Purpose and properties of the JSKOS data format for knowledge graphs

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Introduction

Terminology

- **Such as**: classifications, thesauri, ontologies...
- **Known as**: terminologies, knowledge organization systems, semantic artefacts, concept schemes, knowledge graphs...
- **Core idea**: things, not strings
- **Done with**: URIs, labels & links between

JSKOS In a nutshell

- Encoding SKOS and related artefacts (concepts, mappings, concordances…) in JSON
- Established infrastructure for controlled vocabularies at VZG
- Mature specification at `https://gbv.github.io/jskos/`
  JSKOS 0.7.0 just released yesterday

Background and motivation

- Project **coli-conc** (2013-): infrastructure for (mappings between) knowledge organization systems
- **Cocoda** web application combines terminologies, mappings, annotations via APIs in the client ⇒ JSON
- Integration of federated data ⇒ RDF

Influences and references

- **SKOS** for core classes and properties
- **JSON-LD** and existing ontologies (DCAT, vCard, XKOS, SSSOM…) for URIs and mapping to RDF
- Skosmos and other **APIs**
- **Wikibase** Data Model
- **Standards**: Web Annotation Data Model for annotations, GeoJSON for geospatial data, IIIF for media, RFC 6570 for URI Templates, XSD for Data Types…

JSKOS Features by examples

Concepts


```
{
  "type": [
    "http://www.w3.org/2004/02/skos/core#Concept"
  ],
  "notation": [ "641" ],
  "uri": "http://dewey.info/class/641/e23/",
  "prefLabel": {
    "en": "Food & drink",
    "de": "Essen und Trinken"
  }
}
```


Class **641** from Dewey Decimal Classification (DDC)

Mappings

```
{
  "type": [ "http://www.w3.org/2004/02/skos/core#exactMatch" ],
  "from": {
    "memberSet": [ {
      "uri": "http://dewey.info/class/641/e22/",
      "prefLabel": { "en": "Food & drink" }
    } ]
  },
  "to": {
    "memberSet": [ {
      "uri": "http://www.wikidata.org/entity/Q118451828",
      "prefLabel": { "en": "food and beverage" }
    } ]
  },
  "justification":
      "https://w3id.org/semapv/vocab/ManualMappingCuration",
  "tool": [ { "url": "https://coli-conc.gbv.de/cocoda/" } ]
}
```

Concept Bundles


```
{
  "uri": "http://dewey.info/class/641.50902/e23/",
  "notation": [ "641.50902" ],
  "memberList": [ {
      "uri": "http://dewey.info/class/641/e23/",
      "prefLabel": { "en": "Food & drink" }
    }, {
      "uri": "http://dewey.info/class/1--0902/e23/",
      "prefLabel": {
        "en": "6th to 15th century (500-1499)"
      }
  } ]
}
```


Combined DDC class for “medieval cuisine”

Concept Occurrences


```
{
  "database": {
    "uri": "http://uri.gbv.de/database/opac-de-627"
  },
  "memberSet": [ {
    "uri": "http://dewey.info/class/641.50902/e23/",
    "prefLabel": { "en": "Fodd & drink" }
   } ],
  "count": 18,
  "modified": "2025-11-17",
  "url": "https://opac.k10plus.de/DB=2.299/CMD?ACT=SRCHA&IK
}
```


