Formal semantic description standard family for Chinese KOS (Ⅱ): Research and implementation of Classification Scheme Sharing Service System①

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Abstract

In the context of globalization of network information, it is an urgent need to consider networked development and sharing for classification schemes. Since 2000, the international mainstream classification schemes have published their Web versions one after another, while there is still a lack of an integrated, reusable and Semantic-Web-oriented solution for classification schemes and classification-like knowledge organization systems. By using computer programs to automatically analyze the source files of the classification schemes in the MARC or HTML format, this paper adopts CNKOS to produce the semantic description of the classification schemes. On account of this, this paper employs international advanced open-source technologies, takeing the representative domestic CLC as an example, to construct the CLSS prototype system. It is proved that this solution can be put into practical use and can facilitate the quick deployment of other classification-like Chinese knowledge organization systems. The successful implementation of the system verifies the scientificity and practicality of CNKOS, and it plays a demonstrating and promoting role and provides a reusable solution for other domestic classification schemes and classification-like knowledge organization systems. The solution can serve as a reference for similar international knowledge organization systems in realizing their Semantic Web style sharing services.

Keywords

Classification scheme, CNKOS, CLSS, Web service, Linked Data, Automatic classification, *CLC*, KOS

0 Introduction

In the context of globalization of network information, the library community needs to consider the networked development and sharing for classification schemes with an extensive user base, and also focuses on applications of automation and socialization, in order to continuously play an important role in the network information resource organization. The classification scheme

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sharing service aims to provide a solution that meets the requirements of people, machines and applications.

Based on the features and developmental demands of national knowledge organization systems (KOSs), this paper targets at the construction and application practice of classification-like Chinese networked KOS. It mainly introduces the design and implementation method of the Classification Scheme Sharing Service System (CLSS), and provides practical experience for fast realizing the semantic description and networked sharing service of the existing national and international classification schemes by utilizing the system. The CLSS system is a unified support system developed for classification-like Chinese networked KOSs, so the classification schemes, categorization schemes or standard code tables, etc. described in the CNKOS format (J. Wang & Bu, 2012; X. H. Zeng, 2012) can have all functions that the system provides.

The main purposes of this paper lie in that: 1) realizing semantic description of classification scheme in order to meet the requirements of providing knowledge service in the Semantic Web environment; 2) constructing the Web version of classification scheme to promote its networked development and application; 3) providing terminology Web service of classification scheme and making it easy to interoperate between different systems or applications; 4) realizing Linked Data of classification scheme to accelerate the establishment of the Web of data in the library field; 5) and simulating the artificial classification process to realize automatic classification, trying to open experimental automatic or computer-assisted classification service.

1 Classification Scheme Sharing Service System overview

1.1 Classification scheme and semantically described classification scheme

Classification scheme is an important tool for indexing and retrieval of books and documents. As a complete and precise KOS, it plays an irreplaceable role in the library field. Currently, popular classification schemes in the world are *UDC*, *DDC*, *LCC*, etc. With the passage of time, their contents and forms are constantly improving. As a large-scale comprehensive classification scheme, *Chinese Library Classification*, or *CLC* for short, is the most widely used classification system with the greatest impact in current Chinese libraries.

The semantically described classification scheme is built on the basis of classification scheme by introducing ontology theory and technology, and adopting Semantic Web description language. CNKOS (J. Wang & Bu, 2012; X. H. Zeng, 2012) is a semantic description standard developed under the organization of the National Library of China (NLC) for Chinese traditional KOSs (including controlled vocabularies such as thesauri, classification schemes, etc.). It expands CKOS vocabulary based on SKOS, in order to realize

a full description of Chinese KOSs. The standard is a constituent part of the Knowledge Organization Standards of NLC. The construction of the CNKOS ontology of classification scheme offers an effective way for its networked development and application. The vocabularies are shown in Table 1.

Table 1. SKOS and CKOS vocabularies used in CNKOS description of classification scheme①

