Information aggregation of Qin Huai coloured-lanterns

Nannan Li¹, Zhangping Lu² and Mingzhu Li³
¹Department of Industrial Design, Jiangsu University, Zhenjiang, 212013, China
763106949@qq.com

Abstract. The scattered information concerning Qin Huai coloured-lanterns was integrated from literature resources through information digging, organization and association. Firstly, the topic types about Qin Huai coloured-lanterns from literature resources were clarified on the software Cite Space and through card sorting. Then associations and semantic relation networks were constructed together with the semantic relations among topics. A literature resource information base on Qin Huai coloured-lanterns was established with the help of Ontopia topic maps. This study offers some convenient research methods for coloured-lantern researches and fans, improves the utilization rate of coloured-lantern resources, and promotes the transmission and sharing of coloured-lantern information. Finally, the usability of coloured-lantern information base was confirmed by designing a case study. The research methods and flowchart used here can be adopted by researchers from other fields.

1. Introduction
Qin Huai coloured-lanterns as a state-level intangible culture of China, integrates both practical and aesthetic art values and reflects the thinking ways and ideology of people living near Qin Huai River, China. Qin Huai coloured-lanterns have developed into a cultural symbolization and through appropriate use, these cultural connotations can significantly guide the living behaviors and works creation for modern people. After long-term baptism, Qin Huai coloured-lanterns have accumulated diverse resources, but like other intangible cultural heritages, coloured-lantern resources are under the scattered state as an information island without any association [1], leading to the inaccurate user information positioning and the low resource utilization rate. Thus, the scattered resources should be aggregated, so as to connect all information points through simple associated relations, forming a Qin Huai coloured-lantern information resource network, which will improve the utilization rate of coloured-lantern resources and promote the transmission of coloured-lantern cultures. In this study, the literature resources of Qin Huai coloured-lanterns were dug, organized and associated, and a coloured-lantern information base based on Ontopia topic maps as the information organization method was built.

2. Relevant research
2.1. Qin Huai coloured-lanterns projects
Qin Huai coloured lanterns also called ”Jin Ling coloured lanterns”, ”Nanjing coloured lanterns” or ”Qin Huai festive lanterns” (short for festive lanterns) originated from the Six Dynasties and were honored as ”Qin Huai coloured lanterns are the best in the world” in Ming Dynasty. Qin Huai coloured lanterns are traditional coloured lanterns manufacture customs inherited along Qin Huai River and were included as the first batch of state-level intangible cultural heritages expanded projects --
traditional arts (folk arts) of China in 2008. Coloured lanterns integrate calligraphy, paper-cutting, coloured drawing and carving and possess profound cultural connotations. The various forms related with coloured-lanterns, including the making, put-up, watching, playing and enjoying of lanterns, are ubiquitous in life at specific periods and influence the ideology of the folks. The civilian coloured-lanterns are the ornamental products or decorations for physical and mental enjoyment and are the sustenance of yearning for living and working in peace and contentment at certain ages. Furthermore, Qin Huai coloured-lanterns to some extent reflect the social life, customs and cultures of Nanjing at different periods. During the long-term development, the cultural genes and innovations hidden in coloured-lanterns have gradually become cultural inspirits. Thus, Qin Huai coloured-lanterns are of significant values for us to study the humanistics and history of Nanjing.

However, the intensification of international cultural and economic competition and the expanding of modern industrial civilization have limited the development of festive lanterns. Thus, scholars and researchers from all walks of life are exploring the route of coloured-lantern development, and the information resources and the utilization of festive lanterns become increasingly diverse. So far, festive lantern resources are widely distributed in books, monographs, poetry, essays, newspapers, journals and news reports. The books include Nanjing Intangible Cultural Heritage: Qin Huai Lantern Festival by Zhou Anqing (2012), China Coloured Lanterns by Yan Dongdong (2013), and Nanjing Traditional Manual Arts by Sun Yiyi and Gao Anning. Poetry frequently mentions lantern raising and scenes on Lantern Festivals, such as Art and Literature Collections --80 Fires, Poetic Essay of Lanterns, and the popular works Romance of the Three Kingdoms and Water Margins. Newspapers include China Youth Daily, Nanjing Daily, and Yangtse Evening Post. The news websites include xinhuanet.com, Sohu.com, people.com.cn, sina.com.cn, cottv.com, js.ifeng.com, NetEase News, and qq.com. Traditional operas include Put up Dragon Lanterns and Nine Lotus Lanterns from Qu Opera, and Qin Huai festive lantern riddles, Qin Huai festive lantern ballads, and Qin Huai eight exclusive skills from Gathering of Heroes.