18 records on medieval cuisine in K10plus catalogue

JSKOS Overview

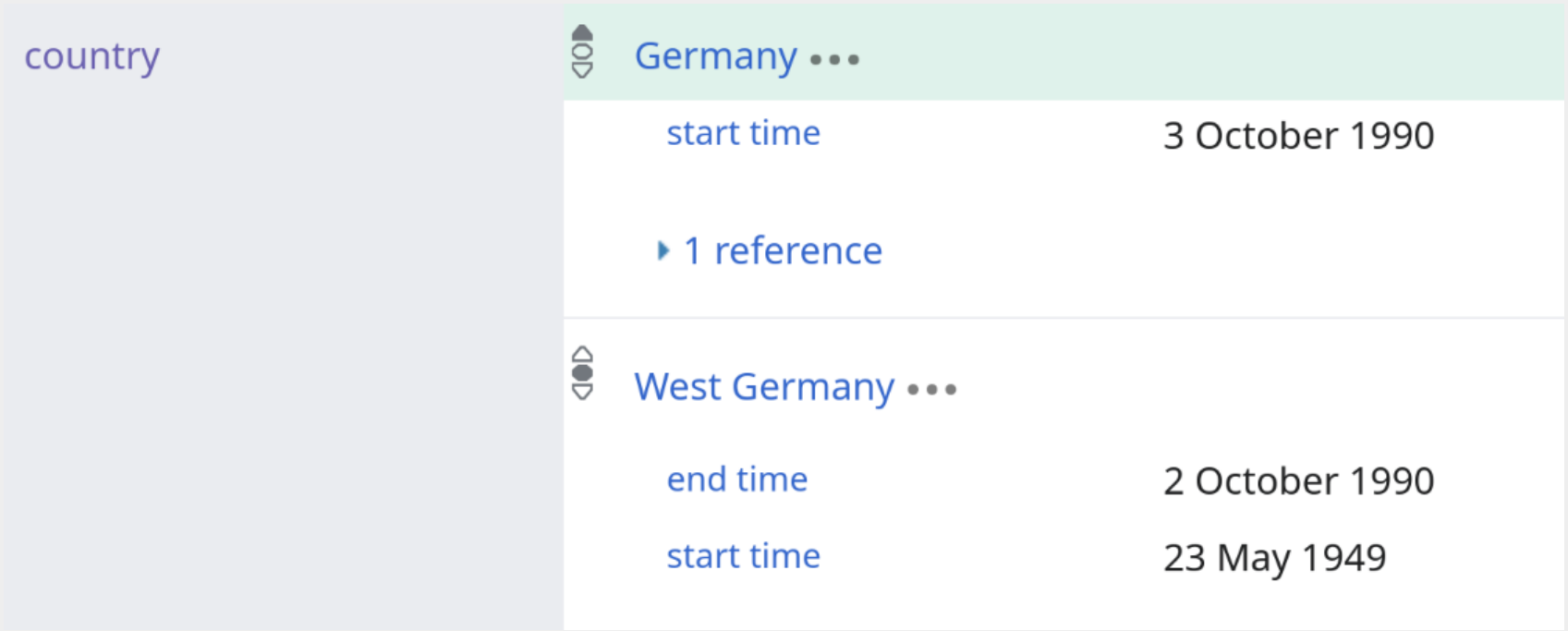
JSKOS Object types

- Superclasses
  - **Item** (named entity) and **Resource** (anything)
  - ***Concept Bundles*** (combined concepts)
- ***Concepts*** and **Concept Schemes**
- ***Mappings*** and **Concordances**
- ***Occurrences*** of Concepts
- **Registries**, **Distributions** and **Services** to collect and access
- Subsets of JSON formats IIIF, GeoJSON, and Web Annotation

Common fields of JSKOS items

- prefLabel, altLabel...
- identifier
- previous, next
- startDate, endDate
- location, address, media...
- version, versionOf
- ...

Qualified statements



Qualified statements

```
{ "prefLabel": { "en": "Göttingen" },
  "qualifiedRelations": {
    "http://www.wikidata.org/entity/P17": [ {
      "resource": {
        "uri": "http://www.wikidata.org/entity/Q183",
        "prefLabel": { "en": "Germany" }
      },
      "rank": "preferred",
      "startDate": "1990-10-03",
      "source": [ { ... } ]
    }, {
      "resource": {
        "uri": "http://www.wikidata.org/entity/Q713750",
        "prefLabel": { "en": "West Germany" }
      },
      "rank": "normal",
      "startDate": "1949-05-23", "endDate": "1990-10-02" } ] } }
```

Qualified statements

- Inspired by Wikibase data model
- Ranking (`preferred`/`normal`/`deprecated`)
- References
- Arbitrary fields, identified by URIs
  $\Rightarrow$ Full knowledge graph format
- Flexibility & extensibility at cost of full interoperability

Closed world statements

- *missing field*: unknown
- `[]`: no value exists
- `[..., null]`: more values exist

Applications of JSKOS

Use cases

- Cocoda, BARTOC, DANTE... at VZG
- NFDI4Objects & TS4NFDI
- Slowly being adopted outside of VZG
  (2 or 3 implementations)

Applications & Libraries

- **jskos-server**: DBMS to store JSKOS data
- **jskos-vue**: widgets to nicely display JSKOS objects in browser (e.g. tree)
- **jskos-proxy**: serve and browse JSKOS data (terminologies) as Linked Open Data
- **jskos-tools**: helper functions for JSKOS data
- **jskos-cli**: tools to validate and convert JSKOS data
- **subjects-api**: query subject indexing of K10plus catalogue in JSKOS via JSKOS-API

JSKOS API

Relevant, but not focus of this talk.

- GET/POST/PUT/PATCH data in JSKOS format
- Defined read & write endpoints for concepts, mappings, annotations...
- Optional authentification included
- Multiple implementations exist (servers and clients)!

Beyond JSKOS

Some limitations of JSKOS

- Labels MUST have language tag (use `und` for undefined)
- Notations don't have data types
- No support of SKOS Collections (yet?)
- Fields about entities and metadata are mixed
  (e.g. `startDate` vs. `created`)
- Wikibase data model only covered partially
- No standards body behind the specification

Alternatives

- Plain RDF or RDF*
- JSON-LD
- Property Graphs

Limitations of RDF

Most elements of JSKOS can directly be mapped from/to RDF!

- Agreement on global URIs required
- Triple store required to access data
- Reification (e.g. data about mappings)
- RDF* adds more complexity

Limitations of JSON-LD

Most of JSKOS is JSON-LD, there is a non-normative JSON-LD context!

- Triple store required to access data (?!)
- Multiple ways to express the same data
- Only JSON Schema can guarantee a strict JSON format

Property graphs

- Easier to work with than RDF/SPARQL (tools)
- Not for merging data
- No standard data format exists (see Property Graph Exchange Format for a proposal)

When to use JSKOS

- Access to terminology APIs from VZG, in particular mappings
- Processing of semantic artefacts in JSON
- RDF compatibility without RDF technology stack

Please ask & try out!