URI	Definition or explication	URI	Definition or explication
skos:Concept	Concept (Class)	ckos:referenceClassEntry	has reference class entry (Property)
skos:ConceptScheme	Concept Scheme (Class)	ckos:Auxiliary	auxiliary (Class) (i.e. subdivision table)
skos:inScheme	is in scheme (Property)	ckos:topConcept	has top concept (Property) (its rdfs:domain is skos:Concept)
skos:hasTopConcept	has top concept (Property) (its rdfs:domain is skos:ConceptScheme)	ckos:relatedClassNote	related class entry note (Property)
skos:prefLabel	preferred label (Property)	ckos:stopNote	discontinued note (Property)
skos:notation	notation (Property)	ckos:useClassEntry	use class entry (Property)
skos:note	note (Property)	ckos:altClassEntryOf	is the alternative class entry of… (Property)
skos:scopeNote	scope note (Property)	ckos:altClassNote	alternative class entry note (Property)
skos:historyNote	history note (Property)	ckos:classEntryType	class entry type (Property)
skos:related	has related concept (Property)	ckos:classGuideNote	relevant class entry note (Property)
skos:mappingRelation	is in mapping relation with (Property)	ckos:combineNote	subdivision note (Property)
skos:closeMatch	has close match concept (Property)	ckos:combineFrom	with subdivision table (Property)
skos:relatedMatch	has related match concept (Property)	ckos:notationSpan	class number span (Property)
skos:broader	has broader concept (Property)	ckos:notationCommon	common class number (Property)
skos:narrower	has narrower concept (Property)	ckos:notationBegin	start class number (Property)
ckos:nonCloseMatch	has non-close match concept(Property)	ckos:notationEnd	end class number (Property)

① Vocabularies listed in this table are currently used in this project. See more information about semantic description vocabularies for classification-like Chinese KOSs in Wang and Bu (2012).

Our research is based on related research results from the NKOS research office of the Shenzhen University Library and on the Knowledge Organization Standards of NLC. Taking *CLC* v4.0 as an example, we use its data in the CLCMARC format or the HTML format as data source, and convert the source data to CNKOS ontology by computer programs automatically through the corresponding relationship between source data and SKOS/CKOS vocabularies, therefore realizing formal semantic description of *CLC*. The detailed conversion plan will be given in Section 2.2.

1.2 Classification Scheme Sharing Service System

1.2.1 Overseas and Chinese research status

Copyright owners of international mainstream classification schemes have had their Web versions published one after another in the 21st century through their continuous efforts. For example, OCLC, the copyright owner of *DDC*, took the lead in opening the Web version service Web Dewey① in 2000, followed by two other famous international classification schemes *LCC* and *UDC* releasing their Web versions Classification Web② and UDC Online③ successively in 2001. Cao,Yan, and D. B. Wang (2002) provided a comprehensive evaluation and analysis of the earlier Web versions of *DDC*, *LCC* and *UDC* with a detailed comparison of their main functionalities.

In recent years, there have been many research works on constructions of classification schemes' Web versions and even ontology versions of KOSs based on computer network technology in China (X. Q. Huang, 2000; X. C. Liu & Zuo, 2001; Pan, 2009; He & Hou, 2010; Zhang, 2012), all of which have agreed on the trend of networked development for classification schemes. However, there are few practical applications of networked classification schemes, not to mention the provision of mature knowledge services. In order to make up for those deficiencies, and by learning from advanced results and application experience of classification schemes abroad, the National Library of China released the *CLC* v5.0 Web version online in December 2011 (National Library of China [NLC], 2011), the original 6-month beta period of which was extended to September 1st, 2012. L. J. Liu (2012) analyzed the functionalities of *CLC* v5.0 Web version in detail, and proposed her own suggestions and outlook. Compared with the Web versions of *DDC*, *LCC* and *UDC*, the *CLC* Web version does not provide automatic number building service.

The publication of classification scheme Web version is only the first step towards a networked development. Terminology Web service, Linked Data service, automatic classification

① OCLC. Dewey© services. Retrieved February 23, 2014, from http://www. oclc. org/dewey.
② Library of Congress. Classification Web. Retrieved February 26, 2014, from http://classificationweb.net.
③ UDC Consortium. UDC online. Retrieved February 26, 2014, from http://www.udc-hub.com/index.php.

service, etc. are all needed for a broader sharing, and are of significant importance for traditional KOSs to be accessible outside the relatively closed library sector, for the realization of Web service integration and sharing, and for linking information resources inside and outside the library.

The CLSS system, which this paper studies, is a networked sharing platform with the combination of functions, such as classification scheme Web version, Web service, Linked Data service and automatic classification. The solution this paper offers aims at all classification-like Chinese networked KOSs, hoping to serve as a reference and support for related groups and individuals to construct networked applications of various classification-like Chinese KOSs both at home and abroad.

1.2.2 General structure of Classification Scheme Sharing Service System

CLSS firstly converts an existing classification scheme (taking *CLC* v4.0 as an example) to a CNKOS ontology, constructs index by using the Lucene full-text index toolkit, and then realizes networked sharing services through B/S model based on J2EE platform, offering networked sharing services such as classification scheme Web version, terminology Web service, Linked Data, automatic classification, etc. The general structure of the system is shown in Figure 1.

