INFO/CS 4302
Web Information Systems

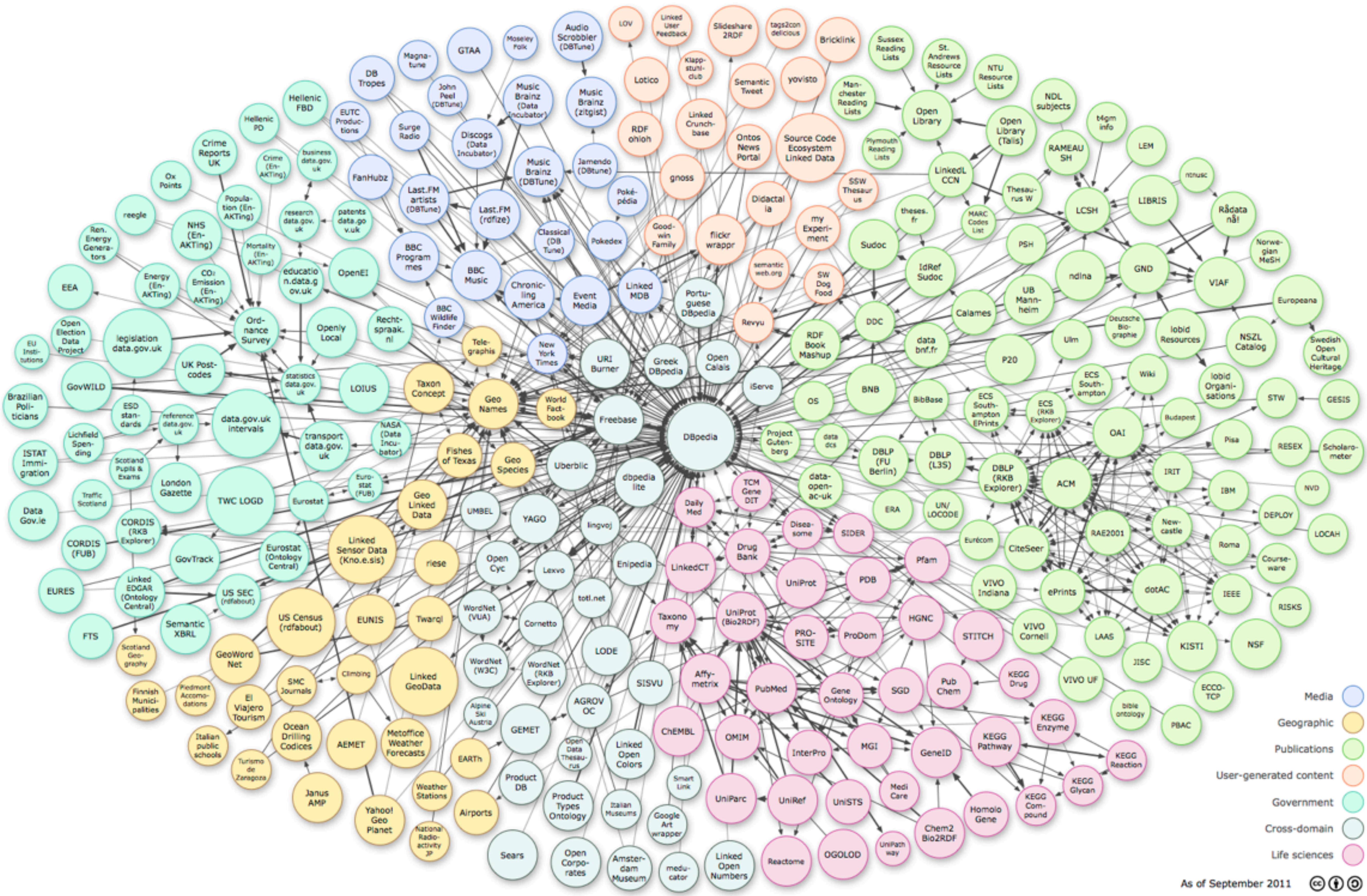
FT 2012
Lecture 17: SKOS, SPARQL

- Bernhard Haslhofer -

Plan for today...

