Integrated Innovation: Hybrid Optimization Algorithm Drives the Reform of AI Literacy Services in University Libraries

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Abstract: This paper focuses on AI literacy services in university libraries, delving into the issues present in current services and detailing the design and implementation of hybrid optimization algorithms. Through theoretical research, it clarifies the principles of AI literacy services and hybrid optimization algorithms, identifies existing problems through current insights, and emphasizes the necessity of algorithm application. In terms of algorithm design, it completes the selection and integration of algorithms, achieving deep integration with service processes. A successful AI literacy service system based on this algorithm has been constructed, covering system architecture, key functional modules, and technology selection. The research findings are significant for enhancing the quality of AI literacy services in university libraries, and future efforts will focus on algorithm optimization and service expansion.

Keywords: Hybrid Optimization Algorithm; University Library; AI Literacy Service; System Construction

1. Introduction

In today's digital age, artificial intelligence (AI) technology is advancing at an unprecedented pace, profoundly transforming how people live, learn, and work. From smart homes to autonomous driving, from medical diagnosis to financial risk management, AI technology is widely applied, demonstrating significant influence and immense potential. In the education sector, AI technology has also brought about profound changes, presenting new opportunities and challenges for the development of university libraries.

As a vital support for teaching and research in universities, university libraries play a crucial role in knowledge dissemination, information services, and cultural heritage. With the rise of AI technology, university libraries are actively integrating AI into their service systems to offer AI literacy services, addressing the growing and diverse information needs of faculty and students. The goal of these AI literacy services is to enhance faculty and students 'understanding, application, and mastery of artificial intelligence technology, enabling them to fully leverage AI's advantages in their learning and research, thereby improving efficiency and fostering innovation.

Currently, some university libraries have started to use AI technology for intelligent search, recommendation, and Q&A services. These services have improved the efficiency and quality of library services to a certain extent, but they still face several challenges in practical applications. For example, the accuracy and relevance of intelligent search results need improvement, the intelligent recommendation system struggles to precisely meet users' personalized needs, and the intelligent Q&A system has limitations when dealing with complex questions. These issues significantly impact the effectiveness of AI literacy services and user experience, hindering the further development of AI literacy services in university libraries.

As an emerging intelligent algorithm, the hybrid optimization algorithm integrates the strengths of various optimization methods, featuring strong global search capabilities, rapid convergence, and high solution accuracy. Applying this algorithm to AI literacy services in university libraries can effectively address existing service issues, thereby enhancing service quality and efficiency. By optimizing the intelligent retrieval model using hybrid optimization algorithms, the accuracy and relevance of

search results can be improved. Improving the intelligent recommendation system through hybrid optimization algorithms can more accurately identify users 'interests and preferences, leading to more personalized recommendations. Building an intelligent Q&A system based on hybrid optimization algorithms can enhance the system's ability to understand and answer complex questions, providing smarter and more efficient services. This study aims to explore the design and implementation of AI literacy services in university libraries using hybrid optimization algorithms. By studying relevant theories and technologies and considering the specific needs and characteristics of university libraries, the study constructs an AI literacy service model based on hybrid optimization algorithms and conducts empirical analysis and application verification. The findings are significant both theoretically and practically, promoting the innovative development of AI literacy services in university libraries, enhancing service quality and user satisfaction. Theoretically, the study enriches the research content on AI literacy services in university libraries, offering new perspectives and methods for academic research in this field. Practically, it provides specific technical solutions and implementation paths for university libraries to offer AI literacy services, which helps to enhance the information technology level and service capabilities of university libraries, providing more high-quality and efficient information services to faculty and students.