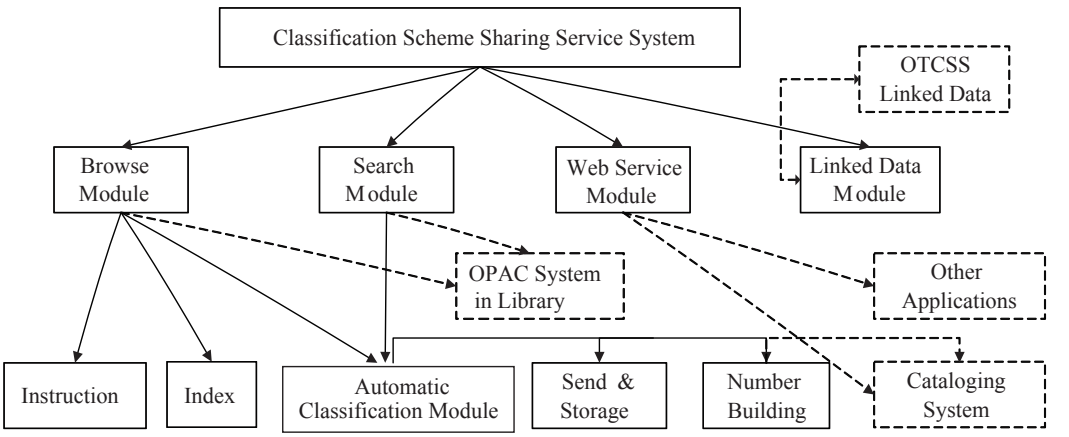

Figure 1. The general structure chart of Classification Scheme Sharing Service System (CLSS).

2 Classification scheme Web version

The so-called classification scheme Web version is the classification scheme version that is browsed, searched, retrieved and even updated on the Web (Cao et al., 2002). Currently, Web versions provided by *DDC*, *LCC*, *UDC* or *CLC* are paid services. Normally, network users can apply for a free trial period. The CLSS solution is oriented to all classification-like Chinese KOSs,

aiming to provide free public service. This paper takes *CLC* v4.0 as an example, and introduces its functionalities.

2.1 Introduction of CLC v4.0 Web version of CLSS

2.1.1 Classification scheme browsing and searching

CLC v4.0 Web version of CLSS covers primary table (taxonomic schedules), specific subdivision tables, and common subdivision tables. It maintains the class entries' static contents and formats in printing, while introducing their Linked Data representations. Representing detailed information of class entries in the form of Linked Data is a highlight of the *CLC* v4.0 Web version, which provides various mapping relations with *Chinese Classified Subject Thesaurus* (hereafter referred to as *CCT*), reflecting the idea of classification-subject integration. In addition, the class numbers in the class entries' notes, reference class numbers and other relevant class numbers, are provided with hyperlinks, and are offered with convenient guidance and operations. They break through the traditional "linear" method of resource organization and accomplish the reticular browse-path and searching route. There are various browsing ways, including displaying the complete classification scheme by means of "browsing" and entering each part of the classification scheme through the index of main classes and auxiliary tables.

In the Web edition, with the simple, intuitive and humanized interface, users can know clearly about the hierarchy of items through browsing. Web version provides diversified approaches for searching, including arbitrary way, class numbers, class names (i.e. headings), and notes. Matching modes include the arbitrary matching, the forward matching, and the exact matching. Search results are listed according to the ordering rules of the system. Besides, Web version provides the mapping from keywords to formal subject term (i.e. descriptor). It can avoid missing to the greatest extent, ensure the precision, and improve the accuracy of classification indexing. User can click the wanted class for more details and the operation buttons (various functions such as opening class numbers or class names for OPAC searching, see Figure 2) in "browsing" and "searching".

2.1.2 Classification indexing

CLC v4.0 Web version in this paper provides indexing service. User can enter keywords in the "searching" to search and get the searching result list, then choose a class directly, or unfold the classification in the "browsing" then choose a class. On the right hand side, it will show details of the class entry and the operation buttons. The default indexing is the chosen class number or built number after subdivision. Upon clicking the "get" button, the class number will be sent automatically and stored.

