

...Construction of the Chinese
Traditional Music Culture Knowledge
Base (Knowledge Graph in Linked
Data) from a “Digital Humanities”
Perspective

Junjun Cao
—June

- Invited expert, Library of China Conservatory of Music (Beijing), musicologist of morphology etc.
- Former Postdoctoral Researcher & Linked Data Scientist for Distributed Digital Music Archive and Library Laboratory (DDMAL), McGill University (Montreal)

Slides will be available via GitHub:
[linkedmusic-datalake]



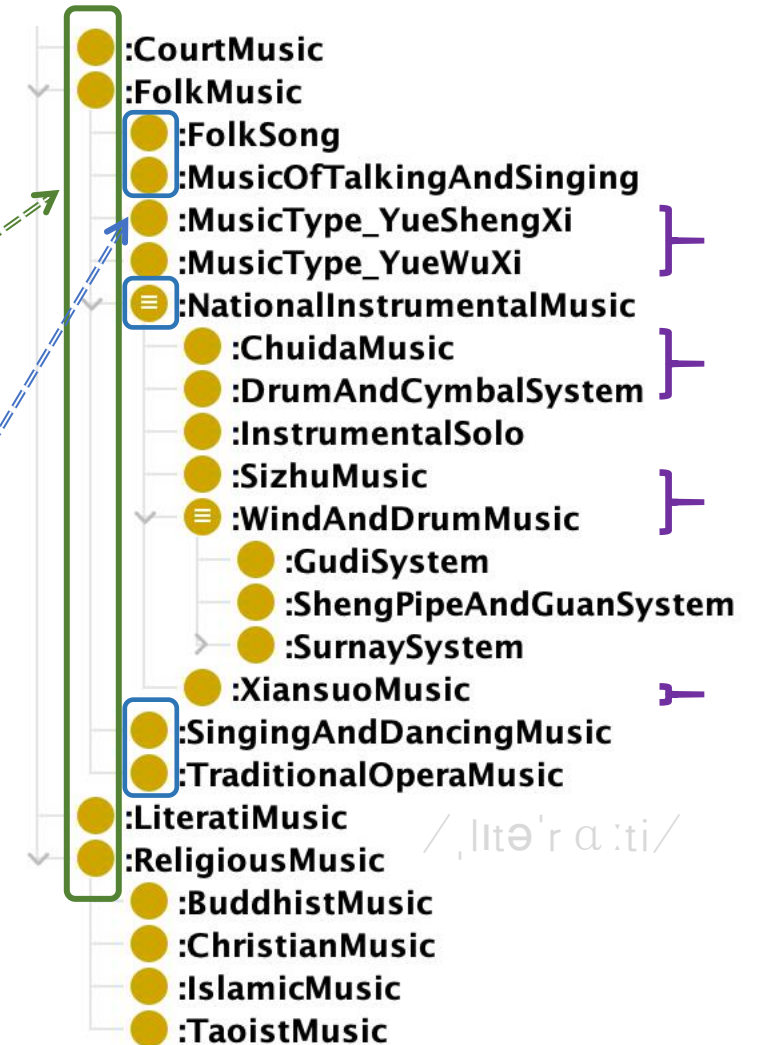
Background 1 : Introduction of Chinese Traditional Music Culture

- Characteristics of Contemporary Chinese Musicology :

(1) ethnomusicology + (2) Chinese traditional Music morphology \rightarrow applied to music composition, blending Eastern & Western Music flavors

- — 1. classification (top \rightarrow bottom)
- Chinese Traditional Music Culture, categorized via:
- sociological perspective: 4 classes, one of which is
- morphological perspective: FolkMusic \leftrightarrow 5 classes
- for instrument-associated music (music species perspective): 7 classes

Vocal Integrated Instrumental Music Species; Dance Integrated Instrumental Music Species; Wind and Percussion Music Species; String Ensemble Music Species... — Drew upon the viewpoint of orchestration



Background 1 : Introduction of Chinese Traditional Music Culture

- 2. cataloging (bottom → top)
- Chinese Traditional Music Culture Resource Warehouse (database)
- (1) 20 years old
- (2) folk collection and fieldwork, visual ethnography
- (3) a “Music Map” vision



視	音	圖	文	譜
贵州黔东南从江县采风实录 (二)	拉祜族创世史诗《牡帕密帕》演唱专辑 (之一)	甘肃庆阳唢呐马自刚乐班所用的乐器	走访北京的民间曲艺票房：好的就是这一口儿	甘肃庆阳唢呐马自刚乐班演出乐谱
贵州黔东南从江县采风实录 (一)	拉祜族创世史诗《牡帕密帕》演唱专辑 (之二)	甘肃庆阳唢呐马自刚乐班来我院进行学术展演	民间鼓曲的组织与机制建设	豫剧唱段100首
辽宁复州鼓乐学术展演	拉祜族创世史诗《牡帕密帕》演唱专辑 (之三)	采访四川清音伴奏琴师李长元	从新媒体新经济视角研究赫哲族“伊玛堪”的传播	兰州鼓子清唱选段
四川省凉山彝族自治州彝族传统音乐访谈 (三)	拉祜族创世史诗《牡帕密帕》演唱专辑 (之四)	采访四川清音伴奏琴师曹正礼	黑龙江省赫哲族传统音乐学术演出节目单	四川清音《羞月亮》
四川省凉山彝族自治州彝族传统音乐访谈 (二)	甘肃庆阳唢呐马自刚乐班采访录音	采访四川清音演员王小平	甘肃庆阳唢呐马自刚乐班演出节目单	四川清音《赶花会》

Background 2: Technology (and My Research Journey)

lots of following graph instances

- 1. social network analysis (homogeneous network, Web 2.0) →
- 2. **knowledge graph (heterogeneous network)** in "linked data" format
 - triples + URI (unified resource identifier) ⇒ linked data/RDF (Resource Descriptive Framework)
 - Why linked data?
 - FAIR principle: e.g., especially semantic web (Web 3.0)
- 3. a semantic turn of knowledge organization:

music metadata → "metadata ontology"

evolve toward

→ **knowledge base** (an ontology-driven knowledge graph) that supports intelligent knowledge retrieval, visualization, network analysis...

to be introduced later

tomorrow

a normal database →

Findable,
Accessible,
Interoperable,
Reusable

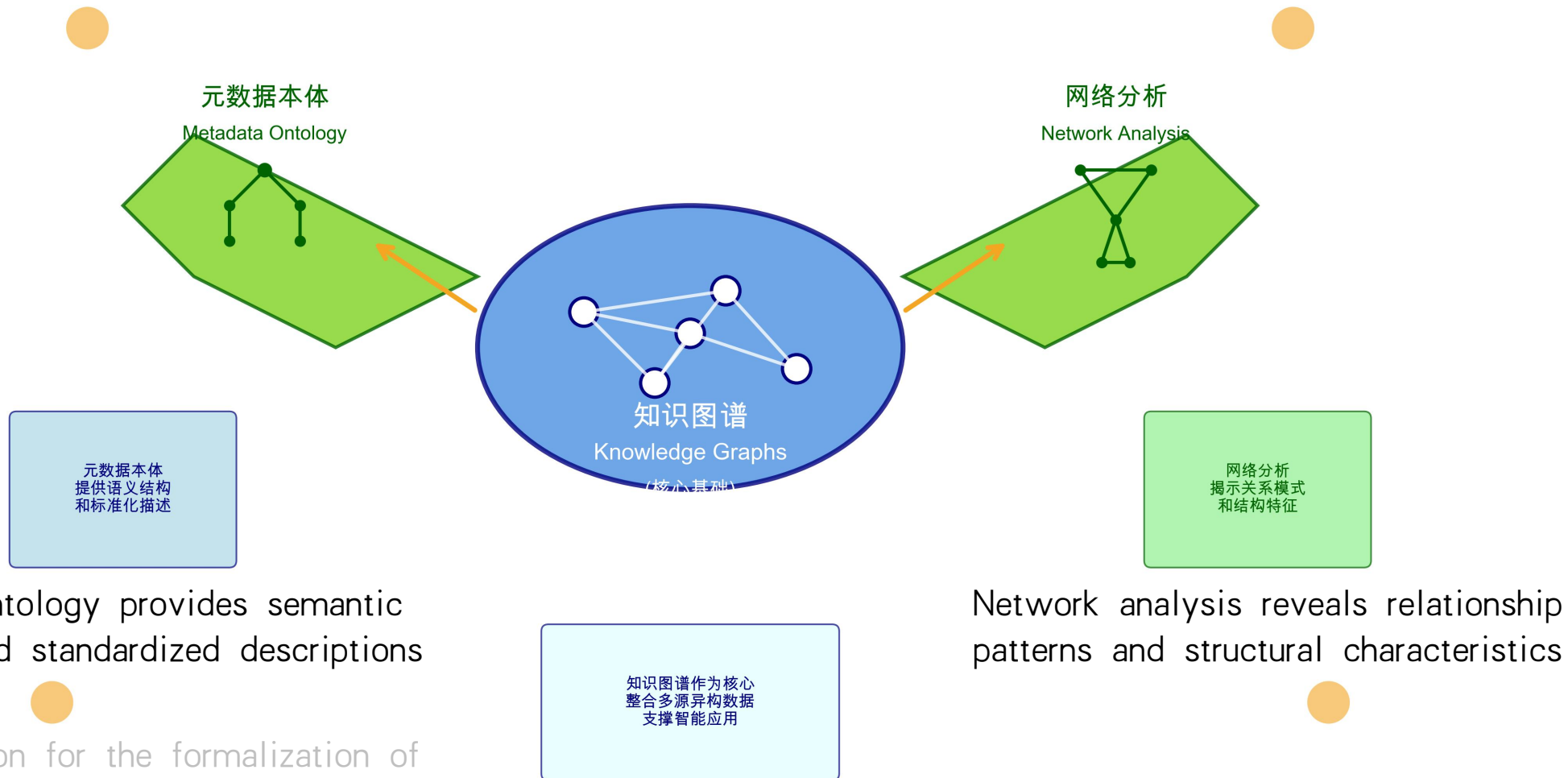
Background 3: Digital Humanities

core appeal of digital humanities lies in ...approach

- connecting data science to serve humanities
 - an ideal joint point: **structuralism and semiology** —[corner stone]
 - —> focus on text—structuring...with such recognition, to find a common set of digital humanities discourse system (*which requires even no mathematics foundation at early stage*):
- “以知识图谱为体，以元数据本体和网络分析为两翼” (Junjun, 2024, Feb) slogan translation:
 - — Knowledge graphs serve as the **the "body"**
 - — Metadata ontology and network analysis serve as **the "two wings"**:

