Construct the Knowledge Graph of Information Security Introduction Course to Help Subject Teaching

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Abstract. With the rapid development of China's online courses and the national proposal of the task of intelligent education development, how to promote the deep integration between artificial intelligence and higher education, accelerate the higher education from digitization and networking to intelligence, improve the quality of online course construction, and promote the innovation and development of higher education has become an overall, long-term and strategic issue in the field of higher education question. As an important carrier of deep integration between artificial intelligence and higher education, online course knowledge graph is the core influencing factor of the development of intelligent education. In this paper, knowledge graph, an intelligent and efficient way of knowledge organization, is introduced into the teaching of information security introduction course. For the knowledge of "information security" course, a visual knowledge graph is constructed, and then the teaching resource platform of the course is formed.

Keywords: Knowledge graph · Intelligent education · Introduction to information security

1 Introduction

In the era of "Internet plus", the new generation of information technology represented by Internet, Internet of things, cloud computing, big data, artificial intelligence and block chain, promote the development of intelligent education in higher education, provide impetus and support for educational modernization, and bring opportunities and challenges to for the development of higher education [1]. Since 2017, the new generation of artificial intelligence development plan, colleges and universities artificial intelligence innovation action plan, China modern education modernization 2035 and other documents have been issued, supporting the development of intelligent education, promoting the deep integration of artificial intelligence and education, promoting the reform of learning environment, teaching methods, education management and evaluation [2]. Online learning platform effectively integrates modern information technology, and has been launched in colleges and universities for daily auxiliary teaching [3].

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As the most basic unit of talent training system in colleges and universities, curriculum is the core element of specialty and discipline construction [4]. There are many knowledge points in the information security introduction course, and there are countless connections among them. After a semester of study, students can basically master all the knowledge points, but it is difficult to connect them and build them into a whole to form a complete knowledge system.

Knowledge graph is an intelligent and efficient way of knowledge organization. With the help of graph theory, statistics, modern information technology and other means, it can show the core structure of a certain field, the relationship between each node of the development history and the overall framework in a visual way. With its powerful semantic processing function and rapid analysis ability, knowledge graph has become an intelligent search and organization tool that can quickly and accurately obtain information resources, and has been widely used in finance, public security, telecommunications, medicine, agriculture, government affairs and other fields [5].

In the field of education, knowledge graph, as a visual representation of the structural relationship of subject knowledge points, can promote learners' cognition, understanding, memory and dissemination of knowledge content, and cultivate the application ability of new knowledge, so as to help them better complete knowledge construction and thinking training in the information age [6].

2 Construction of Knowledge Graph of Information Security Introduction Course

2.1 Overview of Knowledge Graph

Kant believes that knowledge and experience in human memory are stored in the form of graph, and only when new concepts and original knowledge concepts are connected can they produce meaning [7]. Using knowledge element association can help learners establish knowledge system, integrate and associate new knowledge with their own existing knowledge through systematic learning, practice, reflection and transformation, and finally internalize them into knowledge system that can be output independently. With the development of artificial intelligence to the stage of cognitive intelligence, subject knowledge graph, with its unique semantic relevance, knowledge reasoning and interpretability, is highly consistent with intelligent education, and plays an important role in the establishment of learner model, online learning platform and intelligent question answering system.

In 2012, the concept of knowledge graph was proposed by Google [8]. In recent years, knowledge graph has become a research hotspot in the field of artificial intelligence [9–11]. According to the differences of knowledge categories, knowledge graph can be divided into industry knowledge graph and general knowledge graph. The former is oriented to specific fields, such as educational knowledge graph, medical knowledge graph, financial knowledge graph, etc. The latter is popular, not oriented to specific fields, and belongs to encyclopedic knowledge graph, such as Yago, free base, Zhixin, etc. There is a complementary relationship between the two knowledge graphs. For example, the former can provide the latter with knowledge in specific fields, expand the

latter's knowledge reserves and improve the quality of knowledge. The latter can provide the former with knowledge of other related fields, improve the knowledge coverage of the former, and enhance the knowledge service ability. As an industry knowledge graph, education knowledge graph is the cornerstone of the development of intelligent education [12].