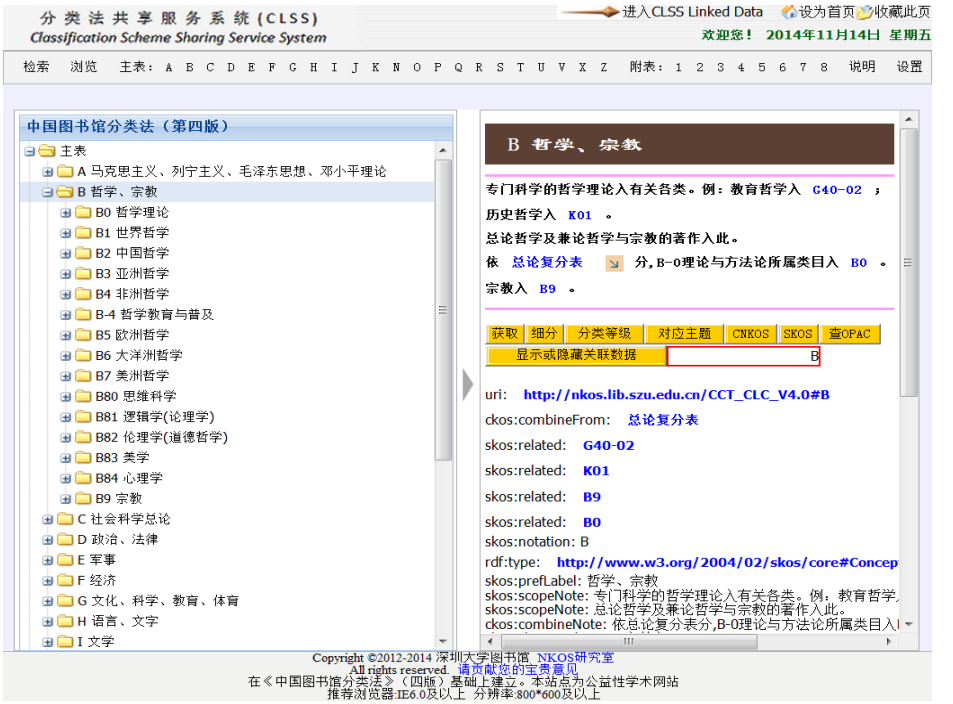

Figure 2. A screenshot of the *CLC* v4.0 Web version of CLSS.

Copying the class number corresponding to the keywords to the clipboard will help avoid cataloguers' input errors and attain classification indexing in a computer cataloging system. Besides, a computer cataloging system can use Terminology Web Service APIs provided by CLSS directly to attain automatic indexing. Under the concrete practice of classification indexing, indexing efficiency can be improved and burdens on cataloguers can be reduced by customizing the data format to the needs of the system. Storing the information about the corresponding relation between keywords and class numbers in the database will make classification indexing more convenient in the future.

2.1.3 Automatic number building service

Automatic number building service means that users can build new class numbers in the system interface. That is, by simulating classifiers and using existing class numbers, it can synthesize a compound number according to instructions in the schedules, so as to express a specific class which is not specifically listed in the schedules. It can improve the descriptive power for dealing with new topics (*Chinese Library Classification* editorial board of National Library of China, 2012). It is a Gordian knot in developing Web version of classification scheme. In terms of class numbers' automatic building, this paper realizes two cases: the subdivision with common subdivision tables, and the subdivision with specific subdivision tables.

Number building service in this paper can automatically calculate the combined class number

with the base number from the schedules and notations from the subdivision tables by computer programs. Taking Table 2 for example, operation steps of number building are shown in Figure 3. Computer programs automatically calculate the accurate combined class numbers according to subdivision regulations. And the same results can be got through invoking Web Service APIs. The Web versions of *DDC*, *LCC* and *UDC* all provide number building functions. At present, the Web version of *CLC* v5.0 of the NLC does not provide the function yet. Compared with the Web versions of international mainstream classification schemes, it started late, but the possibility of providing the functionality of building new class numbers with the existing class numbers for users in the future should not be excluded.

Table 2. The random test data of subdivision operation

Title	Main keywords	Subdivision keywords	Subdivision regulations	Combined class numbers
The Uygur folk arts and crafts	The folk arts and crafts	Uyghur nationality	The folk arts and crafts→TS938. The main table doesn't specify adding subdivisions from Chinese Nationality Table. But when needed to be subdivided with the table, we need to add "2" which is the notation for Chinese nationality in front of "15" which is the notation for Uyghur nationality. The result is "215"	TS938"215"
Anxiety of influence: a theory of poem (America)	Literature in various countries	American poetry	Literature in various countries→I3/7.This book is the comment on American modern poetry, so adding notation from the Global Area Table at first, then subdivide using the specific subdivision table for I3/7. The class number after subdivisions is I712.072. The notation 712 represents America in the Global Area Table and the notation 072 means poetry review in the specific subdivision table for I3/7	I712.072