一体两翼数字人文框架

Digital Humanities Framework: One Body, Two Wings



中华传统音乐文化知识库建设的理论框架

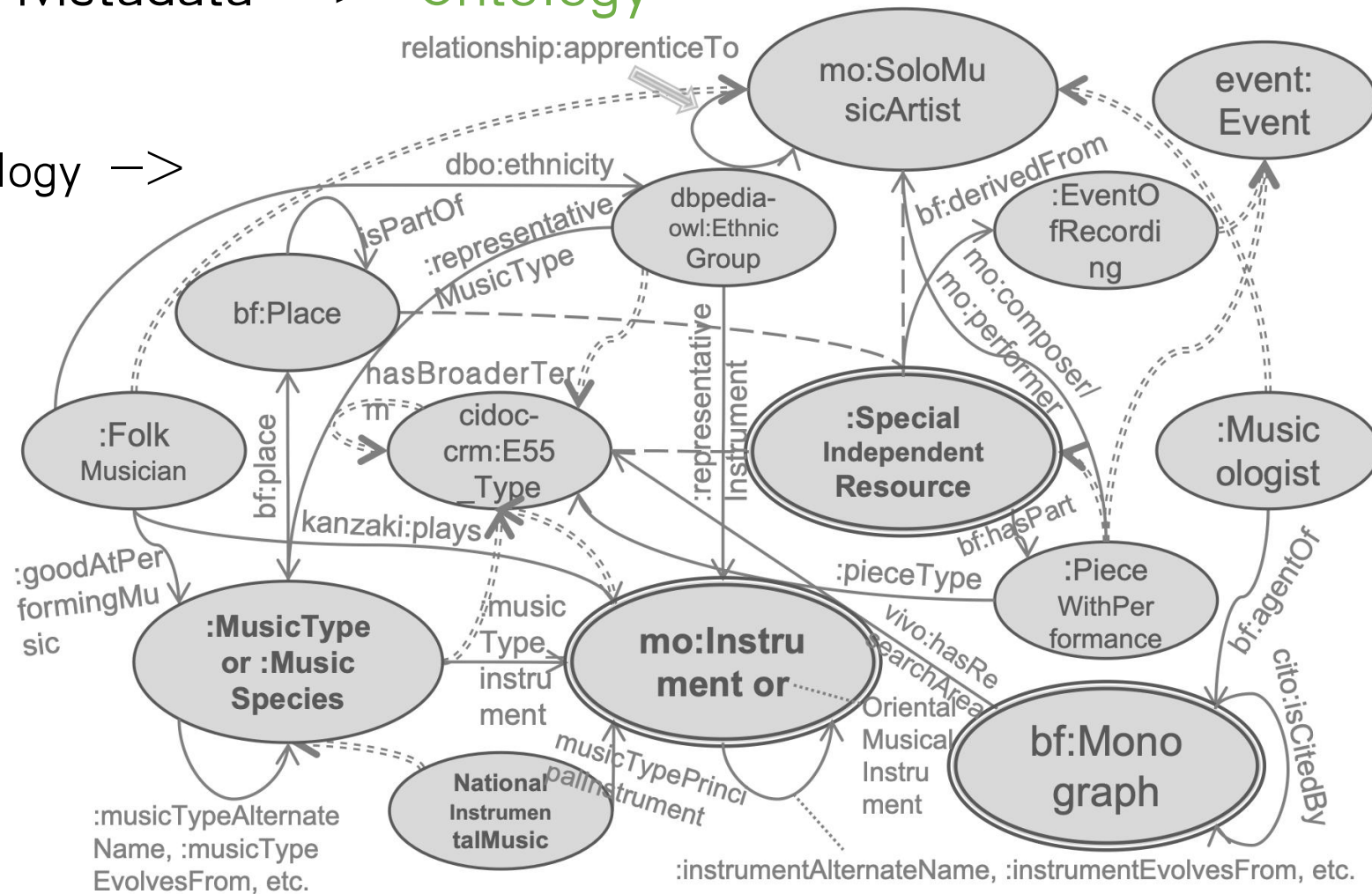
Theoretical Framework for Chinese Traditional Music Culture Knowledge Base Construction

Semantic Organization of Metadata —> **Ontology**

- (rendered in OWL—a special RDF language)
- A graph database with ontology is a genuine knowledge graph. **Definition:**
- Ontology reflects knowledge structure and knowledge organization method, involving **nodes as instances of classes**, and **edges as shared semantic relationships or properties**, such as hierarchical relations between parent and child classes. Ontology embodies the way of defining knowledge and classification methods...and even what kind of **knowledge inference** effects can be formed. An ontology serves as the foundational model of the semantic web and is also a descriptive language, such as those using **RDF Schema and OWL formats**.
Metadata has shown a trend toward ontologization, so it is appropriate to collectively refer to them as "metadata ontology."

Semantic Organization of Metadata \rightarrow Ontology

- [a “knowledgeBase” with ontology \rightarrow superceeds a normal “dataBase”]
 - \leftarrow a more intuitive & flexible approach of:
 - – organizing knowledge;
 - – displaying knowledge;
 - – retrieving knowledge.
 - Ontology: Chinese Traditional Music Culture Knowledge Base (CTM)
-



Legend =====> hierarchical relationship: such as `rdfs:subClassOf`
 ---- `bf:relatedTo` —————> other semantic relation

Single-box Search on the Main Page



中國音樂學院
CHINA CONSERVATORY OF MUSIC

Library

Type of music (music) Instrument library Specially Collected Independent Resources - Works Metadata ontology Knowledge graph The AI Assistant About Us

Full library search Enter any keyword, which can involve the type of music (music) | musical inst Search

中華傳統

音樂文化知識庫

中国传统音乐，来自宫廷、文人、宗教、民间，又有歌曲、说唱、歌舞、戏曲、器乐等形态，还可以从族性、乐器、地理、宗派等角度观照。探索“知识网络”中的各式群落，一同领略音乐文化的异彩纷呈……

the global/holistic ontology: background



translation: Chinese traditional music comes from the acient courts, literati circles, religeous groups and folk communities, manifesting in forms as songs, narrative rap (speech-song fusion), singing-dancing integration, instrumental music, which can also be observed from viewpoints as ethnicity, instrumentation, geography and factions. Let's explore various communities within the “knowledge network”, reveling in their dazzling multiplicity.

Single-box Search, e.g., after inputting “福建南音” (translation:Fujian Nanyin/South Sound)

18号字 (dark color 15)

This references
China's ancient
gongchepu notation
system (工尺谱)
- a traditional
musical tablature
using Chinese
characters to
represent pitch
and rhythm.



中国音乐学院
CHINA CONSERVATORY OF MUSIC

library

Music type Instrument Library Special Collection Independent Resources_Works Metadata Ontology
Knowledge Graph AI Assistant about Us

福建南音

Query

RESOURCE TYPE

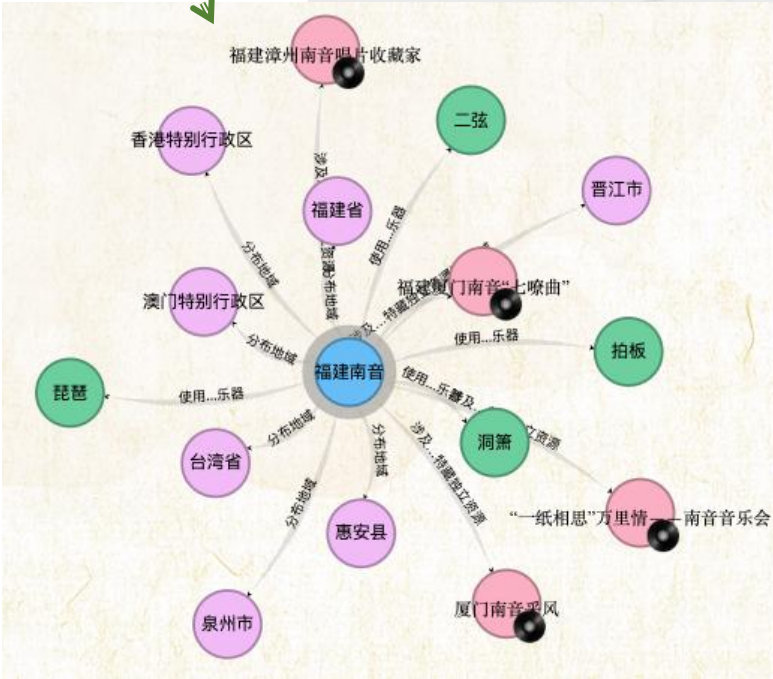
- MUSIC TYPE (221)
- MUSICAL INSTRUMENTS (81)
- SPECIAL COLLECTION RESOURCES (NON-REPERTOIRE) (36)
- PERFORMANCES OF THE TRACK (21)
- (MUSICIAN) (17)

Matched to 221 music types (music genres) Record


- [Fujian Nanyin - refers to the knowledge graph](#)
- [Fujian Nanyin-score knowledge graph](#)
- [Fujian Nanyin-Music Knowledge Graph](#)
- [Fujian Nanyin-Upper Four-pipe-Quality Control Knowledge Graph](#)
- [Fujian Nanyin-Shangsiguan Knowledge Graph](#)
- [Fujian Nanyin Knowledge Graph](#)
- [Fujian Nanyin-Xia Si Guan Knowledge Map](#)
- [Fujian Nanyin-Upper Four-Tube-Dongguan Knowledge Map](#)
- [Liyuan Opera-Silk String Music Knowledge Map](#)
- [Knowledge graph of string and bamboo music ensemble](#)
- [Nanyin Knowledge Graph](#)
- [Quanzhou Nanyin-Music Knowledge Graph](#)
- [Quanzhou Nanyin-score knowledge graph](#)
- [Quanzhou Nanyin-refers to the knowledge graph](#)
- [Guangdong Chaozhou string poetry knowledge map](#)
- [Chaozhou Music-String Poetry Knowledge Graph](#)
- [Guangdong Music-Cantonese Music Knowledge Graph](#)
- [Knowledge map of Hebei Errentai brand songs](#)
- [Su Nan Shibai Gonggu-Qing Gonggu Music Knowledge Map](#)
- [Knowledge graph of Shibai gongs and drums](#)
- [Huidiao-Siping Knowledge Graph](#)
- [Yichang Xile Knowledge Graph](#)
- [Huidiao-Kunyi Opera Knowledge Map](#)
- [Knowledge map of Shanxi Errentai brand songs](#)
- [Jiangnan Sizhu Knowledge Graph](#)
- [Knowledge graph of Zhanzaigu](#)
- [Knowledge Graph of the Eight Immortals](#)

knowledge graph: graph query
-> visualization

next page



migrated to the “**Linked Data Publishing Platform**”; Each **blue field** links to other URI-linked nodes.



中國音樂學院

CHINA CONSERVATORY OF MUSIC

library

Music typeInstrument LibrarySpecial CollectionIndependent Resources_WorksMetadata Ontology

Knowledge GraphAI Assistantabout Us

Fujian Nanyin

RDF

Attributes/Fields	Property Value	Attributes/Fields	Property Value
Music type:	Musical genre; literati music	Former name:	-
Music type (music genre) alias (object attribute):	-	Music type (music genre) alias:	Nanyin; Fujian Nanqu
There are... Broad terms:	Nanyin Literati Music	There are... Narrow terms:	Nanyin Seven Songs Quanzhou Nanyin Fujian Nanyin - Upper Four-pipe Fujian Nanyin - Lower Four-pipe Fujian Nanyin - Finger Fujian Nanyin - Song Fujian Nanyin - Score
Originated from... Period:	Five generations	Died since:	-
Distribution area: (Click to view the map)	Taiwan Province Hui'an County Jinjiang City Quanzhou City Macau Special Administrative Region Fujian Province Hong Kong Special Administrative Region Southeast Asia	Origin: (Click to view the map)	Quanzhou City
Traditional music branches:	Fujian-Taiwan Branch	Derived from:	Xishu Quzidiao
is part of:	-	Corresponding to...Group:	-
Named after:	-	Representative tunes:	[A Letter];[Ancient Luntai];[Four Dynasties];[Du Weiniang]
Representative tracks:	"Heartbroken"; "Thinking of the Rest"; "Spring"; "Enjoying the Lanterns"	Related to:	-
Main instrument:	Erxian clappers, dongxiao, pipa	Instruments used:	-
Representative folk musicians:	-	Recommended collection resources:	<ul style="list-style-type: none">"A piece of love letter" - Nanyin ConcertXiamen Nanyin CollectionFujian Nanyin"Seven Liangqu" of Nanyin from Xiamen, FujianNanyin record collector from Zhangzhou, Fujian
Definition/Explanation:	(1) Nanyin, also known as "string and pipe" and "Quanzhou Nanyin", is a traditional music of the southern Fujian region, one of the contents of the UNESCO Representative List of the Intangible Cultural Heritage of Humanity (Baidu Encyclopedia entry "Nanyin") (2) The music of Fujian Nanyin is divided into three categories: "finger", "score" and "song", and the form and structure of each type are different (Chinese Music Studies, p.548) (3) The author believes that from the Five Dynasties to the Song Dynasty, the dongxiao was an accompaniment instrument for the quzidiao (called cidiao after the Song Dynasty) music, and the quzidiao music of the Five Dynasties in Western Shu was the origin of the formation of Quanzhou Nanyin (Chinese Music Studies, p.547)		

javascript:void(0)