With the help of education knowledge graph, the link relationship between knowledge can be reconstructed, and the network knowledge architecture of disciplines and specialties can be formed, which can effectively support flexible, accurate "teaching" and personality, lifelong "learning".

2.2 Construction of Knowledge Graph of Introduction to Information Security Course

The ontology based knowledge graph construction process of "Introduction to information security" course mainly includes OWL ontology construction and neo4j knowledge graph construction. The first part is to build a practical domain ontology of "Introduction to information security" by using the ontology tool protege; the second part is to use neo4j graphic database to store the related resources and semantic relations of "Introduction to information security" on the basis of the above ontology. Around these two parts, combined with the construction principles of knowledge graph, this paper finally constructs the knowledge graph of "Introduction to information security" course through five stages to form a more perfect domain knowledge graph. Figure 1 is the specific construction flow chart of the course knowledge graph.

1) Identify domain ontology: Referring to the information security introduction textbook compiled by Qi'anxin Institute of industry, the authoritative materials such as other relevant books and other teaching literature are collected. According to the purpose and demand of constructing the knowledge ontology of the information security introduction, the scope of ontology research field is determined and the relevant knowledge and terms are defined.
2) Searching available existing ontologies, that is, investigating the possibility of reusing existing ontologies Searching available existing ontologies, that is, investigating the possibility of reusing existing ontologies: At present, the field of introduction to information security is not mature, and the standard ontology library can be used directly. Therefore, building the ontology library of introduction to information security by hand is chosen.
3) List the important concepts in the field and summarize them: The related resources of "Introduction to information security" course are collected, and the concepts are extracted, duplication removed, semantically analyzed and merged to obtain domain terms.

   For example, the extracted digital signature technology, identity recognition technology, etc. are the application realization of information authentication technology of information security. These concepts can be summed up as "application realization". According to this method, we finally summarize six knowledge sets: "research subject", "concept", "algorithm and principle", "research object", "application realization" and "instance".