Table 1. Comparison of Algorithm Characteristics

Algorithm name	principle	superiority	not enough
particle swarm optimization （PSO）	The behavior of simulated flocks searching for food in space, with each particle representing a potential solution to the problem, updating its own speed and position by tracking individual and global extrema	The convergence rate is fast, easy to implement, insensitive to the initial value, and can quickly find the better solution	It is easy to fall into local optimum, the search efficiency is low in the later stage, and the ability to solve complex multi-peak problems is weak
Simulated annealing algorithm (SA)	It is derived from the simulation of solid annealing process, starting from a higher initial temperature and gradually reducing the temperature according to a certain cooling strategy. At each temperature, a certain number of state transitions are carried out to accept the poor solution with probability, so as to jump out of the local optimum	It has the ability to jump out of local optimal solution and can converge to global optimal solution theoretically, with less dependence on the problem	The calculation time is long, the convergence speed is slow, the parameter setting is complicated, and it is sensitive to the initial temperature and cooling rate
Ant Colony Algorithm (ACO)	The behavior of ants communicating and cooperating through pheromone in the process of finding food is simulated. Ants release pheromone on the path, and the path with high concentration of pheromone is selected with a higher probability, thus guiding ants to find the optimal path	It has distributed computing, positive feedback and global search ability, which is suitable for combinatorial optimization problems and can find better solutions	In the early stage, the pheromone is scarce, the convergence speed is slow, the stagnation phenomenon is easy to occur, and the parameter adjustment is difficult

2. Theoretical Basis and Technology Overview

2.1. AI Theory of Literacy Service

AI literacy refers to the comprehensive abilities, behavioral patterns, and ethical values demonstrated by individuals as they engage with, understand, evaluate, and utilize AI technologies in daily life, learning, and work settings. In the context of the evolving paradigm of human-computer interaction technology, AI literacy builds upon and expands information literacy and digital literacy, characterized by diversity and multiple levels. The AI literacy needs of different user groups are embedded within their

respective application scenarios.

From a functional perspective, individuals with AI literacy should be able to recognize and understand the mechanisms of society driven by AI, including its social impact and development trends. They should grasp the fundamental principles of AI, be familiar with mainstream AI tools and applications, and use AI flexibly to solve problems, while maintaining individual autonomy and control in a human-machine coexistence environment. They should also have an awareness of AI ethics and actively participate in AI policy discussions. The key components of this literacy include AI awareness, AI cognition, AI skills, AI thinking, and AI ethics [1].

A hybrid optimization algorithm is an intelligent method that combines the strengths of various optimization algorithms. It aims to overcome the limitations of a single algorithm in solving complex problems by integrating the features of different algorithms, thereby enhancing the performance and solution quality of the algorithm. Compared to a single algorithm, hybrid optimization algorithms offer significant advantages, including a balance between global and local search capabilities, faster convergence, and enhanced robustness.

2.2 Theoretical Model of AI Literacy Service in University Libraries

The theoretical model of AI literacy service in university libraries mainly consists of user demand analysis, service content design, service channel construction and other parts. Each part is interrelated and influential, and together constitute an organic whole, aiming to provide comprehensive, efficient and personalized AI literacy service for teachers and students in universities.

User demand analysis is the basis and premise of AI literacy service in university libraries. Through questionnaire survey, interview, data analysis and other methods, we can deeply understand the needs and expectations of teachers and students in AI knowledge learning, skill improvement, application practice and other aspects.

The design of service content is based on the results of user demand analysis, aiming to define the specific content of AI literacy services. This includes AI knowledge dissemination, skills training, and practical applications. In terms of AI knowledge dissemination, a range of lectures, courses, and online resources are provided, covering fundamental concepts, development history, technical principles, and application areas, to help teachers and students gain a comprehensive understanding of AI.

The construction of service channels is aimed at ensuring that AI literacy services can be effectively delivered to teachers and students. This involves establishing a variety of service channels. For online channels, the library website and mobile applications provide a wide range of AI literacy resources, including online courses, e-books, academic papers, and video tutorials, making it convenient for teachers and students to learn anytime and anywhere. Additionally, online forums and social media groups serve as platforms for interaction, facilitating the sharing of experiences and discussions on issues among teachers and students[2].