12

Linked Data Publishing Platform for Fujian Southern Sound

福建南音

<https://lib.ccmusic.edu.cn/data/musictype/aS923pRv9J00BirG>



数据格式: RDF/XML JSON NT GRAPH

AN ENTITY OF TYPE: MusicType

skos:definition

(1)南音也称“弦管”“泉州南音”，福建省闽南地区的传统音乐，联合国教科文组织人类非物质文化遗产代表作名录内容之一(百度百科词条“南音”)(2)福建南音的音乐分为“指”“谱”“曲”三类，各类曲式结构形态均不相同(《中国乐种学》p.548)(3) 笔者认为五代至宋以来，洞箫是曲子调（宋以后称词调）音乐的一件伴奏乐器，五代西蜀曲子调音乐是泉州南音的形成之发端（《中国乐种学》p.547）

rdfs:label

福建南音
fu jian nan yin @py

ctm:musicTypeOrInstrumentAlias

南音
福建南曲
fu jian nan qu @py
nan yin @py

ctm:nameOfMusicTypeOrInstrument

福建南音
fu jian nan yin @py

ctm:originationPeriod

五代

ctm:place_DP

东南亚

ctm:representativePiece

《心肝跋悴》 《思得下》 《春令》 《趁赏花灯》

ctm:representativeQupai

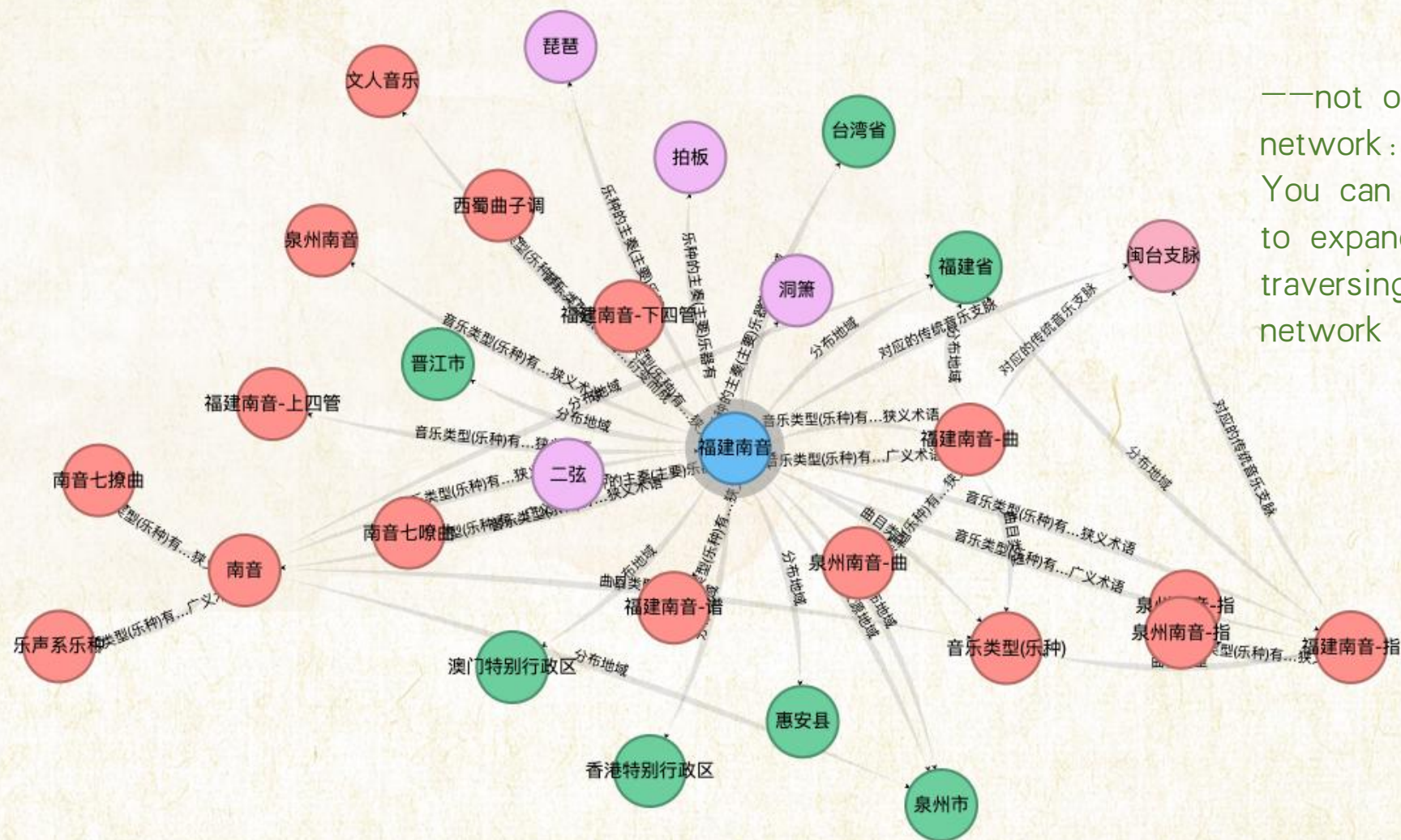
[一封书] [古轮台] [四朝元] [杜韦娘]

rdf:type

ctm:MusicType
↳ 音乐类型(乐种)
ctm:MusicType_YueShengXi
↳ 乐声系乐种
ctm:LiteratiMusic
↳ 文人音乐

If we say the previous page resembles a Wikipedia display, this page mirrors the structured—data interface of linked knowledge bases like DBpedia or Wikidata.

scroll down to see the **egocentric network** for “福建南音” (translation: Southern Music/Sound in Fujian Province)




—not only one-step ego network:
You can double-click nodes to expand the scope, traversing the knowledge network for exploration

Can also enter the “Music type” tabular interface to retrieve Fujian South Sound. Advanced query interface with multiple filtering condition (intersection relationship)

(1) musicType
(2) instrument
(3) traditional music branches

professional search syntax

(4) distribution area
(5) ethnic group
(6) originates from historical period (dynasty)



中国音乐学院
CHINA CONSERVATORY OF MUSIC

library

Music type

Instrument Library

Special Collection

Independent Resources_Works

Metadata Ontology

Knowledge Graph

AI Assistant

about Us

Advanced Search

Professional Search

Music type (music genre)/Music type (music genre) alias/Pinyin (separated by syllables)

Distribution area/Origin area

The main instrument used in this music is...

Corresponding to...

Corresponding traditional music branches

Originated from...period (e.g., input: Tang Dynasty; Southern Song Dynasty; Republic of China)

Query

Leave blank

Download (RDF)

MUSIC TYPE

- FOLK SONGS (914)
- OPERA MUSIC (541)
- RAP MUSIC (418)
- DANCE MUSIC (407)
- GONG AND DRUM MUSIC (153)
- NATIONAL INSTRUMENTAL MUSIC-DRUMS AND CYMBALS (153)
- DRUM AND CYMBAL MUSIC GENRES (153)
- TRADITIONAL INSTRUMENTAL MUSIC-WIND AND PERCUSSION MUSIC (123)
- WIND AND PERCUSSION MUSIC (123)
- WIND AND PERCUSSION MUSIC (123)


DISTRIBUTION

- YUNNAN PROVINCE (362)
- FUJIAN PROVINCE (205)
- HUNAN PROVINCE (186)
- GUANGXI ZHUANG AUTONOMOUS REGION (182)
- GUANGDONG PROVINCE (175)
- HUBEI PROVINCE (163)

Matched to3182Records

data reusable

Music type	Category Tags	Distribution	Use a musical instrument	Corresponding nationality	Traditional music branch
Abalasi Spring Dance	folk song	-	-	-	-
Achang Nationality Song and Dance Music	Dance Music	Longchuan County, Mangshi City, Dehong Dai and Jingpo Autonomous Prefecture , Yunnan Province	-	Achang Nationality	Yunnan-Guizhou-Qiangxi branch-Diqiang branch
Achang stick dance	Dance Music	Yunnan Province	-	Achang Nationality	Yunnan-Guizhou-Qiangxi branch-Diqiang branch
Achang Gourd Flute Song	Folk instrumental solo	Yunnan Province	-	Achang Nationality	Yunnan-Guizhou-Qiangxi branch-Diqiang branch
Achang sacrificial songs	folk song	-	-	Achang Nationality	-
Achang folk songs	folk song	Longchuan County, Mangshi City, Dehong Dai and Jingpo Autonomous Prefecture , Yunnan Province	-	Achang Nationality	Yunnan-Guizhou-Qiangxi branch-Diqiang branch



中国音乐学院

CHINA CONSERVATORY OF MUSIC

library

Music type

Instrument Library

Special Collection Resource Works

Metadata Ontology

Knowledge Graph

AI Assistant

about Us

Advanced Search

Professional Search

Theme/Special Collection Independent Resources are... Keyword

Special collection of independent resources involving... Music f

Special Collections Independent Resources Related to... Musica

Special collections of independent resources covering...

Special collections of independent resources involving...

Special collection of independent resources involving...Musiciar

Query

Leave blank

Download (RDF)

RESOURCE TAGS

- VIDEOS - MUSIC FESTIVALS, CONCERTS, COMPETITIONS, ETC. (297)
- VIDEO - LECTURE OR CLASS, ETC. (218)
- SPECIAL COLLECTION INDEPENDENT RESOURCES_WORKS (151)
- VIDEO-FIELD TRIP OR FIELD INVESTIGATION (122)
- VIDEO-INTERVIEW (104)
- VIDEO-ACADEMIC CONFERENCE (102)
- RECORDINGS (101)

TYPES OF MUSIC INVOLVED

- FOLK SONGS (54)
- SICHUAN QINGYIN (42)
- DANCE MUSIC (36)
- RAP MUSIC (33)
- FOLK INSTRUMENTAL MUSIC (20)
- FOLK INSTRUMENTAL SOLO (18)
- XI'AN DRUM MUSIC (13)
- SONG (12)
- NATIONAL INSTRUMENTAL MUSIC-DRUMS AND

Matched to1108Records

1

2

3

4

5

6

>

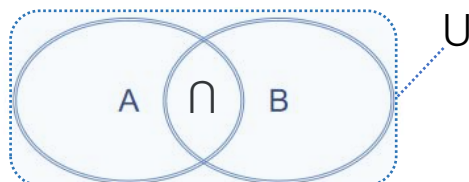
>>

theme	Resource Tags	Recording start date	Type of music involved	Musical instruments involved
Nanyin Finger Song Lyrics (I) 10-11 sets	Textual Documents	-	Fujian Nanyin-Finger	-
Professor Chen Ziming giving a lecture	Video - lecture or class, etc.	-	-	-
The 24th anniversary of the reconstruction of the Qujiaying Music Concert in Hebei Province (Performance): Qujiaying "Music Sacred Meeting" World Music Week Special Concert	Videos - music festivals, concerts, competitions, etc.	-	Hebei Concert-Hebei Concert-Beijing Music Club	-
Yunnan Dali Bai Nationality Traditional Music and Dance Academic Performance Program	Textual Documents	-	Dance Music	-
Yunnan Musical Instruments Kingdom Investigation Notes Part 3: Hani People	Video - lectures or classes, etc.; Video - field trips or field trips	-	Habage	-

16

[1] Search results are derived from the backend server.