The current situations concerning the research and application of Qin Huai coloured-lanterns were analyzed from literature resources. Sun Lili from Zhejiang University analyzed in detail the theme selection, contents and nature of Qin Huai lantern festivals by utilizing four newspapers including Contemporary Express, Xinhua Daily, Wanjia Evening News, and People's Daily, and summarized the mutual compliance between the media representation and cultural identity of Qin Huai lantern festivals [2]. Jiang Meiling from Nanjing University of the Arts analyzed the coloured-lantern crafts, design elements and artistic values, found the integrating point between traditional coloured-lanterns and modern lamps/lanterns and thereby redesigned Qin Huai coloured-lanterns [3]. Wang Juan from Jiangnan University comprehensively considered the idea sources, crafts, visual elements and other factors of Qin Huai coloured-lanterns and proposed new inheritance and developing methods for the theoretical innovation, design innovation, industrialization and branding [4]. Zhang Qin interviewed Gu Yeliang, a famous artist of Nanjing lantern-making, and introduced the details of coloured-lantern making and the current situations of coloured-lanterns [5]. Mu Yijun and Huang Tao collected and organized the materials of Qin Huai festive lanterns and through an animated interactive design, displayed the lantern festival scenes at critical periods during the development of Qin Huai lantern festivals and built VR/AR/MR virtual experience exhibitions in the animation to reproduce the coloured-lantern making process of craftsmen [6].

So far, much progress has been made in research on Qin Huai coloured-lanterns, but the affluent types of coloured-lantern resources are like isolated information islands without association. Researchers often have to consume huge time and labor to collect the resources of certain targets. Furthermore, the utilization rate of coloured-lantern resources cannot be maximized.

2.2. Literature information organization of Qin Huai coloured-lanterns with the help of topic maps

Topic maps are an information resource management technique originating in 1995, and mainly consist of three basic elements of TAO (namely Topics, Associations and Occurrence), which constitute the information network. Topic maps present information in the form of structures and are
capable of information positioning and information connection. Topic maps are outstanding in information resource organization: (1) the massive and scattered information is gathered in an orderly way, which enhances the utilization rate of information resources; (2) information resources are logically linked by associations, which enhances the efficiency of information retrieval by users; (3) users search the matched information and acquire other associated information and concepts [7].

Research on topic maps in China focuses on two aspects: theoretical research on topic maps at the technical level (field of information management and computer application), and application research of topic maps in information management (in field of books information and archives management). Gui Sisi and Cheng Xiufeng introduced the XTM standards and XTM codes of XML grammar topic maps [8]. Liu Qian elaborated the interoperation between XML Topic Maps (XTM topic maps) and other information organization systems and proposed and validated the XTM-based interoperation models [9]. Li Qingmao et al. validated the accuracy and comprehensiveness of ontology information retrieval models of topic maps in the field of tourism [10]. Zhang Yunzhong et al. used topic maps into digital archives annotation systems [11]. Wang Meng built intangible cultural heritage topic map models and plotted topic maps in the case of Beijing Opera and Kunqu Opera. Shi Yi and Xiong Huixiang used topic maps into Huangmei Opera information organization [12, 13]. Li Qingmao et al. validated the feasibility of topic maps into tourism resources with Prefecture of Aba, Sichuan as example [14]. Li Qin explored the application of topic maps into information organization in the field of traditional Chinese medicine with the example of Treatise on Fevers. Moreover, topic maps have also been used to establish corporate and urban portal websites.

In this study targeting at coloured-lantern literature resources, the topic types of coloured-lantern were determined through information digging, a coloured-lantern literature information network was built according to the semantic relations among topics, and a Qin Huai coloured-lantern literature information base was constructed by using Ontopia topic maps.

