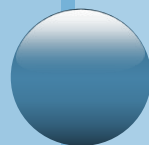


关联数据基本理论 及其在图书馆中的应用



刘晓娟





主要内容



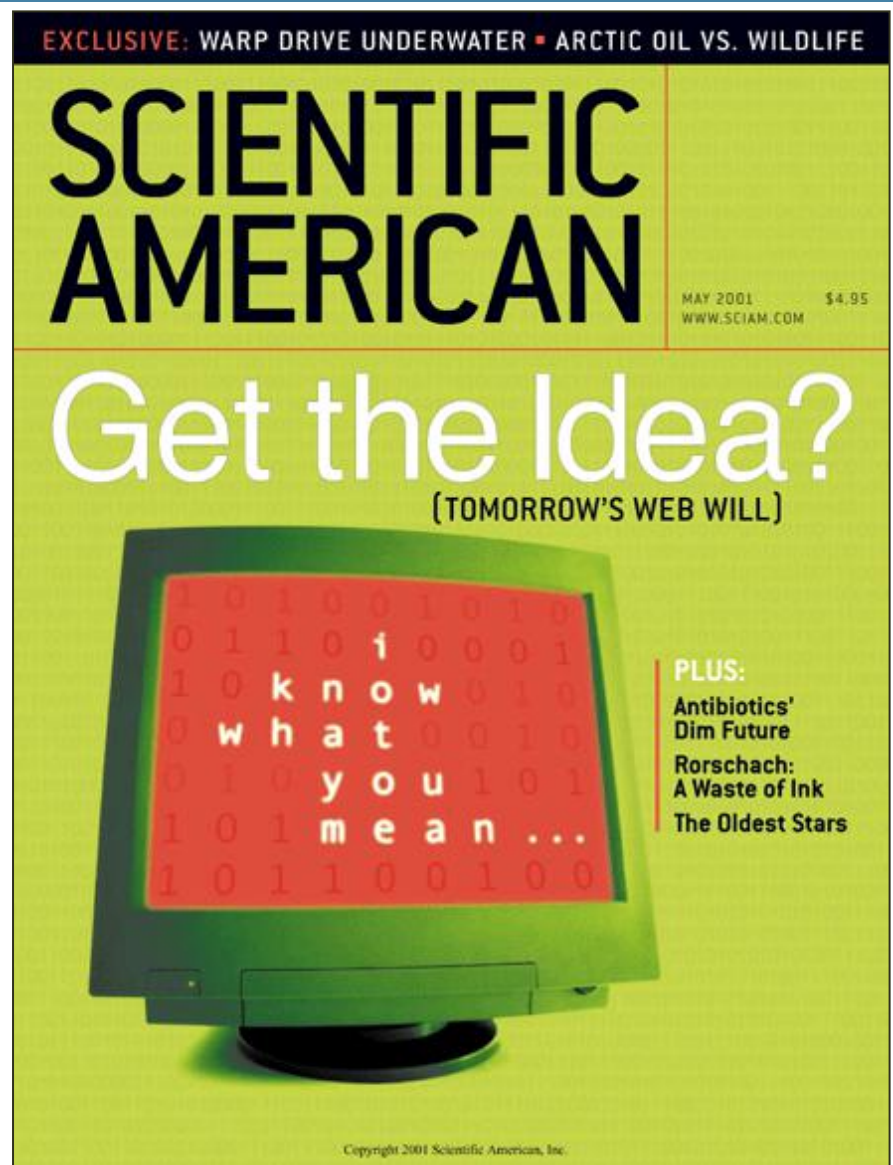
- 1. 关联数据的起源
- 2. 图书馆为什么需要关联数据？
- 3. 什么是关联数据？
- 4. 关联数据在图书馆中的应用



关联数据 (Linked data)



Tim Berners-Lee





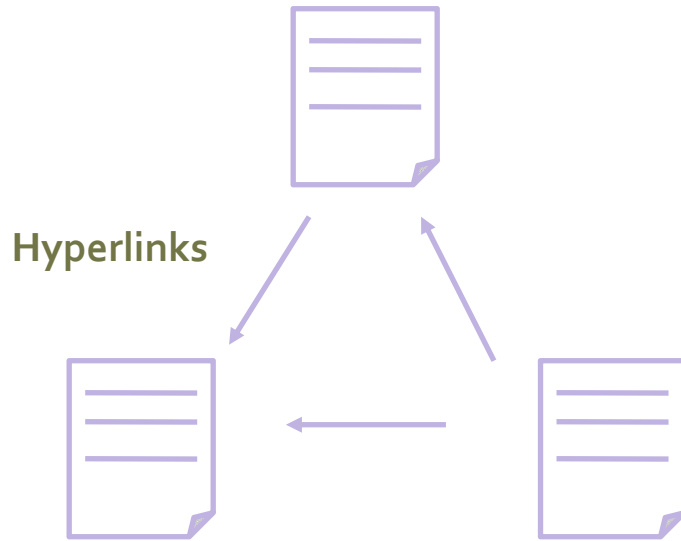
Web的演变



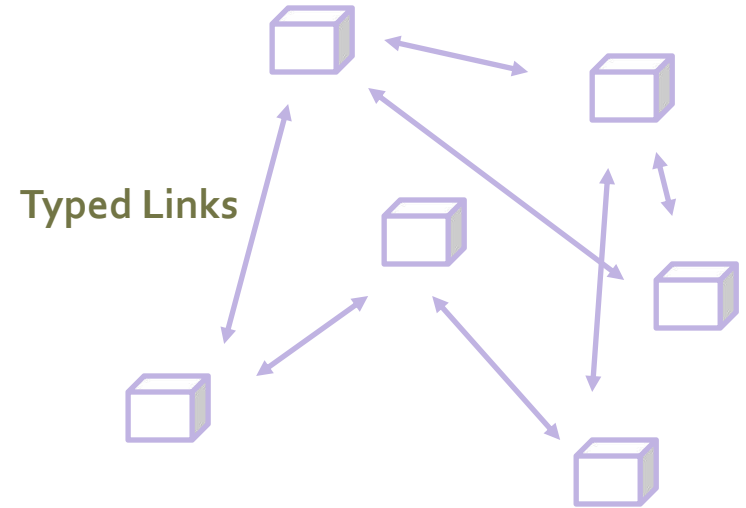
Web of Documents



Web of Data



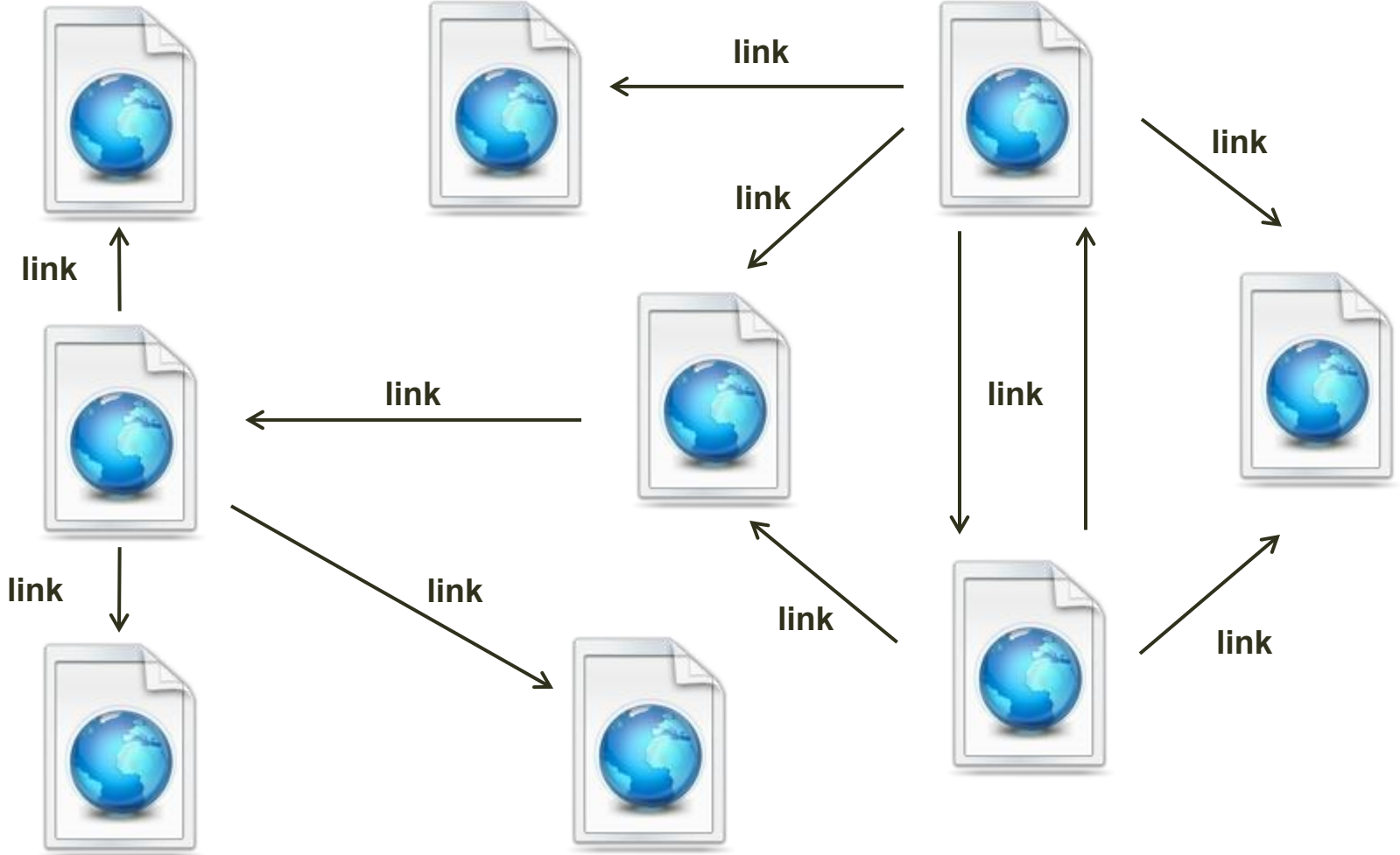
"Documents"