Graph Query **1**: facilitate both **union** and **intersection** relationship



You can select multiple related keyword—nodes as starting points. By expanding their respective neighborhoods simultaneously, the visualization reveals **topological community structures**. E.g., the bridge part between 2 densely clustered communities may represent \cap

China Conservatory of Music library

Music type Instrument Library Special Collection Independent Resources_Works Metadata Ontology Knowledge Graph AI Assistant about Us

Music type (use ";" to query multiple values) Musical instrument (use ";" to query multiple values) Special Collection Independent Resources_Works

area Nationality (or ethnic group) (Music) People

Step 1

Generate Graph Leave blank Download (RDF) full screen

Music <id>: 00 name: "Fujian Nanyin" size: "25"

to switch between 1-step or 2-step length ego network

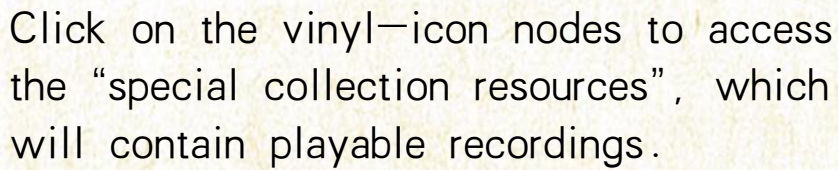
E.g., input more than one music species. Then you can see their relation via observation on the community boundary connection with the intuitionistic density.

next page——
query condition:
MusicType: 福建南音; 西安鼓乐
Instrument: 二胡; 琵琶
area/place: 江西省

Node Information

- Node
- Fujian Nanyin
- Type

check the details



[2] Search results are derived from data periodically uploaded by the music librarian.

Graph Query 2:

- node neighbourhood retrieval
- panoramic visualization:
- A→B path traversal

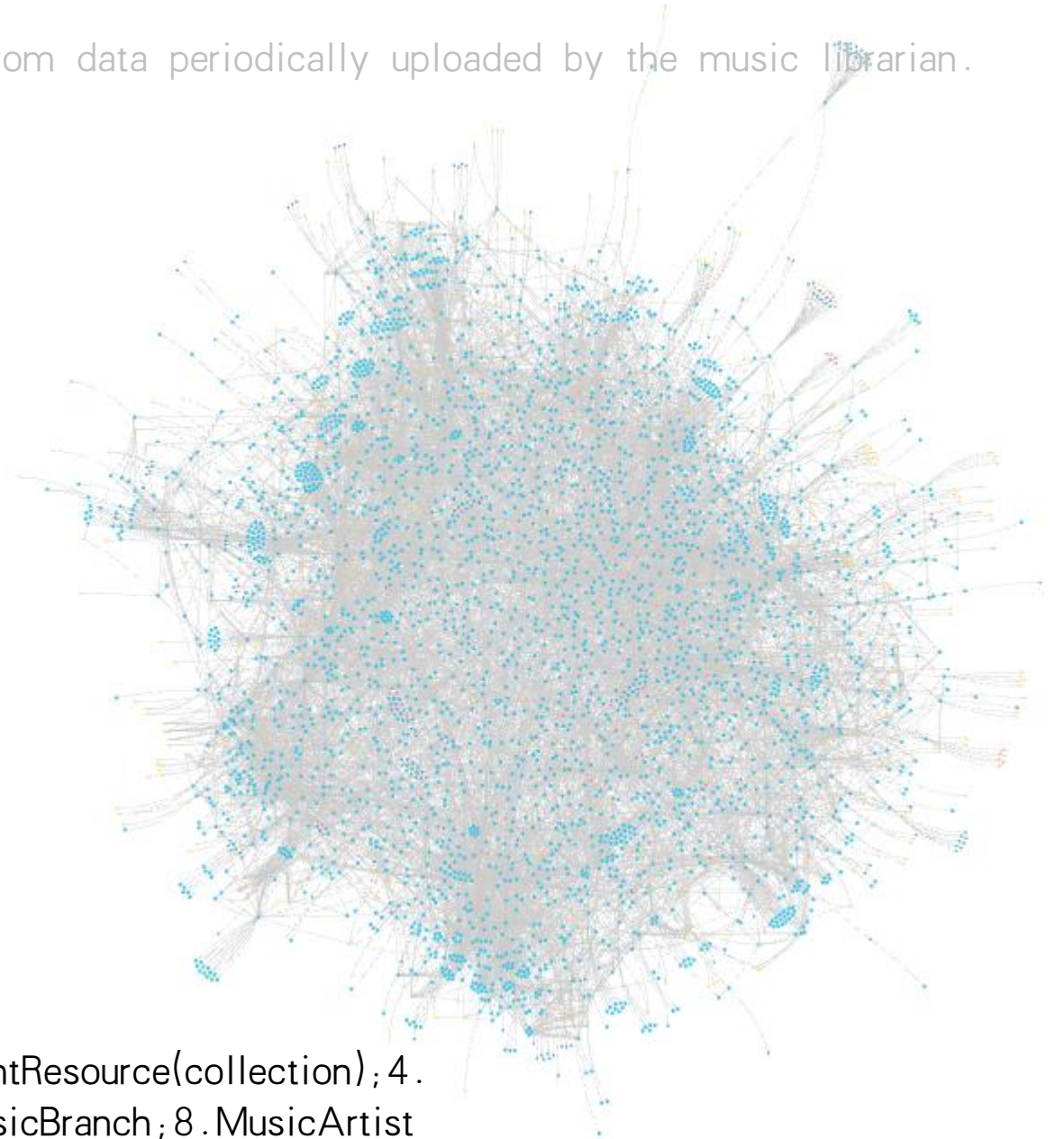
/ˌpænəˈræmɪk/

THEME_DEFAULT ▾

☒ 乐种 ☒ 乐器 ☒ 特藏资源(非曲目) ☒ 曲目 ☒ 地域 ☒ 民族 ☒ 音乐支脉 ☒ 乐人

乐种	<input type="text"/>	乐器	<input type="text"/>	特藏资源(非曲目)	<input type="text"/>
<input type="text"/>	曲目	<input type="text"/>	地域	<input type="text"/>	民族
<input type="text"/>	音乐支脉	<input type="text"/>	乐人	<input type="text"/>	

1. MusicSpecies; 2. Instrument; 3. SpecialIndependentResource(collection); 4. PieceWithPerformance; 5. Place; 6. EthnicGroup; 7. MusicBranch; 8. MusicArtist

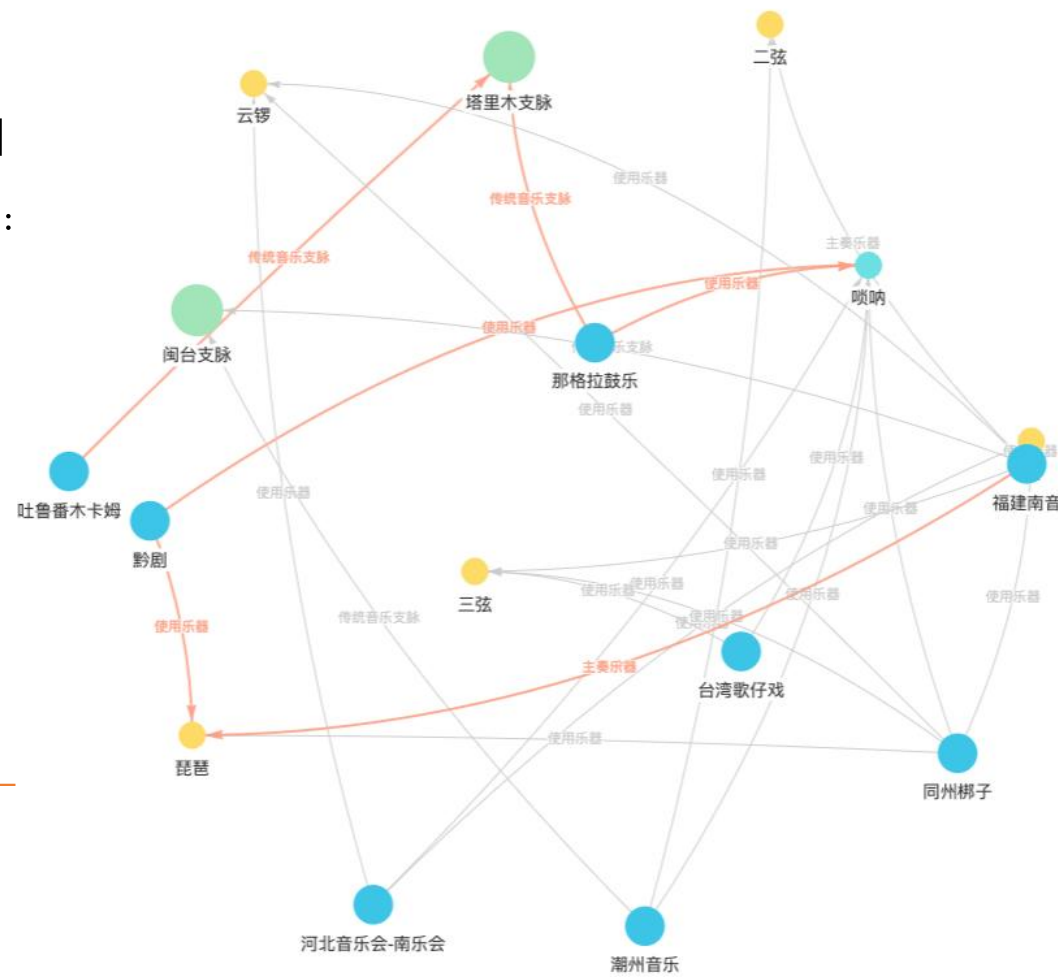


graph query ②: $A \rightarrow B$ path traversal

- to explore the relationship with distance threshold
 - to explore the shortest path between 2 nodes:

e.g., What's the potential relationship between Turpan Muqam in northwest China and Fujian South Sound in southeast China?

- TurpanMuqam $\xrightarrow{[traditionalMusicBranch]}$ (1)TarimMusicBranch $\xleftarrow{[traditionalMusicBranch]}$ (2)NgalraDrumMusic $\xrightarrow{[usesInstrument]}$ (3)surnay $\xleftarrow{[usesInstrument]}$ (4)QianOpera $\xrightarrow{[usesInstrument]}$ (5)pipa $\xleftarrow{[hasPrincipalInstrument]}$ (6)Fujian SouthSound



知识图谱

知识图谱

← → ↺ 🏠

🛡️ 不安全

http://dh.usources.cn:8280/mcdemo/abpath

90% ☆

👤 📌 🗒️ ☰

📁 火狐官方网站 🌟 新手上路 📁 常用网址 🖼️ 中华传统音乐文化知... 🖼️ 中华传统音乐文化知...

