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Article

One Kind Method for Constructing Knowledge Graph of Yijing

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Abstract: Due to the inclusion of both the principles and divination methods, the study of Yijing (Yijing) becomes more complex. The complex data types, diverse semantic relationships, and unclear influencing mechanisms in Yijing pose challenges to its scientific research. Knowledge graph, as an advanced way of organizing knowledge, can provide technical support in exploring the hidden connections and knowledge structure within text resources. This paper proposes a method of constructing a Yijing knowledge graph based on Neo4j. By analyzing the concepts, entities, and various related relationships in Yijing, the method discusses the basic architecture, data model, and implementation steps of constructing the Yijing knowledge graph. It also extracts, integrates, and structures the Yijing knowledge, allowing for inquiries, associations, and reasoning about the knowledge and its various elements. By adopting a top-down approach, the paper reconstructs the fundamental knowledge system of the Yijing, including yin-yang, the five elements, generation and restriction, 64 hexagrams, and six lines(yao). It establishes a knowledge graph pattern layer and a data layer that encompass concepts, attributes, and relationships. With the technical support of the Neo4j platform, the visualization and retrieval of Yijing knowledge are realized, providing new ideas and methods for studying the mechanisms of the Yijing. The proposed method of constructing a Yijing knowledge graph can be expanded to other types of ancient scripture knowledge graph research and can be applied to the field of digital humanities, promoting in-depth cross-disciplinary research and integration.

Keywords: Yijing; knowledge graph; Neo4j; visualization retrieval; new method

1. Introduction

Yijing has been full of mystery since it came out. Although few people understand it, it has been passed down from generation to generation and has been enriched and developed continuously. As an important part of China traditional culture, Yijing contains profound philosophical thoughts and wisdom. However, due to its highly generalized language and complex theoretical system, many people are difficult to understand. In the development of thousands of years, I have formed different schools, such as Yi school, Xiang Shu school, Mathematical school, Na Yin school and so on. Some famous philosophers, thinkers and scientists have established their own school system and discipline system based on the ideological data provided by the classics and biographies of Yijing, so there are also Confucian Yi, Physician Yi and Artist Yi. As a result, the Yi-ology has been enriched and developed, and the scope and contents of the Yi-ology have also been expanded, thus forming a systematic academic with a unique oriental way of thinking, integrating the wisdom of China's civilization for thousands of years, and aiming at exploring the law of the change of human nature in heaven. There are many people who study Yijing or engage in matters related to Yijing. To sum up, it can be roughly divided into three types: academic, Jianghu and supernatural. Therefore, the people we see studying Yi cannot be generalized, but vary from person to person. The author thinks that Yijing and divination prediction are not science, but contain science and surpass it.

Although Yijing is an ancient book in China, its spread is not limited to China. As early as the Han Dynasty, it spread to the Korean Peninsula and Japan. After the 15th century, it spread to Europe, and then it developed continuously. With the development of globalization, more and more

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cultures have been spread and recognized around the world. In this process, Yijing, as one of the representatives of Chinese culture, is also playing an important role. Yijing has been translated into many languages and widely spread around the world. Many western philosophers and scholars have developed a strong interest in Yijing, which is regarded as a classic with profound philosophical thoughts. [1] The core idea of Yijing has been applied to modern scientific fields, such as quantum mechanics and information science, which provides new ideas and methods for the development of modern science.

Yijing is a comprehensive compilation of concepts, rules, and laws derived by ancient Chinese people in their quest to understand the material world. It serves not only as a philosophical classic but also as a methodology that encompasses the I Ching divination prediction model. This predictive model can be likened to the big data forecasting models of the information age, although it is more qualitative and less precise when it comes to specific details. Nonetheless, the Yijing demonstrates remarkable accuracy in speculating about general patterns. Through study and training, ordinary individuals can grasp its essential principles, which is why it has endured for thousands of years. In contrast, big data analysis becomes more complex when attempting to predict specific details. It relies on intricate mathematical logic and formulas, often requiring advanced mathematical knowledge and computer technology to effectively model and apply. Once such a big data model is established, however, it can provide highly accurate predictions, and ordinary people can learn to utilize it with great convenience. In summary, the Yijing model is relatively simple to grasp and apply, whereas the application of big data models can be more challenging.In the era of big data, knowledge graph(KG) is an important data resource for knowledge management and application. It has become the key technical basis of semantic retrieval, knowledge reasoning and decision support in various fields of search engines. The development of new technologies such as big data and knowledge graph has brought new opportunities for the study of Yijing. [2,3,4] In the official entry of Wikipedia: knowledge graph is the knowledge base used by Google to enhance its search engine function. [5]In essence, knowledge graph is a semantic network that reveals the relationship between entities, and can formally describe things in the real world and their relationships. [6] Knowledge graph has been used to refer to various large-scale knowledge bases. [7,8,9,10]For example, in view of the characteristics of big data in the medical field, such as strong professionalism and complex structure, the architecture and construction technology of medical knowledge graph are studied. [11] Some scholars also apply Neo4j to the research in the field of traditional Chinese medicine, [12,13] Zhao Kai et al. used Neo4j to construct a knowledge graph of Guizhi Tang and similar formulas. [14]Jiang Huijuan et al. utilized Neo4j to build a medicinal diet formula graph database using "Chinese Medicinal Diet Dictionary" as the data source. [15]Zhu Liangbing et al. combined thematic maps, Neo4j, and other technologies and tools to analyze the thematic types, relationships, and attribute information in the "Shan Hai Jing." Based on this analysis, they proposed the technical architecture, data model, and implementation steps for constructing a knowledge graph of the "Shan Hai Jing." [16]

