

# FOUNDATIONS IN LINKED DATA FOR SERIALISTS

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NASIG

Amber Billey ([abilley@bard.edu](mailto:abilley@bard.edu))  
Bard College Libraries  
Robert Rendall ([rr2205@columbia.edu](mailto:rr2205@columbia.edu))  
Columbia University Libraries

# AGENDA AND LEARNING OUTCOMES

- Linked Data 101 (Robert)
- Ontology Basics (Amber)
- Turtle Tutorial (Amber)
- Serials RDA Elements in BIBFRAME (Robert)
- Hands-on lab time!

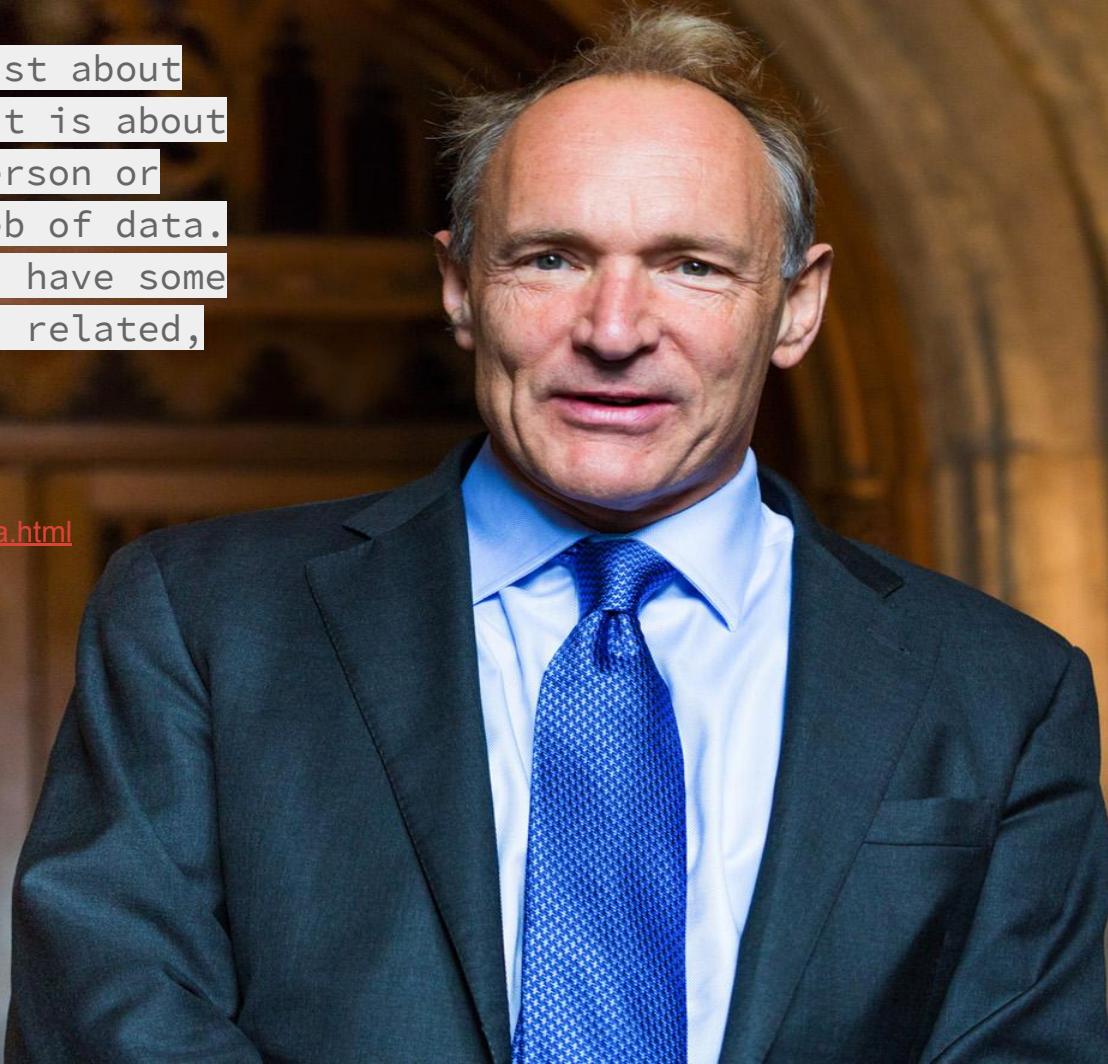
[https://github.com/amberbilley/NASIG18\\_LDworkshop](https://github.com/amberbilley/NASIG18_LDworkshop)

# LINKED DATA 101

“The Semantic Web isn't just about putting data on the web. It is about making links, so that a person or machine can explore the web of data. With linked data, when you have some of it, you can find other, related, data.”

<https://www.w3.org/DesignIssues/LinkedData.html>

Tim Berners-Lee, 2006



# RULES OF LINKED DATA

- Use URIs as names for things
- Use HTTP URIs so that people can look up those names.
- When someone looks up a URI, provide useful information.
- Include links to other URIs so that they can discover more things.

<https://www.w3.org/DesignIssues/LinkedData.html>

# 5-STAR LINKED OPEN DATA

★

Available on the web (whatever format) *but with an open licence, to be Open Data*

★★

Available as machine-readable structured data (e.g. excel instead of image scan of a table)

★★★

as (2) plus non-proprietary format (e.g. CSV instead of excel)

★★★★

All the above plus, Use open standards from W3C (RDF and SPARQL) to identify things, so that people can point at your stuff

★★★★★

All the above, plus: Link your data to other people's data to provide context

<https://www.w3.org/DesignIssues/LinkedData.html>

# THE LINKED DATA TECHNOLOGY STACK

URI (Uniform Resource Identifier)

HTTP (HyperText Transfer Protocol)

<http://id.loc.gov/vocabulary/issuance/serl>

# THE LINKED DATA TECHNOLOGY STACK

RDF (Resource Description Framework)

```
<http://bibframe.example.org/instance/instanceY>
<http://bibframe.org/vocab/instanceOf>
<http://bibframe.example.org/work/workX> .
```

# THE LINKED DATA TECHNOLOGY STACK

RDFS (RDF Vocabulary Definition Language)

OWL (Web Ontology Language)

```
<owl:DatatypeProperty rdf:about="http://id.loc.gov/ontologies/bibframe/firstIssue">
  <rdfs:range rdf:resource="http://www.w3.org/2000/01/rdf-schema#Literal"/>
  <skos:definition>
    Beginning date of a resource and/or the sequential designations.
  </skos:definition>
  <rdfs:comment>Used with Work or Instance</rdfs:comment>
  <rdfs:label>Multipart first issue</rdfs:label>
  <dcterms:modified>2016-04-21 (New)
  </dcterms:modified>
</owl:DatatypeProperty>
```

# THE LINKED DATA TECHNOLOGY STACK

SPARQL (SPARQL Protocol and RDF Query Language)

```
PREFIX bf: <http://bibframe.org/vocab/>
SELECT ?title
FROM <http://loc.gov/catalog/dataset.rdf>
WHERE {
    ?x bf:title ?title .
}
ORDER BY ?title
```

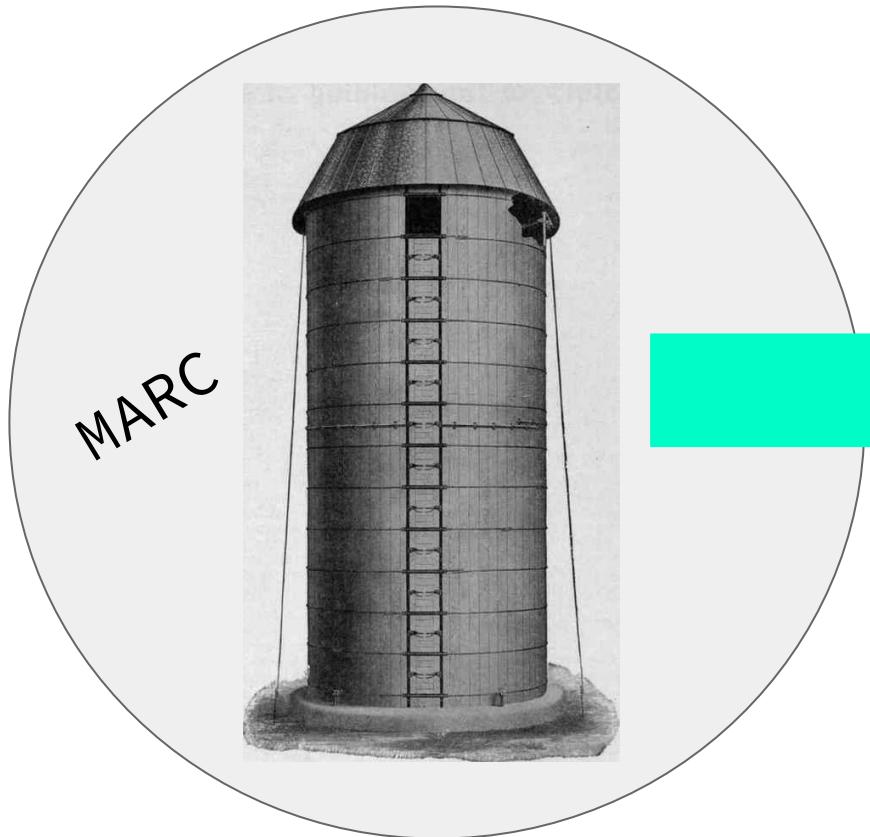
# WHO IS USING LINKED DATA?