🏠

中国音乐学院

CHINA CONSERVATORY OF MUSIC

图书馆

音乐类型(乐种) 乐器库 特藏独立资源_作品 ▾ 元数据本体 ▾ 知识图谱 ▾ AI助手 关于我们

🔧 📄 🗂️ 🌐

福建南音

吐鲁番木卡姆

maxdepth: 6

find relations stop

福建南音

吐鲁番木卡姆

↑ ↓ ↻

nodes: 5408, edges: 11854

⏻ ⏹

🏠

中国音乐学院

CHINA CONSERVATORY OF MUSIC

Copyright ©中国音乐学院


地址: 北京朝阳区安翔路一号 中国音乐学院图书馆2023年校内科研专项
2022年中国图书馆学会、中国博士后科学基金, 2023年北京市 (含朝阳区) 等项目资助

22

2025/07/04 09:20:00

SPARQL query: referring to ontology list from the frontend

- SPARQL — an RDF specific query language;
- Structurize any NLQ (Natural Language Question) into SPARQL syntax prior to mapping with the schema (e.g., ontology) the way knowledge was originally organized. **Ontology elements:**



中国音乐学院 Library
CHINA CONSERVATORY OF MUSIC

Type of music (music) Instrument library Specially Collected Independent Resources - Works **Metadata ontology** Knowledge graph The AI Assistant About Us

ONTHUB.NET (本体服务中心)

中华传统音乐文化知识库本体 (ctm) Chinese Traditional Music Knowledge Base

This Version:
2.0

Publisher|Contributor:
曹建军 (中国音乐学院中国音乐研究基地), 中国音乐学院图书馆技术部、数字人文工作坊全体成员

Description:
以中国音乐学院图书馆“中华传统音乐文化资源库”的实践为基础, 尤其结合其“影像志”特点, 进行基础本体方案设计; 再结合传统音乐文化关联多领域的特点, 构建相应类、关系和语义约束方式, 如涉及乐种、乐器、民族主题词表, 及对曲目、乐人、地域、文字文献等领域的语义关联。该方案将有利于传统音乐分类研究和垂直领域的知识检索, 且具有音乐地理学、音乐人类学社群分析等方向上的应用前景。相关论文可参考《中国传统音乐知识库的“元数据本体”构建研究》(《数字人文研究》2022年第4期)。联系我们: 邮箱: alienmusedh@gmail.com; 529360500@qq.com 微信: MuseDH 关于 versionInfo: 该版本是在原有的乐种元数据本体之上扩展而形成的, 即 2.0 版, 针对武汉大学文化遗产智能计算实验室(教育部)开放基金课题“基于‘东方乐器’的音乐类文化遗产知识图谱构建研究”而设计。特此注明“”; owl:versionInfo "2.0 highlighting Oriental Instruments"^^rdfs:Literal; ctm:logForUpdating ""从领域知识角度来看, 已知目前知识推理尚存在问题: (1) :ethnicGroup (2) :representativeInstrument (3) :representativeMusicType (4) :relatesInstrument (5) :relatesMusicType (6) :relatesWork (如上供参考) Since 2025Feb25, following modifications are as follows: (1) ObjectProperty ':musicType_instrument' is updated to ':musicType_instrument' (2) ... (3) Add name space and prefix. See geo

Table of Content

1. Classes
2. Object Properties
3. Data Properties
4. Annotation Properties
5. Namespace Declarations

Classes

<http://dbtune.org/musicbrainz/page/instrument/68> bf:Audio bf:Instance bf:Item bf:Monograph bf:MovingImage bf:MusicInstrument bf:NotatedMusic bf:Place bf:StillImage bf:Text bf:Work musicbrainz:Track event:Event bibo:Book bibo:Periodical mo:Composer mo:Conductor mo:Instrument mo:MusicGroup mo:SoloMusicArtist place:City place:County place:Province place:Town place:Township place:Village fabio:JournalArticle cidoc-crm:E24_Physical_Man-Made_Thing cidoc-crm:E53_Place cidoc-crm:E55_Type kanzaki:Player kanzaki:Singer

<http://dbtune.org/musicbrainz/page/instrument/68> [back to ToC or Class ToC](#)

Labels: 笙

IRI: <http://dbtune.org/musicbrainz/page/instrument/68>

has super-classes
[ctm:BlowPipeInstrument](#)

bf:Audio [back to ToC or Class ToC](#)

Labels: 录音

IRI: <http://id.loc.gov/ontologies/bibframe/Audio>

Resources expressed in an audible form, including music or other sounds.

has super-classes
[ctm:SpecialIndependentResource](#)

bf:Instance [back to ToC or Class ToC](#)

Labels: 独立资源_实例

IRI: <http://id.loc.gov/ontologies/bibframe/Instance>

has sub-classes
[ctm:InstanceOfInstrument](#)

is in range of
[bf:hasInstance](#) ^{op}

bf:Item [back to ToC or Class ToC](#)

Labels: 实体单件

IRI: <http://id.loc.gov/ontologies/bibframe/Item>

has sub-classes
[ctm:ItemOfInstrument](#)



SPARQL Query Example

1 Database overview, exploration of internal structure

1.1 Querying the size of the database

That is, the total number of instances of the main name guest triple

1.2 Returning a part of the triple

For example, the 50 articles.

1.3 Exploring how many classes are in the knowledge base

And with each class how many examples, do the descending order arrangement

1.4 Querying an instance of a class

If you look for examples of folk songs.

1.5 The weight of the relationship

The number of predicates (or attributes)

1.6 Uploading of specific collections of resources in addition to metadata in the knowledge base

Find out which "specially independent resources_works" have been associated with specific readable sounds and like resources

Click to view the default namespaces

Gamelan Music

```
1 Does my library have any special resources related to Gammei Lan music, and if so, where is the area involved in this resource?
2 define input:inference 'urn:owl.ccmusicrules0214' #Activate Reasoning Mechanism
3 PREFIX ctm: <https://lib.ccmusic.edu.cn/ontologies/chinace_traditional_music#>
4 PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
5
6 The select? The resource? The resourceLabel? place? placeLabel WHERE {
7     # Find unique resources
8     ? resource a ctm: SpecialIndependentResource .
9     ? Resource rdfs:label rdfs:label? ResourceLabel .
10
11     # This resource involves the Cammelan music genre
12     ? Resource ctm:relatesMusicType ctm:relatesMusicType? MusicType .
13     ? musicType rdfs:label "Gammelan music". .
14
15     # Geographic areas of the resource
16     ? Resource ctm: deletesPlace? place .
17     ? Where rdfs:label? placeLabel .
18 }
```

Table Raw Response

Showing 1 to 3 of 3 entries

Searched for: Show All ▾ The entries

	Resource	ResourceLabel	place	PlaceLabel
1	https://lib.ccmusic.edu.cn/data/sdresource/82KtNL8305adF0E0	Gamelan Music (Department of Music)	https://lib.ccmusic.edu.cn/data/place/southeastasia	Southeast Asian
2	https://lib.ccmusic.edu.cn/data/sdresource/XumB0bv3mNe3Mk	Chen Ming Dao's trip to Bali, Indonesia	https://lib.ccmusic.edu.cn/data/place/bali	Balinese
3	https://lib.ccmusic.edu.cn/data/sdresource/XumB0bv3mNe3Mk	Chen Ming Dao's trip to Bali, Indonesia	https://lib.ccmusic.edu.cn/data/place/bali	Balinese

Showing 1 to 3 of 3 entries

nodes as URI are accessible to linked data publishing platform

SPARQL query result—> linked data publishing platform

陈铭道印度尼西亚巴厘岛之行

<https://lib.ccmusic.edu.cn/data/sdresource/XumB0bv3mNe3XnMk>



数据格式: RDF/XML JSON NT **GRAPH**

AN ENTITY OF TYPE: StillImage

Chen Mingdao's Trip to Bali, Indonesia and related resources

properties values with labels:


rdfs:label	陈铭道印度尼西亚巴厘岛之行
bf:mount	《传承与变异：印度尼西亚巴厘岛考察的一点想法》(DATA16 (成品1) -8, 含ppt与图片)
<http://www.cidoc-crm.org/cidoc-crm/P3_has_note>	由“特藏部数字音视频及图片资料硬盘登记表(合并)张家琪交接, 总表, 重要”引入
bf:subject	陈铭道印度尼西亚巴厘岛之行
bf:identifiedBy	_927
<http://rdfs.co/juso/locator_address>	印度尼西亚巴厘岛
rdf:type	bf:StillImage ↳ Still image
properties inFormOf name SpacePrefix+FragmentID...	ctm:Video-InterviewOrFieldTrip ↳ 视频-采风或实地考察
owl:sameAs	<http://www.usources.cn:8480/music/data/sdresource/XumB0bv3mNe3XnMk>
ctm:relatesMusician	<https://lib.ccmusic.edu.cn/data/agent/v2KV2PkdFj6ezU3g> ↳ 陈铭道
ctm:relatesMusicType	<https://lib.ccmusic.edu.cn/data/musictype/G4dTVrSu85i1d3qB> ↳ 甘美兰音乐
ctm:relatesPlace	<https://lib.ccmusic.edu.cn/data/place/bali> ↳ 巴厘岛

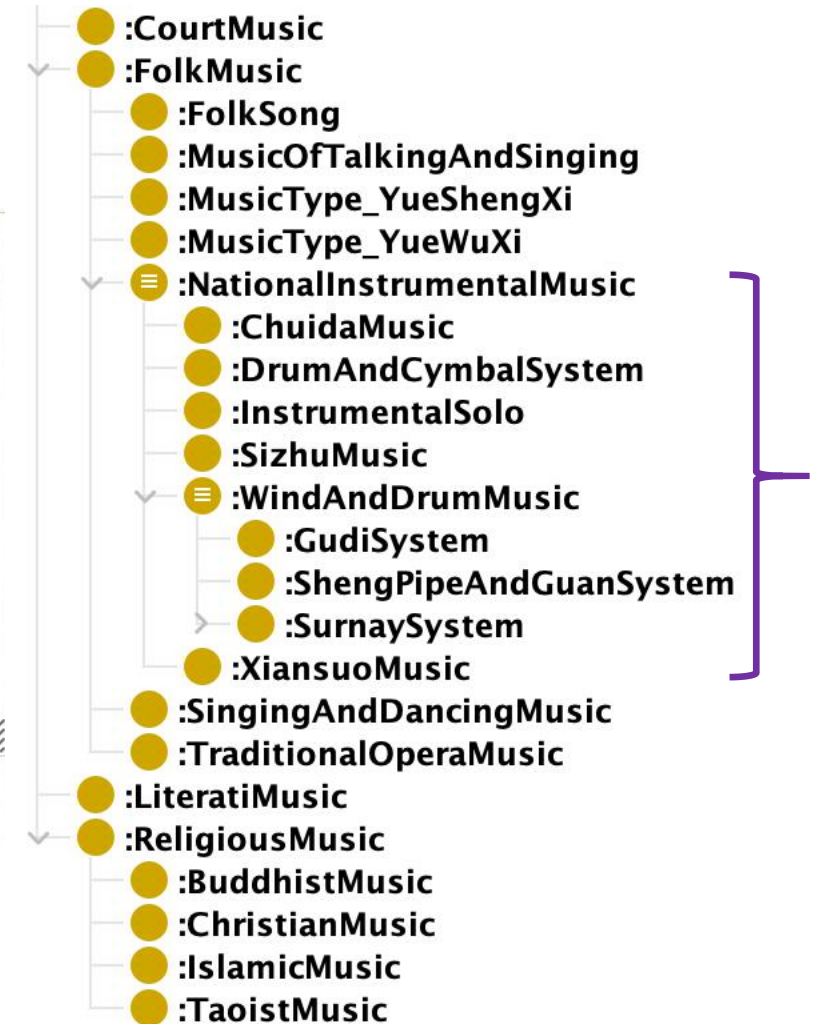


SPARQL query based on knowledge reasoning/inference

- ontology-based reasoning activation

```
1 # note:
2 # Users can remove the hash symbol (#) before 'define' to
3 # activate the reasoning engine, so that inferred and completed
4 # data can be obtained during queries.
5 # define input:inference 'urn:owl.ccmusicrules0214'
6 PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
7 PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
8 SELECT * WHERE {
9   ?sub ?pred ?obj .
10 } LIMIT 10
```

Table Raw Response  retrieved data can be downloaded as RDF



e.g., Find the national instrumental music.

SPARQL query based on knowledge reasoning/inference

- ontology-based reasoning activation

e.g., Find the national instrumental music

```
define input:inference 'urn:owl.ccmusicrules0214'
```

```
PREFIX ctm:
```

```
<https://lib.ccmusic.edu.cn/ontologies/chinese_traditional_music#>
```

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
```

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
```

```
SELECT * WHERE {
```

```
  ?MusicSpecies a ctm:NationalInstrumentalMusic;  
                rdfs:label ?label }
```

without supplementation from reasoning: 132 entries → 1290 entries



Through the activation of reasoning capabilities, resources belonging to child-classes of NationalInstrumentalMusic are automatically retrieved. This effectively addresses the inherent limitations of conventional flat cataloging and classification methodologies.