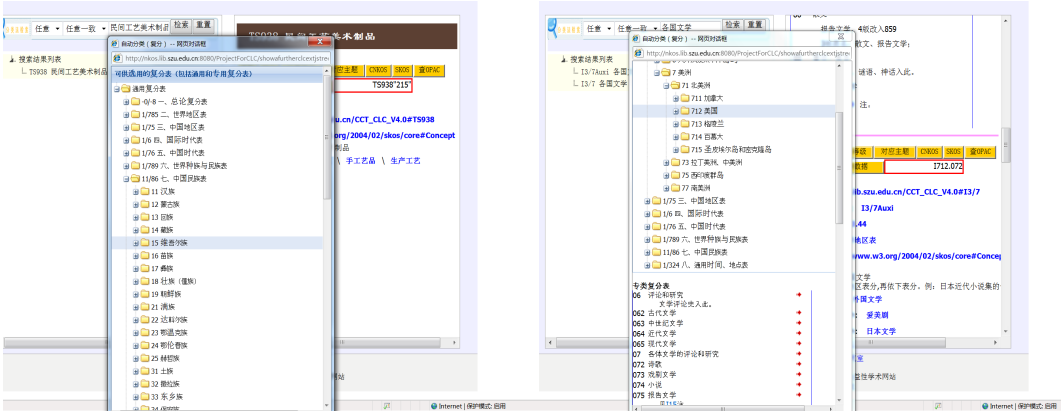

Figure 3. The screenshots about CLSS's number building.

2.2 Implementation of the Web edition of classification scheme

The methods and techniques to implement the Web edition of *CLC* v4.0 in this paper consist of the following aspects.

1) Preparing data source: based on the NKOS Research Office's related research achievements and Knowledge Organization Standards of NLC (X. H. Zeng, 2012; J. Wang & Bu, 2012), the electronic documents in HTML format or CLCMARC format of the *CLC* v4.0 were automatically converted to a RDF ontology file in CNKOS format by computer programs. Taking the data in CLCMARC format as an example, each class entry's MARC record was extracted from the CLCMARC data at first, then the record was translated to a byte array. According to the structure characteristic of MARC data, the Leader and Directory could be obtained in turn. Based on the initial position and length of every field provided by each directory item in the Directory, the information of each field in the data area could be obtained circularly. Then the information of each subfield was extracted through the subfield codes, and all messages should not be missing. Finally, based on the correspondence between CLCMARC format and SKOS or CKOS vocabularies, the CNKOS data of each class and the relationships between them were generated. The source data includes the information of the *CCT* v2.0; therefore the auto-generated CNKOS ontology holds the relationships between *CLC* and *CCT*, which means achieving the classification-subject integration.

The conversion from CLCMARC format to SKOS or CKOS vocabularies requires complex judgment and processing. Taking field 250 as an example, its concrete conversion rules can be found in Table 3. In the process of conversion, the problems that need to take into consideration include URI solutions for the common subdivision tables and specific subdivision tables, the representation and handling of special notations (such as "/", "+", "-"), preventing the loss of semantic information between associated fields, completing relevant semantic data in accordance with the existing information, etc.

2) Data processing: *CLC* ontology file is organized with the attribute-centered RDF triples, then it is indexed to build an indexed triples database by the Lucene full-text search engine, and the concrete implementation methods can be found in X. H. Zeng, H. J. Huang, and Lin (2010). The mapping from keywords to formal subject terms (i.e. descriptors) can be added manually from the Web interface or batch imported by computer programs.

3) The development and experimental environment: all services in this paper use Eclipse and Tomcat development environment, where the taxonomy interface is mainly realized through jsp pages with jstree and ExtJs plugins; the main business functions use a Struts framework and are written with Java, and the system configuration, parameter info and classification indexing data etc. are stored in a MS SQL Server. Later in this paper, Web service and Linked Data service are developed using the Axis SOAP engine and the URL Rewrite plugin respectively.

