Exploration on the construction of knowledge graph and Smart Education system of Python language programming course

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Abstract: Python language has become one of the most popular programming languages, and its importance is self-evident. However, there are still many problems in the teaching process and teaching effect of Python language programming. Researches showed that the application of knowledge graph in education is helpful to the formation of knowledge structure, improve students' learning efficiency and stimulate students' autonomous learning ability. This paper attempts to build the knowledge graph Smart Education system of Python language programming course from three aspects: the construction of subject knowledge ontology, the development of teaching platform based on knowledge graph and the teaching mode based on knowledge graph.

Keywords: Python,Knowledge Graph,Smart Education

Introduction

Current teaching situation of Python language programming

Known as the "universal glue language", python language has powerful functions. It is characterized as being elegant, clear and concise grammatical. It can free users from grammatical details and focus on problem-solving methods and analyzing the logic and algorithm of the program itself. Since Sichuan Aerospace Vocational College opened this course four years ago, it has found several problems in the traditional teaching methods: first, students' mastery of Python language is poor and their practical operation ability is weak; Second, the teaching in class is mainly done by teachers, and the students do not have enough time to practice on the computer, so the teaching effect is poor; Third, the students' consciousness is not high, the completion of after-school homework is not enough, the learning efficiency is low and the effect is poor.

Application of knowledge graph in Education

Knowledge graph technology is a new knowledge management method proposed by Google in 2012. It is a structured semantic knowledge base. The application of knowledge graph in education is one of the hot areas in the reform and research of intelligent teaching methods. For example, in the article "Research on the construction method of SPOC curriculum knowledge graph from the perspective of teachers", Liu Hongjing and Tan Liang took "C language programming" as an example and used SPOC teaching mode to construct curriculum knowledge graph for teaching. They found that this method can promote students' ability to learn and transfer new knowledge, improve understanding and innovation; in his article "Knewton adaptive learning platform", Doec built an education platform Knewton based on the knowledge graph. The platform was used for mathematics teaching at Arizona State University in the United States. While greatly improving students' mathematics level, it also increased the graduation rate of students in the University by 11%.

Construction of knowledge graph Smart Education system

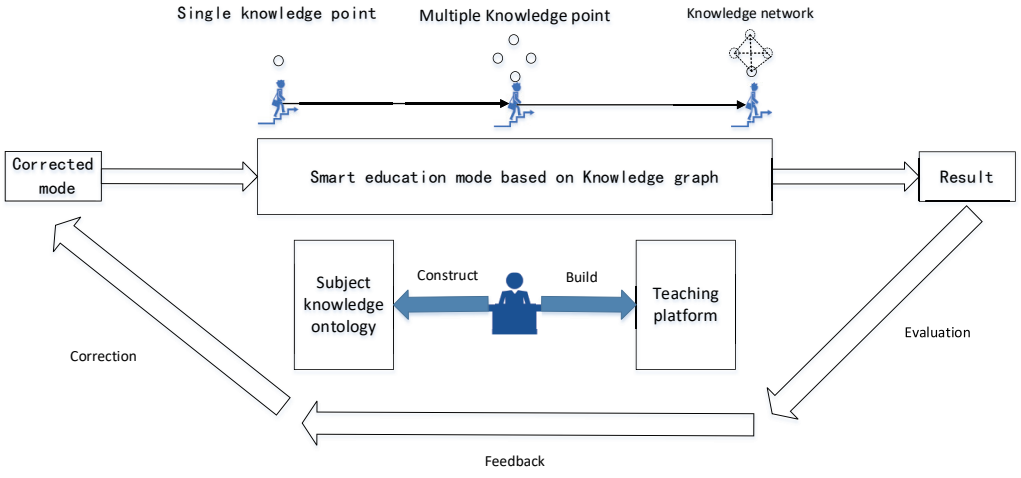

Fig. 1. Knowledge graph and Smart Education system

It can be seen that the application of knowledge graph to education is conducive to the formation of knowledge structure, improve students' learning efficiency, stimulate students' autonomous learning ability and other advantages. Based on the python language programming course offered by Sichuan Aerospace Vocational College, this paper attempts to build a knowledge graph intelligent education system and explore the intelligent education mode of higher vocational colleges based on knowledge graph, as shown in Figure 1.

To realize the education system, we need to solve three core problems: "construction of subject knowledge ontology", "the teaching platform based on knowledge graph" and "the teaching mode based on knowledge graph".