Digital Humanities Application: correspondence between geo music branches and language branches / language families

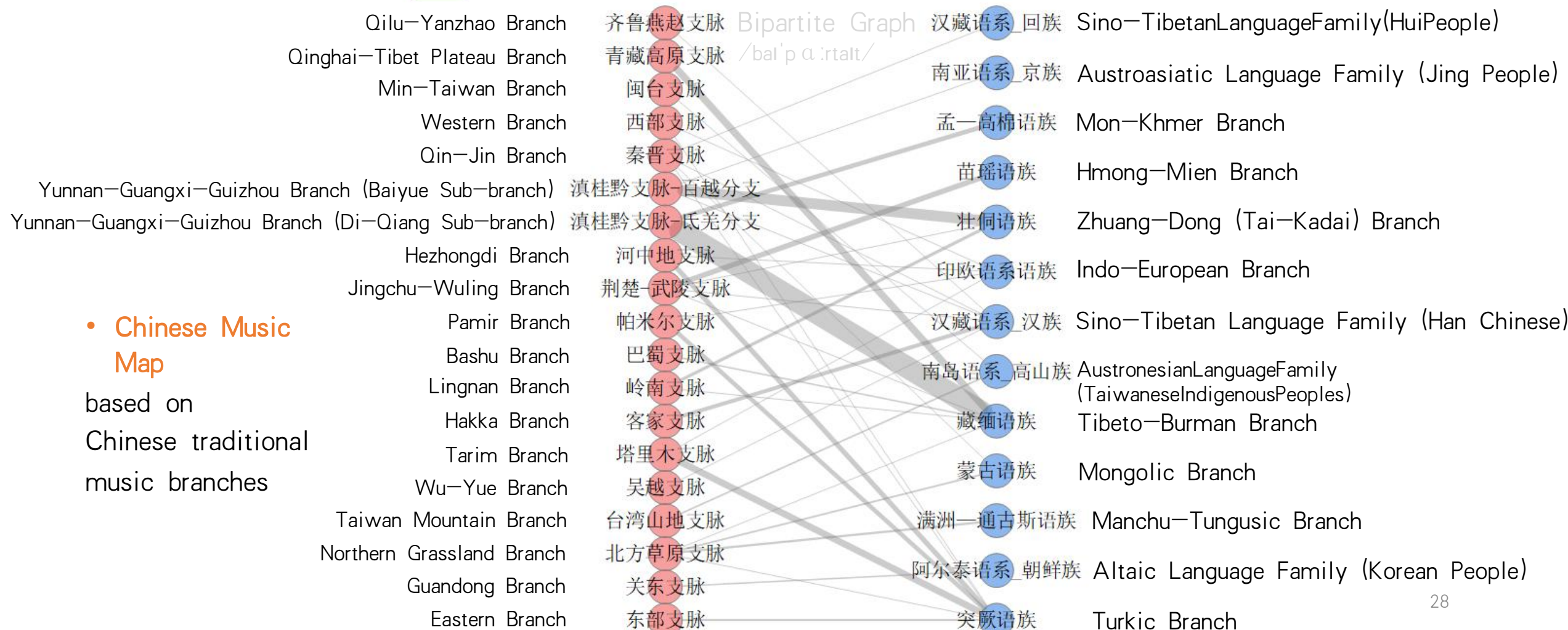




 retrieved data can be downloaded as RDF

Bipartite Graph

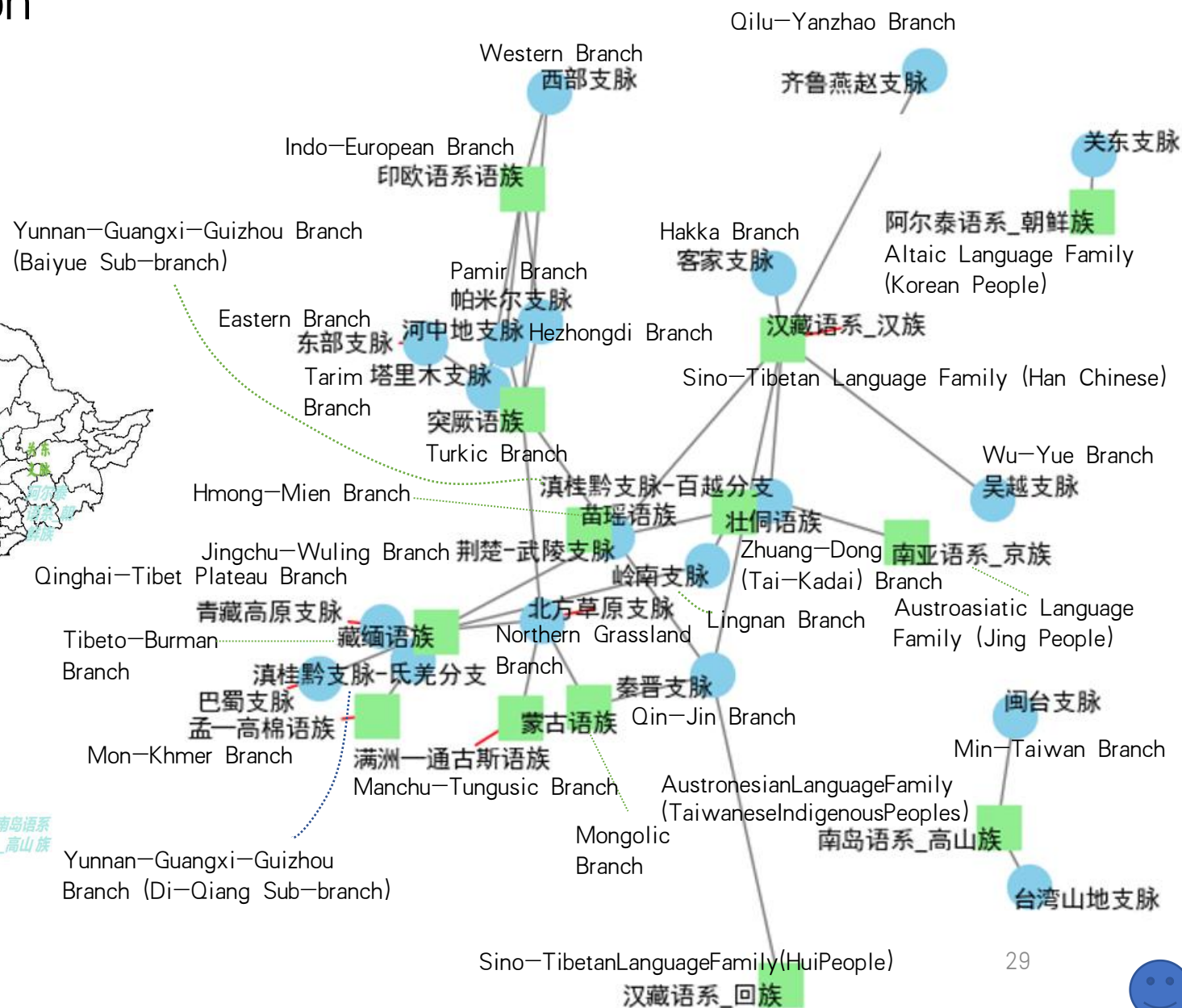
/baɪ'pɑ:rtalt/



Chinese Music Map

based on
Chinese traditional
music branches

- Chinese music map based on Traditional music branches

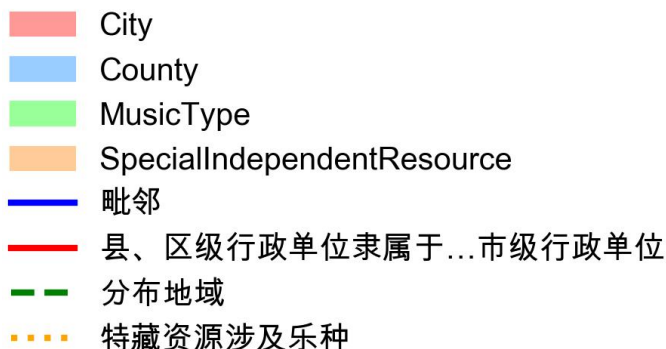


Digital Humanities Application: geographical music research

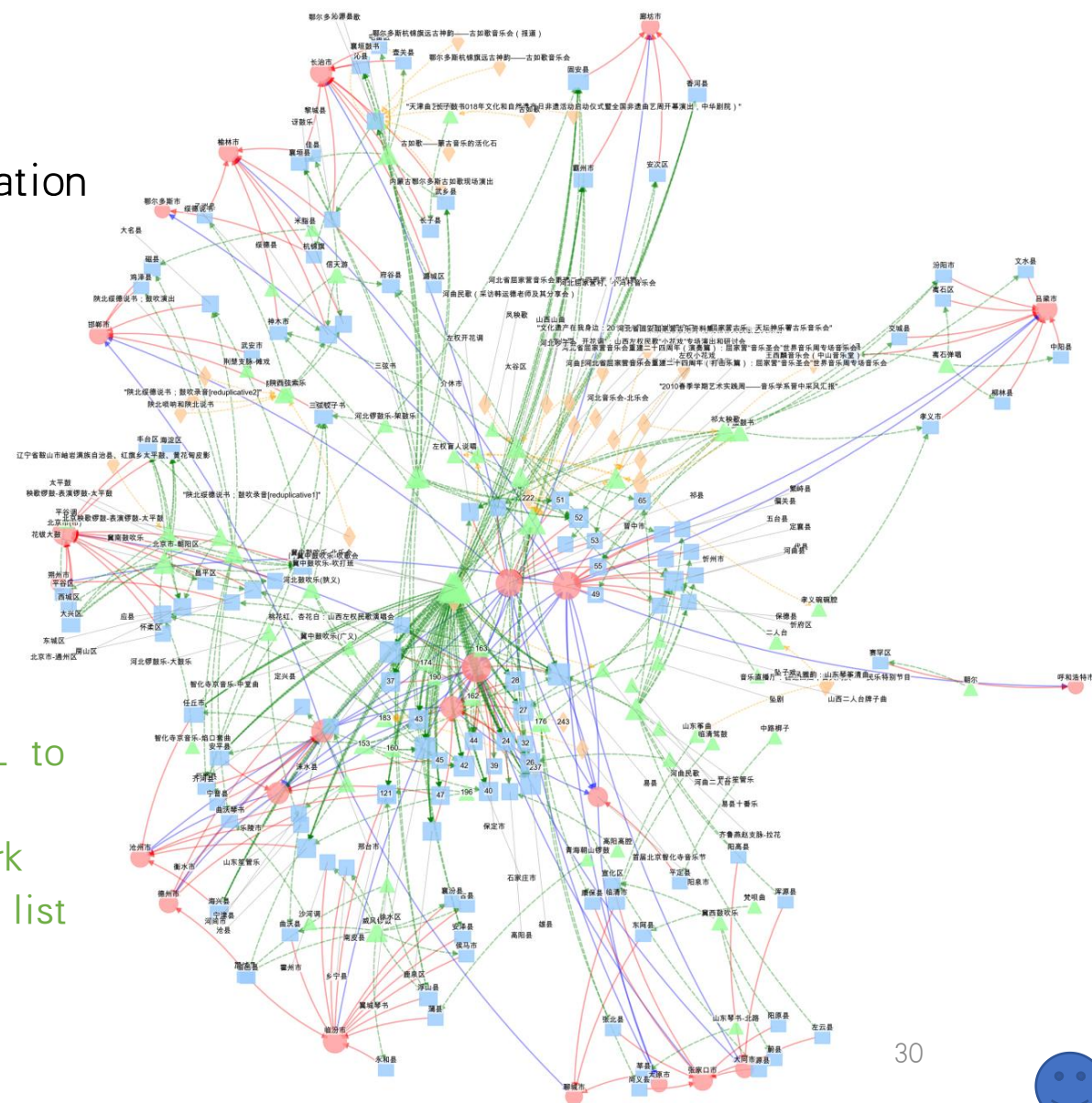
- 1. retrieval based on geographical neighbouring relation

What musical genres exist in other cities within a 2-step range adjacent to Shijiazhuang City, Hebei Province, and their subordinate administrative units at all levels? Regarding these musical genres, does our library/museum have any special collections or resources?