- Context & Recap
- SKOS
- SPARQL
- Questions

CONTEXT & RECAP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Moseley Folk
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Surge Radio
Discogs (Data Incubator)
RDF ohloh
Linked Crunch-base
Ontos News Portal
Source Code Ecosystem Linked Data
Plymouth Reading Lists
Open Library (Talis)
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RAMEAU SH
LEM
Crime Reports UK
Crime (En-AKTing)
business data.gov.uk
FanHubz
Last.FM artists (DBTune)
Music Brainz (DBTune)
Jamendo (DBtune)
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LinkedL CCN
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ESD stan-dards
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Taxon Concept
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Course-ware
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UniProt
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Twarql
WordNet (VUA)
Cornetto
LODE
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UniProt (Bio2RDF)
PRO-SITE
ProDom
HGNC
STITCH
VIVO Cornell
LAAS
KISTI
NSF
Scotland Geo-graphy
GeoWord Net
SMC Journals
Climbing
Linked GeoData
WordNet (W3C)
WordNet (RKB Explorer)
AGROV OC
SISVU
Affy-metrix
PubMed
Gene Ontology
SGD
Pub Chem
KEGG Drug
JISC
VIVO UF
bible ontology
ECCO-TCP
Finnish Munici-palities
Piedmont Accomo-dations
El Viajero Tourism
Ocean Drilling Codices
AEMET
Metoffice Weather Forecasts
Alpine Ski Austria
GEMET
ChEMBL
OMIM
MGI
GeneID
KEGG Pathway
KEGG Enzyme
PBAC
Italian public schools
Turismo de Zaragoza
EARTh
Open Data Thesau-rus
Linked Open Colors
InterPro
KEGG Reaction
Janus AMP
Yahoo! Geo Planet
Weather Stations
Airports
Product DB
Product Types Ontology
Italian Museums
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UniSTS
Medi Care
KEGG Com-pound
KEGG Glycan
National Radio-activity JP
Sears
Open Corpo-rates
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UniPath way
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Homolo Gene
Media
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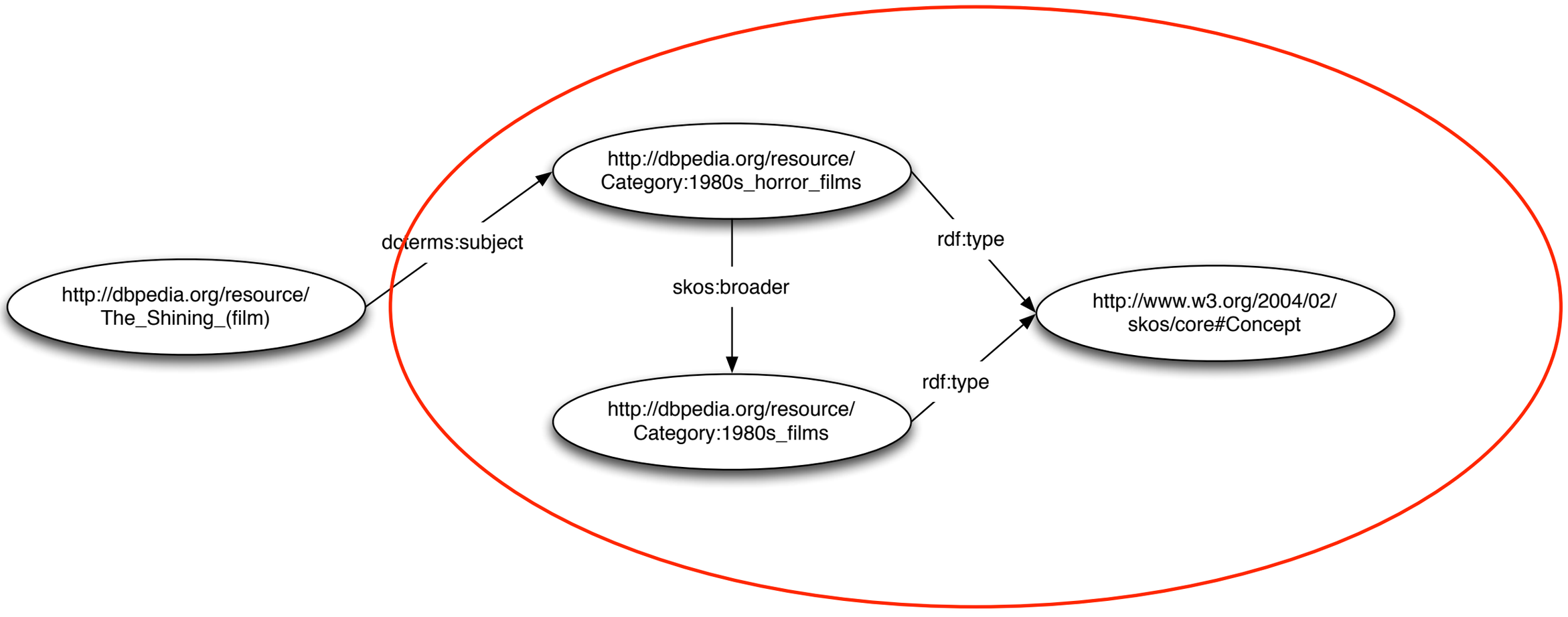
Government
Cross-domain
Life sciences
As of September 2011