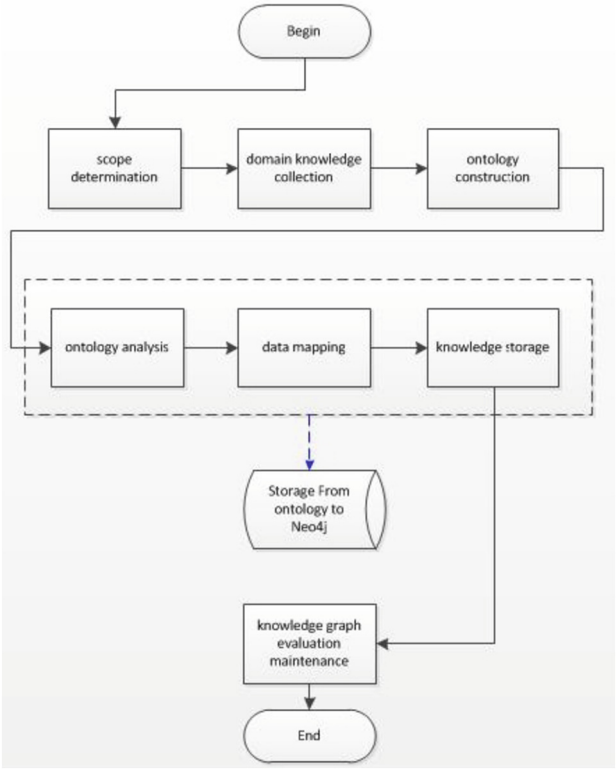

Fig. 1. Construction flow chart of the course knowledge graph

4) Define classes and their hierarchical relationships: The knowledge set summarized in the previous step is defined as "class", that is, "class" can be understood as containing several knowledge sets with the same characteristics. Starting from the goal of creating ontology of information security, the appropriate hierarchical relationship is selected on the premise of ensuring logic and practicability. There are two ways to construct class and hierarchy: top-down and bottom-up [8]. As the ontology of introduction to information security belongs to the mature field of information science, and the knowledge system has strong completeness, the top-down modeling method is adopted to construct the logical relationship of ontology, that is, first construct the top-level concept, and then gradually refine it down. The above six knowledge sets are defined as "research subject", "concept", "algorithm and principle", "research object", "application implementation" and "instance". And define the "research subject" class as a subclass of the top class, the remaining five classes are subclasses of the "research subject" class, and are of the same level relationship; then establish subclasses under each class, such as "research object" class, establish three subclasses of "information security technology", "information authentication technology", "information hiding technology", and create the third level class of

"digital signature technology" and "identity recognition technology" under the "information authentication technology". It represents that "Information authentication technology" belongs to "research object", while "digital signature technology" and "identity recognition technology" are also included in "information authentication technology".

5) Define the attributes of the class: The attributes of a class mainly include internal attributes, external attributes and relationships with other classes. Here, in addition to the parent-child relationship between classes, there are also a lot of logical relationships between knowledge points of information security course. According to the relationship between the concepts of the introduction to information security, the object attributes used in this paper to describe the internal relationship between classes are: "whole and part", "concept definition and description", "algorithm", "implementation", etc.
6) Defining facets of attributes: Facet refers to the type, number or other characteristics of an attribute. An attribute may consist of several facets. For example, there are static and dynamic types of attribute "algorithm"; there are three types, namely "input variable", "output value" and "procedure function interface"; other characteristics include that attributes are private.
7) Add individuals and construct data attributes for each individual: According to the characteristics of the core knowledge of the introduction to information security, data attributes such as "concept definition and description", "algorithm" and "implementation" are established respectively, and the value field of each data attribute is defined as "string". For example, the "information hiding technology" is added to the "research object" class, and then the data attributes such as "concept definition and description", "algorithm" and "implementation" are edited for the individual "information hiding technology". Among them, the specific description content of attribute "concept definition and description" is: "information hiding, also known as information camouflage, is to hide sensitive information by reducing some redundancy of the carrier, such as spatial redundancy, data redundancy, etc., so as to achieve a special purpose. Information hiding breaks the thinking category of traditional cryptography, and examines information security from a new perspective. Compared with the traditional encryption, information hiding is more covert. In information hiding, we can combine these two technologies. First, the secret information is encrypted and preprocessed, and then the information is hidden. The effect of confidentiality and imperceptibility of secret information is better. " The specific description of the algorithm is "LSB algorithm"; the specific description of the implementation is "input, output, implementation process".

2.3 Storage of Knowledge Graph of Introduction to Information Security

In this paper, we use the network knowledge base neo4j to store the knowledge graph, which can not only meet the storage of calculus knowledge, but also achieve the purpose of high-quality resource sharing by relying on the network. Neo4j is a graph database based on cypher language. It stores, processes, queries and presents data graphically. Each node of graph database has a directed edge pointing to the neighbor node, which makes it possible to traverse to the neighbor node in the case of O (1) time complexity, and

the database stores the relationship between nodes separately, which is more conducive to improve the speed of graph traversal and search speed.

2.4 Realize the Web Front Display Interface

The knowledge graph application system can realize the functions of visualization display, intelligent search, Knowledge Q & A based on information security knowledge (Fig. 2).