- Search engines (schema.org)
- Wikipedia (DBpedia and Wikidata)
- Europe
- GeoNames

<http://lod-cloud.net/>

# ONTOLOGY BASICS

# MOVING FROM MARC SILOS TO THE WWW



W3C®

# DIFFERENCES BETWEEN MARC AND LD TECH STACKS

## MARC

- MARC (syntax)
- ILS (data storage and delivery)
  - SQL Database
- Z39.50 (query and transmission)
- Discovery Layer (data delivery)

## LINKED DATA

- RDF (data model)
- XML, JSONLD, N3, Turtle, ... (syntax)
- Triplestore (data storage)
- SPARQL (query)
- WWW (data delivery)

# WHAT EXACTLY IS BIBFRAME?

- BIBFRAME is a LD **vocabulary**
- Being formally encoded for machine processing using W3C standards such as **OWL** or **RDFS** makes it an **ontology**
- BIBFRAME is heavily inspired by MARC to prevent loss of legacy data
- BIBFRAME is intended to accommodate FRBR and RDA, but is structure and content standard agnostic for an evolving standards landscape

# PRIMARY DESCRIPTIVE CATALOGING MODEL AND THEIR STANDARDS

## Structure Standard

- ISBD, MARC, FRBR, Dublin Core, EAD, MODS, VRACore, CIDOC, **BIBFRAME**

## Content Standard

- AACR2, RDA, CCO, DACS, ...

## Value Standard

- LCSH, NAF, LCGFT, RDA Vocabularies, RBMS Thesauri, AAT, ...

## Encoding Standard

- 3x5 card, MARC (ISO 2709), CVS, XML, RDF-XML, JSON, Turtle ...

# CHERRY PICK VOCABULARIES. BUILD CUSTOM ONTOLOGIES.

- Build 5-star linked data
- Linked data allows for customization
- So BF can be one of several ontologies that we use for bibliographic descriptions
- Be careful!
- <https://lov.okfn.org/dataset/lov/>





The Structure Standard for Linked Data

# RESOURCE DESCRIPTION FRAMEWORK

- Conceptual model for structuring data and relationships
- It is a W3C Standard framework for data interchange on the Web
- Enables the creation of relationships between things on the Web

# THE RDF TRIPLE

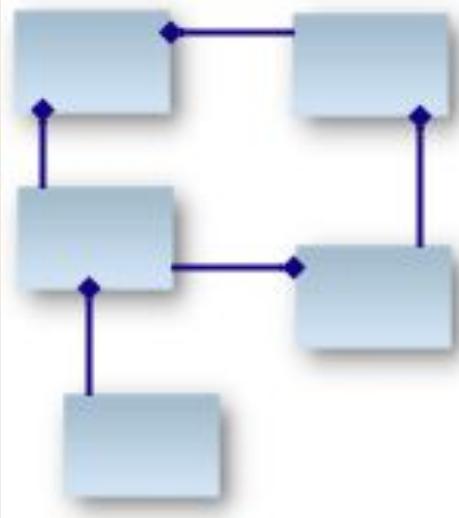


# RDF TRIPLE IN XML

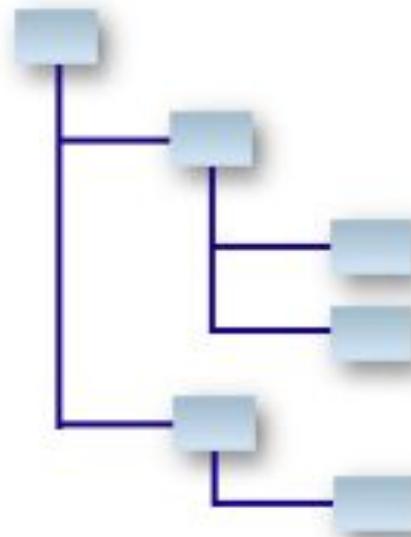
```
<?xml version="1.0"?>
<!DOCTYPE rdf:RDF PUBLIC "-//DUBLIN CORE//DCMES DTD 2002/07/31//EN"
  "http://dublincore.org/documents/2002/07/31/dcmes-xml/dcmes-xml-dtd.dtd">

<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:dc="http://purl.org/dc/elements/1.1/">

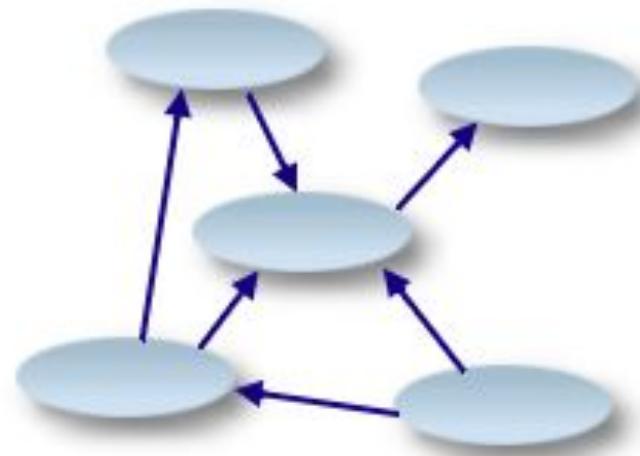
  <rdf:Description rdf:about="https://ejournals.lib.vt.edu/valib/index">
    <dc:title>Virginia Libraries</dc:title>
    <dc:publisher rdf:resource="http://id.loc.gov/authorities/names/n80023576">Virginia
    Library Association</dc:publisher>
    <dc:identifier>ISSN 1086-9751</dc:identifier>
  </rdf:Description>
</rdf:RDF>
```