The structured or unstructured information expression of knowledge graph is closer to the form of human cognitive world, which provides a better ability to organize, manage and understand massive and complex information. Its purpose is to establish a semantic network composed of knowledge, that is, a multi-relational graph. [17]Many scenes in the real world are very suitable to be expressed by knowledge graphs. Although there is a lot of international knowledge about Yijing and divination, due to the lack of a visual logic system of Yijing, such as the yin and yang, five elements generating and controlling cycle, it is impossible to realize the accurate correlation and reasoning of Yijing, and it cannot meet the research needs of intelligent identification and prediction of Yijing under the current data-driven research paradigm. [18]

This paper aims to enhance the conceptual knowledge of Yijing and enhance its theoretical knowledge system by constructing a knowledge graph system based on the six divination principles. The construction process utilizes Neo4j graph database and the Mindmaster software, resulting in a comprehensive knowledge representation of Yijing. The developed system not only enriches the

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understanding of Yijing but also provides valuable insights for building knowledge systems and representation models for other ancient classics.

2. Principles and Methods

2.1. Yijing knowledge graph construction process

The construction of a general knowledge graph primarily involves processing multimodal data from diverse sources, including structured, semi-structured, and unstructured data. This process aims to create a semantic network of considerable scale, utilizing technologies such as data collection, data fusion, knowledge extraction, knowledge representation, knowledge fusion, knowledge reasoning, and knowledge update. See Figure 1.

In general, knowledge graph construction methods include bottom-up, top-down and their combination. [19] This paper mainly constructs a knowledge graph based on the basic principle of divination of 64 hexagrams, and adopts a top-down way to construct a knowledge graph. From top to bottom, we first build concepts, entities, attributes, etc. from the top-level concepts, and then refine concepts and relationships. From top to bottom, based on the knowledge system of Yijing, concepts, attributes, relationships and their hierarchical systems are defined and accurately constructed step by step, and knowledge from different sources is aligned and integrated, and stored, visualized and queried in the form of secondary graph database. Because Yijing has a wide range of knowledge, large information capacity and many semantic associations, this paper automatically extracts and enriches the knowledge system through the computer based on the manual design of the knowledge system of Yijing.

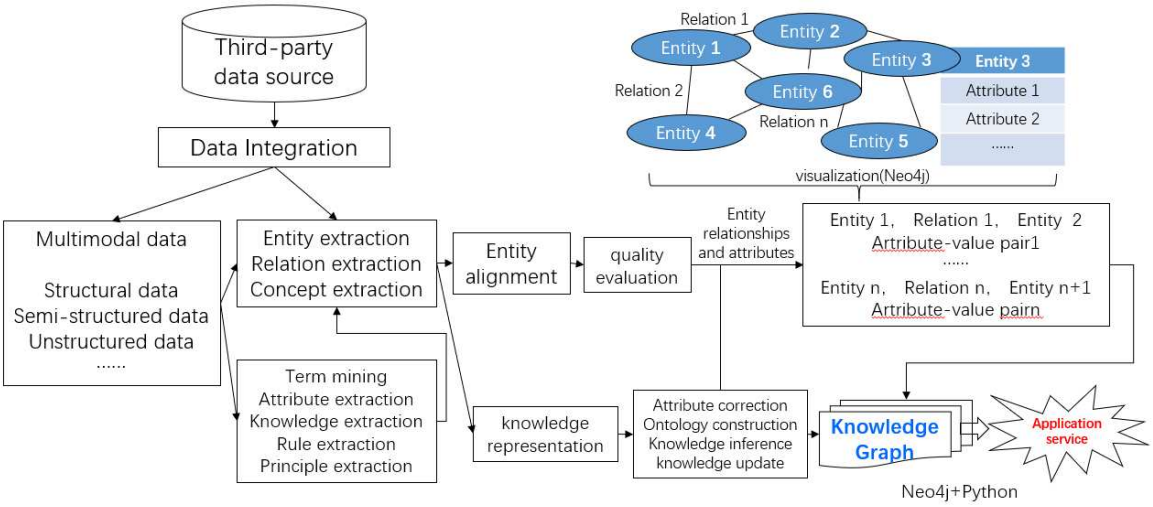

Figure 1. Schematic diagram of the basic process of knowledge graph construction.