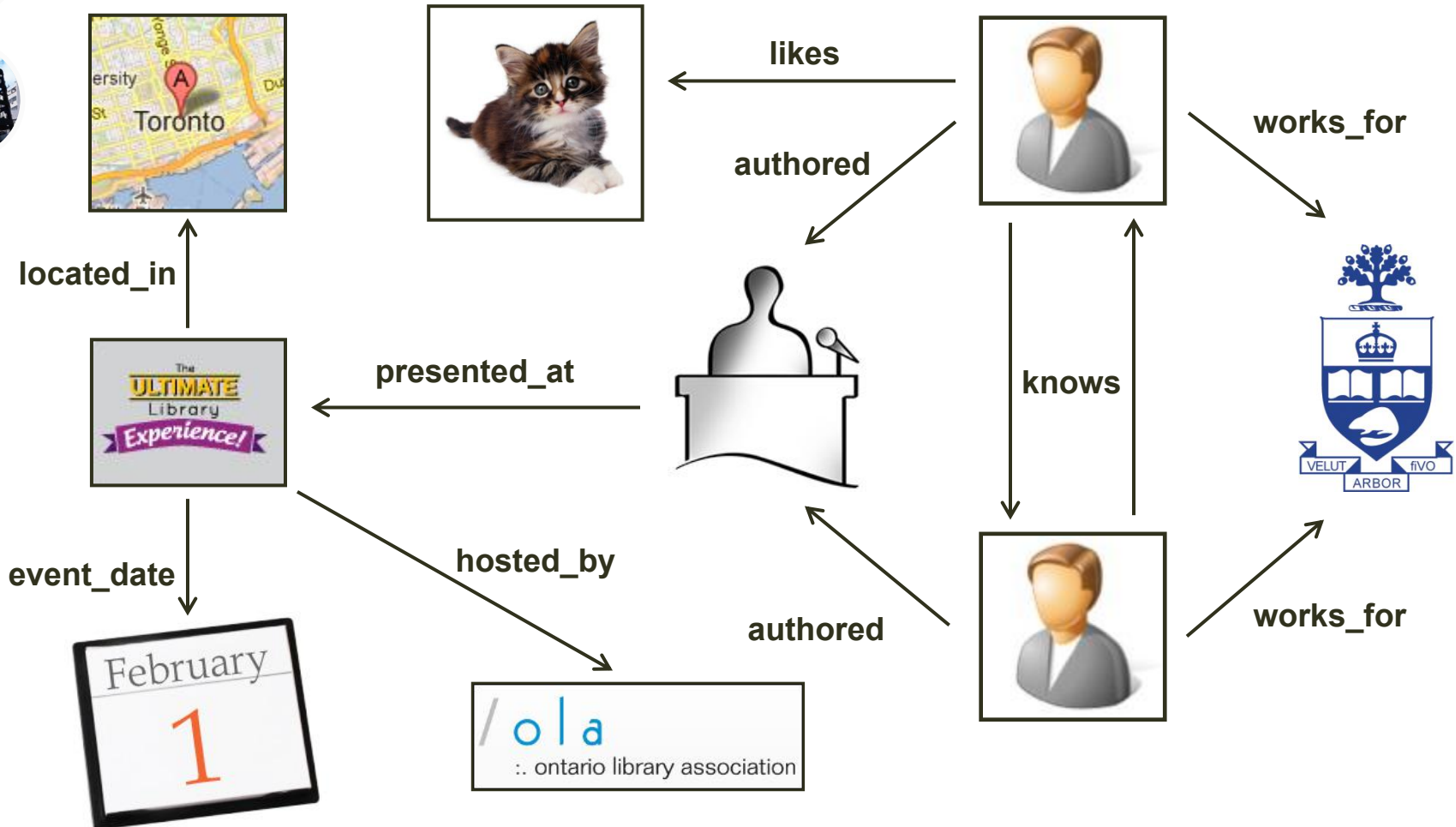
"Things"



传统Web



Linked Data





Why Linked Data?



- Web上有大量信息



- ... 有价值的信息的重用问题

- 信息通常以HTML文档的形式存在
- 深层次的原始数据锁在封闭的数据孤岛（大部分是关系数据库）中



Why Linked Data?



● Web的成功在于它提供了

- 统一的编码 (HTML)
- 统一的定位 (URI)
- 统一的传输 (HTTP)

以进行文档的交换

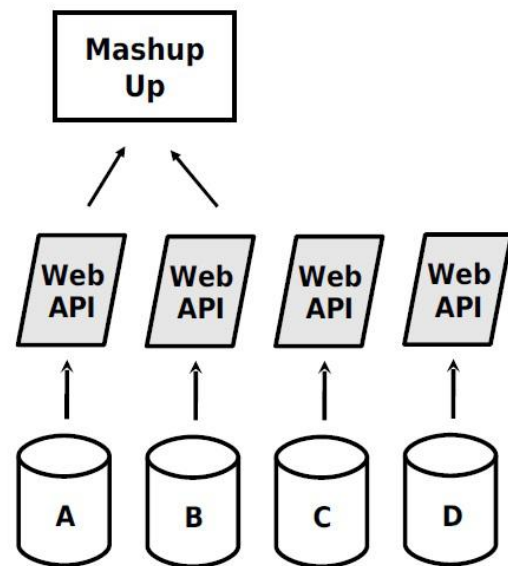
● 为什么不能将相同的机制应用到深层次的 数据上？



Need for Linked Data



- 为了提高数据的重用性、可查找性和可见性
- 除了传统的HTML页面，结构化数据也可以直接发布在Web上
- 不同的方法
 - Microformats
 - Web APIs & Mashups
 - **Linked Data**





主要内容



● 1. 关联数据的起源



● 2. 图书馆为什么需要关联数据？

● 3. 什么是关联数据？

● 4. 关联数据在图书馆中的应用

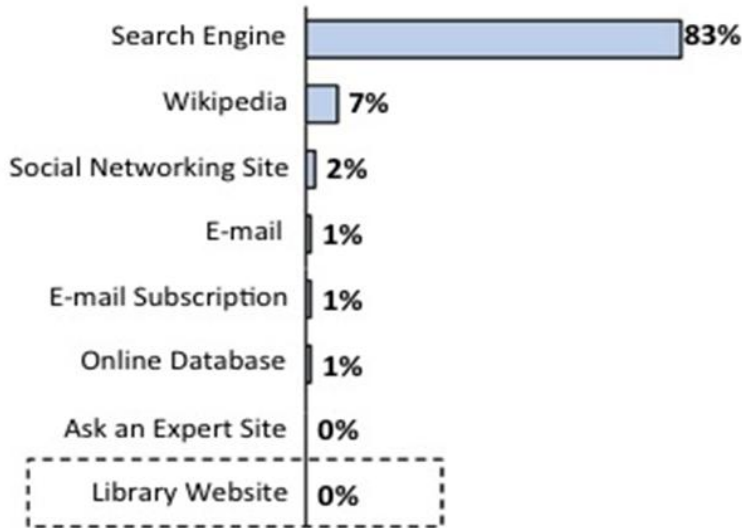


OCLC 'Perceptions of Libraries, 2010'

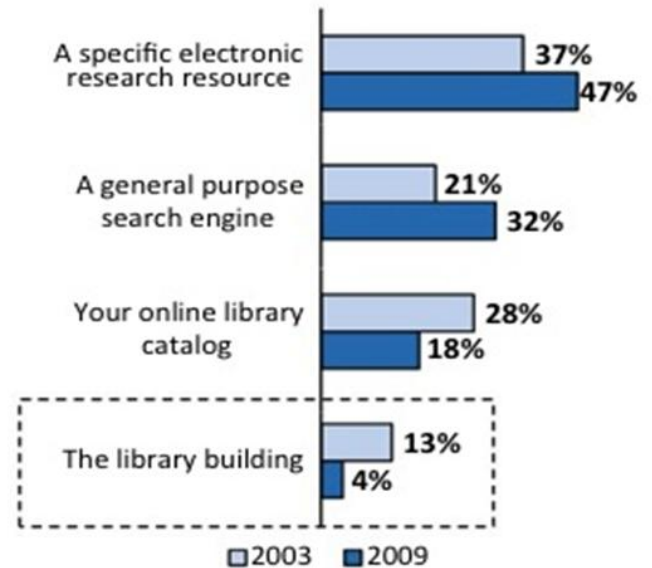


Patrons Switching Faster Than Libraries *Faculty and Students Already Looking Elsewhere for Search Help*

Where Do Students Start a Search? *n = 2,229*



Where Do Faculty Start Their Research? *n = 3,025*

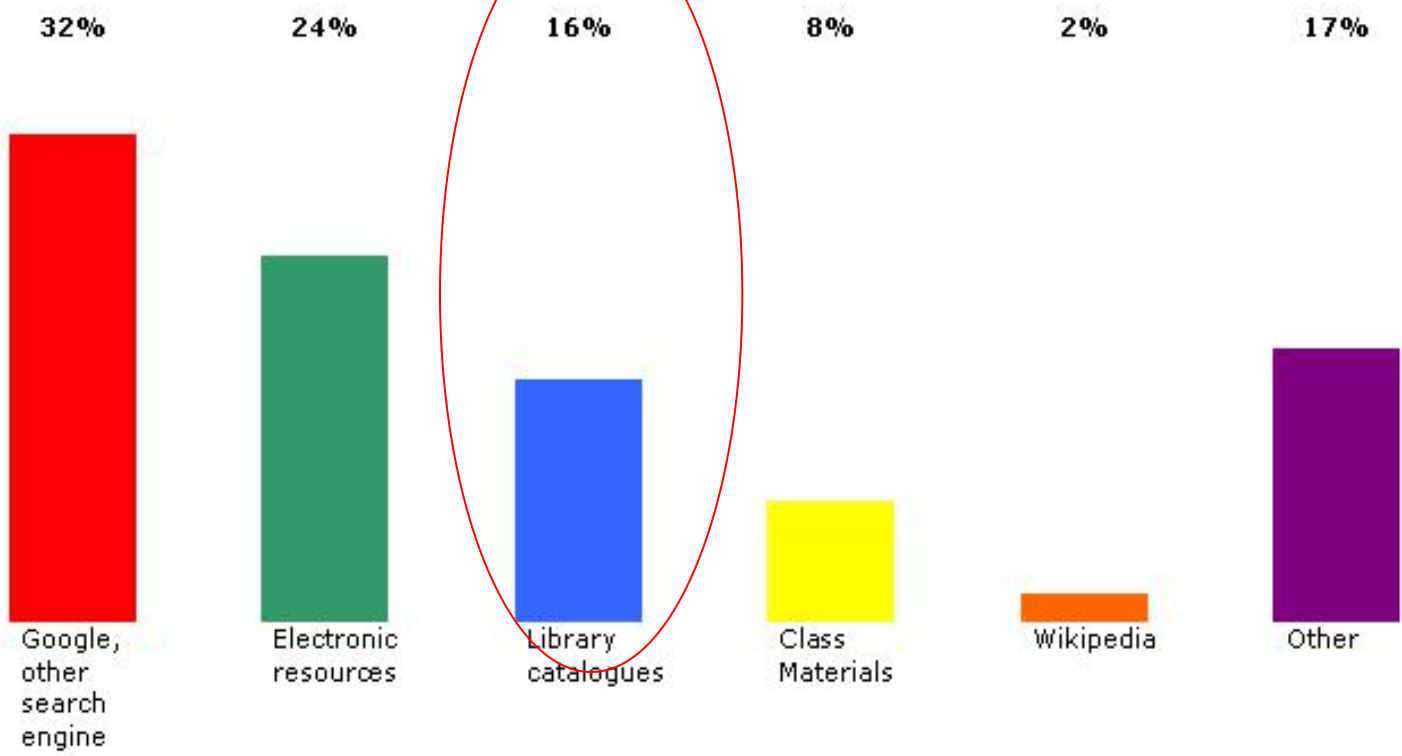




Credo Reference “Libraries Thriving” survey 2012



Where Do You Start Your Research?