3. Construction of Qin Huai coloured-lantern literature information base

3.1. Topic type analysis

3.1.1. Keyword classification .The topics were mainly classified by resources. Any things with the same property can be considered as one topic, such as concepts, characters and objectives, but the determination of topics should be comprehensive and accurate. Generally, a hierarchical method is used to first set the first-level topics and then the sub-topics or concrete contents. Shi Yi determined the archives resource topics of Huangmei Opera by referring to the professional terms, literature keywords and network resource theme words in the existing vocabularies of Huangmei Opera, but did not present any detailed introduction of steps [13]. Based on the thoughts of faceted classification by the Indian library scientist Ranganathan, Li Qingmao determined the topics of tourism culture information resources in Aba [14]. We think this qualitative method is still limited by subjectivity. In this study, we determined the topics by using a structured method involving 3 steps: (1) use Cite Space to extract the keywords from the literature; (2) analyze the keywords through card clustering; (3) extract and determine the types of topics according to the card sorting results.

The articles on Qin Huai coloured-lanterns from CNKI were imported into Cite Space for keyword exploration, which returned 80 keywords. These keywords were ranked by the occurring frequency from high to low (Table 1). Keywords are the frequently-occurring words and core contents of an article. The results of keywords from Cite Space are comprehensive and clear. Comprehensiveness means the literature of coloured-lanterns is comprehensively analyzed to involve all possible concepts in the literature resources. Clearness means the semantics of keywords are definite and have no different meanings.
Card sorting is an effective and agile method that helps us to understand how to organize information and how to understand and describe different types of information and thereby to acquire inspirations and more effectively classify information into the first-, second- and third-level guidance types [15]. The keywords were classified via open card sorting. Firstly, the serial numbers and keywords were matched and made into 80 cards. Then 15 users (including 4 inheritors, 6 festive lantern researchers, 5 festive lanterns fans) were asked to sort the cards according to their personal information. The classifications of all users were recorded and imported into EZSort. Then tree-like plots by Complete, Single and Average were drawn, and through discussion with the users, the tree-like plot of the Complete algorithm was selected as the final basis for keyword classification (Figure 1).
Figure 1. Tree-like plot of Qin Huai coloured-lantern keyword clusters.

The inheritors, researchers and fans of festive lanterns were all experienced users, which ensured the reliability of the classifications. On the Qin Huai coloured-lantern clustering tree-like plot, the boundaries of first-level (1), second-level (0.7) and third-level (0.3) information separated the
keywords into 7, 9 and 18 groups, respectively. The 46 articles were analyzed by paragraphs with "article" as the unit, and the 9-group keyword classification was selected as the 9 types of topics. According to our preliminary investigation and the paragraphs of the literature, we selected 7 types of topics, including “05 Qin Huai lantern festivals”, “02 folk handicrafts”, “29 artistic values”, “37 inheritance and development”, “13 inheritors”, “01 Qin Huai coloured-lanterns” and “77 way of impart”. Moreover, the keywords including Confucius Temple, Qin Huai River, Nanjing Confucius Temple Qin Huai scene belt, and Confucius Temple Qin Huai scene belt were summarized as "origin and development", while keyword development advantage was summarized as "current situations".

3.1.2. Determination of topics
(1) Topic of "Qin Huai lantern festivals" Qin Huai lantern festivals are folk and custom activities with Qin Huai festive lanterns as the carrier. The keywords traditional festivals, Lantern Festival, and flaming are all associated with Qin Huai lantern festivals. The prevailing annual lantern festivals have gradually enlarged the diversity and scale of festive lanterns. From 2013 to 2018, the lantern festivals facilitated users to understand the categories and development of coloured lanterns at different periods.

(2) Topic of "folk handicrafts" The manufacture crafts are the core of Qin Huai coloured-lanterns. After baptism by ages, the materials of festive lanterns have slightly changed, but the lantern-making crafts are unchanged. After visiting festive lantern craftsmen and by reviewing literature, we summarized the lantern-making crafts into conceiving, frame preparing, dyeing, petal making, papering, and decorating. This topic offers users the steps of coloured lantern manufacture and incisively and vividly reflects the craftsman spirits of coloured-lantern handicraftsmen.

(3) Topic of "artistic values" Coloured-lanterns as the state-level intangible cultural heritage are known as "the best in the world" and can be used into festival decoration, entertainment, sacrifices to gods or ancestors, or daily use. The artistic values of coloured-lanterns are summarized as congratulation, praying and blessing, which offer users the way of macroscopic cognition of coloured-lanterns.