图例 (Legend)



We can use SPARQL to obtain heterogeneous network data (in typed edge list format)



Digital Humanities Application: geographical music research

- 2. retrieval based on geographical coordinates

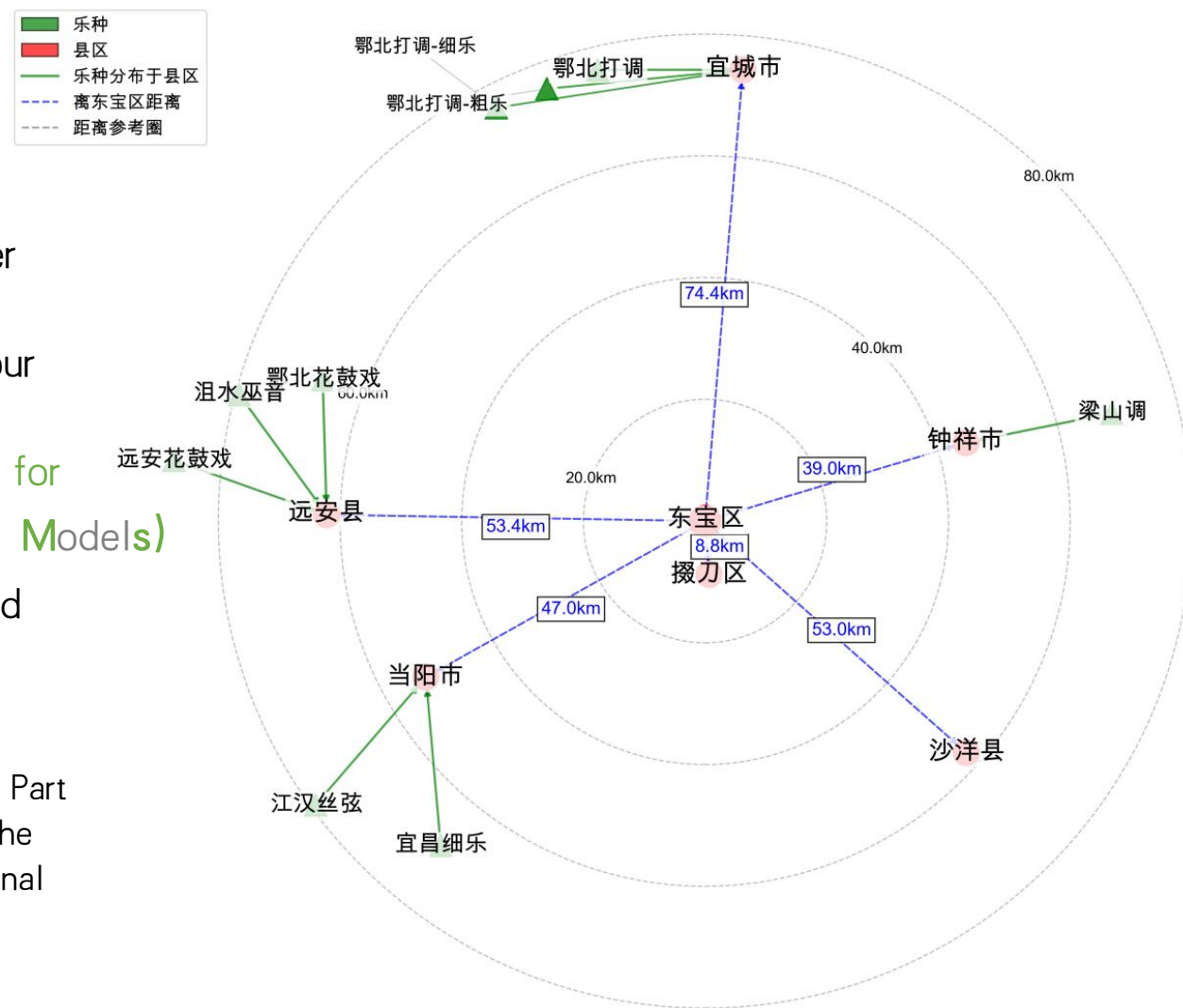
- What music genres exist within a 75-kilometer radius of Jingmen City (Dongbao District), Hubei Province, and among these, which ones are in our library's collection?

—SPARQL results → LLMs → python scripts for visualization:
(short for Large Language Models)

- The distances and positions precisely correspond to the real map.

- Answer:

There are 3 items related: 'Hubei Xianghe Daozhuizi Series Part One: Hubei "Xianghe Daozhuizi" Performance', 'Hubei Xianghe Daozhuizi Series Part Two: "Xianghe Daozhuizi" as a Regional School and Its Formation (Yao Yijun)', and 'Hubei Xianghe Daozhuizi Series Part Three: "Xianghe Daozhuizi" Lecture'.



up to now

Question: Should music librarians master SPARQL before conducting complicated retrieval?

—Not Necessarily!

prevalence • LLMs to convert users'

Natural Language Question (NLQ) to SPARQL with “prompt engineering”

• Context: ontology snippet (serving as the schema) that reflects the structure of the NLQ

brings up • Issue: How to find a corresponding ontology snippet for varied questions? If we provide the whole, LLMs may not concentrate...

straightforward line of thought

The screenshot shows the 'China Conservatory of Music Library' (中国音乐学院图书馆) website. The header includes navigation links: Music type, Instrument Library, Special Collection, Independent Resources_Works, Metadata Ontology, Knowledge Graph, AI Assistant, and about Us. The main section is titled 'intelligent Question answering Assistant' (智能问答助手). Below the title is a text input field with the placeholder '请输入您的问题:' and a sample question: '我馆有什么特藏资源涉及甘美兰音乐, 该资源涉及的地域在哪?'. Below the input field are two dropdown menus: 'Entity Count' (根据实体数量决定处理策略, 范围10~50, 默认25) and 'Max Retries' (报错重试次数, 最多3次, 默认3). Below these is a large blue button labeled '开始问答'. Below the button is a section titled '示例问题' (questions for instance) with a list of sample questions, each with a right arrow icon. The sample questions are: '泪水巫音的主奏乐器有哪些?', '有没有涉及泉州北管这个乐种的曲目?', '我馆有什么特藏资源涉及甘美兰音乐, 该资源涉及的地域在哪?', '云南省有哪些音乐类型 (乐种), 这些乐种可能用到什么乐器, 这些乐器又可能涉及哪些族群 (这些族群又可能属于哪些语族)?', and '我想看看乐器中, 哪些是涉及新疆维吾尔自治区 (地域) 或中国的大西北地区的, 尤其是它的弹拨乐器 (也可以考虑从霍萨分类法的角度来考察)。再如, 这些乐器可能用在我们的哪些特藏资源或者演出的曲目中?'.

Digital Humanities Application: Intelligent Question-answering System

- my paper: *ESEA (East-and-Southeast-Asian) Traditional Music and Its Ontology-Subgraph-Driven NLQ2SPARQL Intelligent Question-Answering System Research* (to be published on *Cataloging and Classification Quarterly*)

- **Workflow:**

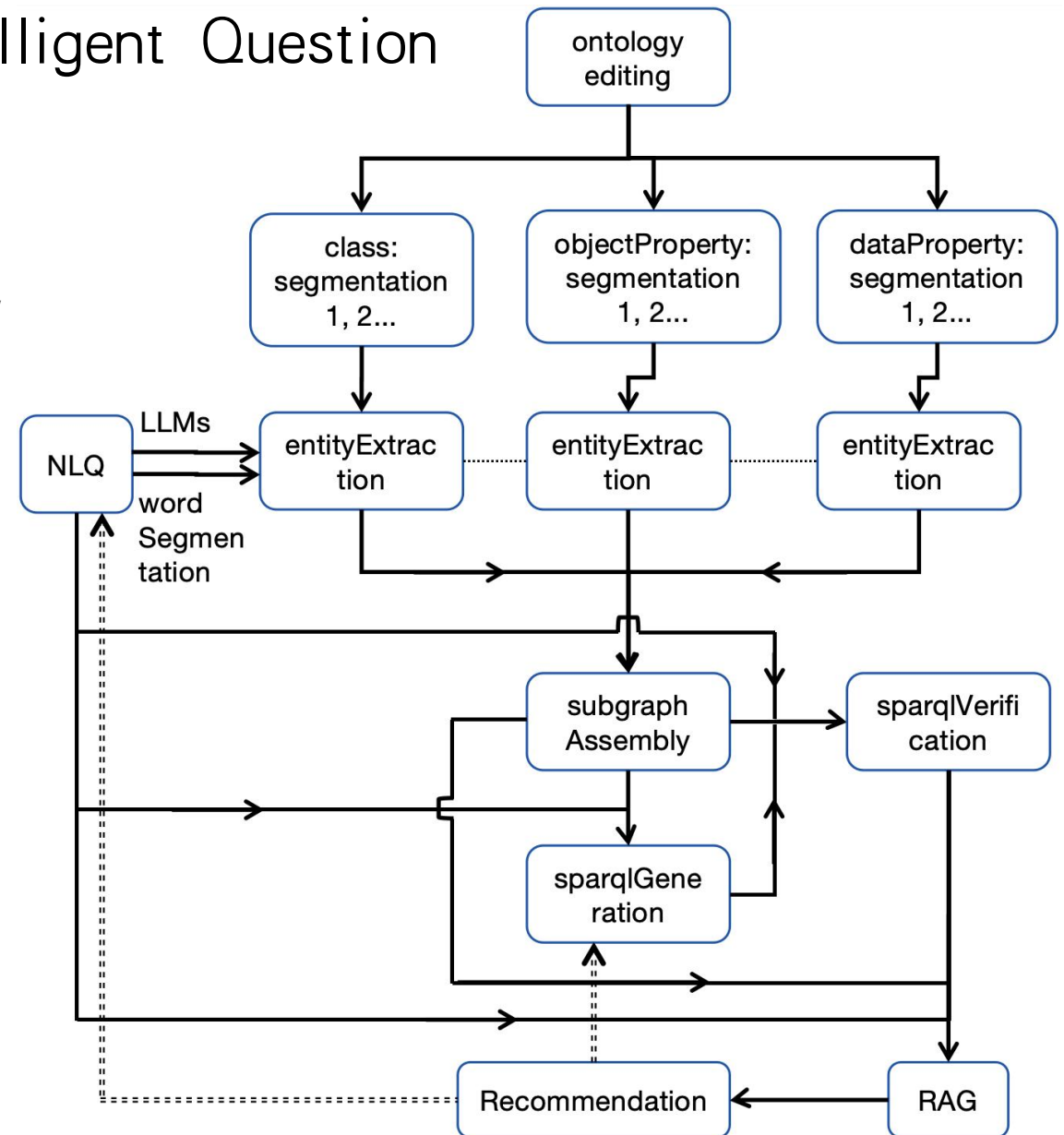
- 1. Specific Ontology Editing

- —Protege

- (1) Clarification and Enrichment of ...

- (2) Semantic reinforcement. Eg: inverse
 - use ontology to replace shapes

- (3) Simplification



Intelligent Question—answering System Workflow

- 2. Ontology Segmentation: into 3 parts

- 3. Entity Extraction from the Ontology Segments

LLMs are prompted to extract (isolated) entities from an NLQ by mapping them with all segments of the ontology. Hereby, the “entities” also include class, property, or instance.