2.2. Yijing knowledge system design

The study of Yi-ology is a theory to explain the nature, society and life of the universe, which is formed in the process of expounding Yigua(易卦), Yishu(易数), Yixiang(易象), Yili(易理), Yibian(异变) and Yizhan(易占). During its development, it has formed unique nouns, terms, propositions and categories (including basic concepts, rules, theories, methods, schemas, etc.). These are the basis for people to know Yijing. The basic knowledge system of 64 hexagrams in Yijing is constructed according to the triple of knowledge graph and the top-down construction idea.

2.2.1. The basic composition of 64 hexagrams in Yijing

Yijing consists of two parts: the Classic of Changes (Jing) and the Commentaries (Zhuan). The 64 hexagrams created by King Wen of Zhou make up the Classic, while the Ten Wings, a collection of commentaries by Confucius, form the Commentaries. Thus, the basic framework of 64 hexagrams that have been circulated so far has been formed. Each hexagram consists of eight pure hexagrams

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overlapping. Each hexagram consists of hexagrams (six hexagrams), hexagrams' names, hexagrams' words and hexagrams' words. Among them, the six hexagrams in the actual divination include hexagrams (hexagrams), internal and external hexagrams, heavenly stems, earthly branches, five elements, six parents and the world. These elements form a complex network of 64 hexagrams through their position and the relationship between birth and gram.

水火既济								
卦辞：亨，小利贞，初吉终乱。								
卦象	爻序	内外	天干	地支	五行	六亲	世应	爻辞
▅ ▅	上六	外卦上卦	戊	子	水	兄弟	应	濡其首，厉。
▅▅▅	九五		戊	戌	土	官鬼		东邻杀牛，不如西邻之禴祭，实受其福。
▅ ▅	六四		戊	申	金	父母		儒有衣袼，终日戒。
▅▅▅	九三	内卦下卦	己	亥	水	兄弟	世	高宗伐鬼方，三年克之。小人勿用。
▅ ▅	六二		己	丑	土	官鬼		妇丧其茀，勿逐，七日得。
▅▅▅	初爻		己	卯	木	子孙		曳其轮，濡其尾。无咎。

Figure 2. Schematic diagram of the composition of one of the 64 hexagrams (taking ji ji hexagrams as an example). Note: Due to the problem of translation of the composition of each hexagram in the Book of Changes, simplified Chinese in picture format is directly used here.

2.2.2. Conceptual systems

According to the basic composition of 64 hexagrams in Yijing, with the help of Mindmaster software[20]carry out the top-level design of the conceptual layer of the knowledge graph of Yijing. Exclusive of Wuji and Taiji, and define the concept layer step by step from two wings, 4 images, 8 trigrams, 64 hexagrams, 6 lines, 6 relatives, heavenly stems and earthly branches. During the process of constructing the concept hierarchy downwards, multiple sub-concept sets are delineated within the same level based on the rules of Yijing. They are bound by the division rules with the conceptual layer at the next higher level. Because the concept classification of Yijing is relatively mature and internationally recognized, the concept level of Yijing in this paper is basically unique. See Figure 3.

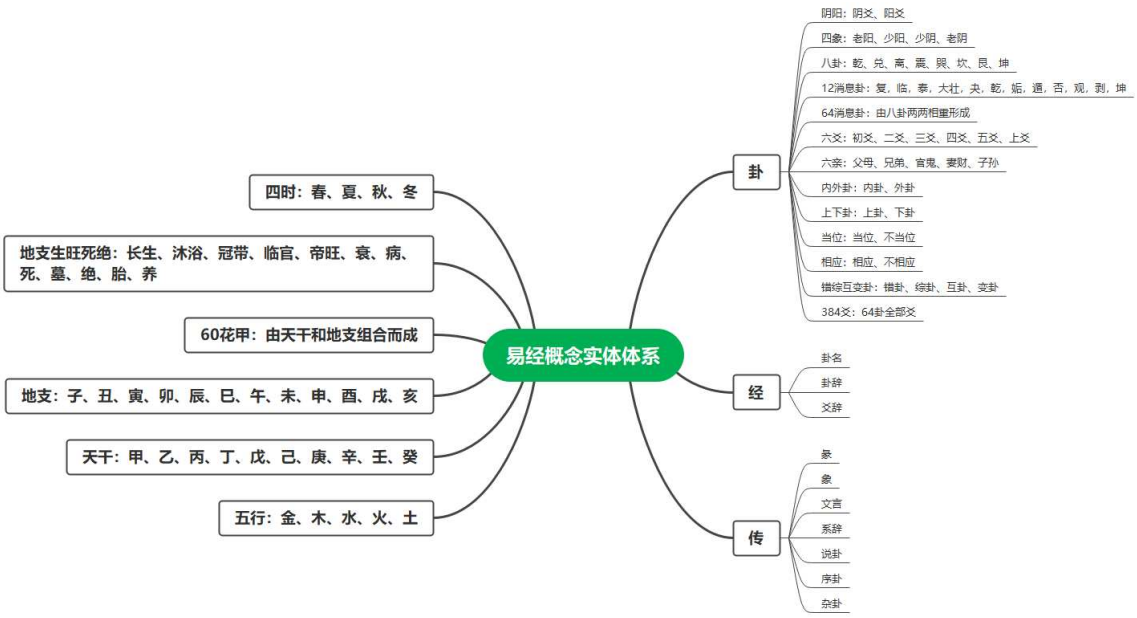

Figure 3. Conceptual systems of knowledge graph of 64 hexagrams in Yijing. Note: Because the divination rule words in Yijing are complicated, there is no unified translation language to express them accurately, so simplified Chinese is used here.