SPARQL

- A language for describing knowledge organization systems (taxonomies, thesauri, classification schemes)



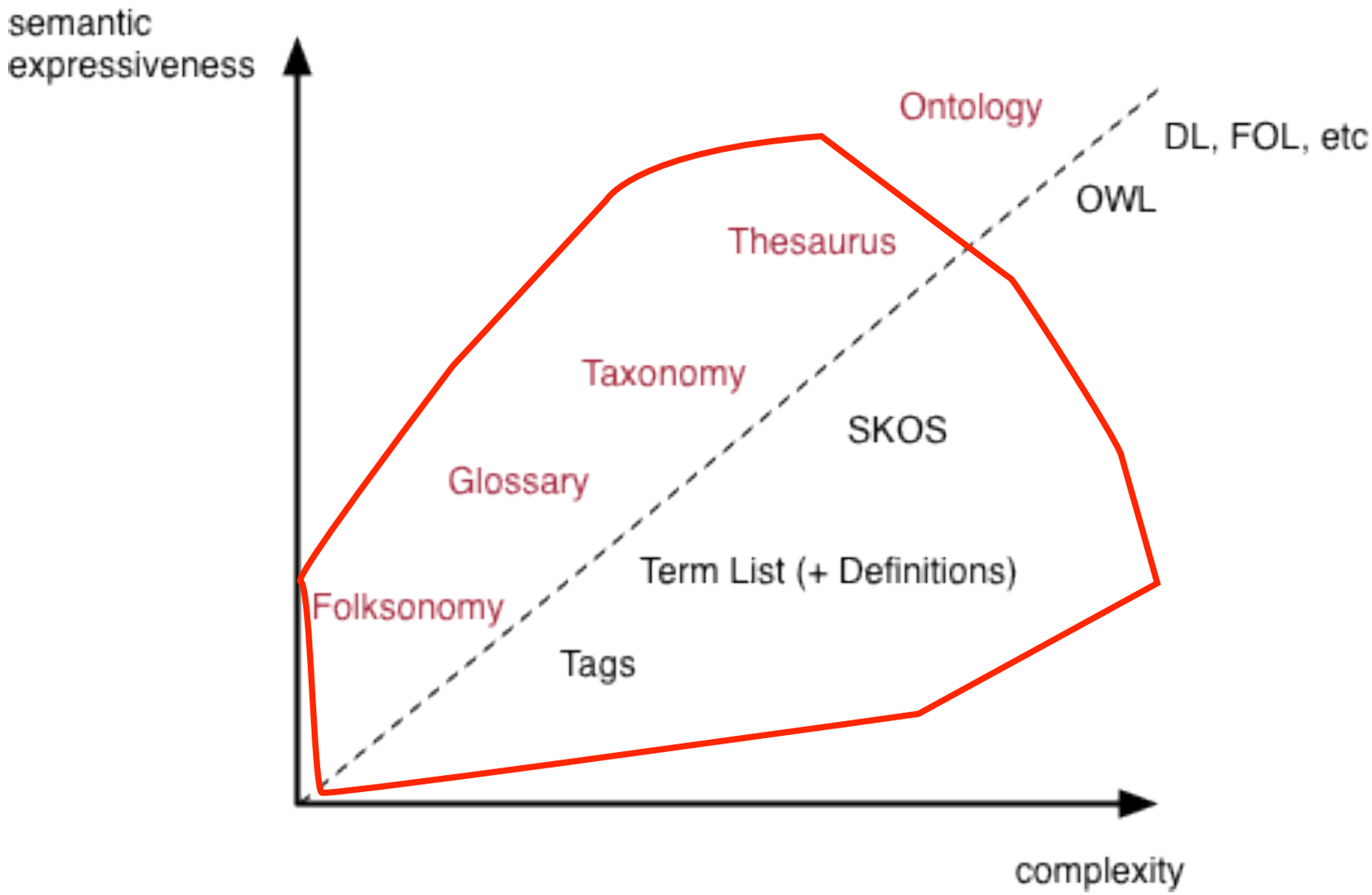
SPARQL

- A query language and protocol for