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An Intelligent Exercise Recommendation System Combining AIGC and Knowledge Graphs

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ABSTRACT
This paper focuses on an intelligent exercise recommendation system combining AIGC and knowledge graph technology. This system uses the advantages of natural language processing and machine learning of AIGC technology, and combines the rich entity relationship network of knowledge graph to realize the accurate capture of students' learning needs and intelligent recommendation of personalized exercises. Through in-depth analysis of students' learning behavior, interest preference and knowledge mastery, the system can generate exercises that meet students' ability level and learning goals and provide detailed analysis and feedback, so as to effectively promote students' learning progress and personalized development. This paper aims to discuss the design and implementation of the system, as well as its application prospects and potential value in the field of education.

KEYWORDS
AIGC; Knowledge graph; Exercise recommendation

1 Introduction

With the continuous innovation of Artificial Intelligence technology, the field of education is entering a new era full of infinite possibilities. In this profound change, the integration of Artificial Intelligence Generated Content (AIGC) and knowledge graph, Undoubtedly, it opens up a new way for the development of intelligent exercise recommendation system and brings unprecedented opportunities and challenges.

AIGC technology, as a cutting-edge technology in the field of artificial intelligence, with its powerful natural language processing and machine learning capabilities, is quietly changing the way educational content is generated and distributed. It can provide in-depth insight into students' learning habits, interest preferences and knowledge mastery, so as to accurately generate high-quality and personalized learning content, which can not only meet the learning needs of different students, but also stimulate their learning interests and improve their learning results. At the same time, as a new form of information organization, knowledge graph, with its unique entity, relationship and attribute structure, provides strong support for the organization and reasoning of educational content. A detailed and comprehensive knowledge graph can clearly show the internal relationship between various knowledge points and reveal the logical relationship between knowledge points. Thus, it provides students with a more systematic and comprehensive knowledge framework, which helps students better understand and master knowledge, and also cultivates their logical thinking ability and innovation ability. Combining AIGC with knowledge graph can build a more intelligent and efficient exercise recommendation system, which can deeply understand students' learning needs, accurately capture students' learning characteristics, and recommend personalized exercises for students that meet their ability level and learning goals according to the correlation between knowledge points in the knowledge graph. This intelligent recommendation method can not only help students consolidate what they have learned and improve their problem-solving ability, but also stimulate their learning interest and cultivate their independent learning ability and innovative thinking. At the same time, this recommendation method can also provide teachers with more accurate teaching guidance, help them better understand students' learning situation and develop more effective teaching strategies. This paper aims to deeply explore the application of AIGC and knowledge graph in intelligent exercise recommendation system, in order to build an intelligent system that can help students learn efficiently and improve the quality of education.

2 Relevant theoretical and technical basis

2.1 AIGC

Artificial Intelligence Generated Content (AIGC) is a process or method that uses artificial intelligence technology to generate various forms of content. This technology trains and learns a large amount of data through machine learning, deep learning and other algorithms. It can automatically generate text, pictures, audio, video and other types of content. The core of AIGC is its ability to simulate human creativity and ways of thinking to generate content that is innovative, unique and personalized. The application range of this technology is very wide, including but not limited to content

creation, virtual characters, virtual scenes and data analysis and prediction, etc. With the continuous development and improvement of artificial intelligence technology, AIGC has an increasingly broad application prospect. AIGC technology plays an important role in the intelligent exercise recommendation system. It uses artificial intelligence algorithms to generate personalized exercise recommendations according to students' learning data. These algorithms can analyze students' learning habits, mastery level and interest points, so as to recommend exercises that meet their learning needs[1].

2.2 Knowledge Graph

The origins of the knowledge graph can be traced back to expert systems, which integrate a wide range of expertise and experience to simulate expert decision-making processes, increasing their effectiveness and assisting human experts in addressing complex challenges. The core structure of the knowledge graph is composed of entities, edges and relationships between entities, which is similar to the graph theory model in data structure, where entities are mostly nouns, and edges are mostly represented by verbs. For example, in the statement "I love learning", "I" is the head entity, "learning" is the tail entity, and "love" is the verb to connect the two. The triplet structure of knowledge graph is formed. Each knowledge graph contains a large number of triples[2], and each triplet carries specific information, which makes the knowledge graph become a huge information repository. In view of this feature, more and more scholars are committed to exploring how to efficiently use these rich data information.