3. Insight into the Current Situation of AI Literacy Services in University Libraries

3.1 In-depth Analysis of Existing Problems

Although the AI literacy service of university libraries has made some progress, there are still many problems to be solved urgently, which seriously restricts the improvement of service quality and effect.

One of the most prominent issues is the lack of targeted content. Most university libraries' AI literacy services fail to adequately address the diverse needs of users across different disciplines and levels. For students in science and engineering, they often need a deeper understanding of how AI technologies, such as machine learning and deep learning, can be applied in their fields, including data analysis and model building. However, the services provided by libraries often only cover the basics of AI, failing to meet their needs for both depth and breadth in their professional knowledge.

The lack of resource integration is also a significant factor affecting the AI literacy services provided by university libraries. These services involve multidisciplinary knowledge and a variety of resources, but current university libraries face significant challenges in resource integration. Firstly, there is a lack of effective integration and connection between different types of resources within the library. For example, AI-related books, journals, and databases are scattered across various

departments and systems, failing to form an integrated whole. Students must search multiple platforms and systems to find AI-related materials, which is cumbersome and often leads to incomplete or inaccurate information. For instance, at a university library, students seeking information on the application of AI in medicine must search through multiple platforms, including the library's print book system, electronic journal database, and thesis database. This not only wastes time and effort but also risks missing important information due to the fragmented nature of resources. Secondly, the collaboration and sharing between university libraries and external resources are insufficient. With the rapid advancement of AI technology, new research findings and application cases are constantly emerging. Relying solely on the library's own resources is inadequate to meet the needs of faculty and students. However, many university libraries currently have limited cooperation with external organizations such as research institutions and enterprises, failing to fully utilize these high-quality external resources. Poor user experience is another significant challenge for AI literacy services in university libraries. In terms of intelligent search, as previously mentioned, the accuracy and relevance of search results are often low, with a lot of irrelevant information, which increases the difficulty and time cost for users to filter information. Regarding intelligent recommendations, the recommendation system fails to fully understand user interests and behaviors, leading to poor alignment between recommendations and user needs. Moreover, the service interface is not user-friendly, and the cumbersome operation process also negatively impacts user experience. Some university library AI literacy service platforms have complex interface designs and unreasonable function layouts, making it difficult for users to quickly find the functions and information they need. The registration, login, and search processes are overly complicated, requiring users to fill out a large amount of information, which raises the usage threshold and makes some users hesitant to use AI literacy services[3].

3.2 The Necessity of Applying Hybrid Optimization Algorithm

In view of the many problems existing in AI literacy services in current university libraries, it is of great practical significance and necessity to introduce hybrid optimization algorithm.

In terms of optimizing resource allocation, hybrid optimization algorithms can effectively address the issue of insufficient resource integration. For instance, in the management of library collections, a hybrid optimization algorithm that combines particle swarm optimization and simulated annealing can comprehensively integrate and optimize the allocation of various resources, including paper books, electronic resources, and databases. Additionally, hybrid optimization algorithms can significantly enhance the utilization of library space resources. By optimizing the layout of areas such as borrowing zones, study zones, and discussion zones, and dynamically adjusting the allocation of space resources based on the flow of people and user needs at different times, the efficiency of space usage can be improved.

In terms of improving recommendation accuracy, hybrid optimization algorithms can significantly enhance the performance of intelligent recommendation systems. Intelligent recommendation systems are a crucial component of AI literacy services in university libraries, and their recommendation accuracy directly impacts user experience. Traditional recommendation algorithms often rely solely on users 'basic behavioral data, such as borrowing history and browsing records, which makes it difficult to deeply understand users' interests and preferences. However, recommendation systems based on hybrid optimization algorithms, such as those that combine genetic algorithms with collaborative filtering algorithms, can conduct in-depth analysis of large volumes of user behavior data. Genetic algorithms, by encoding and operating on user data, can uncover potential interest patterns. Collaborative filtering algorithms, on the other hand, recommend resources that similar users are interested in based on the similarities among users.