Source: Credo Reference, *Libraries Thriving* survey, 2012-13



图书馆系统相对而言是 *Closed* World!





MARC记录



```
LDR 00000nam-a22-----a-4500
001 000660086
003 CZ-PrSTK
005 20100114152838.0
008 090430s2009----xxua---f-----001-0-eng-d
020 |a 978-0-596-15381-6
040 |a DDB |d SzZuIDS NEBIS FHNW-TW |d ABA013 |b cze
050 4 |a TK5105.88815 |b .S34 2009
072 7 |a 004.7 |x Počítačové sítě |2 Konspekt |9 23
080 |a 004.738.52
080 |a 004.65
100 1 |a Segaran, Toby |7 ntk2009537638 |4 aut
245 10 |a Programming the semantic web / |c Toby Segaran, Colin Evans, and Jamie Taylor
250 |a 1st ed.
260 |a Sebastopol : |b O'Reilly, |c 2009
300 |a 280 s. : |b il.
500 |a Obálkový podnázev: build flexible applications with graph data
500 |a Obsahuje rejstřík
650 07 |a www |x vt |2 psh
650 07 |a internet |x vt |2 psh
650 07 |a vyhledávání informací |x in |2 psh
655 4 |a monografie
650 07 |a sémantický web |x vt |2 psh
700 1 |a Evans, Colin |q (Colin Hearne) |7 stk2010477033 |4 aut
700 1 |a Taylor, Jamie |7 stk2010477034 |4 aut
910 |a ABA013 |b A 45734
SYS 000660086
```




MARC-XML



MARC21

245 10 |a Programming the semantic web / |c Toby Segaran, Colin Evans, and Jamie Taylor



OAI-MARC

```
<varfield id="245" i1="1" i2="0">  
  <subfield label="a">Programming the semantic web /</subfield>  
  <subfield label="c">Toby Segaran, Colin Evans, and Jamie Taylor</subfield>  
</varfield>
```




访问协议



● Z39.50



● OAI-PMH

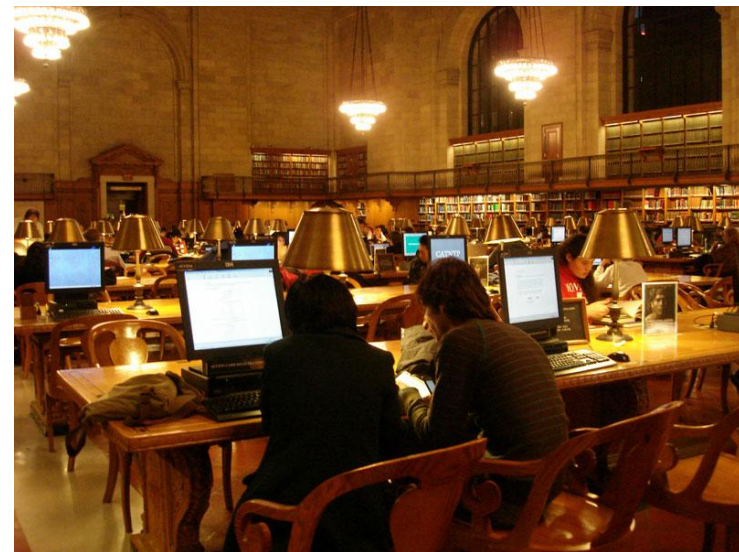




现实



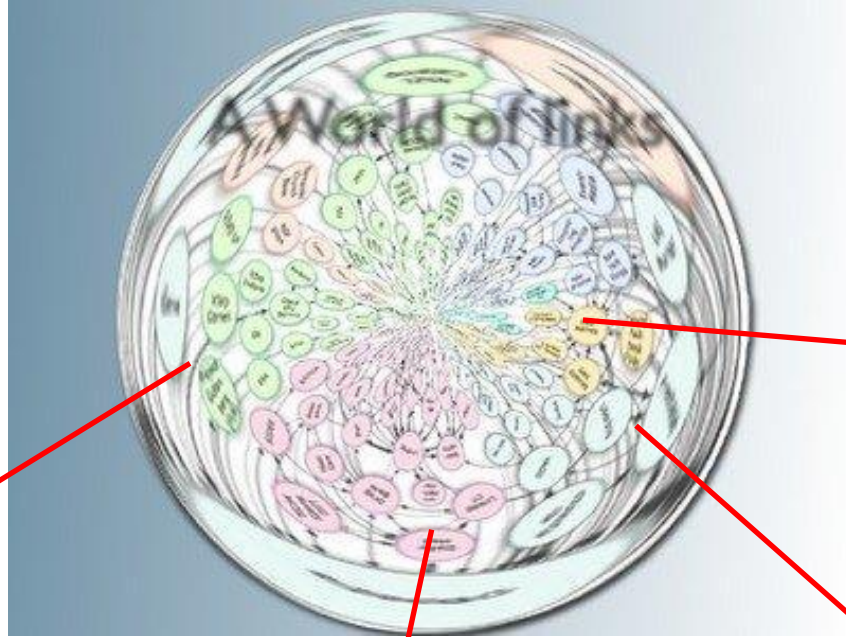
- 用户生成的内容正在大幅增长
- 孤立的内容亟待连接
- 世界是连通的，数据、信息和知识也是连通的



www



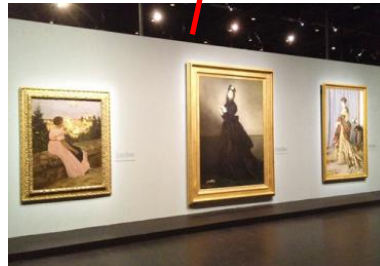
A World of Linked Open Data: enabling data integration on the web



Other..



National Library



Museums



National Archive





Why Linked Data for Libraries?



- 图书馆拥有大量有价值、可信的数据
- 图书馆目录是自包含数据孤岛，与Web上的数据未建立关联
- MARC在图书馆领域外并不流行
- 提供一个框架，可以Web友好的方式语义共享丰富的数据
- 将允许图书馆成为Web of Data中的一部分



主要内容



- 1. 关联数据的起源
- 2. 图书馆为什么需要关联数据？
- 3. 什么是关联数据？
- 4. 关联数据在图书馆中的应用



3.1 关联数据



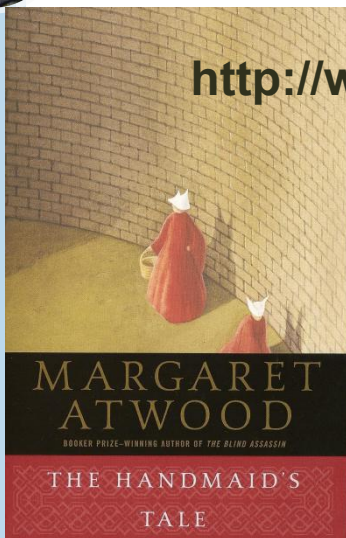
- 关联数据是一种推荐的最佳实践，用来在语义网中使用URI和RDF发布、分享、连接各类数据、信息和知识，实现Web of Data。
- A richer Linking mechanism for the Web that takes us from Hypertext Links (Document to Document) to Hyperdata Links (across things that documents are about) (一种Web上的富链接机制，将超文本链接(由文件指向文件)变为超数据链接(链接文件所代表的事物))



3.2 关联数据的四项基本原则



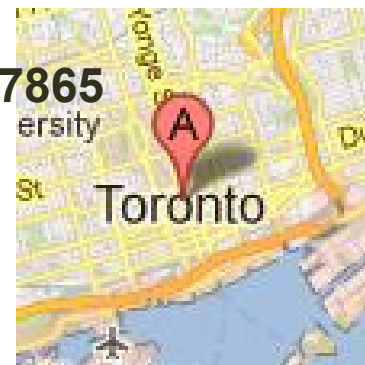
- (1) 使用URI作为任何事物的标识名称，不仅是标识文档
 - Use URIs as names for things



<http://www.worldcat.org/oclc/12558693>



<http://xmlns.com/foaf/0.1/knows>



<http://sws.geonames.org/6167865>



<http://viaf.org/viaf/109322990>



- (2) 使用HTTP URI , 使任何人都可以参引 (dereference)这一全局唯一的名称
 - Use HTTP URIs so that people can look up those names



- (3) 当有人访问名称时 , 以规范的标准(RDF, SPARQL) 提供有用的信息
 - When someone looks up a name, provide useful information