accessing RDF data on the Web

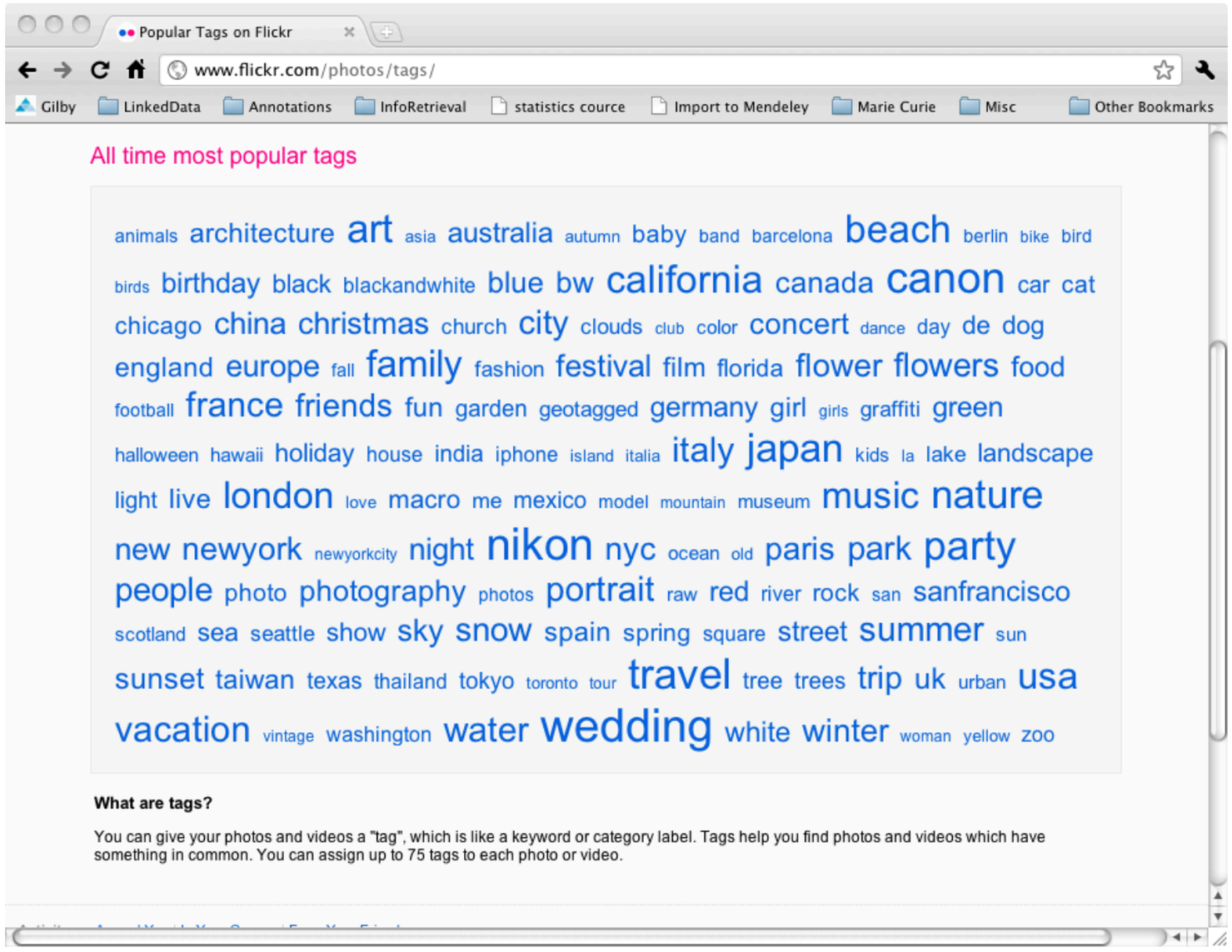
```
SELECT DISTINCT ?x
WHERE {
      ?x dcterms:subject
      <http://dbpedia.org/resource/Category:1980s_horror_films> .
}
```