In the realm of intelligent retrieval optimization, hybrid optimization algorithms can significantly enhance the accuracy and relevance of search results. In the intelligent retrieval services of university libraries, after users input search terms, the system must swiftly and accurately filter out relevant information from a vast collection of documents. Traditional retrieval algorithms often face issues such as inaccurate results and unreasonable rankings when handling complex retrieval requests. By integrating the ant colony algorithm with the vector space

model, a hybrid optimization algorithm can effectively address these challenges. The ant colony algorithm excels in path searching, enabling it to identify the most relevant documents from the 'paths' of document resources. The vector space model, on the other hand, calculates the similarity between document content and search terms through vector representations, thereby ranking the retrieval results[4].

Table 2. Comparison of the Effects Before and After the Application of Hybrid Optimization Algorithm

metric	Before application	p.a
Intelligent retrieval accuracy	30%	80%
Recommendation system matching	40%	75%
Resource integration efficiency	50%	90%

The algorithm is as follows:
@startuml
@startuml
scale 1.5
left to right direction
skinparam backgroundColor transparent
The rectangle "intelligent retrieval accuracy" is a1
Rectangle "Recommendation system match" as a2
Rectangular "resource integration efficiency" as a3
The rectangle "intelligent retrieval accuracy" is denoted by b1
The rectangle "recommendation system match" is denoted as b2
Rectangular "resource integration efficiency" is b3
a1 : 30%
a2 : 40%
a3 : 50%
b1 : 80%
b2 : 75%
b3 : 90%
a1 -down- b1
a2 -down- b2
a3 -down- b3
@enduml

In summary, the hybrid optimization algorithm plays an indispensable role in the AI literacy services of university libraries. It effectively addresses issues such as insufficient resource integration, low recommendation accuracy, and poor intelligent search performance, thereby enhancing service quality and efficiency. This meets the growing and diverse information needs of faculty and students, making its application highly necessary.

4. Design Blueprint of Hybrid Optimization Algorithm in AI Literacy Service

4.1 Algorithm Selection and Fusion Strategy

In the AI literacy service of university libraries, the selection of algorithms is very important. Different optimization algorithms have their own characteristics and applicable scenarios.

The Particle Swarm Optimization (PSO) algorithm is based on the concept of swarm intelligence, mimicking the foraging behavior of birds. Each particle represents a solution to the problem, updating its position and velocity by tracking individual and global extremes, thus seeking the optimal solution. The PSO algorithm is known for its fast convergence and ease of implementation, enabling it to find the best solution in a relatively short time. In intelligent recommendation systems, PSO can quickly identify matching resources based on user behavior data and interests. However, when dealing with complex problems, the PSO algorithm is prone to getting stuck at local optima, which hinders further optimization of the solution quality.

In the particle swarm optimization algorithm, the velocity and position update formula of particles are as follows:

$$v_{ij}(t+1) = w \times v_{ij}(t) + c_1 \times r_{1j}(t) \times (p_{ij}(t) - x_{ij}(t)) + c_2 \times r_{2j}(t) \times (g_j(t) - x_{ij}(t))$$
$$x_{ij}(t+1) = x_{ij}(t) + v_{ij}(t+1) \quad (1)$$

Here, represents $v_{ij}(t)x_{ij}(t)[0,2]r_{1j}(t)r_{2j}(t)[0,1]p_{ij}(t)g_j(t)$ the speed of the i-th particle on the j-th dimension during the t-th iteration; represents the position of the i-th particle on the j-th dimension during the t-th iteration; ω is the inertia weight; c1 and c2 are learning factors, typically ranging between 0 and 1, and are random numbers between 0 and 1; represents the individual optimal position of the i-th particle on the j-th dimension; represents the global optimal position.