● (4) 尽可能提供链接，指向其它的URI，以使人们发现更多的相关信息

- Include links to other URIs so that they can discover more things

<http://www.utoronto.ca/person/Margaret-Atwood>

http://dbpedia.org/resource/Margaret_Atwood

http://dbpedia.org/resource/Women_novelists

http://dbpedia.org/resource/Booker_Prize_winners

Links to more things

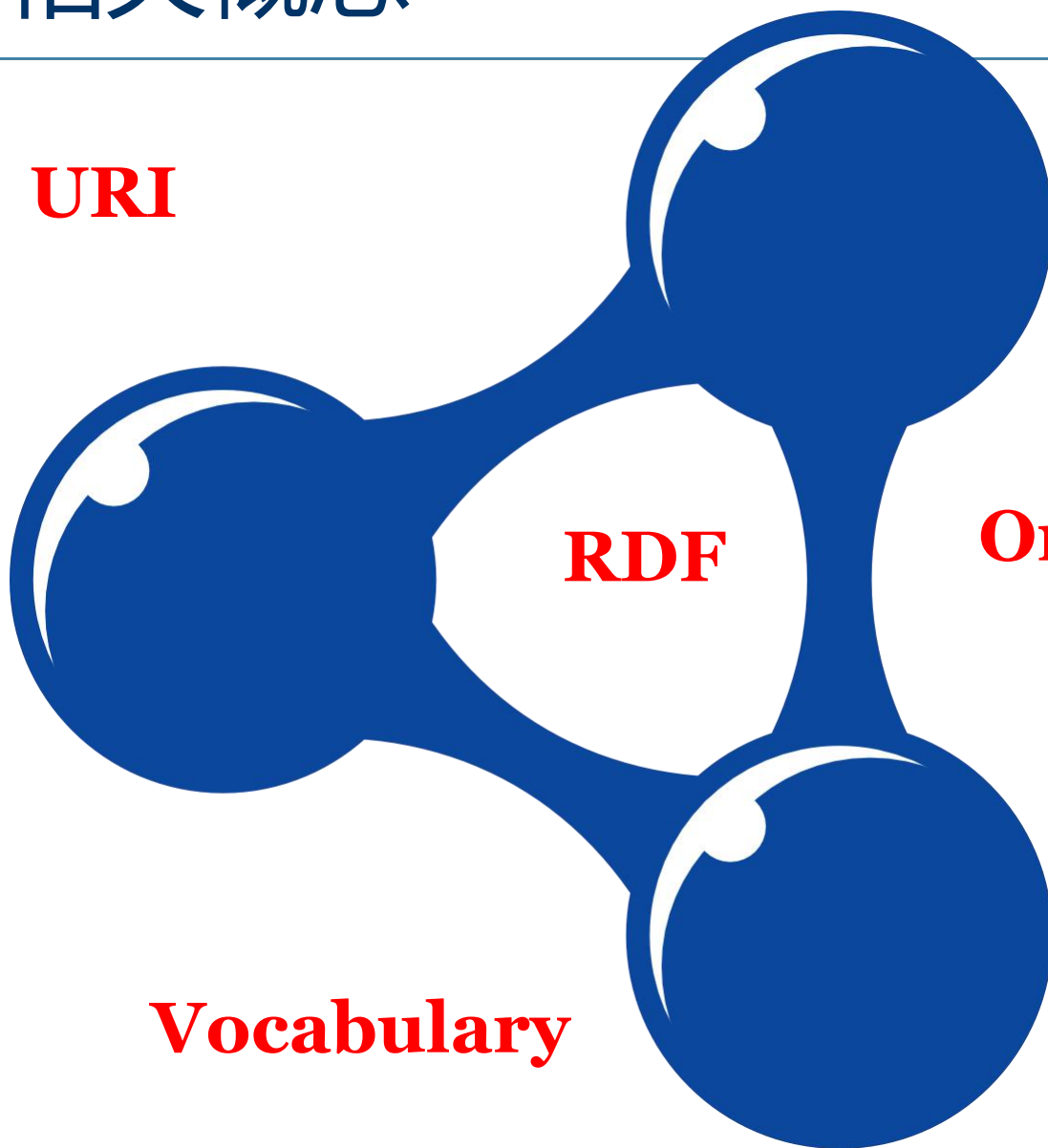
Links to more things



3.3 相关概念



URI



RDF

Ontology

Triple

Vocabulary



(1) URI

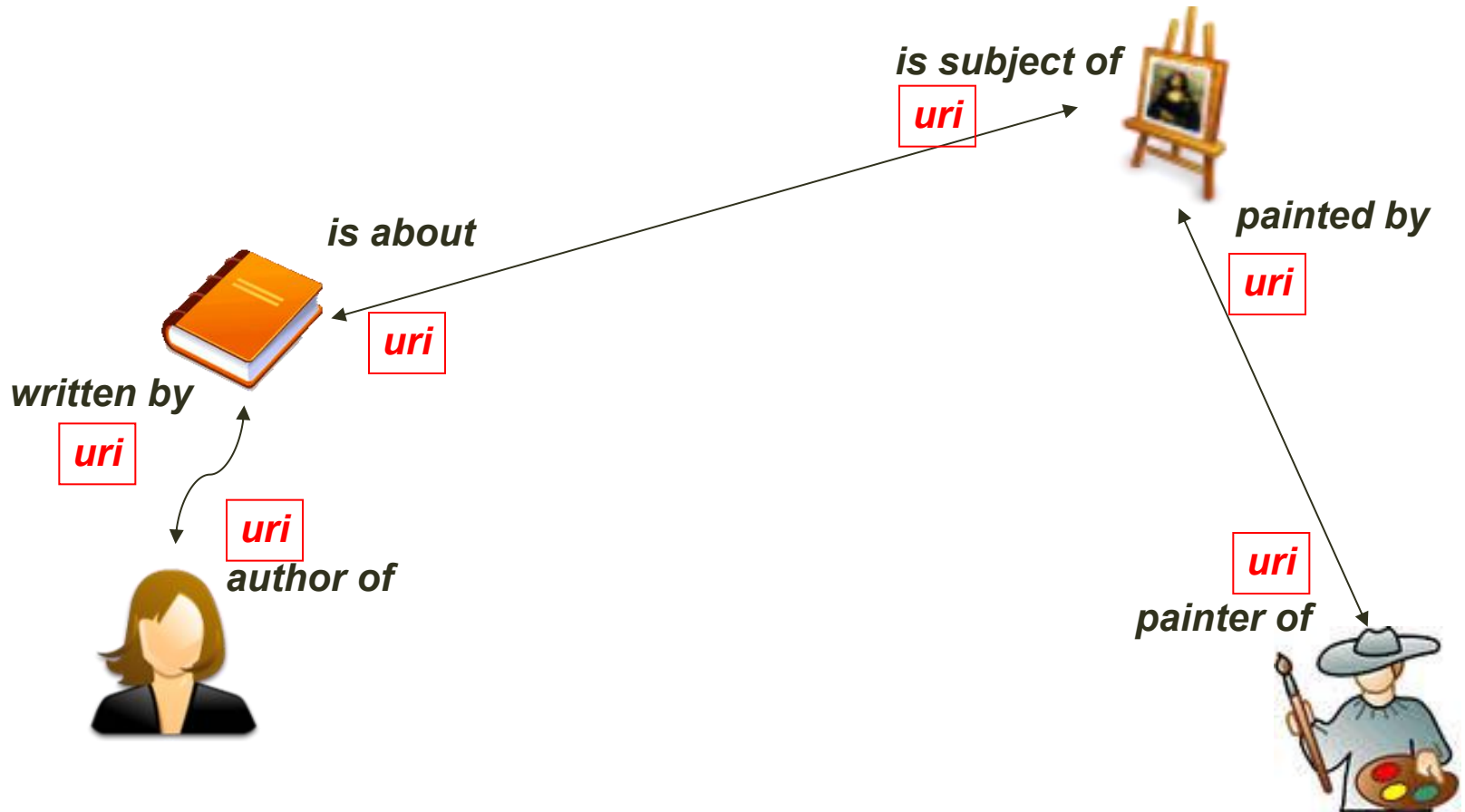


- 统一资源标识符 (Uniform Resource Identifier, URI) 是互联网中数字对象标识的基准,也是语义Web的基础,它能够唯一地标识Web上的任意一个资源,其思想是在需要的时候通过链接引用资源。



(2) Triple

- Subject - Predicate – Object
- Thing – Relation - Thing





(3) RDF



- RDF是描述资源的框架。RDF定义了一个简单的模型，通过指定的性质和相应的值描述资源之间的关系，可以表示一个实体关系图。
 - 资源 (Resource) 是指所有在Web上被命名、具有URI的东西, pages, dogs, ideas... ;
 - 描述 (Description) 指对资源属性 (Property) 的陈述 (Statement) , 以表明资源的特性或者资源之间的联系 ;
 - 框架 (Framework) 是指与被描述资源无关的通用模型 , 以包容和管理资源的多样性、不一致性和重复性。



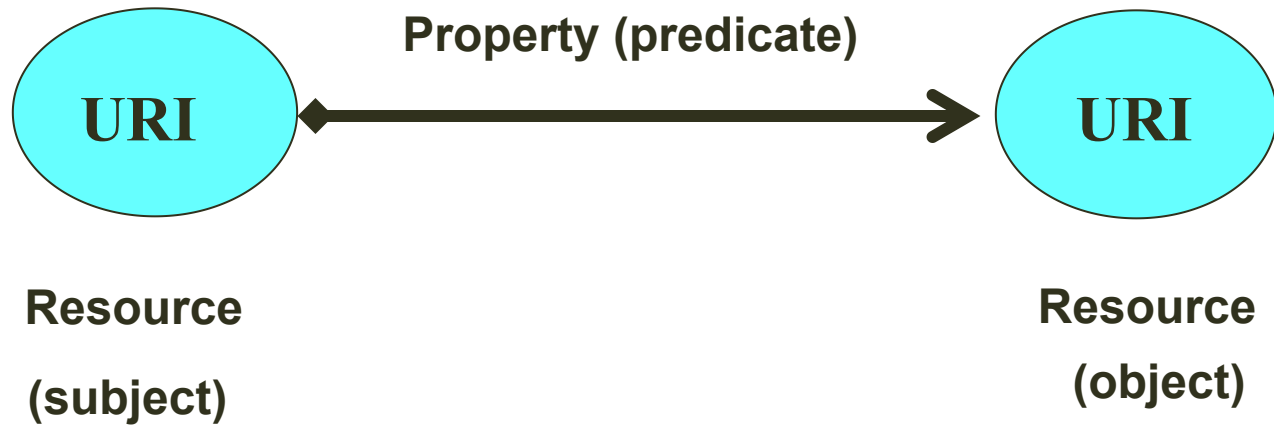
RDF数据模型



- RDF的数据模型基本结构为“对象-属性-值”的三元组，也可以称为“主题、谓词和对象”（subject,predicate,object）。这个三元组称为一个陈述，这种模型结构可以描述由机器处理的大量数据；
- 由于任何复杂的关系都可以分解为多个简单的二元关系，因此RDF的数据模型可以作为其他任何复杂关系的基础模型。



Statement: **SPO triple**





考虑英文陈述：

- `http://www.example.org/index.html` has a creation-date whose value is August 16, 1999

这个陈述里的不同部分用RDF术语来说就是：

- 主体是URL `http://www.example.org/index.html`
- 谓词是词 “creation-date”
- 客体是短语 “August 16, 1999”
- `http://www.example.org/index.html` 就是这句陈述所描述的资源，该资源有一个特性 “creation-date”，其值是一个文字 “August 16, 1999”



RDF模型的描述形式



- RDF的本质是陈述的图模型，而用于描述这个图的表示法是次要的。RDF模型的三种表示方法：

- 图示法：直观，但不便于机器处理
- 三元组：表示简略清楚，但不适合在网络上交换

{index.html creation-date August 16, 1999}

- **RDF/XML语法**：用基于XML的语法编码RDF，是W3C推荐的RDF语法



三元组表示法



<http://www.example.org/index.html>

<http://www.example.org/terms/creation-date> "August 16, 1999"

用命名空间简写法，上述的三元组可以写成：

ex:index.html ex:terms:creation-date "August 16, 1999" .