Table 3. The conversion rules between CLCMARC (field 250) and CNKOS vocabularies

CLCMARC field or subfield	CNKOS vocabularies	Supplementary specification
250 class number	skos:Concept	·$a forms URI identity of the concept.
$d class level	skos:hasTopConcept ($d=01)	·$d's value is "01", which means top concept.
$a the single class number or the beginning number of a number span	skos:notation(when $c exists, converting to ckos:notationCommon or ckos:notationBegin)	If $a is a single class number (i.e. when $c doesn't exist), it will be converted to the value (object) of skos:notation.
$c the end number of a number span	Combine with $a to generate ckos:notationSpan, and remove the same element in the front (If this is an indicative class entry, it should also be converting to ckos:notationEnd)	
$9 the superordinate class number (MARCXML)	skos:broader's skos:notation (it doesn't exist in CLCMARC)	
$h the superordinate class name of the current class number	skos:broader's skos:prefLabel(the last $h)	If there is no superordinate class number $9, only the superordinate class name $h is recorded, the last $h should be the skos:prefLabel of skos:concept of superordinate class. However, the class name is not guaranteed to be unique. We should locate to skos:broader which means the superordinate concept by computer programs.
$k the class name of the outline class number (e.g. an indicative class)	ckos:referenceClassEntry's skos:prefLabel	$k also has above problem.
$j (the class name) corresponding directly with the class number	skos:prefLable	·$j converts to the value of skos:prefLabel.
$z auxiliary table identification fb1 I. General Subdivision Table (similar to Standard Subdivisions in *DDC*) fb2 II. Global Area Table fb3 III. Chinese Area Table fb4 IV. International Era Table fb5 V. Chinese Era Table fb6 VI. World Race and Nationality Table fb7 VII. Chinese Nationality Table fb8 VIII. Universal Time and Location Table	skos:inScheme Note: When $c exists, the description related to ckos:notationSpan is generated in the following way: combining $a with $c to generate ckos:notationSpan. During the combination, add "/" in the middle and remove the main class number before $c which is the same as $a, such as B21/26. When 100$a/11=a (means preferred class), the common element before $a and $c should be converted to: ckos:notationCommon. When 100$a/10=d (means indicative class), $a should be converting to ckos:notationBegin and $c should be converting to ckos:notationEnd.	· The item containing $z is a class entry in a common subdivision table. The name of the auxiliary table (skos:prefLable) and its URI, the sub-class type (such as ckos:GeneralConcept, ckos:LocationConcept, etc.) of the class concepts in the table are predefined by the support system before the transition. The transition generates corresponding skos:inScheme statement, according to the $z value.

4) Except the duplicate checking for classification, all search functions are implemented using the Lucene full-text search toolkit, the specific implementation methods is available in X. H. Zeng et al. (2010).

The *CLC* Web version of CLSS offers the public a free and open sharing service platform, where the interface is simple and intuitive, and the user experience is quite friendly. Comparing with the electronic edition, there is no need for installing any software, and no storage device to carry. Any other Chinese classification scheme can be quickly deployed with this solution.

3 The terminology Web service of classification scheme

The terminology Web service of classification scheme refers to the Web services for browsing, searching and applying classification scheme. The terminology Web service of vocabulary supports machines to access and call to vocabulary via Web Application Program Interface (API), and it's an important approach to using vocabulary in the network environment (Ou & Yu, 2011).

To further offer the machine-oriented terminology Web service of classification scheme, a series of Web Service APIs have been developed to provide flexible services as required. They are used to fulfill the needs of machine, system and application programs. In the future, the APIs of various classification schemes may be intensively provided via the Terminology Service Registration Platform, for users' free selection and call. On the platform, the Web service available classification schemes would be listed, described and indicated, and each classification scheme would be identified by URI, so as to promote the finding, reusing and interoperability of classification schemes.

Geared to the actual needs of classification schemes' networked applications, the set of Web Service APIs offered by CLC v4.0_CLSS are listed on NKOS Research Office's website①. By the standard method of Web Service call, all applications could be implemented on different application platforms②. In this section we conduct experiments with books of the Shenzhen University Library that have no need to be subdivided. Invoking the automatic classification API of the Terminology Web Service of *CLC* 4.0, the expectant classification results could be usually obtained. As for the subdivision-need situation, we randomly extracted two books shown in Table 4 to validate, and the classification result is as shown in Figure 4. These experiments have proven that Terminology Web Service of classification scheme in this paper can support the computer cataloging system to automatically assign class numbers to books, periodicals, dissertations and other information resources that have been indexed with subject terms or keywords. The services provided by APIs could be used in Library Information Management Systems, Database Retrieving Systems, Search Engines, Tag Systems, etc., and could match any kind of development platforms and development languages, to achieve the intelligent retrieval, classification indexing, knowledge linking and knowledge service based on classification schemes.

① http://nkos.lib.szu.edu.cn/level_2/service/webservice.jsp.

② In order to test system function and acquire more demand information, now the experimental opening service is available, and the access address is: http://nkos.lib.szu.edu.cn:8080/ProjectForCLC/services/CLCService/getClassEntryType?schemeURI={0}&conceptURI={1}. Detailed implementation technique and call method see Lin and Zeng (2010).

Table 4. Random test data of automatic indexing for books

Accession number	Title/Author	Main keywords	Subdivision keywords	Combined class numbers
A0645023	American patents and technology review/by Ma Xiushan	Patents in various countries	America	G306.771.2
WX001348/55	The Song and Yuan Dynasty chronicles series /ed. by Zhonghua Book Company Editorial Department	Chronicles of various dynasties	Song Dynasty	K290.44

Note: In the table, the subdivision rules of examples are: American patents →Overview of patent literature in various countries → G306.7 (note under the class: add subdivisions according to the Global Area Table, America:712, the built number: G306.771.2); Song-Yuan local chronicles→ Chorography of various dynasties→ K290.1/.7(note under the class: add subdivisions according to the Chinese Era Table, Song Dynasty: 44 (to be classed with the first dynasty if involving two dynasties), the built number after subdivision: K290.44).

