI. Conclusion

This study proposes a digital accounting talent assessment model for applied undergraduate colleges and universities based on integrated learning technology and intelligent optimisation algorithm to improve the machine learning algorithm, and verifies its effectiveness and feasibility through experiments. This assessment model can provide a scientific, objective and fair talent assessment method for applied undergraduate colleges and universities, which helps to improve the quality of talent training and market competitiveness. However, there are still some shortcomings in the research of this study, such as the assessment index system needs to be further improved and the generalisation ability of the model needs to be improved. Future research can explore more machine learning algorithms and model fusion methods to improve the accuracy and generalisation ability of the model. Through the exploration of these research directions, it is expected to construct a more perfect assessment system for digital accounting talents in applied undergraduate colleges and universities, and provide strong support for the cultivation of high-quality digital accounting talents.

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