图示法



<http://www.example.org/index.html>

<http://www.example.org/terms/creation-date>

August 16, 1999



RDF/XML



描述网页创建日期的RDF/XML



```
<?xml version="1.0"?>
```

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
        xmlns:exterms="http://www.example.org/terms/" >
```

```
<rdf:Description rdf:about="http://www.example.org/index.html" >
```

rdf:Description表示某个资源描述的开始；**rdf:about**表示所陈述主体的URIref

```
<exterms:creation-date>August16,1999</exterms:creation-date>
```

Qname exterms : creation-date做标签提供属性元素，表示谓词及陈述的客体

```
</rdf:Description >
```

```
</rdf:RDF>
```



- RDF的高明之处是它只定义了一个描述框架而没有定义使用何种**元数据**描述资源，这使它可以允许任何人定义**元数据集**来描述特定的资源，元数据集在RDF中也被称作**词汇集**（ Vocabulary ），词汇集也是一种资源，可以用URI来唯一标识。这样，在用RDF描述资源的时候，可以使用各种词汇集，**只要用URI指明它们就行了。**



(4) Vocabulary



● 需要定义 “person” ? Friend of a Friend (FOAF) !

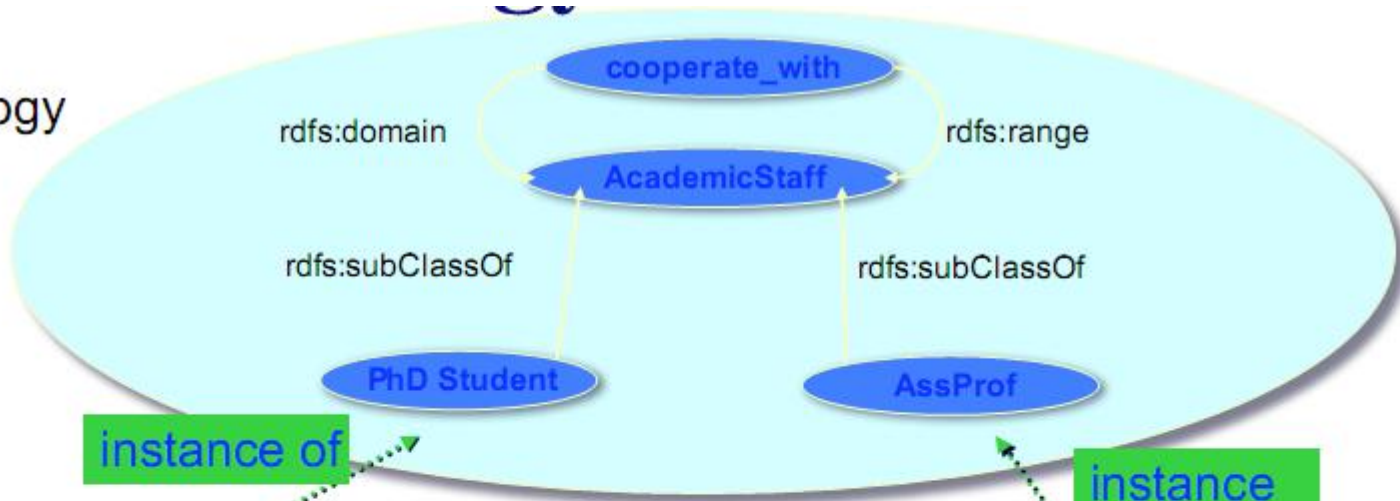


● 需要定义 “subject” ? Dublin Core Metadata Initiative (DCMI) !

● 需要定义 “genre” ? Schema.org!

(5) Ontology

Ontology



instance of

instance of

Anno-
tation

```
<swrc:PhD_Student rdf:ID="sha">
<swrc:name>Siegfried Handschuh</swrc:name>
```

```
<swrc:cooperate_with rdf:resource =
"http://www.aifb.uni-
karlsruhe.de/WBS/sst#sst"/>
```