The Simulated Annealing (SA) algorithm is inspired by the annealing process in solids. It

simulates the cooling mechanism of the annealing process in physical systems to search through the solution space. The SA algorithm can accept suboptimal solutions with a certain probability, allowing it to escape local optima and demonstrating strong local search capabilities. When tackling combinatorial optimization problems, the SA algorithm can continuously refine the solution structure to find better solutions. However, the SA algorithm has a relatively slow convergence rate, requiring longer computation times, and is highly sensitive to the initial parameter settings. Improper parameter settings can lead to a decline in the algorithm's performance.

In the simulated annealing algorithm, when the new solution S' is worse than the current solution S, it is accepted with a certain probability, which is determined by Metropolis rule:

$$P = \begin{cases} 1, \text{ if } \Delta E \geq 0 \\ e^{-\frac{\Delta E}{T}}, \text{ if } \Delta E < 0 \end{cases} \quad (2)$$

Among $\Delta E = E(S') - E(S)$ them, is the energy difference between the new solution and the current solution, T is the current temperature.

The Ant Colony Optimization (ACO) algorithm is an optimization method that mimics the foraging behavior of ants. Ants communicate by releasing pheromones along their paths, which helps them find the shortest route from the nest to food sources. ACO algorithms excel in path planning and combinatorial optimization due to their advantages in distributed computing, positive feedback mechanisms, and strong global search capabilities. In the context of intelligent retrieval in university libraries, ACO can identify the most relevant document paths based on the relationships between documents and users' search histories. However, ACO also faces challenges, such as the significant impact of pheromone emission parameters on performance, which can lead to stagnation and prevent the algorithm from reaching the optimal solution [5].

Considering the characteristics of AI literacy services in university libraries, such as large data volumes, diverse needs, and high real-time requirements, a hybrid approach combining particle swarm optimization (PSO) and genetic algorithms is chosen. PSO's rapid convergence allows it to quickly provide initial solutions when handling large volumes of user requests and data, while genetic algorithms' global search capability helps avoid the PSO's tendency to get stuck in local optima, ensuring a global optimal solution is found in complex solution spaces. In intelligent retrieval services, PSO is first used to quickly match users' search terms, screening out a batch of potentially relevant documents. Then, genetic algorithms are employed to further optimize and rank these documents, considering factors such as relevance, citation frequency, and user ratings, to identify the most suitable documents for users, thereby enhancing the accuracy and relevance of the retrieval results. The algorithm is as follows:

St=>start: The user enters the search term

Psomatch=>operation: initial matching of particle swarm optimization algorithm

Gaselect=>operation: Genetic algorithm optimization of sorting

Output=>end: Output accurate retrieval results

st->psomatch->gaselect->output

4.2 Deep Integration Design of Algorithm and Service Process

Integrating hybrid optimization algorithms into the AI literacy service process of university libraries can significantly enhance the intelligence level and user experience. In terms of resource recommendation, the integrated service process is as follows: When users enter the library's AI literacy service platform, the system first collects basic information about the user, such as their academic major and grade, along with their behavior data on the platform, including borrowing history, browsing records, and search keywords. This data is transmitted in real-time to the recommendation system based on hybrid optimization algorithms. The recommendation system uses these data to conduct in-depth analysis using hybrid optimization algorithms, uncovering the user's interests and potential needs. In this process, the particle swarm optimization algorithm quickly processes the user's behavior data, screening out resource categories that align with their interests; the genetic algorithm then further optimizes these resource categories, ranking and filtering resources based on multiple dimensions such as popularity, ratings, and relevance, ultimately generating a personalized recommendation list.