Construction of Subject Knowledge Ontology of Python Language Programming

Ontology is a formal representation method. The so-called knowledge ontology is to abstract the knowledge domain into a concept system and use a concept to represent the meaning of words. The relationship between words is ontology which means concept + property + axiom + value + nominal. The construction of subject knowledge ontology is to describe and express subject knowledge with knowledge ontology, and then express the structure of subject knowledge. The construction of subject knowledge ontology is the basis for establishingknowledge graph. The process of establishing subject knowledge graph is: data acquisition-data analysis-ontology knowledge base-knowledge graph.

The methods of constructing ontology include automatic method, semi-automatic method, IDEF5, AFM, and skeleton method, etc.. The construction of knowledge ontology can help to build the curriculum knowledge graph based on Python language programming. IDEF5 is a commonly used method to realize the construction, modification and maintenance of ontology. It has the advantages of standardized process and intuitive expression ability. Therefore, IDEF5 method can be used to build the subject knowledge ontology of Python language programming through the following five steps:

Setting goals: to make clear the construction of the knowledge ontology of Python language programming course before, during and after class, including theory and practice, which meets the needs of higher vocational students.

Collecting data: data is the basis for studying the knowledge ontology of Python language programming course. Data should be obtained from two different fields: education and opening. The data in the field of education includes teaching materials, syllabuses, teaching aims, teaching plans and problem sets. It is mainly structured data, that is, text. It is a collection of experience summarized by educational experts and python program developers; Data in the opening field includes blogs, encyclopedias, MOOC, etc., mainly text, pictures, videos, etc., which are mainly unstructured data and can be obtained by crawler technology.

Analyzing data: to filter the collected data. The data in the field of education shall be screened manually to eliminate duplicate data and low-quality data. For the data in the opening field, adopt an automatic way to screen, establish labels, remove low-quality data, and integrate the data.

Ontology preliminary development: for the collected data, the ontology construction is mainly based on the data in the field of education and supplemented by the data in the opening field. Firstly, the data in the field of education are comprehensively analyzed and integrated, the key knowledge points are extracted for the chapters, and the basic chapter knowledge ontology is established, and then the ontology is improved by using data from the opening field.

Optimization and verification of ontology: the local optimization and verification will be completed in the classroom and communication process, which is a continuous iterative process. Finally, the constructed ontology is formed into ontology knowledge base, and then the visualization method is used to complete the construction of knowledge graph by teachers and students.

construction of teaching platform based on Knowledge graph

The teaching platform based on knowledge graph is the infrastructure of applying knowledge graph to intelligent teaching. In order to build the platform, taking into account the development and cost issues, it can be implemented by springboot + Vue + MySQL + neo4j technology. This mode is an advanced design mode in the industry, which can realize the separate development of front and rear ends, with friendly front-end interface and fast back-end development.

The difficulty in the development of the teaching platform is the storage of knowledge graph and other related teaching data. Dual database storage technology can be used. For the storage of knowledge graph, there are a large number of structured, semi-structured and unstructured data in the construction process, which can be solved by the way shown in Figure 2. For structured data, such as the linked data in the knowledge graph of Python language programming, it is stored in the graph database neo4j after D2R conversion; Semi structured data such as tables, lists and infoboxes are stored in the graph database after being encapsulated by the wrapper, and unstructured data such as pictures and videos are stored in the graph database after information extraction. The display of knowledge graph adopts echart JS.

For non-knowledge graph data, mainly relational data outside the knowledge graph, such as student information and registration information, can be directly stored in MySQL database, which is conducive to efficient and fast retrieval of data.

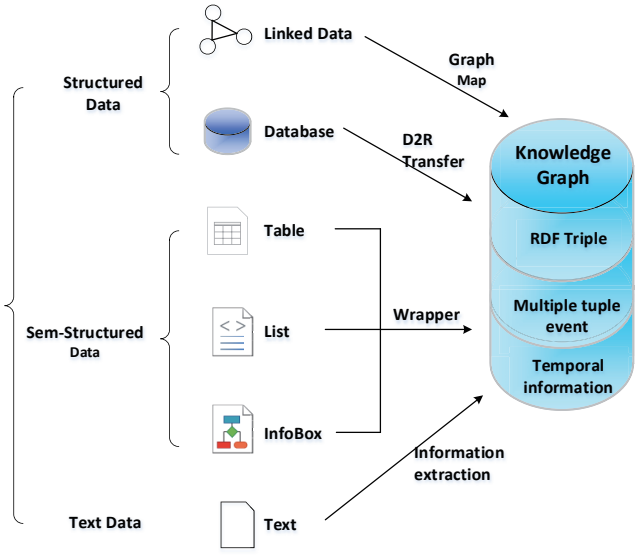

Fig. 2. Data storage process of knowledge graph teaching platform

During the use of the platform design, there will be three roles: teachers, students and system administrators. Therefore, the platform architecture design is shown in Figure 2, which is divided into three parts: teachers, management and students. In the process of accessing the platform, teachers and managers will involve students' private data, such as student ID number and grades. SSL encryption can be used to establish a confidential channel to access data and establish a knowledge graph; Students can access the system platform through ordinary data channels to establish a knowledge graph.