```
</swrc:PhD_Student>
```

```
<swrc:AssProf rdf:ID="sst">
<swrc:name>Steffen Staab
</swrc:name>
...
</swrc:AssProf>
```

Cooperate_with

**Siegfried
Handschuh**



He is working together with
Steffen Staab in the Knowledge
Management Group

Web
Page

URL

<http://www.aifb.uni-karlsruhe.de/WBS/sha>

Links have explicit meanings!

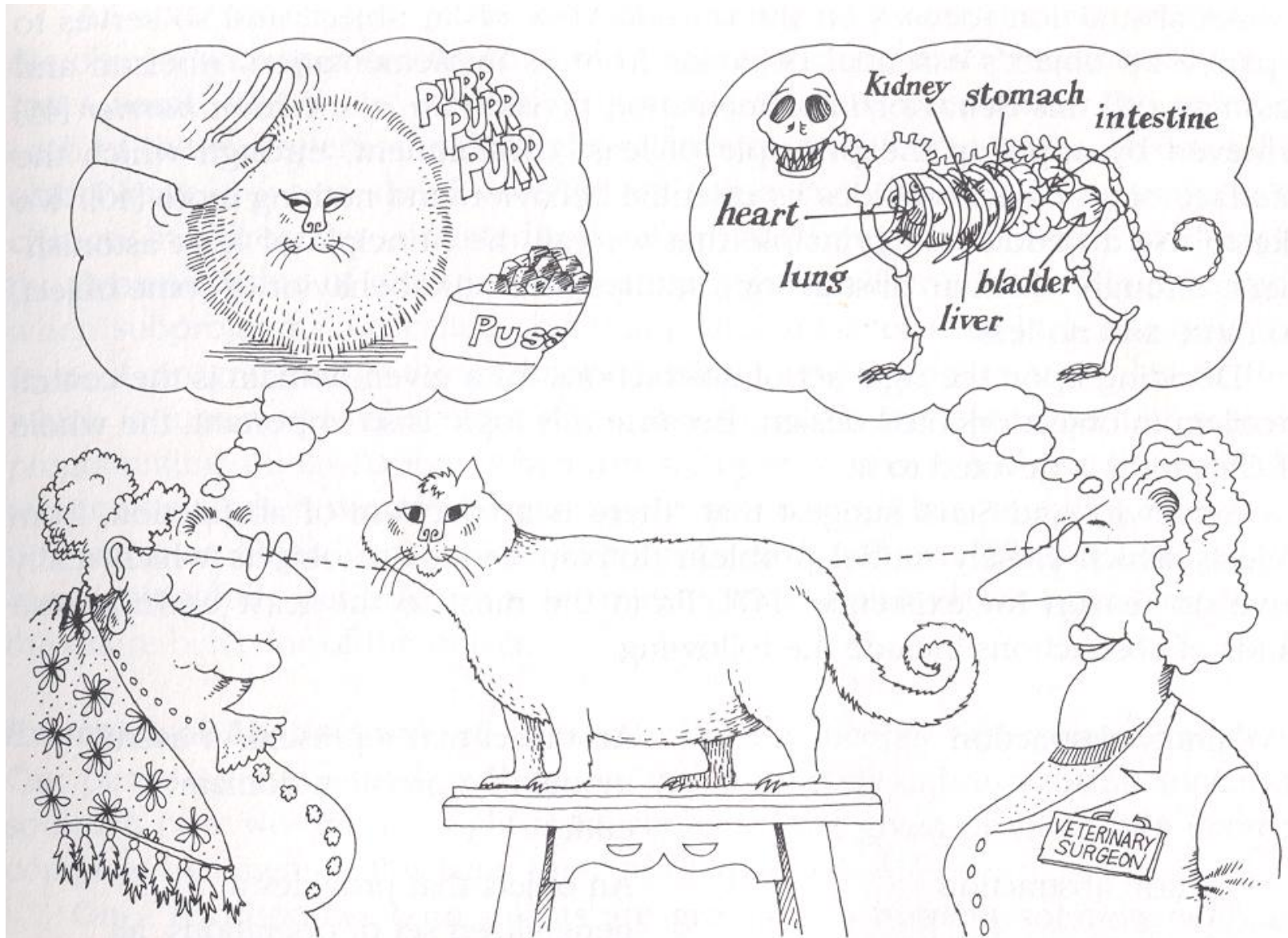


Research:

Semantic Web, Knowledge
Management, Natural Language,

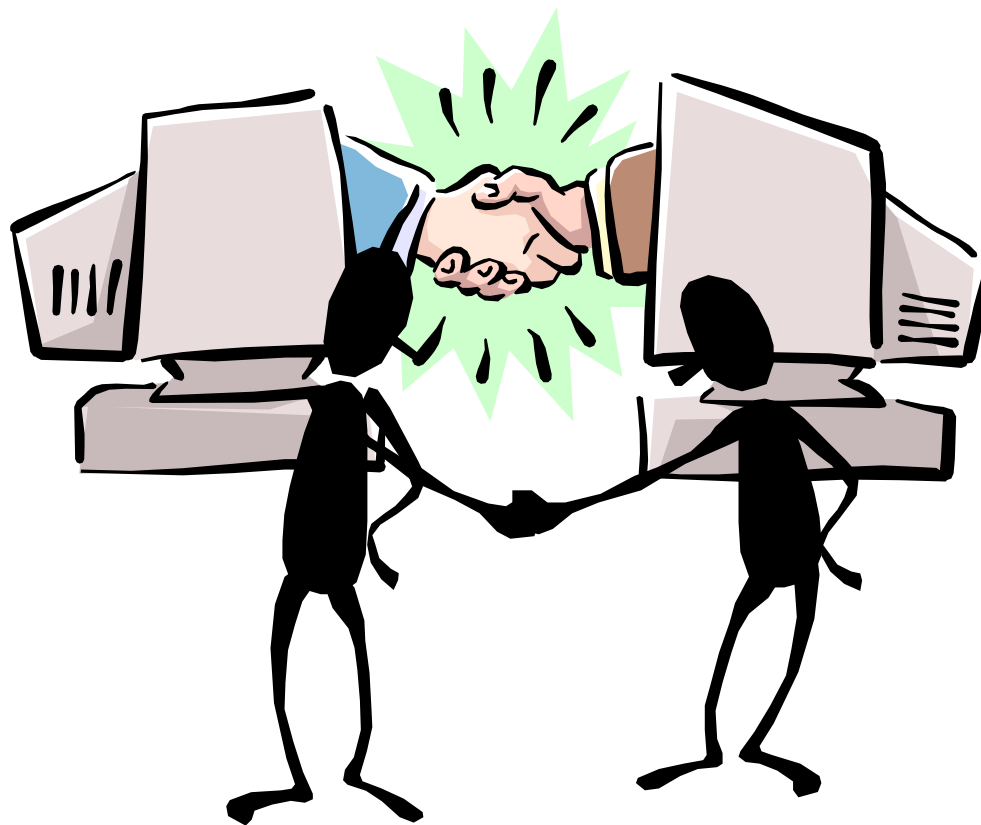
<http://www.aifb.uni-karlsruhe.de/WBS/sst>

Communication between people





- 对于智能Web中的互操作，对领域描述的标准术语或概念层级保证多多少少的全局一致性是必要的。





What is an Ontology?



- 本体是共享的概念模型的形式化的规范说明。
- An ontology is a formal specification of a shared conceptualization.
 - 概念化 (conceptualization) : 客观世界的现象的抽象模型 ;
 - 明确 (explicit) : 概念及它们之间联系都被精确定义 ;
 - 形式化 (formal) : 精确的数学描述 ;
 - 共享 (share) : 本体中反映的知识是其使用者共同认可的。



BIBO - Bibliographic Ontology



The screenshot shows the homepage of the Bibliographic Ontology website. At the top left is the logo for 'The Bibliographic Ontology', which consists of a stylized blue cube with several circles connected to it by lines, resembling a network or ontology. To the right of the logo is a navigation menu with the following items: News, Specification, Changelog (with a dropdown arrow), Examples, Projects, Community, and Login. Below the navigation menu is a 'Navigation' sidebar with a 'Recent posts' link. The main content area features a 'Welcome to the Bibliographic Ontology Website' heading, followed by the same logo as above. To the right of the logo is a paragraph of text: 'This is the official Web site for the Bibliographic Ontology, known as BIBO (namespace: *bibo*). Here you may find the BIBO **specification**, **examples** of its use, links to **news and blog postings**, **projects** that are using or extending BIBO, and links to where the **community** discusses the specification and exchanges information.' Below this text is the names of the co-editors: 'Frédéric Giasson and Bruce D'Arcus, co-editors'. At the bottom of the main content area is a 'Drupal' logo. The footer contains copyright information: 'Copyright © 2008-2011. The Bibliographic Ontology. All content available via Creative Commons Attribution-Share Alike 3.0' and a Creative Commons license icon. It also mentions 'Site hosted by: Structured Dynamics LLC'.

Description: <http://bibliontology.com>

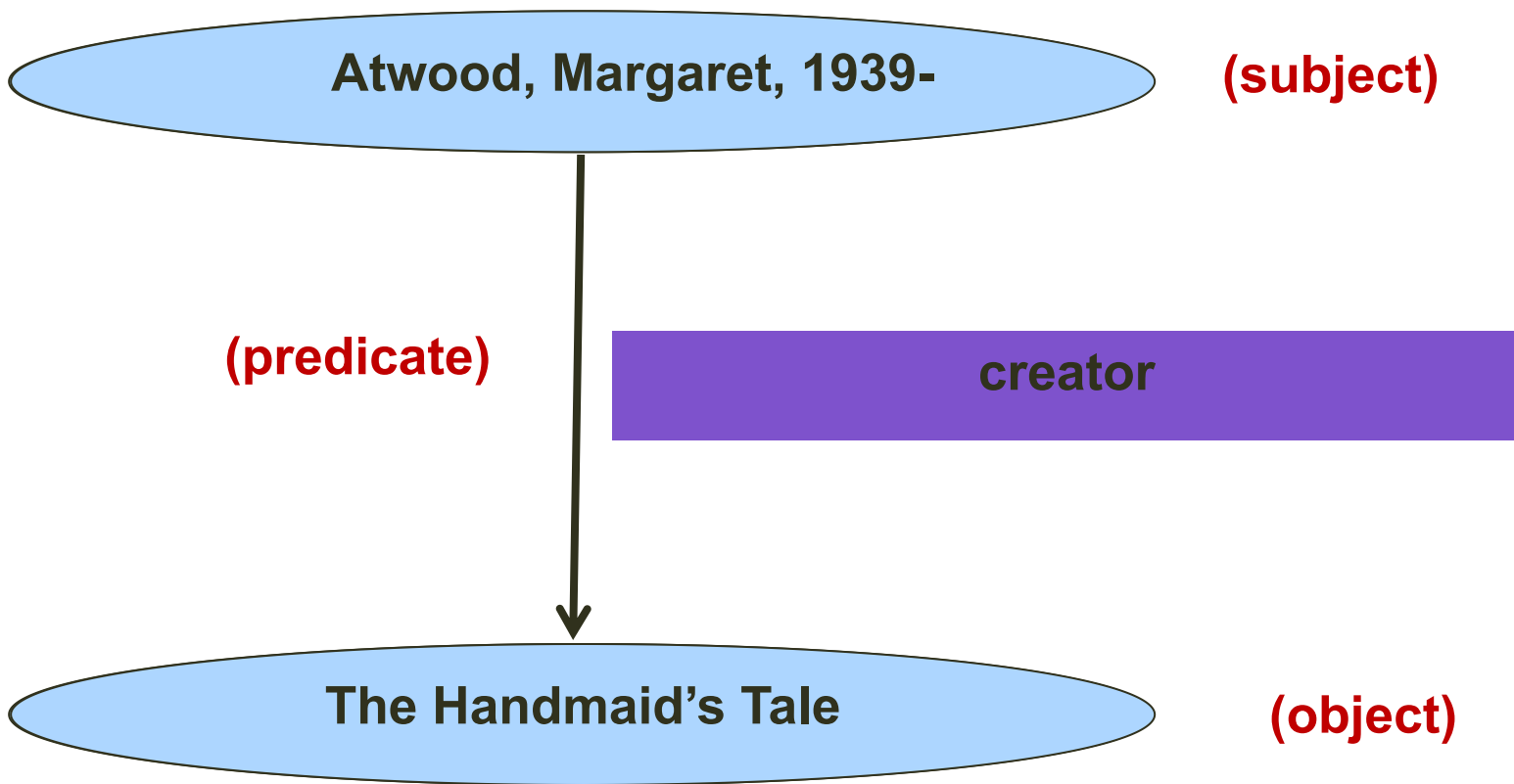
Namespace: <http://purl.org/ontology/bibo/>



3.4 从RDF到Linked data



● RDF三元组





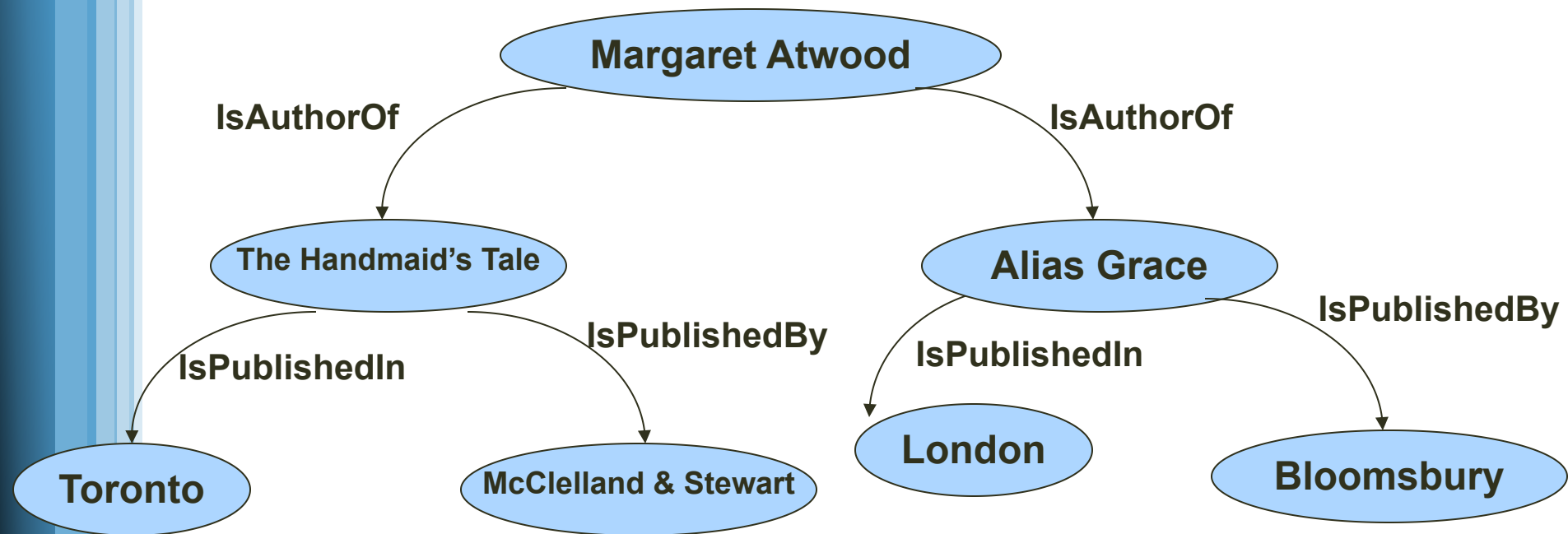
RDF三元组 → RDF graphs



- 陈述的组合形成图

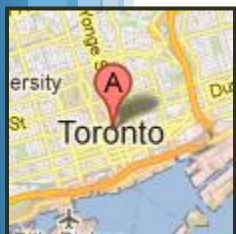


- 图没有固定的尺寸，包含的陈述是未预定义的类型





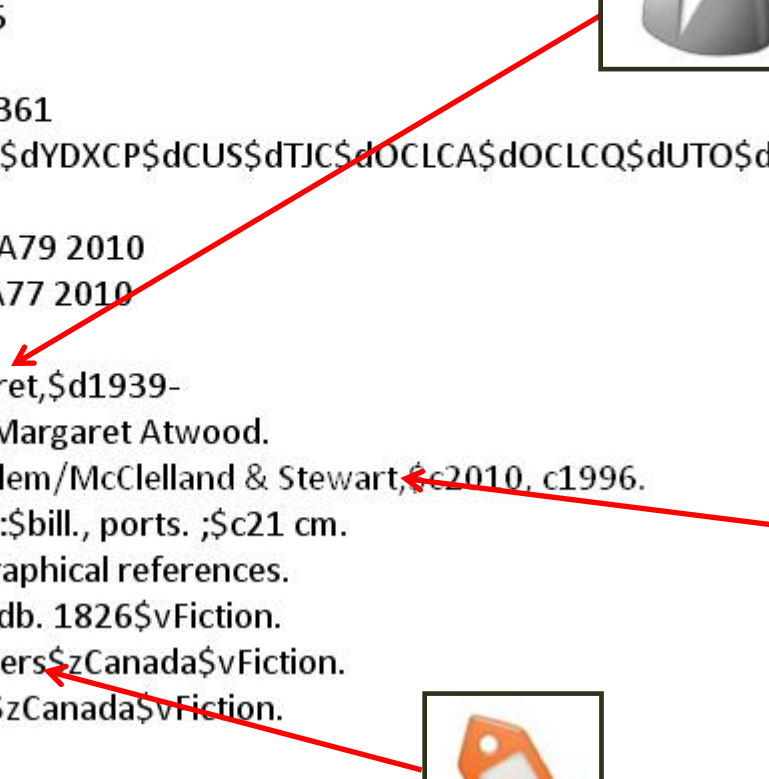
与MARC记录的关联