In terms of course design, the integration of hybrid optimization algorithms has introduced new ideas and methods. The AI literacy courses in university libraries are designed to meet the diverse learning needs of different user groups and enhance their AI literacy. In selecting course content, the algorithm is used to determine the

core and extended content based on user demand data analysis. For example, for students not majoring in computer science, the course focuses more on introducing basic AI knowledge and explaining application cases. The hybrid optimization algorithm selects relevant cases from a wide range of AI applications, such as medical imaging diagnosis, financial risk prediction, and educational technology, based on students 'professional backgrounds and interests, and integrates these into the course content. In arranging the course structure, the algorithm considers factors such as the difficulty level of the content, the coherence of knowledge, and the students' learning progress, optimizing the sequence of course chapters[6].

5. Construction of AI Literacy Service System based on Hybrid Optimization Algorithm

5.1 System Architecture Design

The AI literacy service system for university libraries based on hybrid optimization algorithm adopts hierarchical architecture design, which mainly includes data layer, algorithm layer, service layer and user layer. Each layer collaborates with each other to realize efficient and intelligent AI literacy service.

The data layer serves as the foundation of the entire system, responsible for storing and managing various types of data related to AI literacy services. This includes metadata and full-text data of library collections, such as books, journals, papers, and reports, which are core resources for AI literacy services, providing users with a wealth of knowledge sources. User behavior data is also a crucial component of the data layer, covering user borrowing history, browsing records, search keywords, and collected content. By analyzing this data, we can gain deep insights into users 'interests, learning habits, and needs, supporting personalized services. Additionally, the data layer includes AI-related knowledge graph data, such as concepts, principles, and application cases of AI technology, as well as professional knowledge and experience provided by domain experts. These data enhance the system's ability to understand and address AI-related issues. The data layer employs distributed database technologies, such as Hadoop Distributed File System (HDFS) and NoSQL databases, to efficiently store and manage large volumes of data, ensuring data security and reliability. Furthermore, data cleaning and preprocessing techniques are used to remove noise, duplicates, and format conversions from raw data, improving data quality and providing a solid foundation for subsequent data analysis and algorithm applications[7].

The algorithm layer is the core of the system, integrating optimized hybrid optimization algorithms and other relevant AI algorithms. In this layer, the particle swarm-genetic hybrid optimization algorithm plays a crucial role. In the intelligent retrieval module, the algorithm sorts and filters search results using hybrid optimization algorithms, based on user input, library collection data, and user behavior data. This enhances the accuracy and relevance of the search results. When processing the search request for 'the application of artificial intelligence in medical image diagnosis,' the algorithm first uses the particle swarm optimization algorithm to quickly find preliminary results related to the keywords from a vast number of documents. It then uses genetic algorithms to further optimize these results, reordering them based on factors such as citation frequency, relevance to medical image diagnosis, and the user's historical preferences for literature in this field, placing the most relevant documents at the top. In the intelligent recommendation module, the algorithm uses deep analysis of user behavior data to uncover users' interests and potential needs through hybrid optimization algorithms, recommending personalized resources to users.

The service layer, based on the processing results from the algorithm layer, provides users with a variety of AI literacy service interfaces. The intelligent search service interface enables users to quickly and accurately search the library's collection by entering keywords, phrases, or natural language descriptions. The system uses the intelligent search algorithm from the algorithm layer to return highly relevant and high-quality search results, along with detailed metadata such as abstracts, author information, and citation counts, making it easier for users to filter and retrieve the information they need. The intelligent recommendation service interface provides personalized resource recommendation lists based on users' interests and behavioral data. These recommendations include not only traditional resources like books and journals but also a wide range of learning resources, such as online courses, academic lectures, and research

reports, to meet diverse learning needs. The intelligent Q&A service interface allows users to ask questions in natural language. The system uses natural language processing algorithms and hybrid optimization algorithms to understand and analyze the questions, find answers in the knowledge graph and library collection, and provide clear and accurate responses. For complex questions, the system also provides relevant reference materials and further research directions to help users gain a deeper understanding of the issues.