**Relational DB**  
Tables Related By  
Primary Key

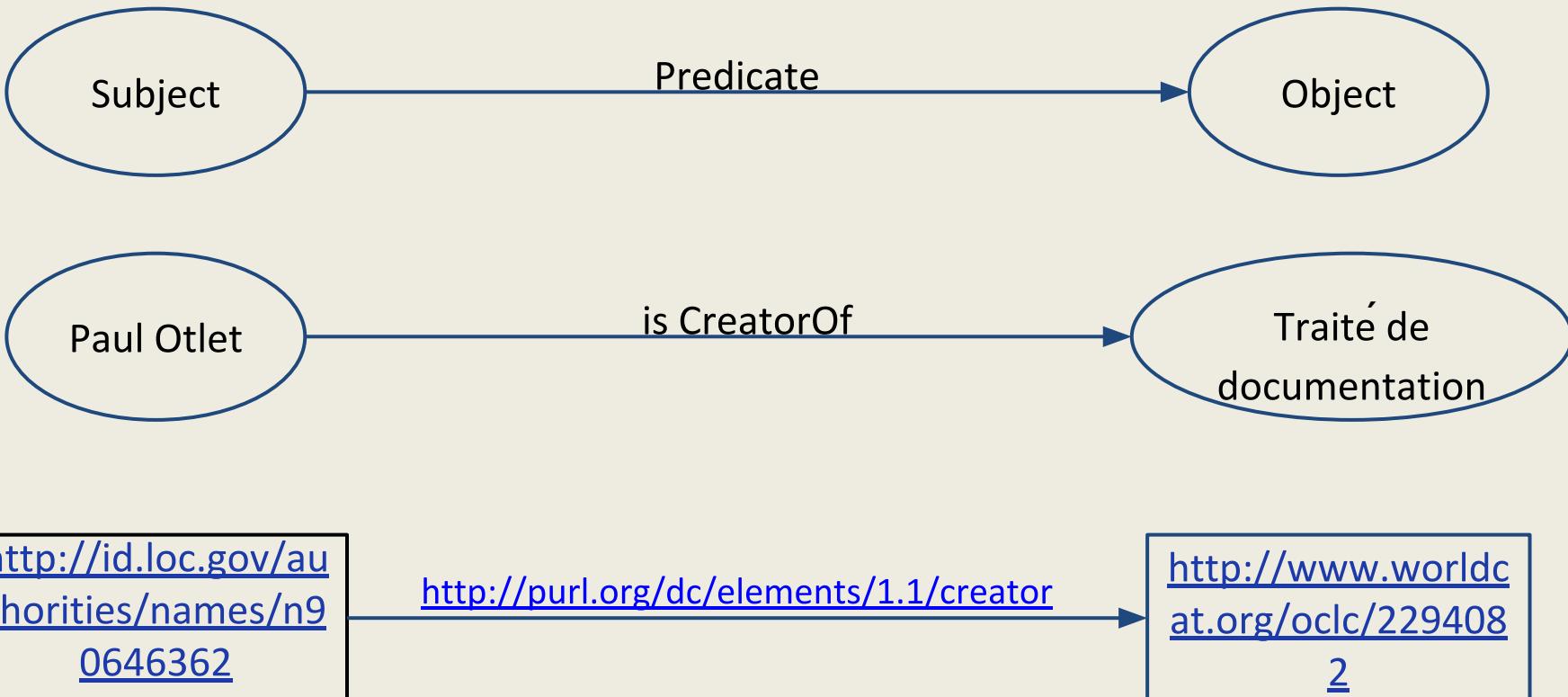


**Hierarchical DB**  
Parent Nodes Have More  
Intrinsic Importance

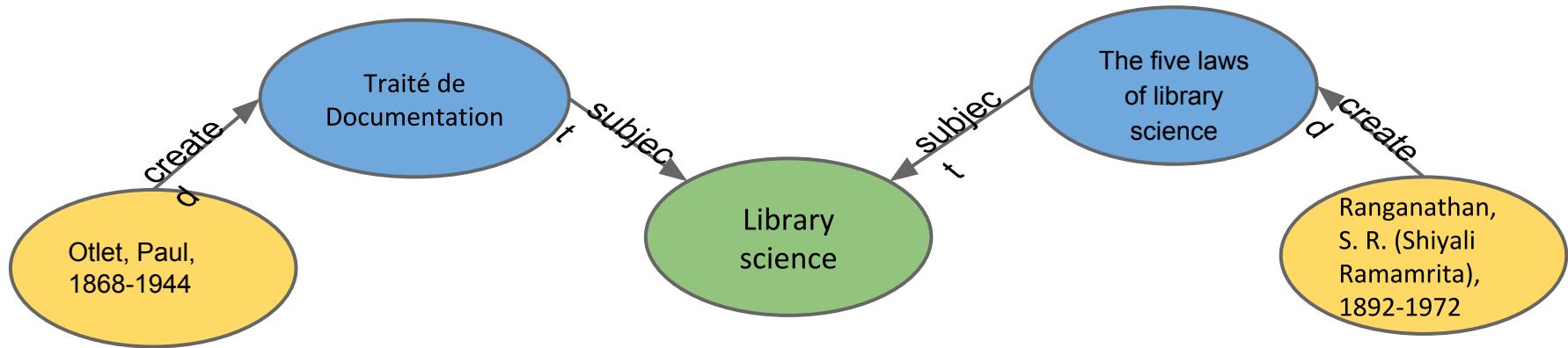


**Graph DB**  
Arbitrary Object Relations  
No Intrinsic Importance

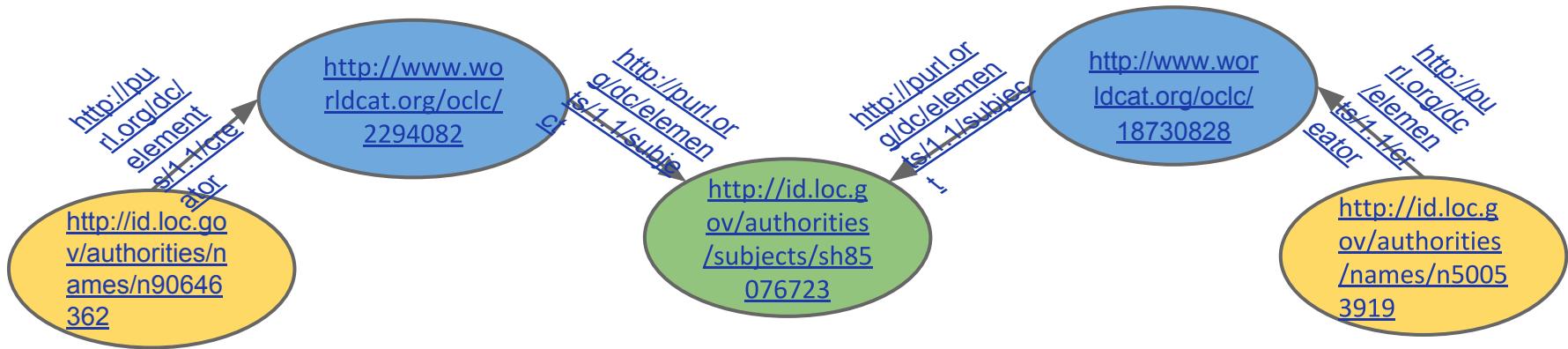
# RDF Triple - another example



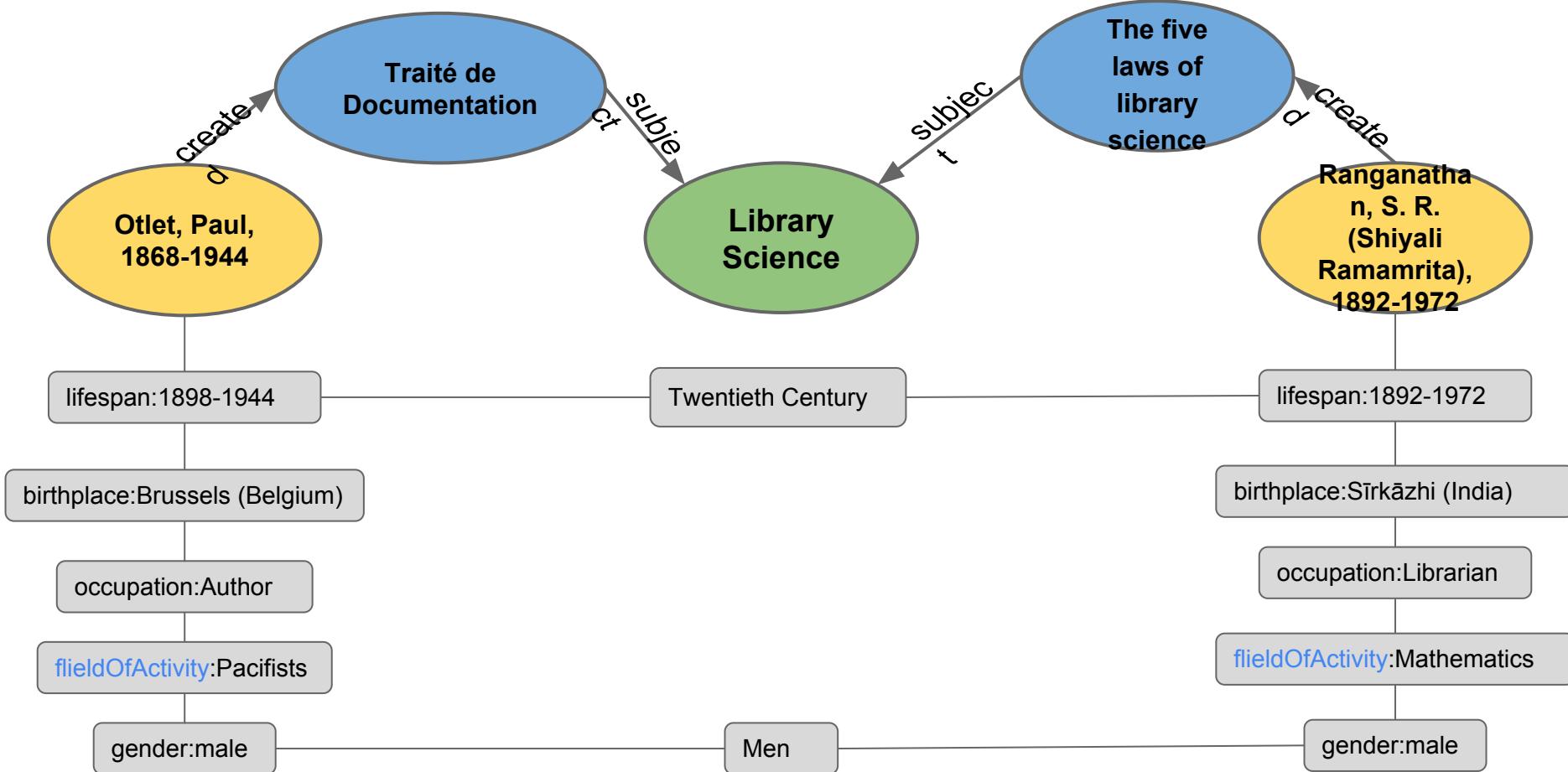
# Linked Data expresses relationships!