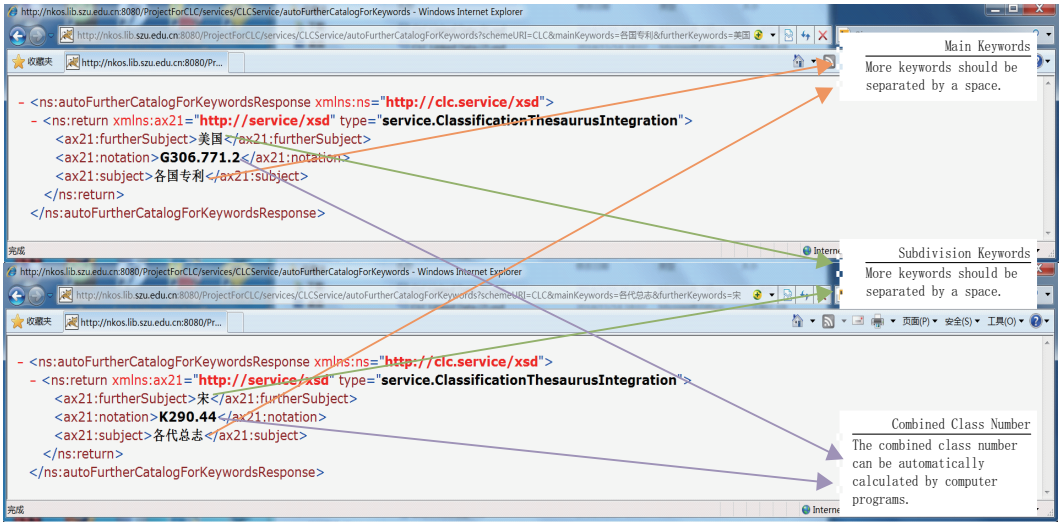

Figure 4. Schematic diagram of invoking Web Service API of CLSS to achieve automatic classification.

4 Linked Data service of classification scheme

With the migration of information resources to a network environment, the Web of data gradually becomes a hot topic. In order to satisfy the user's need for information consumption at any time, it appears specially important for the classification scheme to get out of the relatively closed library and to become part of the Web of data. In January 2011, the NKOS Research Office of Shenzhen University Library published an experimental service of OTCSS Linked Data (NKOS Research Office of Shenzhen University Library, 2011). The recent three-year practice demonstrates that the solution we put forward (H. J. Huang, X. H. Zeng, & Lin, 2012) provides an effective way of

publishing library's traditional Chinese KOS as Linked Data, initially verifies the scientificity of Knowledge Organization Standards of NLC and the feasibility of helping copyright owners create and publish the Linked data. To further verify its maturity and reliability, this paper continues to adopt this solution to achieve the Linked Data service of classification scheme, and creates the interconnection between Linked Data of *CLC* and *CCT*. At present, the interconnection with catalog data is under construction.

In accordance with the needs and features of CNKOS ontology of classification scheme and in line with four principles for publishing information as Linked Data on the Web, this paper realizes the Linked Data service of *CLC*, which provides the following functionalities (see Figure 5).