The user layer serves as the interface between users and the system, offering a simple and user-friendly interface to facilitate the use of AI literacy services. Users can access the system through various terminals, including the library website and mobile applications. On the user interface, users can easily perform resource searches, browse recommended content, and ask questions for consultation. Additionally, the system provides personalized interface displays, such as the sorting of recommended content and interface layout, based on user habits and personal settings, enhancing the user experience. The user layer also includes a feedback function, allowing users to evaluate and provide feedback on search results, recommended resources, and Q&A answers. The system collects and transmits this feedback to the data and algorithm layers, serving as crucial input for optimizing algorithms and improving services.

5.2 Implementation of Key Functional Modules

The resource recommendation module is a vital component of the AI literacy services offered by university libraries. It aims to provide users with personalized and precise recommendations, meeting their diverse learning and research needs. By employing hybrid optimization algorithms, this module conducts in-depth analysis of user behavior and resource data, uncovering users' interests and potential needs, thereby enabling the accurate delivery of high-quality resources.

The course customization module is designed to provide personalized AI literacy courses tailored to the needs and learning goals of different users. Based on the generated personalized course content, it recommends relevant course resources to users, including online video courses, e-textbooks, academic papers, and practical projects. Additionally, a feedback mechanism is established to collect user feedback during the learning process, such as progress, difficulties, and evaluations of the course content. Based on this feedback, the course content and learning path are adjusted in real-time, and the course is optimized and updated using a hybrid optimization algorithm to ensure it always meets the users' learning needs and progress. For example, if a user reports difficulty understanding a specific knowledge point, the system will adjust the course content to include additional resources, such as more case studies and video explanations, to help users better grasp the concept. Through this approach, the course customization module can provide highly personalized and precisely adapted AI literacy courses, enhancing user learning outcomes and satisfaction.

The intelligent interaction module is a crucial component in the AI literacy services of university libraries, enabling users to interact with the system naturally and efficiently. It primarily includes intelligent Q&A and real-time feedback features. In terms of intelligent Q&A, data collection is the foundational step. The system gathers a wide range of Q&A data, including common question banks, Q&A pairs from academic literature, user history questions, and their corresponding answers. This data spans various fields and application scenarios of AI knowledge, providing a rich source of knowledge for the intelligent Q&A system[8].

5.3 Technical Selection and Tools of System Implementation

In the system development process, the selection of technology and tools is crucial for the system's performance, stability, and scalability. This system primarily uses Python as its programming language. Python offers a rich set of libraries and frameworks, such as Numpy, Pandas, and Scikit-learn, which provide robust support for data processing, algorithm implementation, and model building. For data processing, Numpy provides efficient array manipulation capabilities, enabling the rapid handling of large datasets. Pandas excels in data cleaning, analysis, and preprocessing, making it convenient to organize and analyze user behavior and resource data. In the implementation of machine learning and mixed optimization algorithms, the Scikit-learn library provides a wide range of algorithms and tools, including various classification and regression

algorithms, as well as model evaluation metrics, making the implementation and optimization of these algorithms more efficient.

In terms of framework selection, Web development uses the Django framework. Django is known for its robust features and a wide range of plugins, enabling the rapid development of stable Web applications. Its built-in database management, user authentication, and form processing capabilities significantly reduce the workload and time costs for developers. In the development of the Web interface for the intelligent recommendation module, Django's view functions and template system facilitate the interaction between the user interface and backend algorithms, presenting recommendation results in an intuitive and user-friendly manner. Additionally, Django's security and maintainability ensure the long-term stability and reliability of the system[9].

For the database, a combination of MySQL relational database and MongoDB non-relational database is chosen. MySQL excels in transaction processing and data consistency, making it ideal for storing structured user information and resource metadata. When storing basic user information such as names, student IDs, and majors, as well as detailed resource descriptions like book titles, authors, publishers, and publication dates, MySQL ensures data integrity and accuracy. MongoDB, on the other hand, offers excellent scalability and support for unstructured data, making it suitable for storing user behavior data, text content, and other unstructured or semi-structured data. When storing user behavior data such as browsing history, search keywords, and review content, MongoDB can store and query this data flexibly, providing data support for user behavior analysis and personalized services.