2.2.3. Attribute layer

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Attribute is the knowledge used to describe the internal and external characteristics of concepts, including interpretation, concept description, theoretical definition, principle content and so on. Based on the concept system, the attributes of concepts are defined layer by layer. For example, each hexagram is described as an attribute, which constitutes an attribute layer. This time, the attribute layer will not be explained too much, and it will only be labeled as an attribute. See Figure 2.

2.3.4. Relationship layer

The relationship in the 64 hexagrams of Yijing mainly refers to the relationship between different concepts such as concepts and entities. These relationships can be divided into: the relationship between generation and inhibition, the relationship between line position, the relationship between prosperity and decline, and so on. The relationship between generation and inhibition indicates the relationship between two concepts and entities in rules. For example, generation-inhibition in five elements with each other, and the 12 branches chong and he with each other. Six lines positional relations, such as the proper and improper of line position, correspondence and non-correspondence of the six lines in Yijing. The relationship between prosperity and decline includes the prosperity and decline of the five elements in the four seasons and the 12 prosperity and decline grades of the heavenly stems. There are 112 relationships among the 64 hexagrams in Yijing. See Figure 4. These relationships are intertwined and form a complex network of relationships of Yijing.

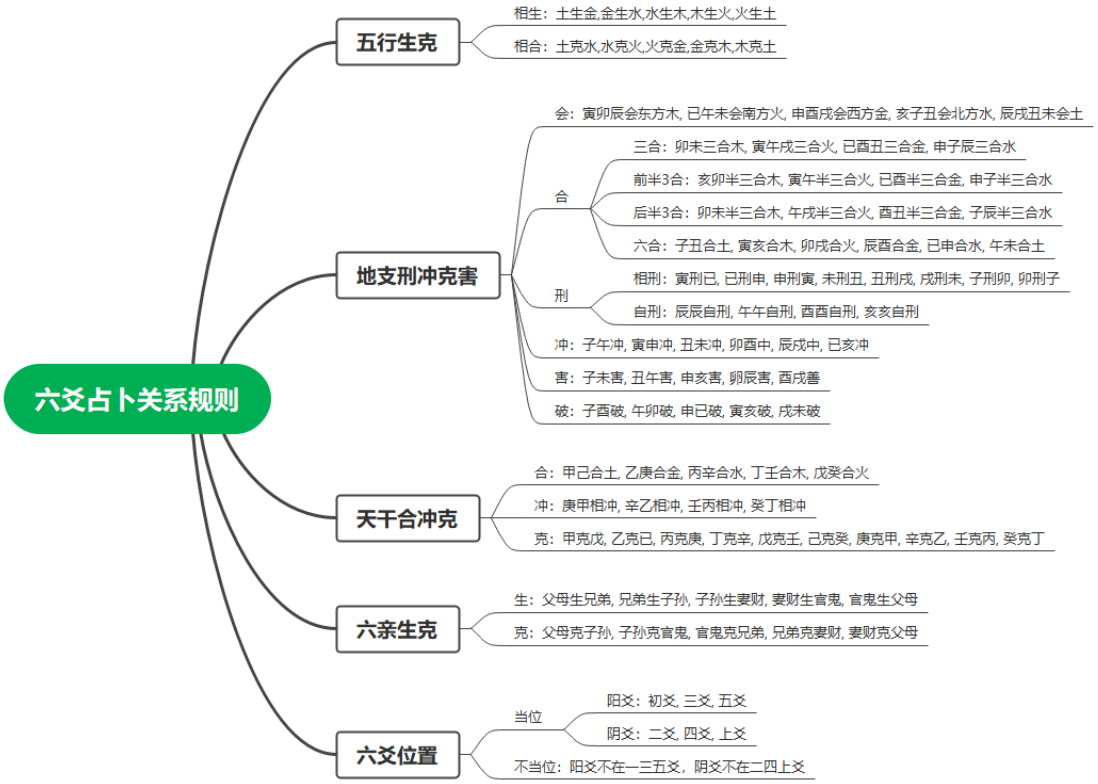

Figure 4. The concept and entity relationship of 64 hexagrams in Yijing. Note: Because the divination rules in Yijing are complicated and simple, there is no unified translation language to express them accurately, so simplified Chinese is used here.