With the continuous evolution of knowledge graph technology, its application scope has expanded from the initial search engine to many fields, such as recommendation system, intelligent question and answer, text analysis, etc., and gradually penetrated into the traditional field. In the field of education, knowledge graph is widely used, involving knowledge base construction, adaptive learning, subject knowledge automatic question answering and learning interest transfer. Using the powerful data storage capability of knowledge graph, some researchers have built an educational resource knowledge base through entity recognition and relationship extraction technology, and provided learners with accurate learning resources through search and recommendation functions, which significantly improved the utilization efficiency of educational resources. Some scholars advocate that before recommending educational resources for learners, they should first evaluate their knowledge reserve and learning ability, and provide personalized educational resources for learners by constructing user portraits and combining the correlation between knowledge points in the knowledge graph to improve service quality. Meanwhile, some scholars use the correlation between knowledge points in the knowledge graph to combine natural language processing technology. In addition, by assigning different weights to nodes in the knowledge graph, the characteristics of user interest transfer can be captured, effectively solving the problem of "information overload" faced by learners[3].

3 Design of intelligent exercise recommendation system combining AIGC and knowledge graph

3.1 System architecture design

The intelligent exercise recommendation system combined with AIGC and knowledge graph constructed in this paper is a highly integrated and feature-rich platform, which aims to provide students with personalized learning experience through advanced technology. Its system architecture is well designed and can be subdivided into the following core and interrelated main parts.

3.1.1 AIGC exercise generation module

AIGC exercise generation module consists of three parts: input layer, processing layer and output layer. As the starting point of the system, the input layer is responsible for flexibly receiving and analyzing a variety of input information from teachers or students, such as teaching needs, student level and specific knowledge points, and providing accurate and comprehensive data support for the subsequent processing layer. The processing layer uses advanced natural language processing and machine learning technologies to deeply analyze and process the information provided by the input layer. By understanding the teaching needs and students' level, the processing layer can intelligently generate exercises that meet the requirements. These exercises not only cover the specified knowledge points, but also adjust the difficulty according to the actual situation of students. In the process of processing, natural language processing technology is used to analyze and understand the natural language content in the input information, such as the description of teaching objectives and knowledge points, while machine learning algorithms are used to generate high-quality exercises based on historical data and current input information. These algorithms can automatically learn and optimize the exercise generation strategy. Improve the quality and efficiency of the generated exercises; Finally, the output layer is responsible for clearly and easily presenting the generated exercise content, including questions, answers and detailed analysis, and providing additional functions such as printing and exporting to meet the different needs of users[4].

3.1.2 Knowledge graph building module

The knowledge graph construction module is a key part of the system. It first collects students' learning records, interest preferences and knowledge points through the data collection layer to ensure the accuracy and integrity of the data and provide a reliable foundation for subsequent construction. Then, the knowledge graph construction layer uses these data to build a knowledge graph including students, exercises, knowledge points and other entities. The triplet relationship of entity-relation-attribute is adopted to represent the complex associations and attributes among entities. Meanwhile, advanced technologies such as entity recognition and relationship extraction are adopted to ensure the accuracy of the atlas and consider the efficiency of storage and query. Finally, the update layer of the atlas constantly updates the knowledge atlas according to students' learning progress and feedback. Including adding new entities and relationships, updating existing entity attributes and relationships, etc., to maintain the timeliness and accuracy of the graph, and provide reliable support for subsequent exercise recommendations[5].

3.1.3 Exercise recommendation module

Exercise recommendation module consists of analysis layer, recommendation layer and feedback layer. The analysis layer makes use of the relationships in the knowledge graph to deeply analyze students' learning situation and interest preference, and uses advanced algorithms and technologies such as neural networks and collaborative filtering to generate personalized learning portraits, which provide important basis for the recommendation layer. The recommendation layer, based on the learning portrait, recommends exercises for students that cover unknown knowledge points and are in line with their interests and preferences. The ranking algorithm and diversity constraints are adopted to ensure the accuracy and diversity of recommendations, helping students consolidate knowledge and improve learning efficiency. The feedback layer is responsible for collecting students' feedback opinions on the recommended exercises, designing a simple and clear feedback interface and mechanism, encouraging active participation and providing valuable opinions, cleaning and analyzing feedback data to optimize the recommendation algorithm and update the knowledge graph, and providing important basis for subsequent optimization and iteration.

3.2 Implementation of key technologies

3.2.1 AIGC exercise generation technology

AIGC exercise generation technology is an important innovation in the field of education. It integrates the two key technologies of natural language processing and machine learning algorithm, aiming at intelligently generating exercise content that meets the teaching needs and students' level. Natural language processing (NLP) plays a crucial role in this technology, which can deeply understand and parse the teaching needs input by teachers or students, such as teaching objectives, course Outlines, etc., and students' specific level information, such as grade, class, personal learning progress, etc. By accurately capturing this critical information, NLP technology ensures that the generated exercises are closely aligned with the teaching requirements and effectively adapted to the actual needs of the student. At the same time, machine learning algorithms are also an indispensable part of AIGC exercise generation technology. These algorithms train and optimize the model by using a large amount of historical exercise data and student learning data. In the training process, the algorithm can learn the rules and patterns of exercise generation and make personalized adjustments according to the actual situation of students. This means that with the continuous accumulation of data and the continuous optimization of algorithms, the generated exercises will be more and more accurate and more in line with the actual needs of students.