```

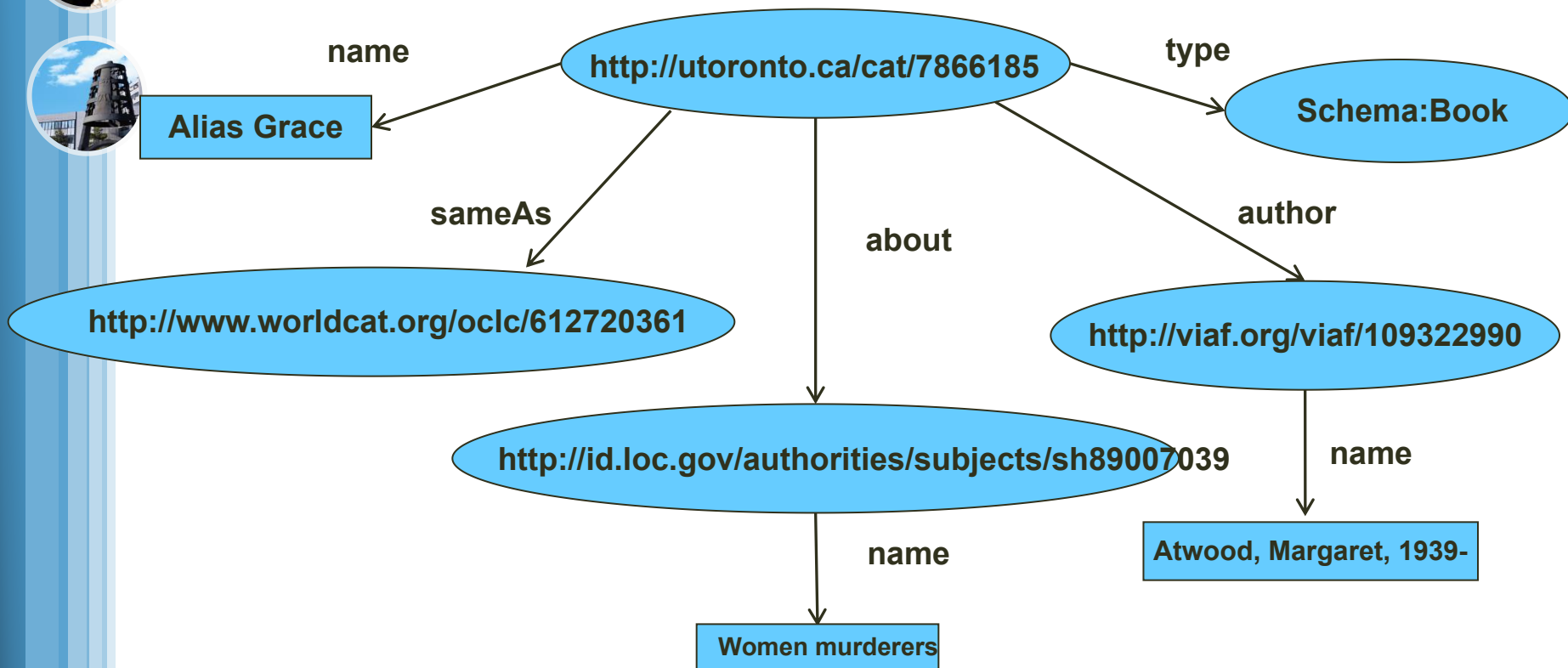
=LDR 01280 am a2200373 a 4500
=001 7866185
=003 OCoLC
=005 20111124011148.0
=008 100423t20101996oncac\\b\\000\f\eng\\
=020 \\$a9780771008825
=020 \\$a0771008821
=035 \\$a(OCoLC)612720361
=040 \\$aNLC$beng$cNLC$dYDXCP$dCUS$dTJCS$dOCLCA$dOCLCQ$dUTO$dCaOTUTF
=043 \\$an-cn---
=050 \4$aPR9199.3.A8$bA79 2010
=055 00$aPS8501 T86$bA77 2010
=082 04$aC813/.54$222
-100 1\ $aAtwood, Margaret,$d1939-
=245 10$aAlias Grace /$cMargaret Atwood.
=260 \\$aToronto :$bEmblem/McClelland & Stewart,$c2010, c1996.
=300 \\$a[10], 567, [3] p. :$bill., ports. ;$c21 cm.
=504 \\$aIncludes bibliographical references.
=600 10$aMarks, Grace,$db. 1826$vFiction.
=650 \0$aWomen murderers$vCanada$vFiction.
=650 \0$aTrials (Murder)$zCanada$vFiction.

```





RDF中定义了多种关系



`http://utoronto.ca/cat/7866185 schema:name "Alias Grace" .`

`http://utoronto.ca/cat/7866185 rdf:type schema:Book .`

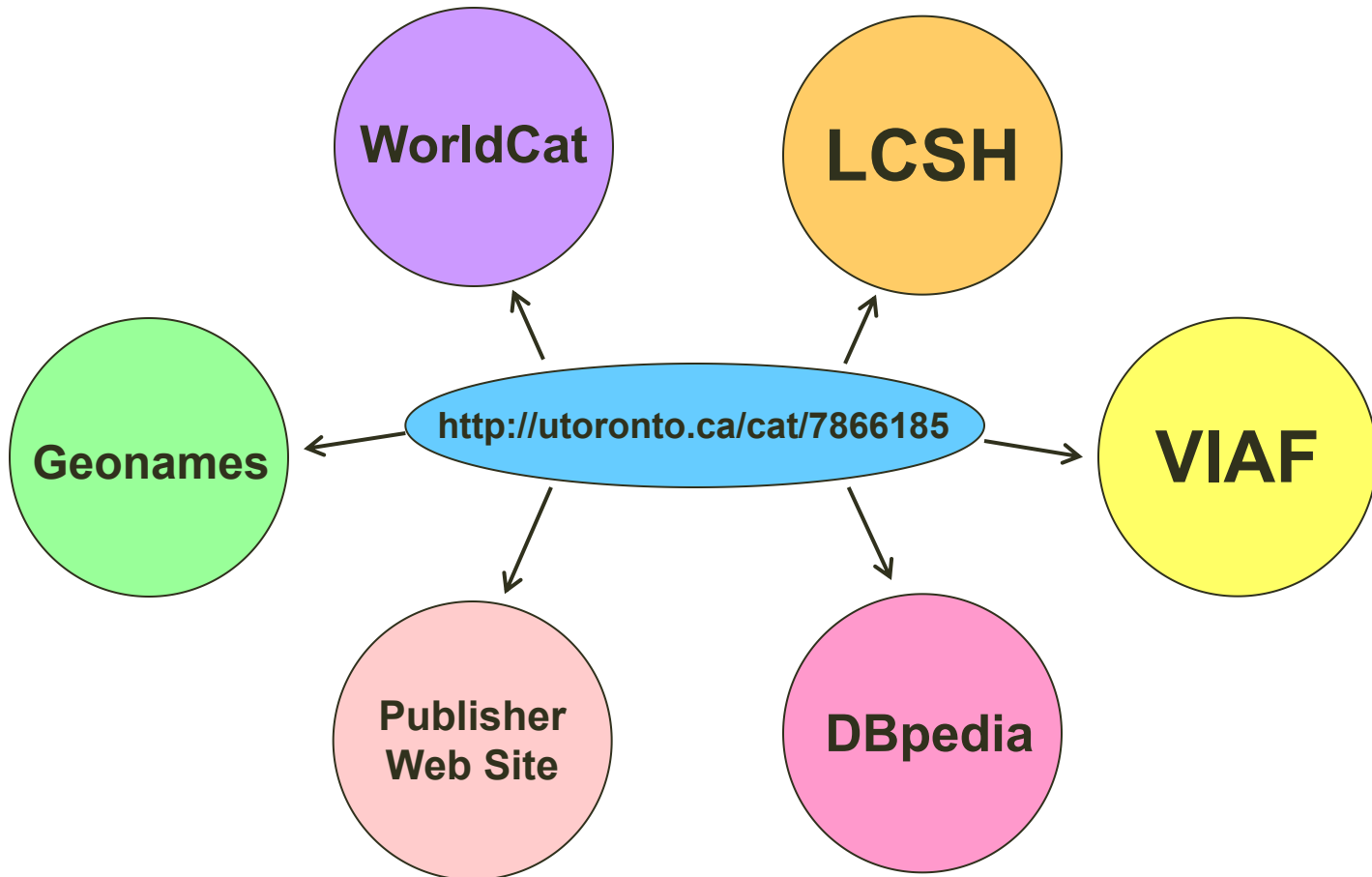
`http://utoronto.ca/cat/7866185 schema:author <http://viaf.org/viaf/109322990> .`

`http://utoronto.ca/cat/7866185 schema:about <http://id.loc.gov/authorities/subjects/sh89007039> .`

`http://utoronto.ca/cat/7866185 owl:sameAs <http://www.worldcat.org/oclc/612720361> .`



RDF graphs → 'web of data'

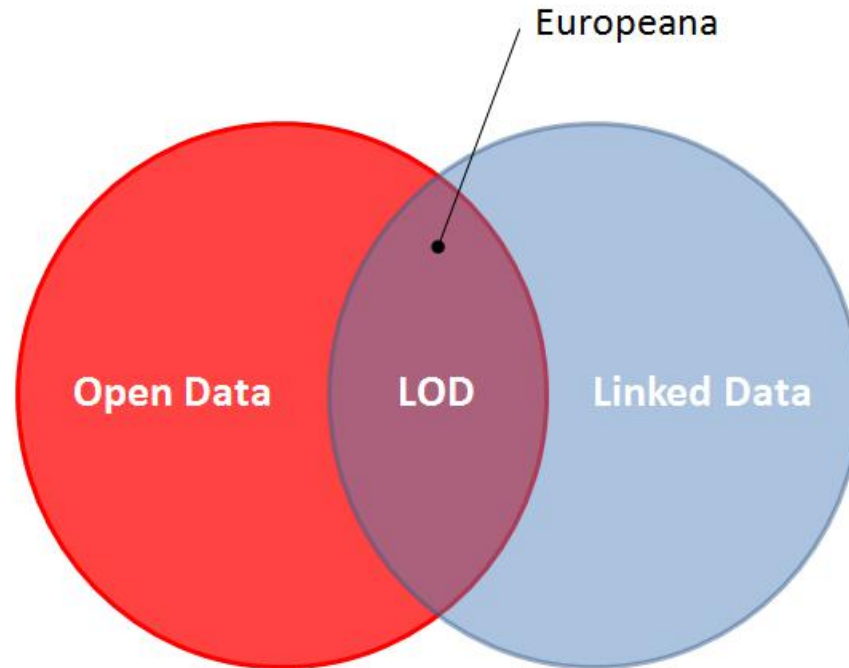




Linked data vs LOD

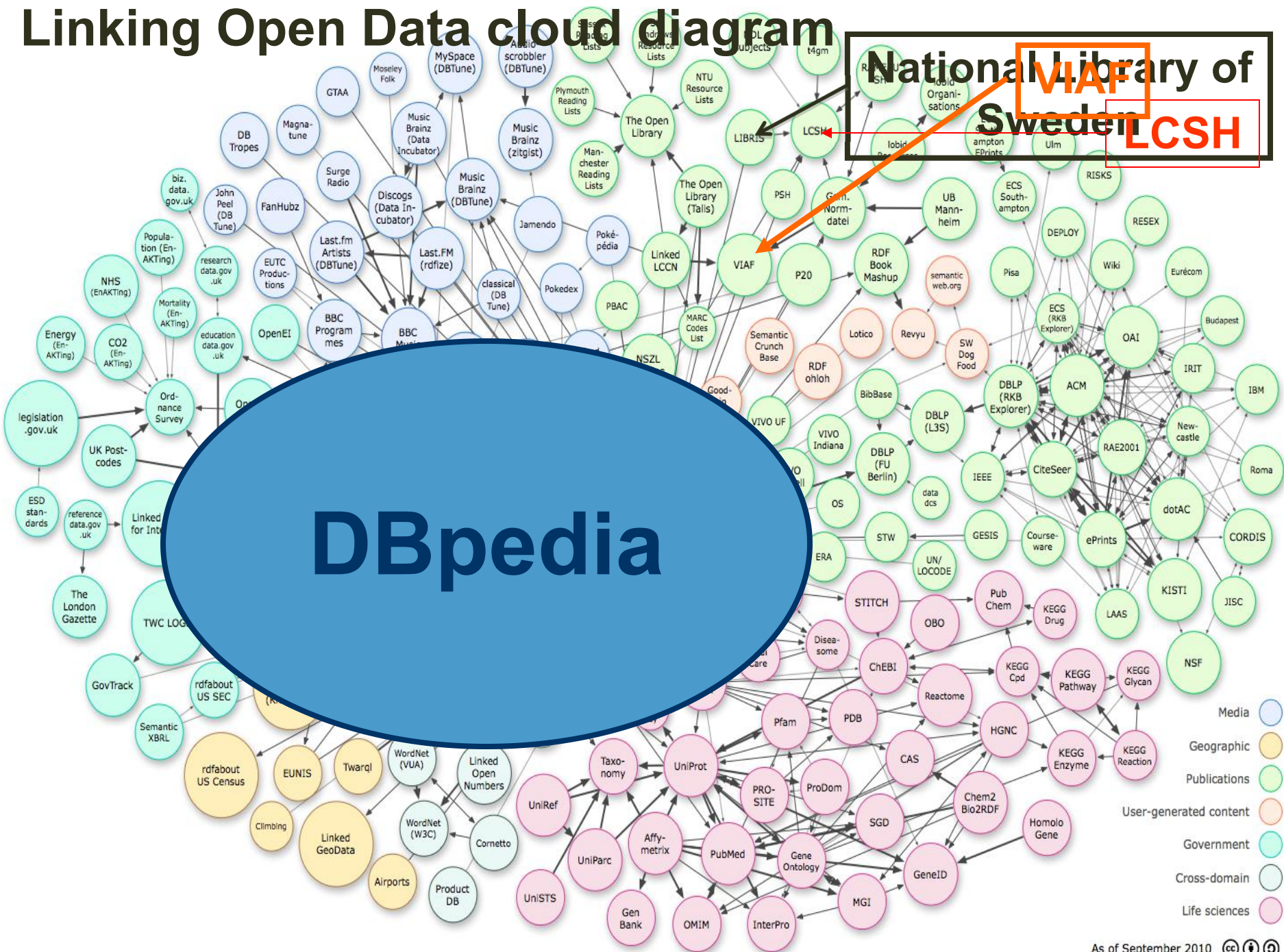


- Linked Data Principles + a public domain license = Linked Open Data (LOD)



Linking Open Data cloud diagram

National Library of Sweden
VIAF
LCSH



DBpedia



主要内容



● 1. 关联数据的起源



● 2. 图书馆为什么需要关联数据？

● 3. 什么是关联数据？

● 4. 关联数据在图书馆中的应用



图书馆的角色



● 作为关联数据的提供者

- 书目资源、受控名称规范文档、词表类表、本体
- 可供别人使用；直接利用规范成果

● 作为关联数据的消费者

- 将外面的 URI 请进来，或让自己资源的 URI 被外面拿去联接
- 利用已有资源，扩充知识组织系统，充实元数据
- 将各类文献目录和元数据变为知识服务的新起点，而不光是提供查到、拿到文献的工具
- 充分利用各种发布的关联数据资源去生产新的知识



4.1 书目数据到关联数据



● RDA



● BIBFRAME



RDA（资源描述与检索）



- 旨在取代AACR2的新一代编目条例
- 把知识世界看成是相互联系的各类实体的空间，这些实体对象有类型，有属性，有关系等，需要利用实体——关系方法进行分析建模。

在图书馆界中使用该词表，此外也作为未来图书馆数据跨越现行基于MARC的系统时的桥梁。

——Diane Hillmann, et al.



BIBFRAME



● MARC的替代



● Linked Data model

- 明确区分概念性内容和它的物理表现（如：作品和实例）
- 致力于明确识别信息实体（如：规范）
- 设法揭示各实体之间的关系



书目数据到关联数据的四个原则



- 要求编目对象所涉及的一切实体都应该是一个网络存在，并以URI表示这个网络存在的名字，而不是一个简单的文档链接。
- 规定了通过网络存在可以通过万维网上最通用的“超文本传输协议”进行获取，不需要任何特殊的、私有的协议（如SRU / SRW等）或者任何应用程序接口（API）。
- 希望以标准的元数据格式（最好是RDF），尽可能完整地提供书目信息，即元数据越丰富越好。
- 希望在对一个资源进行元数据描述时，尽可能复用已有的URI资源，例如某本书的作者，应该以某个权威机构发布的人名规范档中该作者的URI作为属性值。



书目数据到关联数据的实践



- 瑞典联合目录（LIBRIS）是全球第一个将书目数据发布成关联数据的联合目录，主要由瑞典皇家图书馆负责管理，开放其200多个成员馆大约650万条书目记录、20万条规范文档记录（人名、地名、主题标目）。瑞典皇家图书馆已经开始创建从联合目录到Dbpedia的连接，为图书馆界开展关联数据的发布及应用提供了宝贵的经验和思路。



LIBRIS – Swedish National Library

LIBRIS

LIBRIS SEARCH FACILITIES | HELP | PÅ SVENSKA | PREFERENCES | CLEAR HISTORY

Start | Extended search | Index A-Ö | Boolean | Subdatabases | Search history

onr:5060570

Search

Search: onr:5060570 > The difference engi...