2.3. Key technologies for constructing knowledge graph of Yijing

2.3.1. Knowledge extraction

Knowledge extraction mainly extracts the concepts, entities and relationships related to Yijing from a wide range of data sources and stores them in the knowledge base in a certain form. To obtain entities, attributes and relationships directly from these complex data sources, it is necessary to segment these data sources and then extract entities, attributes and relationships. The specific steps

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are as follows: first, the data sources collected from the data sources are sorted into text forms, and then they are segmented, and then entities, attributes and relationships are extracted from the segmented results, and finally a knowledge set in the form of triples is formed.

2.2.2. Knowledge fusion

The data sources in Yijing are diverse, and there is a phenomenon that the concept and entity name are not unified, which leads to multiple names of an entity and requires knowledge fusion operations such as entity alignment. Firstly, it is judged whether the entities of Yijing from two or more information sources point to the same object. Secondly, the same object with different expressions and different sources is merged to eliminate redundancy and correct errors. For example, regarding the six-position-order expression, there are sequence and title that represent the same entity, so it is necessary to point them to the same entity, otherwise it will cause data redundancy. Therefore, in the process of constructing the knowledge graph of Yijing, entity alignment is very important.

2.2.3. Knowledge storage

Knowledge storage is convenient for adding, deleting, modifying and checking knowledge graphs to meet the needs of various scenarios and scientific research applications. Whether knowledge storage is reasonable and efficient can be evaluated by query performance. Different types of knowledge storage methods have their own advantages and disadvantages. General knowledge storage methods include resource description framework (RDF) storage, graph database storage, etc. The latter is used more frequently. In this paper, Neo4j graph database storage mode is selected to store the knowledge graph of Yijing. Because Neo4j graph database storage is intuitive, visual, clear-cut, high-performance, practical and lightweight, it is also the Neo4j commonly used graph database at present. [21] Using Neo4j model the graphic data of Yijing domain knowledge, you can write all triple knowledge in one step, especially use excle file for batch import.

3. Visualization and retrieval of knowledge graph of Yijing

After the previous work, we have established a knowledge graph of Yijing based on Neo4j graphic database, and can display the concepts, terms, attributes, attribute characteristics and relationships of Yijing in a structured form or a visual way, including the target nodes and its related entity nodes, as well as the total number of related nodes and relationships. At present, the knowledge graph of Yijing contains 1123 semantic entities (nodes) and 54996 relationships (edges), in which each node has a unique ID value to avoid node conflicts. The layout design of node position is based on knowledge calculation of node and edge paths, using graphic algorithm.

3.1. Visual atlas of entity relationship of single concept

In the Neo4j software, running the MATCH and RETURN command statements allows querying the knowledge graph database of Yijing for nodes (entities) named “wx”, displaying 5 nodes and 10 relationships (edges) (Figure 5). By querying the relationship between the 12 earthly branches (“dzgx”) and the five heavenly stems (also known as the five elements) (see Figure 6), it is possible to retrieve 17 nodes (entities) and 17 relationships (edges).

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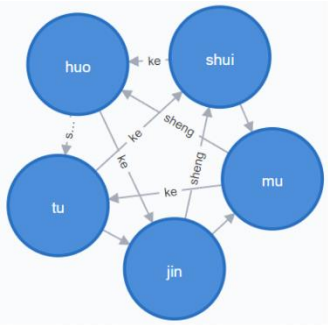

Figure 5 Knowledge Graph between generation Branching and inhibition of the five elements

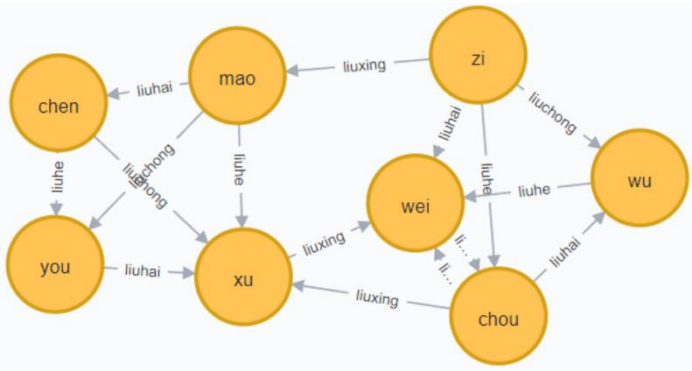

Figure 6 Knowledge Graph of Earthly

3.2. Visual retrieval of multiple conceptual entity relationships

The knowledge graph database of Yijing, built on Neo4j, enables not only querying individual concepts, entities, and relationships but also exploring the comprehensive relationships between different concepts and entities. It can also generate relationship graphs between selected concepts and entities. For example, when querying the graph named "dztg" (relationship between earthly branches and heavenly stems), it displays 17 nodes (entities) and 55 relationships (edges) (refer to Figure 7).