—**key point!** It decides whether this approach is robust enough

- 4. (Ontology) Subgraph Re—Assembly

- Ontology is also a special graph! The nodes represent classes,

- Ambiguity of NLQ—>extract more entities than actually need—>basis for recommendation

intelligent Question—answering System Workflow

- mainbody • 5. SPARQL Generation and Verification Based on Subgraph
 - (1) Claude 4 (2) reflection: ontology for validation instead of shapes
- 6. Retrieval Augmented Generation(RAG)
 - Illustration on the retrieval result...
 - > A combination of LLMs' general knowledge and Knowledge Graph's domain-specific knowledge
 - 2 scenarios of the results:
 - (1) If the result is too large or complicated (2) If the result is too small or even empty:
 - broaden the retrieval scope by relaxing query conditions/constraints in the SPARQL query, and other possible query patterns can be recommended
- 7. Recommendation System: based on the neighborhood in the ontology subgraph

intelligent question—answering system workflow

- The recommended pairs of NLQ & SPARQLs are based on the neighbourhood of the subgraph
 - ontology neighbourhood + other SPARQL $\overset{\text{inversely}}{\Rightarrow}$ other NLQs (e.g.):
 - (1) What acoustic classification does the Dobro belong to, and what other instruments are in the same acoustic classification?
 - (2) In the regions where Dongbula is distributed, besides plucked string instruments, what other types of instruments are there?
 - (3) What music types or genres are found in the regions where Dongbula is distributed?
 - knowledge reasoning
 - knowledge Question—Answering
 - knowledge recommendation
- \Rightarrow a robust system with nearly 100% recall rate and 80% precision

Fu Xiaodong

Fu Xiaodong, PhD in Music Acoustics, Professor, Doctoral Supervisor, Visiting Scholar at the Music Technology Center of Georgia Institute of Technology (2014-2015), Beijing Great Wall Scholar (2017). He is currently the Director of the Academic Affairs Office and the Director of the Library of the China Conservatory of Music. He is also a member of the Chinese Musicians Association, a director of the Chinese Electronic Music Society, the Deputy Director of the Musical Instrument Technology Professional Committee of the China Performing Arts Equipment Technology Association, a member of the Performance Venue Equipment Professional Committee, a member of the Music and Sound Professional Committee of the China Higher Education Film and Television Society, and a member of the Art and Reading Professional Group of the Tenth Council of the Chinese Library Association. His main research direction is music acoustics and music technology. He has published more than 40 papers and three monographs, and has presided over more than ten projects of the National Social Science Fund, the Ministry of Culture and Beijing Municipality.

Cao Junjun

Si Shaojun (Cao Junjun), PhD in Music Communication and Information Intelligence, Postdoctoral Fellow at the Chinese Music Research Institute of China Conservatory of Music and the Department of Music Technology of Schulich School of Music of McGill University, Part-time Researcher at China Music Research Base, Visiting Scholar at Cultural Heritage Intelligent Computing Laboratory of Wuhan University. Chief Expert of LinkedMusic Project of McGill Distributed Digital Music Archive Laboratory (2024-2025), Member of International Music Library Association, Member of Chinese Traditional Music Society, etc. His main research directions are music knowledge base and knowledge graph, etc. He has been the editor-in-chief of the "China Book and Audiovisual Publishing Industry Development Report" issued by the Industrial Development Research Center of Communication University of China for many years. He has published more than 30 papers, published several music works, participated in 1 major project, and presided over 4 provincial and ministerial projects.

Chen Tao

Chen Tao, PhD in Engineering, is a talent introduced by Sun Yat-sen University's "Hundred Talents Program". He is an associate professor and a master's supervisor. He is a postdoctoral fellow jointly trained by Shanghai Library (Shanghai Institute of Scientific and Technical Information) and School of Information Management of Nanjing University. He has served as the project manager of the Shanghai Library System Network Center and an engineer at the Shanghai Life Science Information Center of the Chinese Academy of Sciences. He is also a member of the China Open Data Forest Index Evaluation Expert Committee of Fudan University, a member of the Digital Humanities Professional Committee of the Chinese Society for the History of Science and Technology, a member of the Digital Humanities Professional Committee of the Chinese Indexing Society, and a reviewer for many journals. He has long been engaged in research on emerging technologies such as semantic web, linked data, machine learning, and knowledge graphs in digital humanities and big data. He has rich theoretical and practical experience and has been responsible for more than ten horizontal projects related to linked data and digital humanities. In recent years, he has published dozens of papers in core journals such as Journal of Library Science in China, Journal of University Libraries, and Library and Information Work.

The project has received strong support from the Technical Department of the Library of the China Conservatory of Music and teachers and students of the Digital Humanities Workshop; it has also received attention and professional support from a series of experts and scholars in the field of traditional music in China. The works of some experts and scholars are important sources of metadata cataloging information for this project: such as Du Yaxiong (Overview of Folk Music of Ethnic Minorities in China), Wang Yaohua (Introduction to Traditional Chinese Music, 2020 edition), Ying Youqin (Dictionary of Chinese Musical Instruments), Yuan Jingfang (Introduction to Chinese Musical Species, 2021 edition), Lu Yingkun, Zhao Xiaonan, Wu Xiaoping, Jing Entao, Huang Siqi, Wan Xiaodong, etc. The project database construction has received foreign support from Professor Wang Xiaoguang, Director of the Cultural Heritage Intelligent Computing Laboratory of Wuhan University, Professor Ichiro Fujinaga of the Schulich School of Music of McGill University, Professor Jia Junzhi of the School of Information Resources and Resource Management of Renmin University of China, Professor Ou Shiyan of the School of Information Management of Nanjing University, and Mr. Zhu Houquan, General Manager of Beijing Yuanyin Technology Co., Ltd. Special thanks!

questions and interaction

- I would greatly appreciate it if you could talk slowly and clearly with me.
- For the consecutive information about linked data/semantic web technologies application in music database, please refer to the session of Wednesday (tomorrow):
- Session: **Databases for Music Libraries and Archives**
- Our Paper Title: **LinkedMusic Project: Integrating Online Music Databases**
- <https://linkedmusic.ca/>



Conseil de recherches en
sciences humaines du Canada

Social Sciences and Humanities
Research Council of Canada



Thanks for your criticism
& suggestion!

Email:

alienmusedh@gmail.com

Junjun Cao

—June

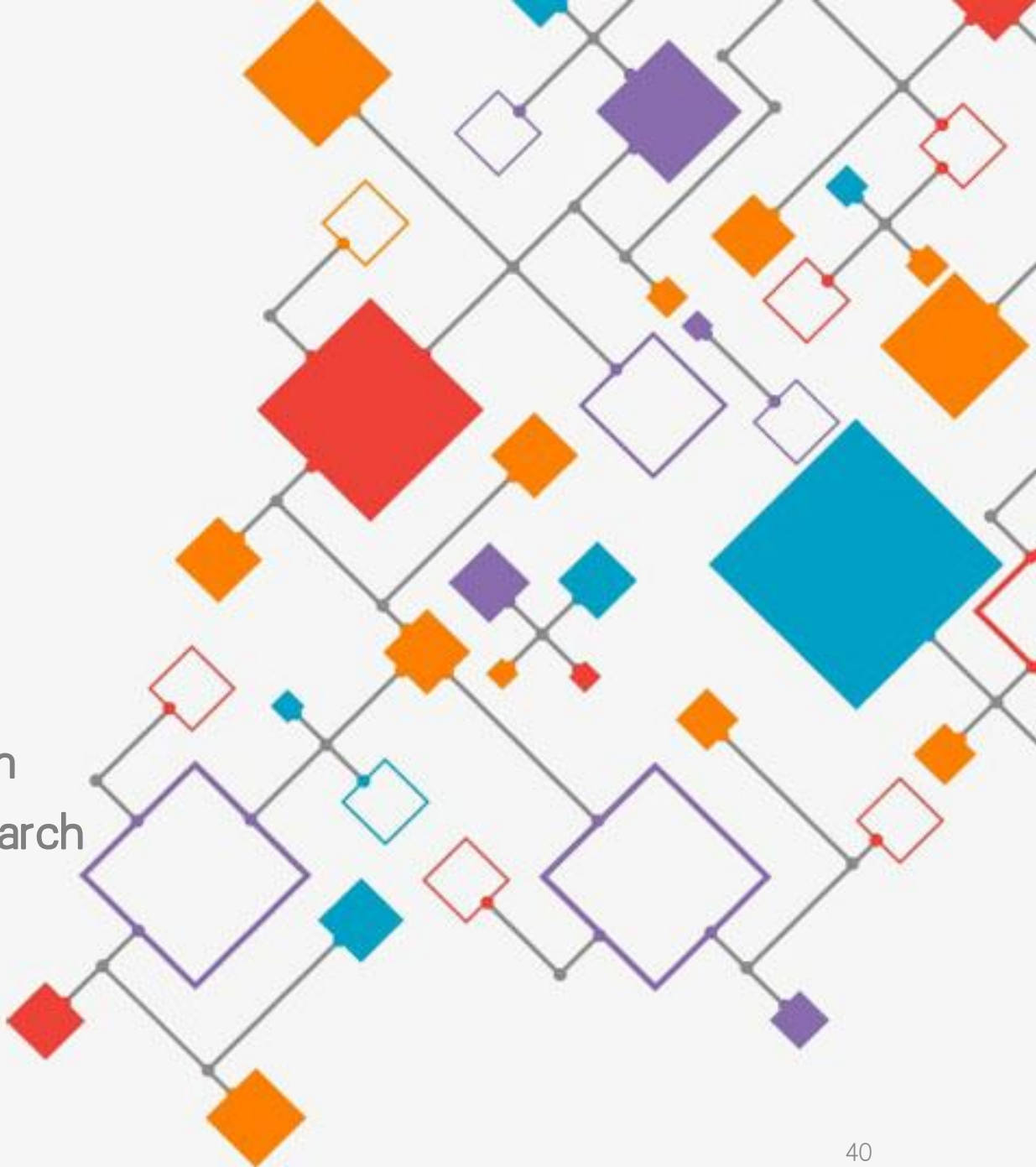
This is supported in part by funding from
the Social Sciences and Humanities Research
Council (SSHRC) in Canada



Conseil de recherches en
sciences humaines du Canada

Social Sciences and Humanities
Research Council of Canada

Canada



Potential Questions

- 1. Your abstract references a comparative analysis between Symbolic AI embodied in knowledge graphs and Connectionist AI. Could you elaborate on how the two **paradigms** were implemented or represented in your research framework?
- 2. Given your observation that Connectionist AI (notably large language models) currently dominates music technology, what strategic recommendations would you propose for balancing this trend with symbolic knowledge systems in the development of music digital humanities or library infrastructures?

Q: Your abstract references a comparative analysis between Symbolic AI embodied in knowledge graphs and Connectionist AI. Could you elaborate on how the two paradigms were implemented or represented in your research framework?

- **R:** Symbolic AI is actually less of what AI appears nowadays such as ChatGPT, deepseek—the intelligent large language models. It's based on structure and symbols, logic and reasoning. Knowledge graph, especially one with embedded ontology is already on the way of Symbolic AI. Ontology-based knowledge reasoning is very typical of Symbolic AI.
- On the other hand, LLMs are a representative of Connectionist AI. We use LLMs to extract entities with context of ontology, to even verify ontology, and to perform NLQ2SPARQL, which are typical **synergy** of Symbolic AI and Connectionist AI.
- What is worth mentioning is, the building of the robust question-answering (Q-A) system workflow, incorporating knowledge's reasoning, Q-A, recommendation and Retrieval Augmented Generation (RAG) is a close combination of the 2 branched of AI.

Q: Given your observation that Connectionist AI (notably large language models) currently dominates music technology, what strategic recommendations would you propose for balancing this trend with symbolic knowledge systems in the development of music digital humanities or library infrastructures?

- R: A good time to revitalize symbolic AI with the assistance of LLMs. We can handle that, because it requires low threshold, and echos the spirit of DH.
- symbolic AI \rightarrow white box. It can serve the formalized and specialized representation of musicology knowledge, which lays the foundation of a flexible AI Q–A system.
- Focus on knowledge graph!
 - Is knowledge graph to be obsolete in the future? \Rightarrow quite adaptable in the library's ecosystem
 - philosophical proposition: **structured info** vs. non-structured info
 - philosophical proposition: Human are born to respect or like knowledge in a both **structured** and **intuitive** way.
- To avoid clash with **Music AI**, we can advocate **Music DH** where humanitarians will play a decisive and vital role: one body and two wings