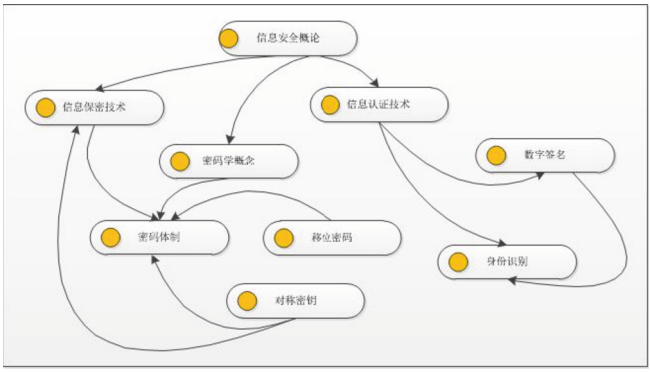

Fig. 2. Knowledge graph for information security courses

3 Construction of Knowledge Graph of Information Security Introduction Course

School education should actively promote the intersection and integration of students' own experience and various information from different channels, and cultivate students' knowledge creativity [13]. In the process of building knowledge graph of online courses, we need to establish the awareness of "open sharing of knowledge, collaborative innovation of interdisciplinary science", and build a knowledge graph at three levels of global, local and individual [14]. The global knowledge graph involves the knowledge of personnel training, including the entities (Concepts) and relationships carried by professional personnel training programs, and integrates the knowledge elements and relationships of disciplines, majors, colleges, teachers and industries. Individual knowledge graph involves students' knowledge, including the entities (Concepts) and relationships carried by students' individual and group characteristics.

As the core level of knowledge graph, local knowledge graph involves curriculum knowledge, including the entities (Concepts) and relationships carried by specific online courses. These three knowledge graphs are relatively independent and closely related. The above relationship is helpful to build and improve the knowledge graph of online courses by using the third-party knowledge library such as global knowledge graph and

individual knowledge graph, and realize the "interconnection" knowledge network, provide a solid guarantee to the sharing of the three knowledge graphs, the co-construction of multi-party cooperation, the rapidity of organic reorganization of knowledge graph and the multi-dimensional integration of online course learning space. In addition, the above relationship helps to reduce the complexity of online course knowledge graph and improve the focus of online course knowledge graph construction.

Finally, with the help of the multi graph ablation system, we can improve the open, personalized and accurate education service level of online courses, meet the flexible, diverse, open, accurate and lifelong personalized education needs, and improve the integration ability of intelligent, networked, personalized and lifelong education system.

With the help of personnel training knowledge graph and student knowledge graph, through the above sharing, co construction, rapidity and multi-dimensional, we can solve the problems of the adaptability of online courses to professional talent training, students' all-round development and personality development, and give full play to the promotion of online course knowledge graph for the deep mastery of knowledge, learning communication and cooperation, knowledge active construction and effective migration ability cultivation support.

Through the integration of global, individual knowledge graph and local knowledge graph, the school's professional and students' actual information is incorporated into the curriculum knowledge graph, so as to improve the integration degree between online courses and school reality (such as teachers and their objects), avoid the separation of online courses from the school's actual learning environment, and build a harmonious and integrated platform of real space and cyberspace, which promote the construction of mixed curriculum, promote the identity transformation of teachers from dominator and instigator to director, helper, organizer and promoter, and enhance the initiative and innovation of students in the learning process. The continuous improvement of knowledge quality and reserves of knowledge graph can further optimize the learning community knowledge, improve the interactive communication and learning collaboration, build the efficiency of knowledge, and promote the construction of collaborative learning environment.

4 Conclusion

This paper discusses how to organically connect the knowledge points of the introduction to information security in the form of knowledge graph, and describes the specific steps of constructing the knowledge graph of the introduction to information security. In the teaching process, teachers can guide students to use the knowledge graph of the introduction to information security for efficient learning, so that students can understand the overall framework of the introduction to information security and know the origin of the knowledge points. In addition, through the combination of knowledge graph and big data machine learning, the goal of sharing high-quality educational resources is expected to better realize the use of knowledge graph of network knowledge base, which can help students acquire knowledge more efficiently, and help students carry out targeted learning through personalized learning recommendation.

Through the construction of the knowledge graph of online courses in Colleges and universities, we can form a knowledge architecture based on semantic network, consolidate the infrastructure for the development of intelligent education, support open, personalized and accurate education services, and provide solid support and reliable guarantee for the development of intelligent education.

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