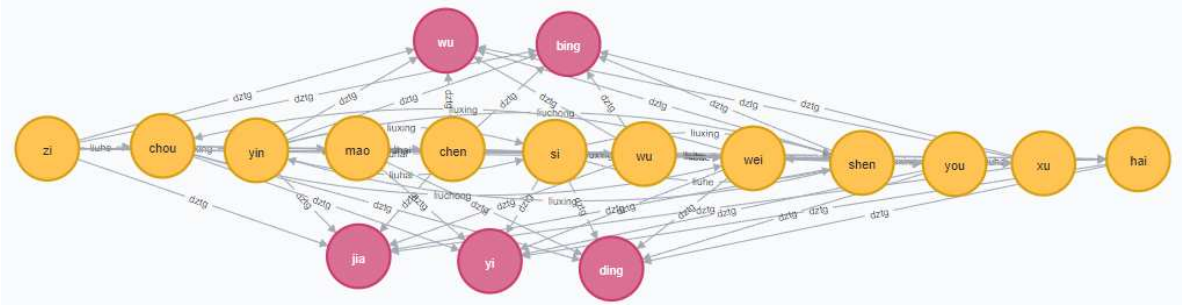

Figure 7. Query on the relationship between heavenly stems and earthly branches. Note: What is shown here is the relationship between 12 earthly branches and 5 heavenly stems.

3.3. Visual retrieval of knowledge graph of lines(yao) in hexagrams

In the practice of divination using the 64 hexagrams in Yijing, diviners typically rely on their knowledge and experience to select key information for comprehensive judgment and analysis, leading to the divination results. With the aid of the knowledge graph, all the information pertaining to a divination can be visually displayed. By incorporating additional factors such as personal experience and other auxiliary means, the divination can be conducted in a more thorough manner. Figure 8 depicts a diagram showcasing individual hexagrams and their relationships with other hexagrams, involving 38 relationships. Furthermore, Figure 9 illustrates the intricate web of relationships between hexagrams, encompassing relationships between individual hexagrams, groups of hexagrams, and complex interconnections among the 64 hexagrams in Yijing.

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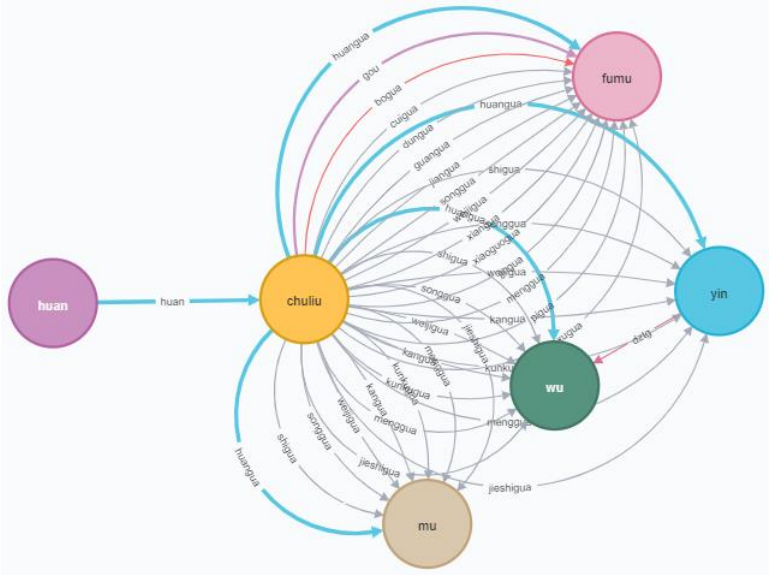

Figure 8. The relationship knowledge graph of the first line(chuliu yao) of Huangua. Note: the nodes are mainly Huangua, the first line(chuliu yao), the wood of five elements, the wu of earth branches, Yin, parents; There are 38 relationships.