(4) Topic of "inheritance and development" Researchers have explored the developing ways of festive lanterns from different perspectives. The keywords of industrialization include industry chains, industry patterns and economic benefits, and the concrete ways of digitized protection are medium transmission, medium online and virtual reality. The keywords of festive lanterns inheritance from the design perspective include design arts, decoration arts and service design. Thus, the topic of inheritance and development is a summarization of coloured-lantern protection measures and development ways. This topic harbors 4 sub-topics, including industrialization, digitized protection, redesign, and others (including talent cultivation, brand establishment, school-based lessons). The aggregation of different inheritance methods is critical in understanding the developing direction of Qin Huai coloured-lanterns.

(5) Topic of "inheritors". Inheritors are indispensable roles in intangible cultural heritages. The keywords associated with inheritors include craft art masters, and old and well-known lantern-making families. Different factions have been formed during the development of coloured-lanterns. The topic of "inheritors" involves 9 sub-topics or factions, including Li faction, Cheng faction, Yin faction, Lu faction, Wang faction, Cao faction, Ke faction, Chen (Nanjing) faction and Chen (Jurong) faction. This topic offers users a convenient entrance to rapidly know the information of inheritors.

(6) Topic of "way of impart". Different styles or factions of coloured-lanterns have been formed during the development of "inheritance in old and well-known families". The way of inheritance differs slightly among different factions. Due to historical reasons, personal reasons of inheritors and other reasons, the limitations of "only imparting to males" or "only imparting within the family" have been gradually broken down during the inheritance process. The paragraphs concerning the way of coloured-lantern inheritance were grouped into the topic of "way of impart", so that users, from the way of impart, can discover the problems faced during the development of coloured-lanterns and indirectly understand the situations of coloured-lantern inheritors.
(7) Topic of "Qin Huai coloured-lanterns" Qin Huai coloured-lanterns developed from the Western Han Dynasty more than 1800 years ago and have accumulated different themes, ranging from small- and medium-sized lanterns for entertainment to large lanterns for decoration, with unique shapes and novel styles. The keyword "intangible cultural heritage lotus lanterns" reflects a classic type of festive lanterns. The paragraphs related to festive lanterns in the literature were summarized as the topic of "Qin Huai coloured-lanterns", which facilitate users to search for concrete works of coloured-lanterns.

(8) Topic of "origin and development" There are different views about the origin of coloured-lanterns. After prosperity and depression, coloured-lanterns have developed into the representative cultures in Qin Huai River areas. The keywords Confucius Temple, Qin Huai River, and Nanjing Confucius Temple Qin Huai scene belt correspond to the paragraphs describing the origin and development of coloured-lanterns in the literature and thus are summarized into the topic of "origin and development".

(9) Topic of "current situations". The keyword "development advantage" summarizes the advantageous conditions of coloured-lanterns, and accordingly, there must have been difficult times during the development of coloured-lanterns. The topic "current situations" is set with two sub-topics of advantages and problems, which correspond to the paragraphs elaborating the current situations of coloured-lanterns.

3.2. Topic association analysis

Association analysis is to connect the independent topics according to the relations among topics, forming a information network with a definite framework system. The same topic may have different associations, such as the association between "Qin Huai coloured-lanterns" and "folk handicrafts" is "coloured-lantern/folk handicrafts", belonging to the association of phenomenon expressions, and the association between "Qin Huai coloured-lanterns" and "Qin Huai lantern festivals" is "inclusion/membership". To establish an efficient information network, we independently determined the types of associations according to the connotations of topics and the semantic relations between topics. As shown on the Qin Huai coloured-lanterns between-topic relation model in Figure 2, the dots represent different topics, where the large and small dots indicate the first-level and second-level topics respectively; the lines between topics indicate the between-topic relations. Seven types of associations were set according to the coloured-lantern between-topic relation model, including "coloured-lantern/folk handicrafts" association, "coloured-lantern/artistic value" association, "deciding" association, "creating" association, "including/affiliating" association, "master and apprentice" association, and "faction/way of impart" association.