SKOS

Knowledge Organization Systems (KOS)



Folksonomy Examples



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North American Product Classification System

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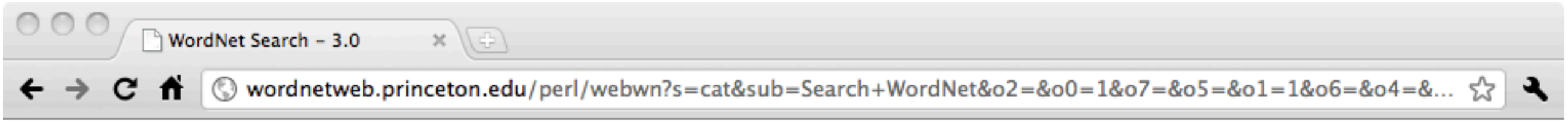
Introduction

In February 1999, the statistical agencies of Canada, Mexico, and the United States launched a joint multi-phase initiative to develop a comprehensive demand-oriented product classification, known as the North American Product Classification System (NAPCS). Work to date has focused on the products produced by service industries in 12 NAICS sectors 48-49 through 81. With that work nearing completion, this web page provides an overview of and progress report on the NAPCS initiative and presents the final versions of the product lists developed so far for the service industries included in those 12 sectors.

Overview and Progress Report

Final NAPCS Product Lists

- Description of product lists
- View PDF files of individual product lists
- Download sequential Excel file of all product lists



WordNet Search - 3.0 - WordNet home page - Glossary - Help

Word to search for: cat Search WordNet

Display Options: (Select option to change) Change

Key: "S:" = Show Synset (semantic) relations, "W:" = Show Word (lexical) relations

Noun

- S: (n) **cat**, true cat (feline mammal usually having thick soft fur and no ability to roar: domestic cats; wildcats)
- S: (n) guy, **cat**, hombre, bozo (an informal term for a youth or man) *"a nice guy"; "the guy's only doing it for some doll"*
- S: (n) **cat** (a spiteful woman gossip) *"what a cat she is!"*
- S: (n) kat, khat, qat, quat, **cat**, Arabian tea, African tea (the leaves of the shrub Catha edulis which are chewed like tobacco or used to make tea; has the effect of a euphoric stimulant) *"in Yemen kat is used daily by 85% of adults"*
- S: (n) cat-o'-nine-tails, **cat** (a whip with nine knotted cords) *"British sailors feared the cat"*
- S: (n) Caterpillar, **cat** (a large tracked vehicle that is propelled by two endless metal belts; frequently used for moving earth in construction and farm work)
- S: (n) big cat, **cat** (any of several large cats typically able to roar and living in the wild)
- S: (n) computerized tomography, computed tomography, CT, computerized axial tomography, computed axial tomography, **CAT** (a method of examining body organs by scanning them with X rays and using a computer to construct a series of cross-sectional scans along a single axis)