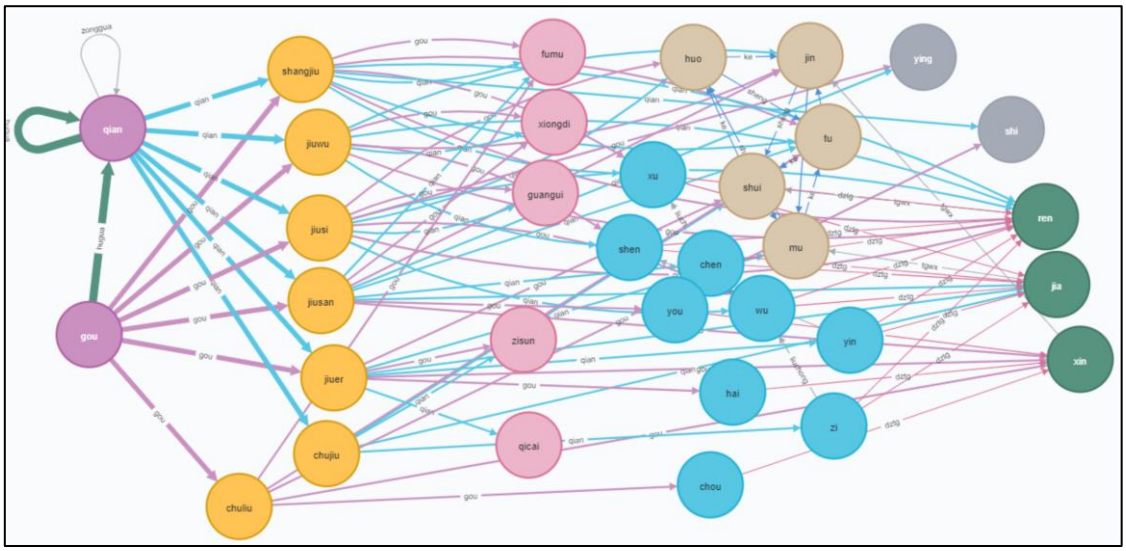

Figure 9. Hexagram group relationship query. Note: The term " hexagram(gua) groups" primarily refers to the main hexagram, the wrong hexagram, the composite hexagram, and the mutual hexagram. The relationships within hexagram groups encompass connections between the five elements, heavenly stems, earthly branches, and the six relatives.

4. Applications of Yijing knowledge graph

4.1. The correlation and guidance of Yijing 64 hexagrams knowledge

Knowledge association is one of the basic elements of knowledge network, and it is also the basis of knowledge management activities such as knowledge guidance, knowledge retrieval and knowledge reasoning. Knowledge guidance is heuristic exploration learning or imitation learning based on knowledge association, and it is also the premise of knowledge reasoning. When these two things are combined with knowledge graph, we can not only make full use of the advantages of knowledge graph, but also provide more thinking directions for scholars to do more in-depth research in their own disciplines. Figure 9 is a diagram of the relationship between hexagrams and

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the five elements, as well as the knowledge of position and diction. From this picture, we can intuitively carry out the knowledge association and knowledge guidance of hexagrams, five elements, lines(yao), hexagrams, and so on.

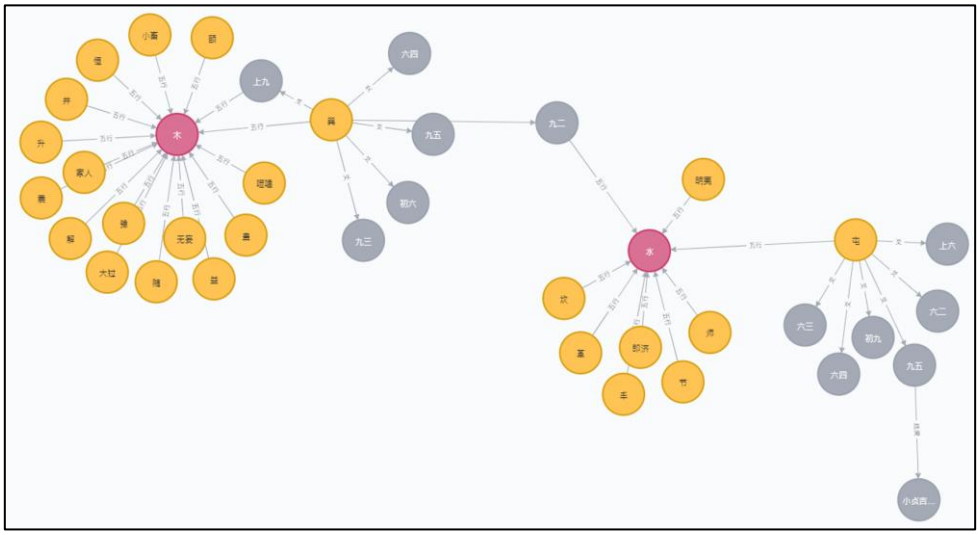

Figure 10. Knowledge association between hexagrams and five elements, position and diction. Notes: (1) This paper designs two versions in Chinese and English, which is the knowledge graph of Chinese version;(2) The jiuer line(yao) is connected with the zhungua through water(shui) of five elements;(3) The connection between the xungua and the other 15 hexagrams through the jiuwu line(yao) wood(mu) of five elements.

4.2. Knowledge Reasoning

Knowledge reasoning includes clue mining and relational reasoning. Clue mining is the contact mining of unrelated entities or concepts. Relational reasoning is to infer the potential relationship and the underlying mechanism according to the relationship between existing entities.[22]For example, the top-down complex relationship mentioned in Yijing cannot be fully related only t hrough the knowledge processing of the human brain. By using knowledge graph, complex relationships can be expressed visually, and then the mechanism of 64 hexagrams in Yijing can be inferred. Figure 11 shows the complex relationships between six hexagrams and five elements, heavenly stems, earthly branches and other hexagrams, which involve 21 entities and 477 relationships. The knowledge graph designed in this paper only constructs the map of the conceptual entities related to the 64 hexagrams in Yijing, and the reasoning about the basic KG of the 64 hexagrams and more hexagrams and rhetoric based on this paper needs further in-depth discussion. Because, the construction of the knowledge graph of Yijing and the good or bad grades of hexagrams need the support of more complex construction techniques.