![Figure 2. Between-topic relation model of Qin Huai coloured-lanterns.](image-url)

The "coloured-lantern/folk handicrafts" association and the "coloured-lantern/artistic value" association imply the crafts and artistic values of coloured-lantern works. For instance, the process flow of coloured-lantern works in Chinese Folk Coloured Lanterns is conceiving, frame preparing,
dyeing, petal making, papering, and decorating, which convey the meaning of blessing. The "faction/way of impart" association shows the way of impart from inheritors. These three associations all belong to the type of phenomenon expression, but are analyzed separately here in order to clearly show the between-topic relations. The "deciding" association: topic (8) "origin and development" decides topic (7) "artistic values" to some extent, while topic (9) "current situations" decides topic (4) "inheritance and development". For instance, the view that coloured-lanterns originated from Taoism decides the meaning of praying for peace and health conveyed by coloured-lanterns. The "creating" association: topic (5) "inheritors" and topic (2) "Qin Huai coloured-lanterns" are under a relation of creation. For instance, Chen Bohua created the curled-up dragons, while Chen Youchang made lotus lanterns. The "including/affiliating" association: the affiliating relation is found under the same topic. For instance, topic (4) "inheritance and development" includes industrialization, digitized protection, redesign and other concrete ways of protection, while topic (5) Cao faction involves Cao Tingfa, Cao Zhengzhong, Cao Zhenrong and other inheritors. The "master and apprentice" association: In topic (5) "inheritors", some inheritors are masters and apprentices.

4. Construction of Qin Huai coloured-lantern literature information base

A coloured-lantern information base was constructed by using Otopia topic maps. Firstly, topic maps were compiled with the Ontopoly on Otopia. Then the topic maps were visualized on Vizigator. Finally, the target resources were reviewed and read on Omnigator.

4.1. Plotting coloured-lantern literature information topic maps

The editor Ontopoly on Otopia topic maps consists of four modules, including Description, Admin, Ontology, and Instance. Firstly, the topic maps of Qin Huai coloured-lanterns were described as a whole on Description, and the content of Admin was set as "whole topic maps", which were outputted and locally stored in the form of XTM1.0. Ontology, as the core of the topic map ontology compilation, consists of 5 parts, including definition of topic types, resource types, association types, role types, and name types. The 9 topics of Qin Huai coloured-lanterns and the corresponding sub-topics and 7 associations were imported into the topic types (Figure 3) and association types. After two resource types (texts and pictures) and corresponding role types were selected, the concrete instances of the corresponding topics were compiled on Instance. Figure 4 shows the instances from the topic "inheritors" -- Ke faction inheritors.

Figure 3. Qin Huai coloured-lanterns literature information topic types.

Figure 4. Qin Huai coloured-lanterns literature information with Ke faction as example.
4.2. visualization of coloured-lantern literature information topic maps

The Vizigator of topic maps consists of three inter-associated parts, including VizDesktop, VizLet and VizPlugin, which differ slightly in terms of functions. Here VizDesktop was used for visualization [16]. Visualization uncovers the associations between topic maps. Based on the between-topic relations, the topics can be presented in an affluent semantic relationship network. For simplification, Figure 5 only displays the semantic relation network of inheritors - Lu faction - Lu Youchang - lotus lanterns - Qin Huai coloured-lanterns. Clearly, the inheritors include Ke, Li and Lu factions, while the Lu faction involves Lu Youchang and Lu Min. Lu Youchang has created lotus lanterns and Chinese Folk Coloured Lanterns, which both belong to the representatives of Qin Huai coloured-lanterns. Users can select the topics of interest to trace relevant information. Figure 6 shows the visualized topic "Qin Huai coloured-lanterns". Due to the diversity of topics and the complex semantic relations and in order to prevent users from being lost in the huge relation network, VizDesktop offers a searching function, which ceaselessly shines the topic as-sought and thereby largely facilitates users to localize the target resources.
4.3. Reviewing coloured-lantern literature information topic maps

The Omnigator of topic maps can be used to review the details of a specific topic and facilitates text visualization. After a user selects the target information, he/she can directly read the internal resources on Omnigator or linking to external resources. With Qin Huai coloured-lanterns as example (Figure 7), the left side shows other information related to the topic "Qin Huai coloured-lanterns", such as the crafts and artistic values of coloured-lantern works, the year of being displayed, the inheritor of this work, which all help to expand the information of users. The right side shows the description of the topic and all the coloured-lantern works. For instance, users who are interested in Chinese Folk Coloured Lanterns can click and connect to Figure 8. On the browse interface of Chinese Folk Coloured Lanterns, users can see all resources related to this work. The left side shows the manufacture crafts, artistic values and creator of this work, while the right side shows all the texts and pictures in Chinese Folk Coloured Lanterns. In this study, the sources of texts are also noted, which help users to trace the corresponding resources.