Verb

- S: (v) **cat** (beat with a cat-o'-nine-tails)
- S: (v) vomit, vomit up, purge, cast, sick, **cat**, be sick, disgorge, regorge, retch, puke, barf, spew, spue, chuck, upchuck, honk, regurgitate, throw up (eject the contents of the stomach through the mouth) *"After drinking too much, the students vomited"; "He purged continuously"; "The patient regurgitated the food we gave him last night"*

WordNet home page

craigslist: ithaca classifieds f

ithaca.craigslist.org

craigslist

post to classifieds
my account
help, faq, abuse, legal

search craigslist

for sale >

event calendar

S	M	T	W	T	F	S
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	1	2	3	4	5
6	7	8	9	10	11	12

avoid scams & fraud
personal safety tips
craigslist blog
craigslist factsheet
best-of-craigslist
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craigslist foundation
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system status

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groups
pets
events
lost+found
musicians
local news
politics
rideshare
volunteers
classes

personals

strictly platonic
women seek women
women seeking men
men seeking women
men seeking men
misc romance
casual encounters
missed connections
rants and raves

discussion forums

1099
apple
arts
atheist
autos
beauty
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crafts
diet
divorce
dying
eco
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fitness
gifts
haiku
health
help
history
housing
jobs
jokes
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linux
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music
npo
open
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housing

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cycle
event
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legal
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labor/move
skill'd trade
real estate
sm biz ads

jobs

accounting+finance
admin / office
arch / engineering
art / media / design
biotech / science
business / mgmt
customer service
education
food / bev / hosp
general labor
government
human resources
internet engineers
legal / paralegal
manufacturing
marketing / pr / ad
medical / health
nonprofit sector
real estate
retail / wholesale
sales / biz dev
salon / spa / fitness
security
skilled trade / craft
software / qa / dba
systems / network
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transport
tv / film / video
web / info design
writing / editing
[ETC]
[part-time]

gigs

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event
labor
computer
creative
domestic