3.2.2 Knowledge graph construction technology

Knowledge graph construction technology can extract key entities from massive learning records, interest preferences and other data, and analyze the complex relationships among these entities, so as to build a comprehensive and accurate knowledge system. In the entity extraction stage, knowledge graph construction technology uses advanced algorithms and models to accurately identify and extract key entities such as students, exercises and knowledge points from various data sources. Through entity extraction, students' learning track, interest points and mastery of knowledge points can be clearly understood. Relationship extraction reveals the complex relationship between entities by analyzing the correlation and interaction between them. For example, the relationship between students and learning records can reflect the learning progress and effect of students, while the relationship between exercises and knowledge points can reveal the knowledge points examined by exercises and the degree of difficulty of knowledge points. In the stage of graph storage and query, knowledge graph construction technology uses advanced technical means such as graph database to realize efficient storage and query of knowledge graph. Graph database can efficiently store and manage complex relational

data and support fast graph traversal and relational query, which enables the required information to be quickly obtained. For example, the learning progress of a certain student, the relevant exercises of a certain knowledge point, etc., provide a strong support for the subsequent learning recommendation and personalized teaching.

3.2.3 Exercise recommendation algorithm

By analyzing students' learning behavior and interest preference, exercise recommendation algorithm intelligently recommends exercises that meet their needs, so as to help students better grasp knowledge points and improve their academic performance. Content-based recommendation algorithm is an important method in exercise recommendation. It recommends suitable exercises for students by analyzing the content features of exercises, such as knowledge points, question types, difficulty, etc., as well as students' interest preferences and learning records. This recommendation method can ensure that the recommended exercises are highly matched with students' learning needs and interest points. So as to improve students' learning enthusiasm and participation. Another common exercise recommendation algorithm is collaborative filtering based recommendation, which recommends similar exercises for students by analyzing the similarities between students' learning records and exercises. Specifically, the algorithm will calculate the similarity between students or between exercises, and then based on these similarities, recommend other exercises to students that are similar to the exercises they have learned or liked in the past. This recommendation method can find students' potential learning interests and provide them with more diversified learning resources. However, a single recommendation algorithm is often difficult to meet the needs of all students. Therefore, this study adopts a hybrid recommendation algorithm, combines the advantages of content-based and collaborative filtering recommendation algorithms, and comprehensively considers the content characteristics of exercises, students' learning records, interest preferences and other factors to recommend more accurate and diverse exercises for students. This recommendation method can more comprehensively meet the learning needs of students and improve their learning experience and effect.

3.3 System implementation steps

This paper studies an intelligent exercise recommendation system that integrates data collection, processing, algorithm development and personalized recommendation functions. The following is a detailed description of the implementation process of the system.

First of all, data collection and pre-processing should be carried out, because data is the basis for all subsequent analysis and recommendation. It is necessary to extensively collect students' learning records, which cover their activities on various learning platforms, such as exercises completed, tests participated in and grades obtained, etc. At the same time, students' interests and preferences should be deeply explored. Through questionnaire survey, learning behavior analysis and other means, we strive to fully understand the individual needs of students. The original data collected often contains redundant, incorrect or inconsistent information, so the next step is to clean the data. This step aims to remove invalid data, correct wrong data and unify the data format to ensure the accuracy and efficiency of subsequent analysis. Next, we use natural language processing and machine learning technology to develop exercise generation algorithms and models. Natural language processing technology enables us to deeply understand teaching needs and students' level, so as to generate exercise content that meets the requirements, while machine learning algorithm trains the generation model by analyzing historical exercise data and students' learning data. Constantly improve the accuracy and pertinence of exercise generation. At the same time, the knowledge graph is constructed. The entities of the knowledge graph include students, exercises, knowledge points, etc., and the relationships reflect the internal relationships among these entities, such as the relationships between students and learning records, exercises and knowledge points, etc., and the attributes and characteristics of these entities and relationships are defined, such as students' grades, disciplines, interests, etc. Exercise difficulty, question type, chapter, etc., and finally integrate each module to form a complete system to provide personalized exercise recommendations for different students.

4 Conclusion

By deeply mining students' learning records, interests and preferences, and combining natural language processing and machine learning technologies, this paper successfully developed exercise generation algorithms and models to achieve intelligent exercise generation. At the same time, the construction of knowledge graph provided a rich knowledge base for the system, and enhanced the semantic understanding and reasoning ability of the system. Looking forward to the future, we will continue to commit to the in-depth research and application of AIGC and knowledge graph technology, constantly optimize and improve the intelligent exercise recommendation system, and provide students with

more quality and intelligent learning services. At the same time, we also look forward to working with more partners to jointly promote the intelligent development of education and contribute to the construction of a better future of education.

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