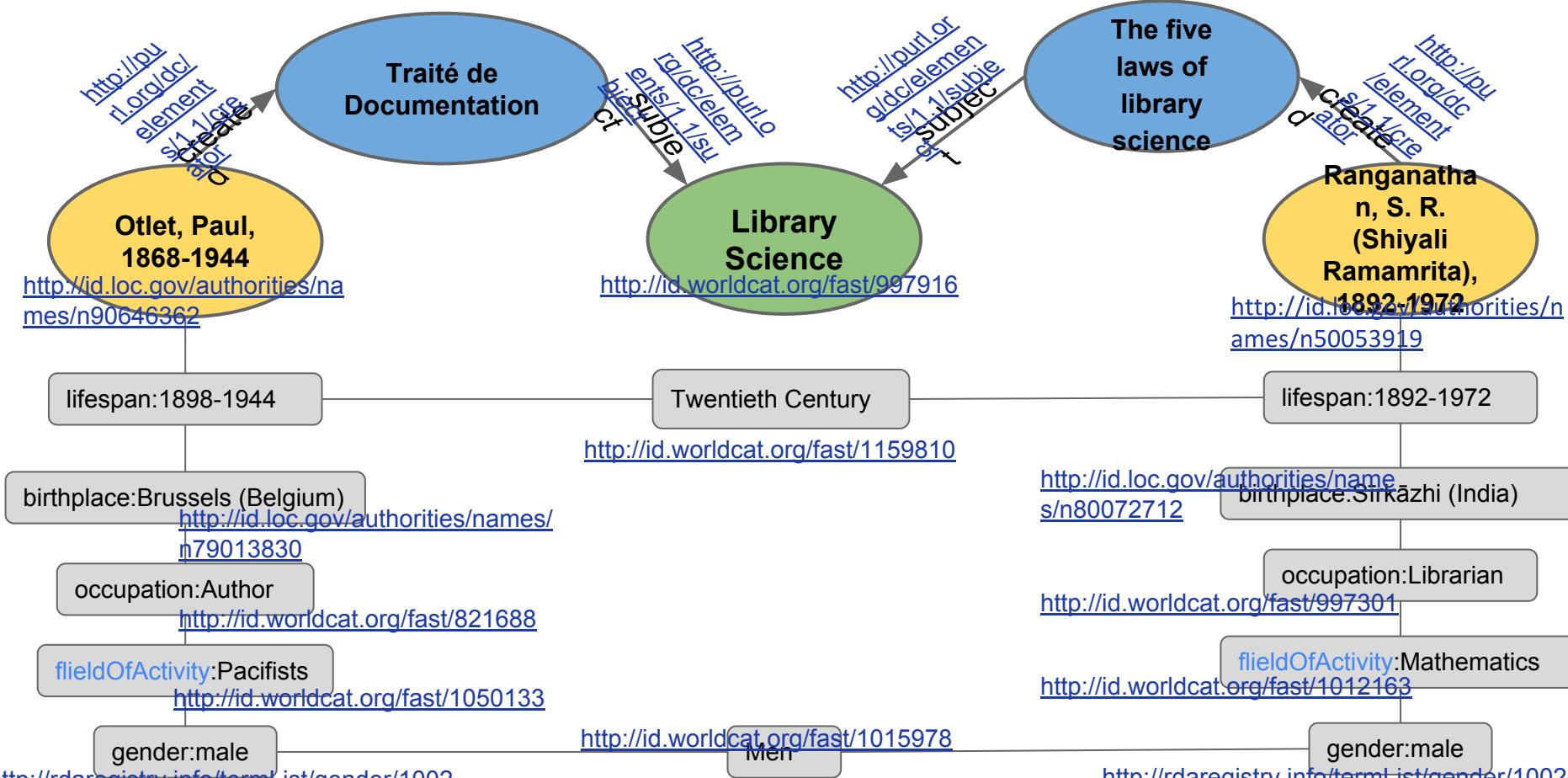
# Linked Data expresses relationships for machine processing.



# Linked Data is all about more relationships!



# Linked Data links all the relationships!



# RDF TRIPLE IN XML

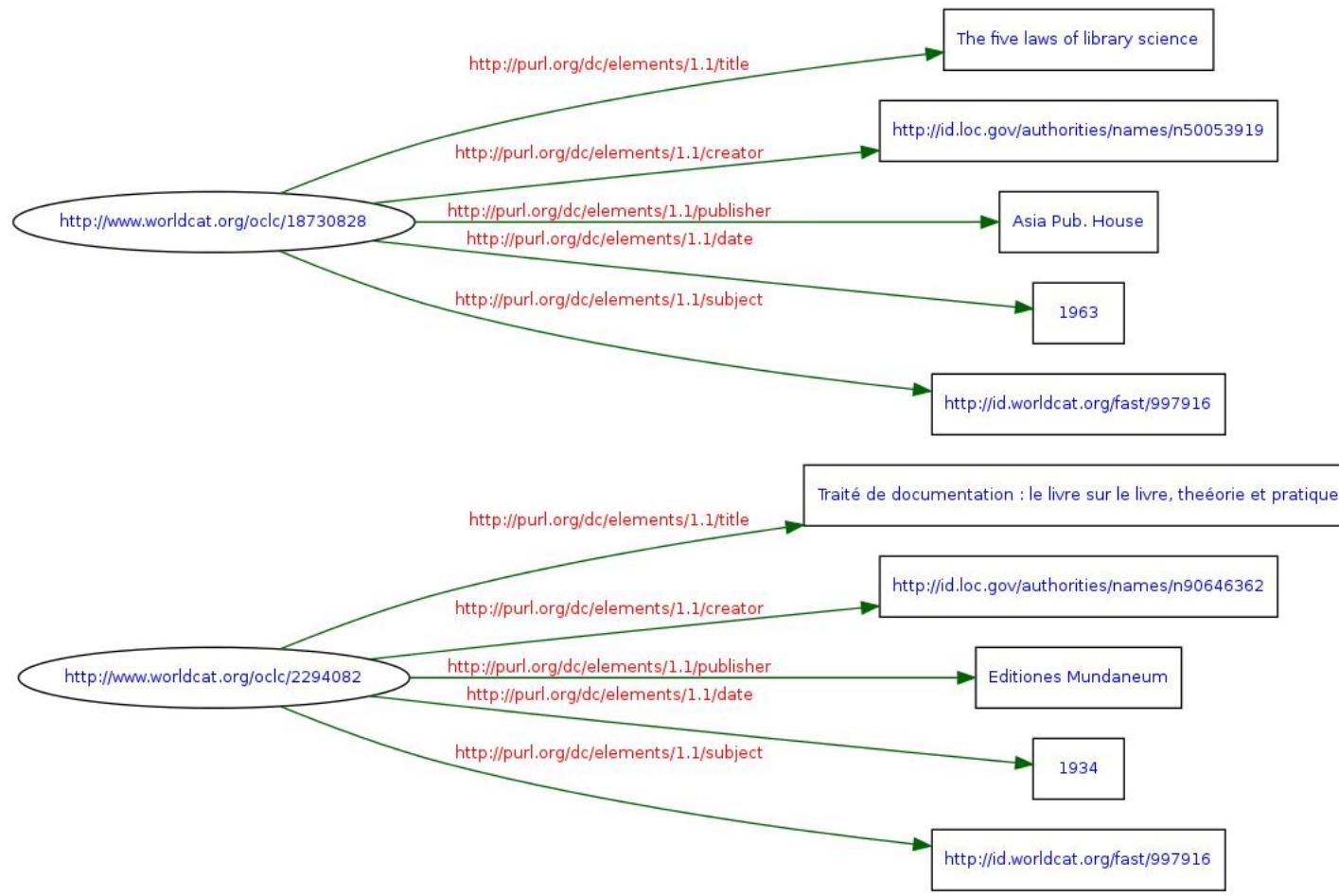
```
<?xml version="1.0"?>
<!DOCTYPE rdf:RDF PUBLIC "-//DUBLIN CORE//DCMES DTD 2002/07/31//EN"
  "http://dublincore.org/documents/2002/07/31/dcmes-xml/dcmes-xml-dtd.dtd">
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:dc="http://purl.org/dc/elements/1.1/">

  <rdf:Description rdf:about="http://www.worldcat.org/oclc/2294082">
    <dc:title>Traité de documentation : le livre sur le livre, théorie et pratique</dc:title>
    <dc:creator>http://id.loc.gov/authorities/names/n90646362</dc:creator>
    <dc:publisher>Editiones Mundaneum</dc:publisher>
    <dc:date>1934</dc:date>
    <dc:subject>http://id.worldcat.org/fast/997916</dc:subject>
  </rdf:Description>

  <rdf:Description rdf:about="http://www.worldcat.org/oclc/18730828">
    <dc:title>The five laws of library science</dc:title>
    <dc:creator>http://id.loc.gov/authorities/names/n50053919</dc:creator>
    <dc:publisher>Asia Pub. House</dc:publisher>
    <dc:date>1963</dc:date>
    <dc:subject>http://id.worldcat.org/fast/997916</dc:subject>
  </rdf:Description>

</rdf:RDF>
```

## Graph of the data model



# LINKED DATA LEXICON

# DE-REFERENCING URIS

“Dereferencing means you can get a lookup on the Web for the description of the reference concept resource.”\*

<http://id.loc.gov/ontologies/bibframe/Work.rdf>

NOT <http://id.loc.gov/ontologies/bibframe.html#c> Work

Utilizes the http protocol and RDF data to provide meaningful information when a URI is looked up by a machine.  
Puts the link in linked data!

\*<http://umbel.org/web-services/uri-dereferencing/>

# CLASS

A kind of thing.

Subjects and Objects belong to Classes.

You will usually see classes with the first letter in Uppercase.

**bf:Work**

**bf:Instance**

**bf:Item**

**bf:Identifier**

**BIBFRAME CLASSES!**

# SUB-CLASS

A kind of thing that is a “sub-type” of a kind of thing.

Chihuahua is a kind of Dog.

ISBN is a kind of Identifier.

**bf:Identifier**

[http://id.loc.gov/ontologies/bibframe.html#c\\_Identifier](http://id.loc.gov/ontologies/bibframe.html#c_Identifier)

# PROPERTY

The relationships between Classes (or things/objects).

The “predicate.”

Usually listed with lower-case.

**bf:title**

**bf:identifiedBy**

**bf:date**

# SUB-PROPERTY

A sub-type of a property.

**bf:date**

**bf:originDate**

**bf:copyrightDate**

**bf:creationDate**

[http://id.loc.gov/ontologies/bibframe.html#p\\_date](http://id.loc.gov/ontologies/bibframe.html#p_date)

# DOMAIN

The **domain** tells us what **individuals** (of a given class) this property is allowed to be applied to. AKA “Used with”  
Concerns the Subjects of a predicate.