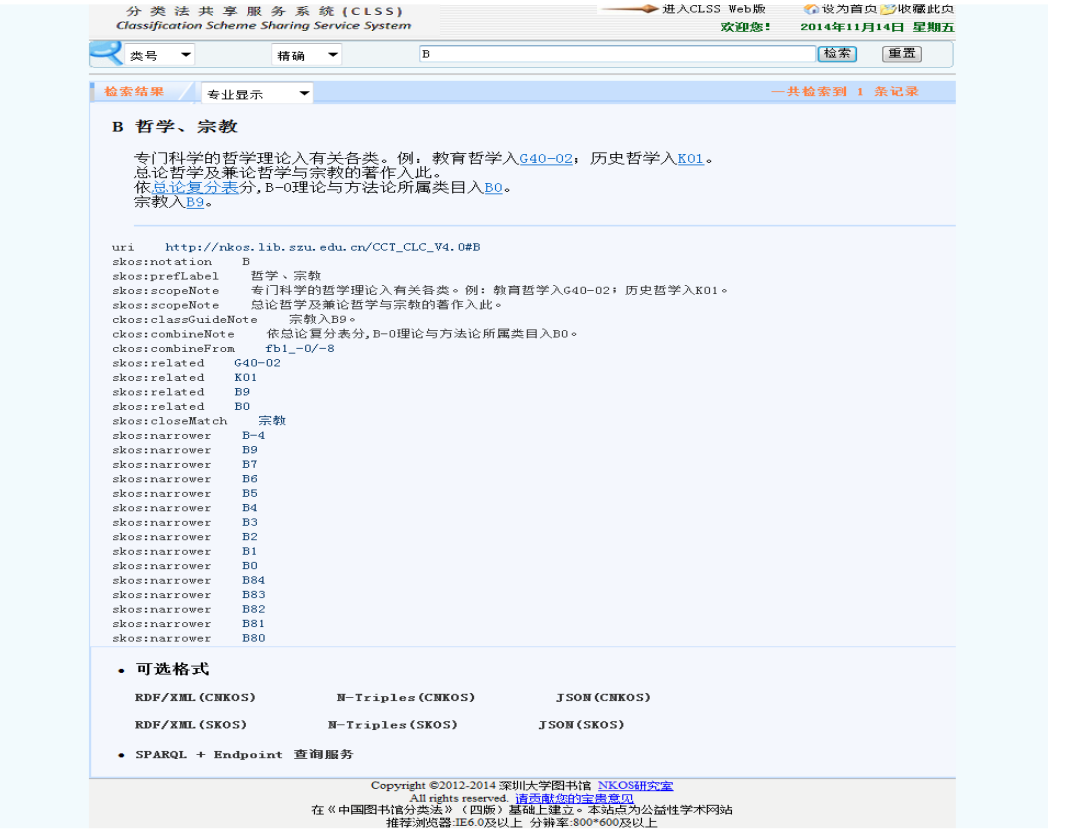

Figure 5. A screenshot of Linked Data service of *CLC*.

1) All resources in the ontology of classification scheme that need to be published are identified with dereferenceable HTTP URIs. As the unique identification of a class, the HTTP URI can be used to locate the detailed information of the class.

2) It offers two input methods, namely, to input URI in address bar or input class number (or class name) in search box, so as to inquire the Linked Data. The result is presented in two ways: the professional display and the common display.

3) Via the URI location, a lot of meaningful information (associated objects) of this object (i.e. class) may be provided, such as the class entry information (including class number, class name, mapping subject, various notes, superordinate class, subordinate class, coordinate class, etc.), its URI, selectable formats for download, and so on. The details of the associated objects can be inquired through their RDF Links. The correlation with similar concepts in other vocabularies (e.g. mapping links to descriptors in *CCT* v2.0) is also provided, so the correlation between *CLC* and other thesauri can be achieved.

4) For the downloading and online browsing, three exchange syntaxes (RDF/XML, N-Triples and JSON) are provided respectively for CNKOS and SKOS under the selectable formats.

5) Moreover, it provides the inquiry service of SPARQL Endpoint, and makes it easier for the users to customize the data formats for *CLC* and *CCT* that a machine can handle.

The Linked Data of classification scheme could build direct or indirect connection between network resources, laying a good foundation for the machine-readable progress and Web progress of classification data and subject data (L. Zeng, 2012). In order to exploit the library's knowledge spreading functionality in the internet era, all kinds of resources in libraries could be linked together. For example, new resource finding and access service may be offered to users through correlating the Linked Data of classification scheme with catalog data, with other traditional KOSs, etc., and the interactive service between machines or application programs may be achieved via sharing formats and SPARQL inquiry. The experimental system was implemented and released in April 2013, and its login address is: http://nkos.lib.szu.edu.cn/CCT_CLC_V4.0.

5 Conclusions

As an experimental study, we take the *CLC* v4.0 as an example and achieve the networked sharing service of classification scheme, which includes the interconnection with thesaurus (e.g. *CCT* v2.0). The existing practices have proven that the service could be put into use, and readers feel free to check out our website (NKOS Research Office of Shenzhen University Library, 2013) to have a real-time test.

CLSS is a uniform supporting system developed for classification-like Chinese networked KOSs. The successful implementation of this system verifies the scientificity and practicality of CNKOS. The classification schemes, categorization schemes, standard code tables and others that are semantically described in CNKOS may have all functions provided by this system.

In future work, we will continue to improve the system service and to intensify the website construction, while keep strengthening the communication with users in practical application of the system. Links to more Web resources (e.g. catalog information), or mappings to the international mainstream classification schemes may also be provided. The sharing and integration between different systems and applications would be intensified.

We should conform to the trend of network information age, break the boundary of the library to set

free classification schemes and offer users more convenient and advanced networked sharing service. In addition, we should rely on collective intelligence of users to achieve its co-construction and dynamic update, and make the traditional classification scheme of library field to radiate new vitality.

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