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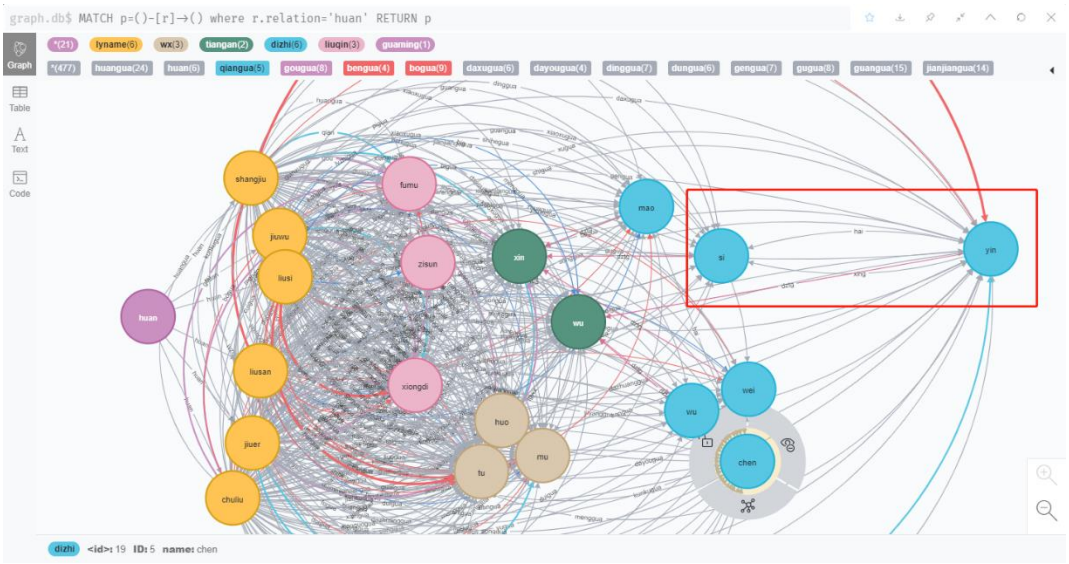

Figure 11. The complex relationship between six lines and five elements, heavenly stems, earthly branches and other hexagrams.

5. Conclusion and prospect

Today, the Yi-ology has made many research achievements in four aspects: classic restoration, philosophical interpretation, the history of Yi-ology and scientific Yi-ology, and the research depth and breadth far exceed the previous studies of Yi-ology. However, with the change of the times and the development of academic culture, the problems in the study of Yi-ology are becoming increasingly prominent, such as the lack of macro vision, the lack of new methods to break through the status quo, the lack of concern close to reality and the lack of substantive academic interaction, which need to be considered and solved by today's Yi-ology researchers. Therefore, in the future study of Yi-ology, it is a new trend and goal to enrich and summarize the existing research results of Yi-ology, open up new fields of Yi-ology, start from the original book of Yi-ology, focus on the present reality, and establish a new system of Yi-ology through the mutual learning of Chinese and Western philosophy and culture with a global vision, so that Yi-ology can truly go global and participate in the world dialogue. [23],3]

Since the evolution of Yijing, scholars in the East and the West have basically reached a consensus that the core idea of Yijing is "change". It emphasizes that changes are inevitable in a certain time and space background and need to be actively dealt with. The divination prediction in Yijing is to guide people to walk out of a suitable road, seek advantages and avoid disadvantages, and make people's lives smoother. When encountering problems or challenges, you can use Yijing for prediction and decision-making reference, so as to take the most appropriate action. This may be the common wish of all researchers. It is the key to apply computer technology to social analysis and prediction to describe social problems with quantitative methods of natural science. [24]This paper introduces the technical method and process of constructing the knowledge graph of Yijing, and compiles the knowledge logic framework of Yijing. Knowledge representation is based on Mindmanager, using the structure of "entity-relationship-entity", designed the triple frame of Yijing knowledge, and realized visualization on Neo4j graphic data software. The construction process of the knowledge graph of Yijing proposed in this paper can be extended to other types of ancient classics research.

Open source software and shared knowledge architecture are the key factors to promote future knowledge discovery and knowledge service. In order to improve the expansibility and general applicability of the knowledge graph in this field, the knowledge graph of Yijing constructed in this paper needs to be further studied. In terms of knowledge extraction, this paper mainly uses the basic framework based on the divination principle of Yijing to construct triples, and does not deeply involve the related words (such as hexagrams , lines(yao), etc.). In view of the knowledge collection

and knowledge extraction related to Yijing, ChatGPT will be considered as an aid in the future. Because ChatGPT plays an extremely important role in the construction of knowledge graphs in other fields, it can help developers to build knowledge graphs more quickly and accurately. [25,26,27] In terms of methods, this paper mainly adopts the top-down knowledge graph construction method, and still needs to explore the combination of bottom-up and top-down, especially the knowledge reasoning based on deep learning, and then put forward some new discoveries, such as philosophical mathematics and [28,29] yin and yang five elements mathematics, etc. [30]

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