**bf:Work**

**bf:Instance**

**bf:Item**

# RANGE

**Range** indicates the range of valid values this property can hold. AKA “Expected value”

Concerns the Objects of a predicate.

Literals

Objects/Individuals/URIs

# DATATYPE PROPERTY

A property that can only relate to data and literals.

rdfs:label “The Organization of Information” .

rdfs:label “The Joy of Cataloging” .

rdf:label “123 pages.” .

bf:date "2007/2010"^^<<http://id.loc.gov/datatypes/edtf>> ;

# OBJECT TYPE PROPERTY

A property that can only relate to objects (URI things).

<[http://example.com/Work\\_1](http://example.com/Work_1)> bf:contributor

<<http://id.loc.gov/authorities/names/n80107118>>

# INDIVIDUAL

Something with a URI or an IRI. A thing. A resource. A subject or an object.

AKA: Named Individual

<[http://example.com/Work\\_1](http://example.com/Work_1)> bf:contributor

<<http://id.loc.gov/authorities/names/n80107118>>

# BLANK NODES

Ugh. blank nodes.

“a **blank node** (also called *bnode*) is a node in an RDF graph representing a resource for which a **URI** or literal is not given.<sup>[1]</sup> The resource represented by a blank node is also called an **anonymous resource**. According to the RDF standard a blank node can only be used as subject or object of an RDF triple.”

Think of it as an alternative to link out to a URI as the object of a property.

# OPEN WORLD ASSUMPTION

“In a formal system of logic used for knowledge representation, the **open-world assumption** is the assumption that the truth value of a statement may be true irrespective of whether or not it is *known* to be true. It is the opposite of the **closed-world assumption**, which holds that any statement that is true is also known to be true.”

([wikipedia](#))

# ASSERTION

Saying something about a thing and expecting it to be true.

“In computer programming, an **assertion** is a statement that a predicate ... is expected to always be true at that point in the code.” ([wikipedia](#))

# INFERENCE

“Inference is the process of deriving logical conclusions from a set of starting assumptions. Using Linked Data, existing relationships are modeled as a set of (named) relationships between resources. Linked Data helps humans and machines to find new relationships through automatic procedures that generate new relationships based on the data and based on some additional information in the form of a vocabulary.”

<https://www.w3.org/TR/ld-glossary/#inference>

# ENTAILMENT

“In pragmatics (linguistics), **entailment** is the relationship between two sentences where the truth of one (A) requires the truth of the other (B).”

([wikipedia](#))

SKOS:Concept and LCNAF example.

ARE THERE OTHER  
TERMS THAT ARE NEW  
TO YOU?

# PROTEGE DEMO

# PROTEGE

Software for ontology modeling and development.

<http://protege.stanford.edu/>

<https://webprotege.stanford.edu/>



# EXPLORE BIBFRAME ONTOLOGY

- Open Protege
- Click File > Open from URL
- Enter the BIBFRAME ontology URL
  - <http://id.loc.gov/ontologies/bibframe.rdf>

bibframe (<http://id.loc.gov/ontologies/bibframe/>) : [<http://id.loc.gov/ontologies/bibframe.rdf>]

Active Ontology x Entities x Individuals by class x DL Query x

Ontology header: Ontology metrics:

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

Ontology Version IRI e.g. <http://id.loc.gov/ontologies/bibframe/1.0.0>

Annotations

modified  
2017-03-15T16:23:59.852-04:00

versioninfo [type: string]  
2017-03-15T16:23:59.852-04:00

label  
BIBFRAME vocabulary

Metrics

Axiom	2198
Logical axiom count	459
Class count	189
Object property count	132
Data property count	63
Individual count	0
DL expressivity	ALH(D)

Class axioms

SubClassOf axioms count	113
EquivalentClasses axioms count	0
DisjointClasses axioms count	0
GCI count	0
Hidden GCI Count	0

Object property axioms

Ontology imports Ontology Prefixes General class axioms

Imported ontologies:

Direct Imports

Indirect Imports

No Reasoner set. Select a reasoner from the Reasoner menu  Show Inferences

# RDF SYNTAX

# RDF-XML

```
<?xml version="1.0"?>
<!DOCTYPE rdf:RDF PUBLIC "-//DUBLIN CORE//DCMES DTD 2002/07/31//EN"
 "http://dublincore.org/documents/2002/07/31/dcmes-xml/dcmes-xml-dtd.dtd">

<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
 xmlns:dc="http://purl.org/dc/elements/1.1/">

  <rdf:Description rdf:about="https://ejournals.lib.vt.edu/valib/index">
    <dc:title>Virginia Libraries</dc:title>
    <dc:publisher rdf:resource="http://id.loc.gov/authorities/names/n80023576">Virginia Library Association</dc:publisher>
    <dc:identifier>ISSN 1086-9751</dc:identifier>
    <dc:subject rdf:resource="http://id.loc.gov/authorities/subjects/sh85076502">Libraries</dc:subject>
    <dc:subject rdf:resource="http://id.loc.gov/authorities/names/n79022909">Virginia</dc:subject>
    <dc:format rdf:resource="http://id.loc.gov/vocabulary/marcgt/per">Periodical</dc:format>
    <dc:type rdf:resource="http://purl.org/dc/dcmitype/Text">Text</dc:type>
  </rdf:Description>

  <rdf:Description rdf:about="http://www.vermontlibraries.org/vlanews/">
    <dc:title>VLA News</dc:title>
    <dc:publisher rdf:resource="http://id.loc.gov/authorities/names/n85375613">Vermont Library Association</dc:publisher>
    <dc:subject rdf:resource="http://id.loc.gov/authorities/subjects/sh85076502">Libraries</dc:subject>
    <dc:subject rdf:resource="http://id.loc.gov/authorities/names/n79007067">Virginia</dc:subject>
    <dc:format rdf:resource="http://id.loc.gov/vocabulary/marcgt/per">Periodical</dc:format>
    <dc:type rdf:resource="http://purl.org/dc/dcmitype/Text">Text</dc:type>
  </rdf:Description>

</rdf:RDF>
```

# JSON-LD

```
{  
  "@id": "http://www.vermontlibraries.org/vlanews/",  
  "http://purl.org/dc/elements/1.1/title": [  
    {  
      "@value": "VLA News"  
    }  
  ],  
  "http://purl.org/dc/elements/1.1/publisher": [  
    {  
      "@id": "http://id.loc.gov/authorities/names/n85375613"  
    }  
  ],  
  "http://purl.org/dc/elements/1.1/subject": [  
    {  
      "@id": "http://id.loc.gov/authorities/subjects/sh85076502"  
    },  
    {  
      "@id": "http://id.loc.gov/authorities/names/n79007067"  
    }  
  ],  
  "http://purl.org/dc/elements/1.1/format": [  
    {  
      "@id": "http://id.loc.gov/vocabulary/marcgt/per"  
    }  
  ],  
  "http://purl.org/dc/elements/1.1/type": [  
    {  
      "@id": "http://purl.org/dc/dcmitype/Text"  
    }  
  ]  
}
```

# N-TRIPLES

```
<https://ejournals.lib.vt.edu/valib/index> <http://purl.org/dc/elements/1.1/title> "Virginia Libraries" .  
  
<https://ejournals.lib.vt.edu/valib/index> <http://purl.org/dc/elements/1.1/publisher>  
<http://id.loc.gov/authorities/names/n80023576> .  
  
<https://ejournals.lib.vt.edu/valib/index> <http://purl.org/dc/elements/1.1/identifier> "ISSN 1086-9751" .  
  
<https://ejournals.lib.vt.edu/valib/index> <http://purl.org/dc/elements/1.1/subject>  
<http://id.loc.gov/authorities/subjects/sh85076502> .  
  
<https://ejournals.lib.vt.edu/valib/index> <http://purl.org/dc/elements/1.1/subject>  
<http://id.loc.gov/authorities/names/n79022909> .  
  
<https://ejournals.lib.vt.edu/valib/index> <http://purl.org/dc/elements/1.1/format>  
<http://id.loc.gov/vocabulary/marcgt/per> .  
  
<https://ejournals.lib.vt.edu/valib/index> <http://purl.org/dc/elements/1.1/type>  
<http://purl.org/dc/dcmitype/Text> .
```

N3

```
@prefix dc11: <http://purl.org/dc/elements/1.1/> .  
  
<https://ejournals.lib.vt.edu/valib/index>  
    dc11:title "Virginia Libraries" ;  
    dc11:publisher <http://id.loc.gov/authorities/names/n80023576> ;  
    dc11:identifier "ISSN 1086-9751" ;  
    dc11:subject <http://id.loc.gov/authorities/subjects/sh85076502>,  
<http://id.loc.gov/authorities/names/n79022909> ;  
    dc11:format <http://id.loc.gov/vocabulary/marcgt/per> ;  
    dc11:type <http://purl.org/dc/dcmitype/Text> .  
  
<http://www.vermontlibraries.org/vlanews/>  
    dc11:title "VLA News" ;  
    dc11:publisher <http://id.loc.gov/authorities/names/n85375613> ;  
    dc11:subject <http://id.loc.gov/authorities/subjects/sh85076502>,  
<http://id.loc.gov/authorities/names/n79007067> ;  
    dc11:format <http://id.loc.gov/vocabulary/marcgt/per> ;  
    dc11:type <http://purl.org/dc/dcmitype/Text> .
```