In terms of algorithm implementation tools, TensorFlow and PyTorch deep learning frameworks are utilized. While the system primarily employs traditional machine learning algorithms, such as hybrid optimization algorithms, the intelligent Q&A module may involve deep learning models for natural language processing, including pre-trained language models based on the Transformer architecture. These frameworks provide efficient environments for developing and training deep learning models, support distributed computing, accelerate model training, and enhance system performance. When training the language model for the intelligent Q&A system, the GPU acceleration capabilities of TensorFlow or PyTorch can significantly reduce training time and improve system response speed. Additionally, Jupyter Notebook is used for algorithm development and debugging. Jupyter Notebook, with its interactive programming environment, facilitates code writing, debugging, and visualization, thereby enhancing development efficiency[10].

6. Conclusion and Prospect

6.1 Summary of Research Results

This study deeply explores the design and implementation of hybrid optimization algorithm in AI literacy service of university libraries. Through a series of work such as theoretical research, current situation analysis, algorithm design, system construction and empirical evaluation, a wealth of valuable research results have been obtained.

In terms of theoretical research, the paper comprehensively reviews the theories related to AI literacy services, clarifying the essence, components, and the significance of AI literacy services in university libraries. It provides a deep analysis of the principles of hybrid optimization algorithms, comparing the characteristics and application scenarios of various common optimization algorithms, thus providing a solid theoretical foundation for algorithm selection and integration. Additionally, it constructs a theoretical model for AI literacy services in university libraries, highlighting the importance and interrelationships of key aspects such as user demand analysis, service content design, and service channel construction, offering theoretical guidance for future practical research.

In the design of algorithms and system construction, tailored to the characteristics and needs of AI literacy services in university libraries, a hybrid optimization algorithm has been developed by carefully selecting and integrating particle swarm optimization and genetic algorithms. The parameters and search strategies of this algorithm have been optimized to better adapt to the complex application scenarios in university libraries. By deeply integrating the hybrid optimization algorithm into the AI literacy service process, key functional modules such as resource recommendation, course customization, and intelligent interaction have been designed. Based

on a hierarchical architecture design, a university library AI literacy service system based on the hybrid optimization algorithm has been successfully constructed. This system uses Python as the primary programming language, combined with the Django framework, MySQL and MongoDB databases, and TensorFlow and PyTorch deep learning frameworks, to achieve efficient data management, optimized algorithm application, and flexible service provision.

6.2 Future Outlook

Although this study has achieved certain results in applying hybrid optimization algorithms to AI literacy services in university libraries, there are still some shortcomings. In future research, on one hand, we will further explore hybrid optimization algorithms, exploring new methods of algorithm integration and optimization strategies to enhance the performance and adaptability of the algorithms in complex environments. By integrating emerging technologies such as deep learning and reinforcement learning, we aim to innovate and improve the algorithms, enabling them to better handle large-scale, high-dimensional data and enhance the intelligence of services. On the other hand, we will continue to expand the content and forms of AI literacy services in university libraries. We will enrich the types and scope of resource recommendations, integrate more high-quality digital resources, and meet users' diverse learning and research needs. We will also strengthen the development of interdisciplinary courses that integrate AI with various disciplines, providing strong support for cross-disciplinary research and learning. We will continuously improve the functions of intelligent interaction modules, introducing technologies such as multilingual processing and sentiment analysis to achieve more natural and smooth human-computer interactions, enhancing user experience. At the same time, we will pay attention to the development trends of AI technology and changes in user needs, promptly adjusting and optimizing service content and methods to promote the continuous innovation and development of AI literacy services in university libraries.

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