```

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@prefix owl: <http://www.w3.org/2002/07/owl#> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
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The difference engine / William Gibson

Gibson, William, 1948- (author)
 Sterling, Bruce, 1954- (author)
 ISBN 0-575-60029-2 (pbk)
 London : Vista, 1996
 English 383 s.

Book

Abstract | Subject headings

Get it | Other editions

Loan | Interlibrary loan/request

Title available at 1 library. [Expand list](#)

Southern Sweden (1)

ADD AS FAVOURITE

Folkbiblioteken i Lund (Ld)

ADD AS FAVOURITE

Local library catalogue

Shelf mark: (Skönlitteratur. Annan uppl. kan finnas vid biblioteket)

Loan status | Opening hours, address etc.

Shakespeare, William, 156...

All tomorrow's parties /
 William Gibson
 Book (1999)
 Gibson, William, 1948-



Library of Congress

LIBRARY OF CONGRESS

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LIBRARY CATALOGS

GO

Options

The Library of Congress > Authorities & Vocabularies > LC Subject Headings

Medicine, Chinese

From [Library of Congress Subject Headings](#)

Details

Visualization

Suggest Term

Medicine, Chinese

URI(s)

- > <http://id.loc.gov/authorities/subjects/sh85083125>
- > <info:lc/authorities/sh85083125>
- > <http://id.loc.gov/authorities/subjects/sh85083125#concept>

Instance Of

- > [MADS/RDF Topic](#)
- > [MADS/RDF Authority](#)
- > [SKOS Concept](#)

Scheme Membership(s)

- > [Library of Congress Subject Headings](#)

Collection Membership(s)

- > [LCSH Collection - Authorized Headings](#)
- > [LCSH Collection - General Collection](#)
- > [LCSH Collection - Term Permitted to be Indirect](#)

Variants

- > Chinese medicine
- > TCM (Medicine)
- > Traditional Chinese medicine
- > Traditional medicine--China

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Virtual International Authority File (VIAF)

VIAF Beta
Virtual International Authority File

Search

Select Field: Select Index: Search Term:

Selected Covers



Beethoven, Ludwig
БЕТХОВЕН, ЛЮДВИГ
Beethoven, Ludwig
VIAF ID:32182557

Preferred Forms

- 200 ja [Beethoven, ꞑb Ludwig van, ꞑf 1770-1827](#)
- 100 ja [Beethoven, Ludwig van ꞑd 1770-1827](#)
- 100 ja [Beethoven, Ludwig van ꞑd 1770-1827](#)
- 100 ja [БЕТХОВЕН, ЛЮДВИГ ВАН, ꞑd 1770-1827](#)
- 100 ja [Beethoven, Ludwig van, ꞑd 1770-1827](#)
- 100 ja [Beethoven, Ludwig van ꞑd 1770-1827](#)
- 100 ja [Beethoven, Ludwig van, ꞑd 1770-1827](#)
- 100 ja [Beethoven, Ludwig van, ꞑd 1770-1827](#)
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BL - British National Bibliography

BRITISH
LIBRARY

rdf | **ttl** | json | xml | html

British National Bibliography

At this time, this dataset is not guaranteed to be stable; its contents may change at any time without warning

Animal Farm / George Orwell

<http://bnb.data.bl.uk/id/resource/012701550>

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extent	xliv, 113p.
isbn 10	185715150X
title	Animal Farm
type	BibliographicResource Book
creator	Orwell, George, 1903-1950
is part of	Everymans' library Everymans library Everyman's library
language	eng
publication event	London : David Campbell, 1993
same as	GB9330497
see also	185715150X
subject	823.912

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OCLC WorldCat



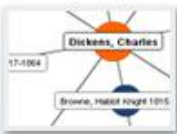
Find items in lib

1.5 billion items available here

Everything Books D

Advanced search | Find a Library

WorldCat connects you to



WorldCat

Visually exp

Browse library collections with **WorldCat Genres**

Linked Data

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<<http://www.worldcat.org/oclc/18417626>>



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	rdf:type	skos:Concept
	schema:name	"Women painters"



4.2 丰富现有数据



更多图片

奥古斯特·斯特林堡

作家



奥古斯特·斯特林堡是一位瑞典作家、剧作家和画家，被称为现代戏剧创始人之一。斯特林堡是一位多产的作家，在其四十余年的创作生涯里，他写了六十多部戏剧和三十多部著作，其著作涵盖范围有小说、历史、自传、政治和文化赏析等。他的作品直观体现他的生活经历和感受。 [维基百科](#)

生于：1849年1月22日，[瑞典斯德哥尔摩](#)

逝于：1912年5月14日，[瑞典斯德哥尔摩](#)

所著书籍和剧作：[En spöksonat](#)

```
select distinct ?uri where {
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      <http://xmlns.com/foaf/0.1/name> "August Strindberg" .
  ?uri <http://dbpedia.org/property/dateOfBirth> ?date .
  FILTER ( xsd:dateTime(?date) >= xsd:dateTime("1849-01-01T00:00:00")) .
  FILTER( xsd:dateTime(?date) < xsd:dateTime("1850-01-01T01:00:00")) .
}
```

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