# TURTLE

```
@prefix dc11: <http://purl.org/dc/elements/1.1/> .  
  
<https://ejournals.lib.vt.edu/valib/index>  
    dc11:title "Virginia Libraries" ;  
    dc11:publisher <http://id.loc.gov/authorities/names/n80023576> ;  
    dc11:identifier "ISSN 1086-9751" ;  
    dc11:subject <http://id.loc.gov/authorities/subjects/sh85076502>,  
<http://id.loc.gov/authorities/names/n79022909> ;  
    dc11:format <http://id.loc.gov/vocabulary/marcgt/per> ;  
    dc11:type <http://purl.org/dc/dcmitype/Text> .  
  
<http://www.vermontlibraries.org/vlanews/>  
    dc11:title "VLA News" ;  
    dc11:publisher <http://id.loc.gov/authorities/names/n85375613> ;  
    dc11:subject <http://id.loc.gov/authorities/subjects/sh85076502>,  
<http://id.loc.gov/authorities/names/n79007067> ;  
    dc11:format <http://id.loc.gov/vocabulary/marcgt/per> ;  
    dc11:type <http://purl.org/dc/dcmitype/Text> .
```

TURTLE!!!



# TURTLE LANGUAGE



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# SIMPLE TRIPLES

<subject> <predicate> <object> .

<Class> <property> <Class> .

<<http://www.worldcat.org/oclc/6626957>>

<<http://id.loc.gov/ontologies/bibframe.html#subject>>

<<http://id.loc.gov/authorities/subjects/sh85020816>> .

# PREDICATE LISTS

When you have to say more than one things about a subject.

```
<subject>      <predicate> <object> ;  
                  <predicate> <object> ;  
                  <predicate> <object> .
```

<<http://www.worldcat.org/oclc/6626957>>

```
<http://id.loc.gov/ontologies/bibframe.html#subject>  
<http://id.loc.gov/authorities/subjects/sh85020816> ;  
  
<http://id.loc.gov/ontologies/bibframe.html#subject>  
<http://id.loc.gov/authorities/subjects/sh85129425> ;  
  
<http://id.loc.gov/ontologies/bibframe.html#classification>  
<http://id.loc.gov/authorities/classification/Z693.A3-Z693.Z> .
```

# OBJECT LISTS

When you have more than one object for a subject on the same predicate -- separate them with a comma

```
<subject>      <predicate> <object>, <object> .
```

```
<some_book>    bf:heldBy    "DLC", "NNC" .
```

```
bf:title        [ a bf:Title, bf:VariantTitle ] ;
```

# URIs (AKA IRIs)

- URIs can be relative or absolute, or prefixed names.
- Relative and absolute URIs are enclosed in angled brackets <URI>
- Relative URIs like <#example> are resolved to the base URI that is declared as the @base or BASE

```
@base <http://library.edu/>
```

```
<#book_0912700513> = http://library.edu/#book_0912700513
```

# PREFIXES

Prefixes allow for shorthand references to ontology domains.

```
@base <http://library.edu/> .  
  
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .  
  
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .  
  
@prefix bf: <http://id.loc.gov/ontologies/bibframe/> .
```

# PREFIXES CONTINUED

<Berman\_work1>

```
@base <http://library.edu/> .  
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .  
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .  
@prefix bf: <http://id.loc.gov/ontologies/bibframe/> .
```

a bf:Work ;

bf:hasInstance <Berman\_inst1> ;

bf:adminMetadata <Berman\_admin1> ;

bf:title [

a bf:Title, bf:WorkTitle ;

bf:mainTitle "Joy of cataloging" ;

bf:subTitle "essays, letters, and other explosions" ;

] ;

# PREFIXES CONTINUED

<Berman\_work1>

```
@base <http://library.edu/> .  
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .  
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .  
@prefix bf: <http://id.loc.gov/ontologies/bibframe.rdf> .
```

a bf:Work ;

bf:hasInstance <Berman\_inst1> ;

bf:adminMetadata <Berman\_admin1> ;

bf:title [



bf:Title, bf:WorkTitle ;

bf:mainTitle "Joy of cataloging" ;

bf:subTitle "essays, letters, and other explosions" ;

] ;

# "A" TYPE OF THING

The token 'a' in the predicate position of a Turtle triple represents the URI  
<http://www.w3.org/1999/02/22-rdf-syntax-ns#type>.

```
<Berman_work1>

  a bf:Work ;

  bf:title [ a bf:Title, bf:VariantTitle ] .
```

# LITERALLY LITERALS

Datatype properties require a literal value for their object. Enclose all literals with quotes -- “literal.” Literals are used to identify values such as strings, numbers, dates.

bf:supplementaryContent "Includes index." ;

bf:responsibilityStatement "by Sanford Berman" ;

bf:shelfmark "Z693 .B47 1981" .

bf:mainTitle "Joie du catalogage"@fr

# DATATYPE IRI

You can specify a datatype for a literal using an IRI with a ^^^ notation.

```
<http://bibframe.example.org/XXX#Instance  
  bf:provisionActivity  
    [ a bf:ProvisionActivity, bf:Publication ;  
      bf:date  
      "2007/2010"^^<http://id.loc.gov/datatypes/edtf> ;  
      bf:place <http://id.loc.gov/vocabulary/countries/ko> ] .
```

# NESTING BLANK NODES

Super common in BIBFRAME when you need to provide legacy literal information.

```
<Berman_inst1>
  bf:provisionActivity
  [
    a bf:ProvisionActivity, bf:Publication ;
    bf:agent
    [
      a bf:Agent ;
      rdfs:label "Oryx Press"
    ] ;

    bf:place
    [
      a bf:Place ;
      rdfs:label "Phoenix, AZ"
    ] ;
    bf:date "1981"
  ] .
```

# TURTLE ~~(POWER!)~~ GRAMMAR



<http://vignette3.wikia.nocookie.net/fictionalcrossover/images/0/03/TMNT.jpg/revision/latest?cb=20131107221430>

# WHITE SPACE

White space is largely ignored in Turtle, except for literals.

```
bf:summary      "A collection of essays and letters on  
cataloging, classification, and indexing." ;
```

Use "" to escape quotes within a literal.

```
bf:summary '""A fantastic read!" says Maurice Freedman.''' ;
```

# COMMENTS

Add comments to your code by using the hash # sign.

```
@base <http://library.edu/> .  
  
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .  
  
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .  
  
@prefix bf: <http://id.loc.gov/ontologies/bibframe.rdf> .  
  
#This is a test record for the PCC BIBFRAME TG  
  
<Berman_work1>
```

# PUTTING IT ALL TOGETHER

[https://github.com/amberbilly  
PCC\\_BIBFRAME/blob/master/BF\\_Berman\\_Example.ttl](https://github.com/amberbilly/PCC_BIBFRAME/blob/master/BF_Berman_Example.ttl)



[http://vignette4.wikia.nocookie.net/tmnt/images/3/31/T\\_U\\_R\\_T\\_L\\_E\\_POWER!.jpg/revision/latest?cb=20130825150401](http://vignette4.wikia.nocookie.net/tmnt/images/3/31/T_U_R_T_L_E_POWER!.jpg/revision/latest?cb=20130825150401)

# LINKED DATA TOOLS

# TEXT EDITOR (YOUR BEST FRIEND)

- MACS
  - [Text Wrangler](#) (Free and open source)
- PCs
  - [Notepad++](#) (Free and open source)
- Either
  - [Sublime Text](#) (Open source, free trial, paid license)
  - [Atom](#) (Open source, free)

# DATA VALIDATORS AND CONVERTERS

- W3C RDF Validator (parses and builds graphs)
  - <https://www.w3.org/RDF/Validator/>
- EasyRDF Converter
  - <http://www.easyrdf.org/converter>
- JSON-LD
  - <http://json-ld.org/playground/>
- Turtle
  - <http://ttl.summerofcode.be/>

Or seriously...just Google it.

# CUSTOM EDITOR

## Library Linked Data Projects

- BIBFRAME Editor
- VitroLib Editor
- Cedar Editor and BiblioPortal
- BIBFLOW Editor

## Library Vendors

- Casalini
- Ex Libris
- Innovative
- Folio
- OCLC Worldshare Management

## Local development

- Fedora 4
  - Samvera
  - Islandora

# PROTEGE

Software for ontology modeling and development.

<http://protege.stanford.edu/>

We already  
talked about this :-)



# KARMA

An ontology modeling and visualization tool.

“A data integration tool.”

<http://usc-isi-i2.github.io/karma/>

# OPEN REFINE

A data munging, modeling,  
reconciling, power tool.

<http://openrefine.org/>



# TEXT EDITOR DEMO

SERIALS IN  
BIBFRAME!