exploration of educational model based on Knowledge graph

Based on the knowledge construction model proposed by Gunawardena and the task driven teaching model, this paper applies the knowledge graph to the whole teaching process. Firstly, the whole teaching process is divided into three parts: before class, during class and after class. The teaching task is constructed with the "knowledge graph" including theoretical and practical teaching contents. The overall structure is shown in Figure 3. The specific process is as follows:

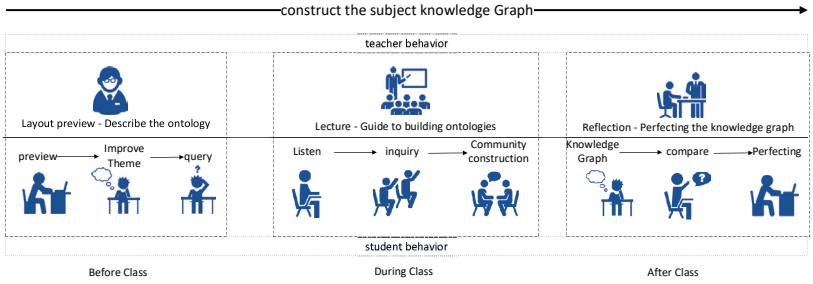

Fig. 3. Educational model based on Knowledge graph

Pre-class preview stage: the teacher releases the teaching task on the teaching platform. After receiving the teaching task, the students preview according to the simple description of the ontology released by the teacher, think about how to improve the ontology and question the problems encountered in the process.

In-class learning stage: the process of teachers' teaching in class is the process of perfecting the subject. Students think about the concept, structure and relationship of ontology taught by teachers in class. Join the discussion link in the classroom. Students discuss with each other and find that the ontology constructed by themselves is different from that constructed by other students; At the same time, accept the ontology knowledge taught by teachers in class and compare it with the ontology constructed by yourself. In view of the points different from the knowledge graph constructed by yourself, think about the reasons and the construction methods from other angles, and accept the same point of view.

After-class feedback stage: teachers release a complete knowledge graph after class. Students practice after class according to the teacher's requirements, and continue to complete and submit their own knowledge graph in the system. Then they can view the knowledge graph released by the teacher. With the help of comparison, students can find their own shortcomings, further improve their knowledge graph, check and fill the gaps in knowledge, and build their own knowledge structure.

The whole teaching process takes teachers as the guide, students as the main body and the construction of knowledge graph as the task

driving. The construction of knowledge graph runs through the whole learning process and strengthens students' mastery of knowledge structure. After completing the whole teaching task, teachers compare and analyze the learning effects of students who do not apply the knowledge graph to teaching and apply the knowledge graph to teaching from four aspects: application, analysis, synthesis and evaluation. On this basis, teachers reflect on teaching from many aspects such as teaching design, teaching process, student interaction and practical effect, and improve the Smart Education model based on the knowledge graph from many dimensions.

Summary

This paper attempts to build the knowledge graph Smart Education system of Python language programming course from three aspects: the construction of subject knowledge ontology, the development of teaching platform based on knowledge graph and the teaching mode based on knowledge graph, and makes some attempts to explore the application of knowledge graph in education and the formation of knowledge architecture. In the future research work, we will further (1) improve the verification research and data comparative analysis of the knowledge graph and Smart Education system described in this paper. (2) It is necessary to combine new technologies such as user portrait and personalized recommendation to further improve learners' learning efficiency and autonomous learning ability.

References

[1]Chen xuexiao Research on teaching reform, innovation and practice of "Python" course [J] Science, technology and innovation, 2022, (04): 116-118

[2]Liu Hongjing, Tan Liang Research on the construction method of SPOC curriculum knowledge graph based on Teachers' perspective [J] Audio visual education research, 2017 (09): 66-72

[3]Doe C . Knewton Adaptive Learning Platform[J]. American Journal of Botany, 2005, 92(11):1797-810.

[4]Menzel C P , Mayer R J . IDEF5 ontology description capture method: Concept paper. 1990.

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