Figure 6. Visualized map of the topic Qin Huai coloured-lanterns.
Figure 7. Browsing resources related to the topic Qin Huai coloured-lanterns on Omnigator.

Figure 8. Browsing the information of Chinese Folk Coloured Lanterns on Omnigator.

5. Application of the Qin Huai coloured-lanterns information base

The coloured-lantern literature information base is manifested in the form of topic maps, so that users can search the target information on Vizigator in a visualized way. When browsing any details on Omnigator, the users will not find information in a blind way thanks to the coloured-lantern literature information resource base.

On the coloured-lantern information base, users can search the representative works of inheritors Lu Bohua and Lu Youchang through the topic "inheritors", and can be familiar with the crafts and feel the cultural connotations by reviewing the texts. Through picture screening and on-site investigation, we selected 35 middle- and small-sized coloured-lanterns and based on the topic of folk handicrafts, created an intelligent leisure game "coloured-lantern collection Qin Huai festive lanterns making crafts" (Figure 9a), where figure a is the home page of the game.

From the "current situations" of Qin Huai coloured-lanterns, users can know that there are large-size and small-size coloured-lanterns. The large-size coloured-lanterns are mainly customized for merchants and governments as ceremonial decorations, while small- and middle-size coloured-lanterns are created for children on holidays. The target of this game is a typical user group of festive lanterns - children. Totally three levels are set, including easy, neutral and difficult (Figure 9b). The contents of the game are determined from two semantic relation networks of "inheritor - Chen Bohua -
representative works - folk handicrafts (artistic values)” and “inheritor - Lu Youchang - representative works - folk handicrafts (artistic values)”. Figure 9c and d shows the easy-level papering craft interfaces of coloured-lanterns and rabbit lantern respectively.

Figure 9. Design of game coloured-lantern collection Qin Huai festive lanterns making crafts.

The coloured-lantern information base can be applied in diverse ways. The game coloured-lantern collection Qin Huai festive lanterns making crafts, starting from inheritors, has innovated the making craft form of representative works from the inheritors. Moreover, specific festive lanterns can also be innovatively studied. With the representative lotus lanterns as example, researchers used to download papers one-by-one and read all the texts. Now, they can extract relevant contents of lotus lanterns and search for all pictures of lotus lanterns before theoretical innovation or design innovation. Through the associations of coloured-lantern literature information and the creation of coloured-lantern literature information base, researchers can directly search the topic maps, localize at lotus lanterns, read all texts about lotus lanterns on Omnigator, and browse all pictures of diverse lotus lanterns as well as relevant information, including the morals and crafts of lotus lanterns. Thereby, researchers can more comprehensively understand lotus lanterns before making one, which improves the work efficiency.

A coloured-lantern literature information base based on topic maps was constructed and stored in the computer system in a digitized form. In the future, we will design the auxiliary “coloured-lantern resource dictionary of the coloured-lantern information base, which will allow users to research information anywhere and anytime. The coloured-lantern resource dictionary will solve the cognition problems faced by special populations when using the emerging themed resource bases.

6. Conclusions

The Qin Huai coloured-lanterns are diverse in both types and forms, which complicate the organization and modeling of huge resources. Thus, in this study, the resources of coloured-lantern projects were first analyzed and then based on literature resources, the literature information was excavated, organized and associated. Then Ontopoly topic maps were plotted with the help of Ontopia and thereby a complete coloured-lantern information base was constructed. The topic association maps formed by VizDesktop were visualized and then browsed on the built-in Omnigator. Finally, the usability of the coloured-lantern information base was illustrated with the use of concrete instances. In the future, the Qin Huai coloured-lanterns information base will be improved and enriched through the superimposition or deletion with other types of resources of Qin Huai coloured-lanterns, which will offer convenient methods for subsequent research on Qin Huai coloured-lanterns and promote the
information transmission and sharing of Qin Huai coloured-lanterns. This study offers a new method for the information organization, expression and discovery of Qin Huai coloured-lanterns. The research methods and flowchart used here can be referred to in research from other fields.

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