# Serials RDA Elements in BIBFRAME

Mappings:

- LC: MARC 21 to BIBFRAME 2.0 Conversion Specifications  
<https://www.loc.gov/bibframe/mtbf/>
- CONSER: BIBFRAME 2.0 CSR Mapping (coming soon; watch this space:  
<http://www.loc.gov/aba/pcc/conser/index.html>)

# BIBFRAME 2.0 ontology

<http://id.loc.gov/ontologies/bibframe.html>

<b>Property:</b>	<b>title</b>
Label:	Title resource
Definition:	Name given to a resource.
Used with:	Work, Instance or Item
Expected Value:	<a href="#">Title</a>
Change Notes:	2016-04-21 (New)

<b>Class:</b>	<b>Title</b>
Label:	Title entity
Definition:	Title information relating to a resource: work title, preferred title, instance title, transcribed title, translated title, variant form of title, etc.
Used with:	<a href="#">title</a>
SubClassed As:	<a href="#">VariantTitle</a>
Change Notes:	2016-04-21 (New) 2017-02-03 (Definition changed)

[\[back to class list\]](#) [\[back to top\]](#)

# Instances

<<http://bibframe.example.org/15297773#Instance>>

**a** bf:Instance

# Title (for display)

<<http://bibframe.example.org/15297773#Instance>>

**bf:title**

[ a bf:Title ;

**rdfs:label** "The international journal of Korean art and archaeology." ]

# Title (for sorting)

<<http://bibframe.example.org/15297773#Instance>>

**bf:title**

[ a bf:Title ;

    rdfs:label "The international journal of Korean art and archaeology."

;

**bflc:titleSortKey** "international journal of Korean art and  
    archaeology." ]

# Title proper

<<http://bibframe.example.org/15297773#Instance>>

**bf:title**

[ a bf:Title ;

    rdfs:label "The international journal of Korean art and archaeology."

;

    bflc:titleSortKey "international journal of Korean art and  
archaeology." ;

**bf:mainTitle** "The international journal of Korean art and  
archaeology" ]

# Title proper (part number, name)

<<http://bibframe.example.org/11315714#Instance>>

**bf:title**

[ a bf:Title ;

    rdfs:label "Philosophical transactions of the Royal Society of London.  
Series A, Containing papers of a mathematical or physical character." ;

**bf:mainTitle** "Philosophical transactions of the Royal Society of  
London" ;

**bf:partName** "Containing papers of a mathematical or physical  
character" ;

**bf:partNumber** "Series A" ]

# Title proper and subtitle

<<http://bibframe.example.org/12382624#Instance>>

**bf:title**

```
[ a bf:Title ;
    rdfs:label "Gastronomica : the journal of food and culture." ;
    bf:lc:titleSortKey "Gastronomica : the journal of food and culture." ;
    bf:mainTitle "Gastronomica" ;
    bf:subtitle "the journal of food and culture" ]
```

# Variant title

<<http://bibframe.example.org/15297773#Instance>>

**bf:title**

```
[ a bf:Title, bf:VariantTitle ;  
  rdfs:label "Korean art and archaeology" ;  
  bf:lc:titleSortKey "Korean art and archaeology" ;  
  bf:mainTitle "Korean art and archaeology" ]
```

# Parallel title

<<http://bibframe.example.org/11273268#Instance>>

bf:title

```
[ a bf:ParallelTitle, bf:Title, bf:VariantTitle ;  
  rdfs:label "Korea today" ;  
  bf:lc:titleSortKey "Korea today" ;  
  bf:mainTitle "Korea today" ]
```

# Abbreviated title

<<http://bibframe.example.org/18270882#Instance>>

bf:title

[ a bf:AbbreviatedTitle, bf:Title, bf:VariantTitle ;  
  rdfs:label "Physician leadersh. j." ;  
  bflc:titleSortKey "Physician leadersh. j." ;  
  bf:mainTitle "Physician leadersh. j." ;  
  bf:source [ a bf:Source ;  
          rdf:value "issnkey" ] ]

# Key title

<<http://bibframe.example.org/18270882#Instance>>

**bf:title**

[ a **bf:KeyTitle**, bf:Title, bf:VariantTitle ;  
rdfs:label "Physician leadership journal" ;  
bf:lc:titleSortKey "Physician leadership journal" ;  
bf:mainTitle "Physician leadership journal" ]

# Statement of responsibility

<<http://bibframe.example.org/17610810#Instance>>

**bf:responsibilityStatement** "edited by Nigel G. Foster, FRSA"

# Edition statement

<<http://bibframe.example.org/8330771#Instance>>

**bf:editionStatement** "Indiana ed."

# Numbering of serials (formatted)

<<http://bibframe.example.org/11315714#Instance>>

bf:firstIssue "Vol. 187 (1896)" ;

bf:lastIssue "v. 233"

# Numbering of serials (note)

<<http://bibframe.example.org/15297773#Instance>>

**bf:note**

[ a bf:Note ;  
  rdfs:label "Began with v. 01 (2007); ceased with v. 04 (2010)." ;  
  **bf:noteType** "Numbering" ]

# Publication statement (transcribed)

<<http://bibframe.example.org/15297773#Instance>>

**bf:provisionActivityStatement** "Seoul : National Museum of Korea, 2007-  
©2010."

# Publication statement (segmented)

<<http://bibframe.example.org/15297773#Instance>>

**bf:provisionActivity**

[ a bf:ProvisionActivity, **bf:Publication** ;  
**bf:agent** [ a bf:Agent ;  
          rdfs:label "National Museum of Korea" ] ;  
**bf:date** "2007-©2010" ;  
**bf:place** [ a bf:Place ;  
          rdfs:label "Seoul" ] ]

# Publication information (using URIs)

<<http://bibframe.example.org/15297773#Instance>

**bf:provisionActivity**

[ a bf:ProvisionActivity, **bf:Publication** ;  
**bf:date** "2007/2010"<sup>^^</sup><http://id.loc.gov/datatypes/edtf> ;  
**bf:place** <http://id.loc.gov/vocabulary/countries/ko> ]

# Copyright date

<<http://bibframe.example.org/19276940#Instance>>  
**bf:copyrightDate** "©2015"

# Series statement

<<http://bibframe.example.org/17610810#Instance>>

**bf:seriesStatement** "Blackstone's statutes series"

# Series statement and enumeration

<<http://bibframe.example.org/317269#Instance>>

**bf:seriesEnumeration** "65, v. 5", "v. 5" ;

**bf:seriesStatement** "Archetypal images in Greek religion", "Bollingen series"

# Mode of issuance

<<http://bibframe.example.org/15297773#Instance>>

**bf:issuance** <<http://id.loc.gov/vocabulary/issuance/serl>>

# Frequency

<<http://bibframe.example.org/15297773#Instance>>

bf:frequency

[ a bf:Frequency ;  
rdfs:label "Annual" ]

# Frequency

<<http://bibframe.example.org/15297773#Instance>>

bf:frequency

[ a bf:Frequency ;  
rdfs:label "Annual" ],

<<http://id.loc.gov/vocabulary/frequencies/ann>>

# ISSN

<<http://bibframe.example.org/15297773#Instance>>

bf:identifiedBy

[ a bf:Identifier, bf:Issn ;  
  rdf:value "2005-1115" ]

# LCCN

<<http://bibframe.example.org/15297773#Instance>>

bf:identifiedBy

[ a bf:Identifier, bf:Lccn ;  
  rdf:value " 2008200843" ]

# DBO/LIC notes

<<http://bibframe.example.org/15297773#Instance>>

**bf:note**

- [ a bf:Note ;  
    rdfs:label "Description based on: Vol. 01 (2007); title from t.p." ;  
    **bf:noteType** "description source" ],
- [ a bf:Note ;  
    rdfs:label "Latest issue consulted: Vol. 04 (2010)." ;  
    **bf:noteType** "description source" ]

# More notes

<<http://bibframe.example.org/11315714#Instance>>

**bf:note**

[ a bf:Note ;

    rdfs:label "Vols. for 1901-1930. 1 v.; 1931-1940. 1 v. (includes issues published under later title)." ;

**bf:noteType** "index" ]

# Media

<<http://bibframe.example.org/15297773#Instance>>

**bf:media** <<http://id.loc.gov/vocabulary/mediaTypes/n>>

# Carrier

<<http://bibframe.example.org/15297773#Instance>>

**bf:carrier** <<http://id.loc.gov/vocabulary/carriers/nc>>

# Extent

<<http://bibframe.example.org/15297773#Instance>>

**bf:extent**

[ a bf:Extent ;  
  rdfs:label "4 volumes" ]

# Illustrations?

<<http://bibframe.example.org/15297773#Instance>>

**bf:note**

[ a bf:Note ;  
  rdfs:label "illustrations" ;  
  **bf:noteType** "Physical details" ]

[but see [http://id.loc.gov/ontologies/bibframe.html#p\\_illustrativeContent](http://id.loc.gov/ontologies/bibframe.html#p_illustrativeContent)]

# Dimensions

<<http://bibframe.example.org/15297773#Instance>>  
**bf:dimensions** "30 cm"

# URL

<<http://bibframe.example.org/item/item5>>

bf:electronicLocator "<http://hdl.loc.gov/loc.pnp/cph.3g11323>"

# Relationships (Instances)

<<http://bibframe.example.org/15297773#Instance>>

  bf:otherPhysicalFormat

<<http://bibframe.example.org/15297773#Instance776-41>> .

<<http://bibframe.example.org/15297773#Instance>>

  bf:instanceOf <<http://bibframe.example.org/15297773#Work>> .

<<http://bibframe.example.org/15297773#Instance>>

  bf:hasItem <<http://bibframe.example.org/15297773#Item050-13>>

# Works

<<http://bibframe.example.org/15297773#Work>>

**a** bf:Text, bf:Work

# Work title

<<http://bibframe.example.org/15297773#Work>>

**bf:title**

```
[ a bf:Title ;  
    rdfs:label "The international journal of Korean art and archaeology." ;  
    bf:lc:titleSortKey "international journal of Korean art and  
archaeology." ;  
    bf:mainTitle "The international journal of Korean art and  
archaeology" ]
```

# ISSN-L

<<http://bibframe.example.org/11273268#Work>>

bf:identifiedBy

[ a *bf:Identifier*, **bf:IssnL** ;  
  rdf:value "1227-1632" ]

# Content

<http://bibframe.example.org/15297773#Work>

bf:content

<<http://id.loc.gov/vocabulary/contentTypes/txt>>

# Language of expression

<<http://bibframe.example.org/15297773#Work>>

bf:language

<<http://id.loc.gov/vocabulary/languages/eng>>

# Contributor

<<http://bibframe.example.org/15297773#Work>>

bf:contribution

[ a bf:Contribution ;  
  bf:agent <<http://id.loc.gov/authorities/names/n81039362>> ;  
  bf:role <<http://id.loc.gov/vocabulary/relators/ctb>> ]

# Subject

<<http://bibframe.example.org/15297773#Work>>

**bf:subject** <<http://bibframe.example.org/15297773#Topic650-28>>,  
<<http://bibframe.example.org/15297773#Topic650-30>>,  
<<http://bibframe.example.org/15297773#Topic650-31>>

# Classification (work)

<<http://bibframe.example.org/15297773#Work>>

bf:classification

[ a bf:ClassificationLcc ;

bf:classificationPortion "N8.K6" ;

bf:itemPortion "I58" ;

bf:source <<http://id.loc.gov/vocabulary/organizations/dlc>> ]

# Classification (item)

<<http://bibframe.example.org/15297773#Item050-13>>

**bf:shelfMark**

[ a bf:ShelfMarkLcc ;

  rdfs:label "N8.K6 I58" ;

  bf:source <<http://id.loc.gov/vocabulary/organizations/dlc>> ]

# Genre/Form

<<http://bibframe.example.org/15297773#Work>>

**bf:genreForm**

<<http://bibframe.example.org/15297773#GenreForm655-38>>

# Relationships (Works)

<<http://bibframe.example.org/15297773#Work>>

**bf:hasInstance** <<http://bibframe.example.org/15297773#Instance>>,  
  <<http://bibframe.example.org/15297773#Instance530-25>> .

<<http://bibframe.example.org/17610810#Work>>

**bf:continues** <<http://bibframe.example.org/17610810#Work780-31>> .

<<http://bibframe.example.org/15297773#Work>>

**bf:continuedBy** <<http://bibframe.example.org/15297773#Work785-42>> .

<<http://bibframe.example.org/17610810#Work>>

**bf:hasSeries** <<http://bibframe.example.org/17610810#Work830-32>>

# Non-Roman script

<<http://bibframe.example.org/19583382#Instance>>

bf:provisionActivityStatement

"Beijing Shi : Jie fang jun wen yi chu ban she",

"北京市 : 解放军文艺出版社"@zh-hani ;

bf:title

[ a bf:Title ;

rdfs:label "中国军事文学年选."@zh-hani ;

bf:mainTitle "中国军事文学年选"@zh-hani ],

[ a bf:Title ;

rdfs:label "Zhongguo jun shi wen xue nian xuan." ;

bf:mainTitle "Zhongguo jun shi wen xue nian xuan" ]

# TESTING AND EXPERIMENTATION

# Library of Congress

## **BIBFRAME Pilot Phase One (August 2015 - March 2016)**

“Forty Library of Congress catalogers participated in Pilot Phase One, with instruction by four Library of Congress staff members in the Cooperative and Instructional Programs Division (COIN). Pilot Phase One tested bibliographic description in multiple formats and in multiple languages using the BIBFRAME Editor.”

<https://www.loc.gov/catworkshop/bibframe/>

# Library of Congress

## **BIBFRAME Pilot Phase Two (June 2017 - )**

“The forty Library of Congress catalogers that participated in Pilot Phase One were joined by twenty-three new participants for Pilot Phase Two. Pilot Phase Two continues the tests from Phase One, with additional testing of the input of non-Latin scripts for description with no corresponding romanization, testing of authority descriptions for Agents, and a fuller level of interaction with a live BIBFRAME database, consisting of a complete BIBFRAME conversion of the Library of Congress bibliographic file.”

<https://www.loc.gov/catworkshop/bibframe/>

# CONSER

- CONSER Bibframe Task Group formed December 2015
- became subgroup of the PCC BIBFRAME Task Group August 2016
- submitted mapping, report and recommendations July 2017

# CONSER

CSR to BIBFRAME Mapping:

<http://www.loc.gov/aba/pcc/bibframe/TaskGroups/CSR-PDF/CSRtoBIBFRAMEMapping.pdf>

- Mapping across:
  - RDA instructions & elements
  - RDA-RDF property
  - BF 2.0 property
- Includes links to sample code documents illustrating the use of the properties listed

# CONSER

## Final Report of the CONSER CSR to BIBFRAME Mapping Task Group:

[http://www.loc.gov/aba/pcc/bibframe/TaskGroups/CSR-PDF/FinalReportCONSERToPCCBIBFRAME\\_TaskGroup.pdf](http://www.loc.gov/aba/pcc/bibframe/TaskGroups/CSR-PDF/FinalReportCONSERToPCCBIBFRAME_TaskGroup.pdf)

- BIBFRAME can accommodate the information required to describe serial resources
- BIBFRAME offers greater potential for exposing the relationships between and among serial publications than the MARC environment
- but there are some general issues to address

# CONSER

## Changes to the Description

- the serial itself has changed
- new information about the serial is available
- errors need to be corrected

# CONSER

## Literal vs. Machine-Actionable Data

**bf:provisionActivity**

```
[ a bf:ProvisionActivity, bf:Publication ;  
  bf:agent [ a bf:Agent ;  
            rdfs:label "National Museum of Korea" ] ;  
  bf:place [ a bf:Place ;  
            rdfs:label "Seoul" ] ]
```

**bf:provisionActivity**

```
[ a bf:ProvisionActivity, bf:Publication ;  
  bf:agent <http://id.loc.gov/authorities/names/n81052631.html> ;  
  bf:place <http://id.loc.gov/authorities/names/n79066627.html>
```

# CONSER

## Enumeration and Chronology

bf:firstIssue "Vol. 187 (1896)" ;

bf:lastIssue "v. 233"

RDA:

- Numeric and/or Alphabetic Designation of First Issue or Part of Sequence
- Chronological Designation of First Issue or Part of Sequence
- Numeric and/or Alphabetic Designation of Last Issue or Part of Sequence
- Chronological Designation of Last Issue or Part of Sequence

# CONSER

## **Modeling and Relationships**

- FRBR: 4 levels
- BIBFRAME: 3 levels
- LRM: for serials: the WEM lock!

# CONSER

## **Administrative Metadata**

- Description Based On/Latest Issue Consulted
- provenance for the “record” or individual assertions?

# CONSER

## Specific Issues

- use value vocabularies from the RDA Registry
- provide actionable links for publication etc.
- use specific note properties whenever possible
- series!

# CONSER

## **Recommendations for CONSER/PCC**

1. explore methods of accommodating the need to change serial descriptive data
2. use typed literals for dates wherever possible
3. provide actionable data whenever feasible in addition to transcribed data
4. develop a common structure for representing enumeration and chronology information

# CONSER

## **Recommendations for CONSER/PCC (continued)**

5. explore PRESSoo and other linked data vocabularies for possible solutions
6. charge a Task Group with monitoring and analyzing the changing serials landscape
7. develop methods and best practices for easily and succinctly recording necessary administrative and provenance metadata at the assertion level
8. use the value vocabularies from the RDA registry for Content, Media, and Carrier Types; Frequency; and Notes

# CONSER

## **Recommendations for BIBFRAME Development**

1. explicitly model start and end dates for descriptive elements
2. develop a common structure for representing enumeration and chronology information
3. develop methods and best practices for easily and succinctly recording necessary administrative and provenance metadata at the assertion level.
4. define properties for the RDA relationships 'augmented by (work)' or 'complemented by (work)'

# LD4P

Columbia, Cornell, Harvard, Library of Congress, Princeton, Stanford

<https://wiki.duraspace.org/pages/viewpage.action?pageId=74515029>

- developing standards, guidelines, and infrastructure to communally produce metadata as linked open data
- developing end-to-end workflows to create linked data in a technical services production environment
- extending the BIBFRAME ontology to describe library resources in specialized domains and formats
- engaging the broader library community to ensure a sustainable and extensible environment

# LD4P

Cross-domain ontology: bibliotek-o (<https://bibliotek-o.org/>)

Domain-specific ontologies:

- art
- cartographic and geospatial
- moving images
- performed music
- rare materials
- but not serials!

# QUESTIONS?

You've got to have some.