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allentown
belleville
binghamton
buffalo
catskills
elmira
finger lakes
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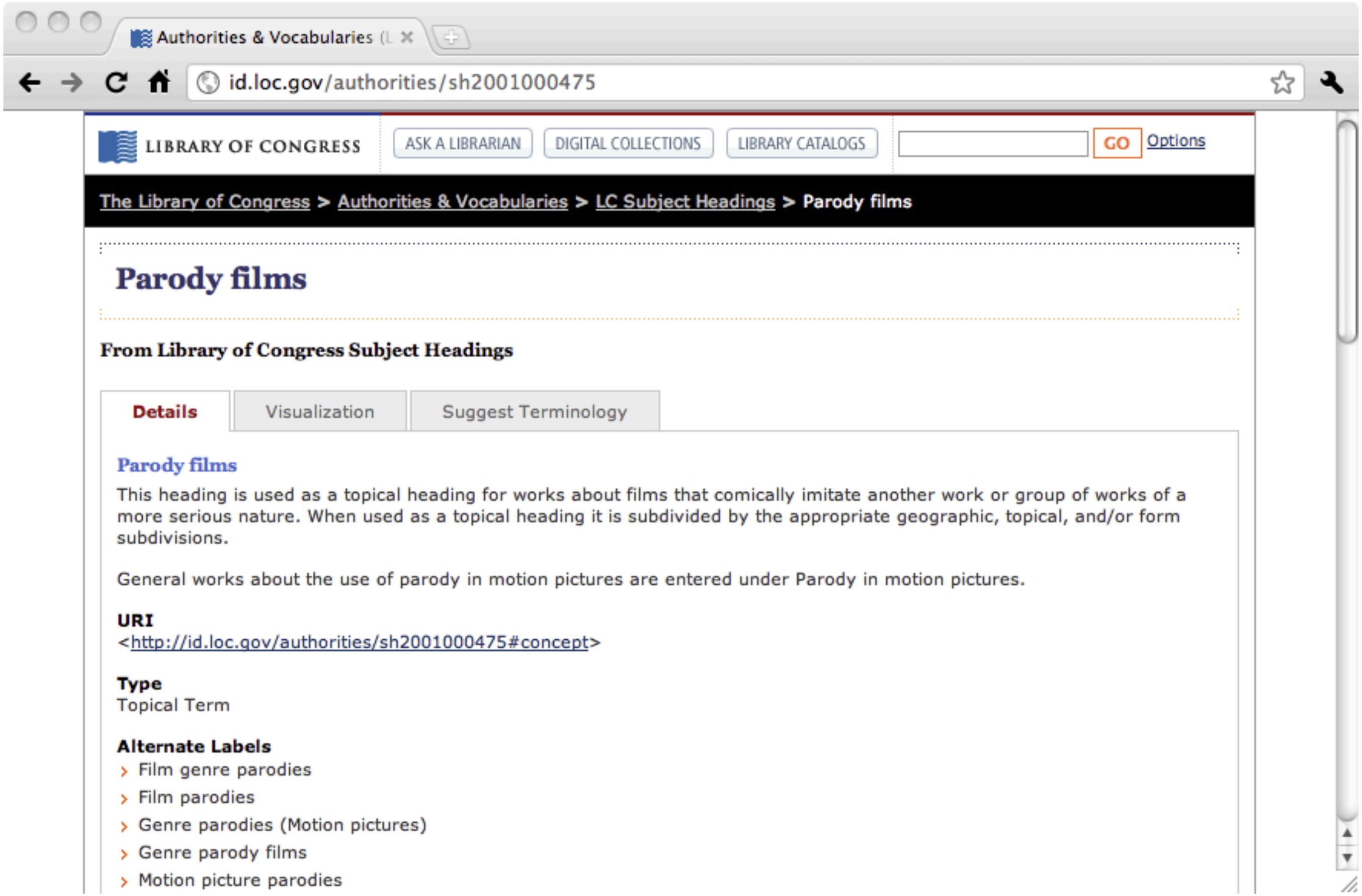
What is SKOS?

- A model for expressing the basic structure and content of concept schemes such as thesauri, classification schemes, taxonomies, folksonomies, and other similar types of controlled vocabularies
- Allows concepts to be composed and published as Linked Data on the Web
- Hides the complexity of OWL - easy to use

SKOS Concepts are...

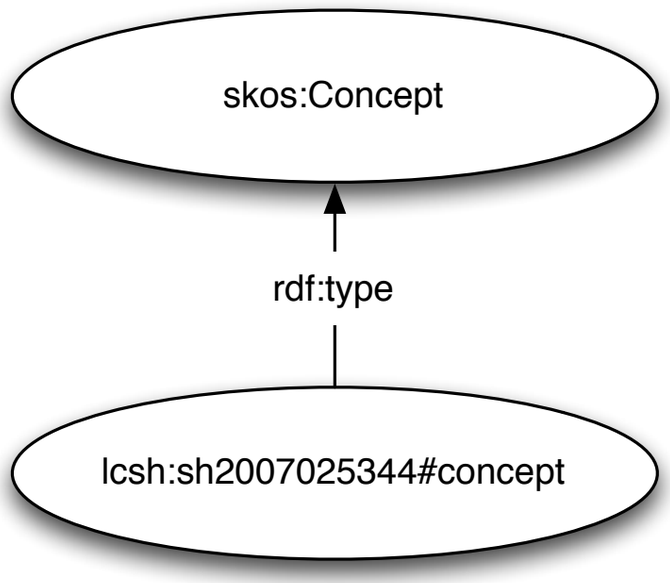
- ... identified by URIs
- ... labeled with 1..* natural language strings
- ... documented with various types of notes
- ... semantically linked to each other
- ... aggregated into concept schemes

Example SKOS Concept



skos:Concept

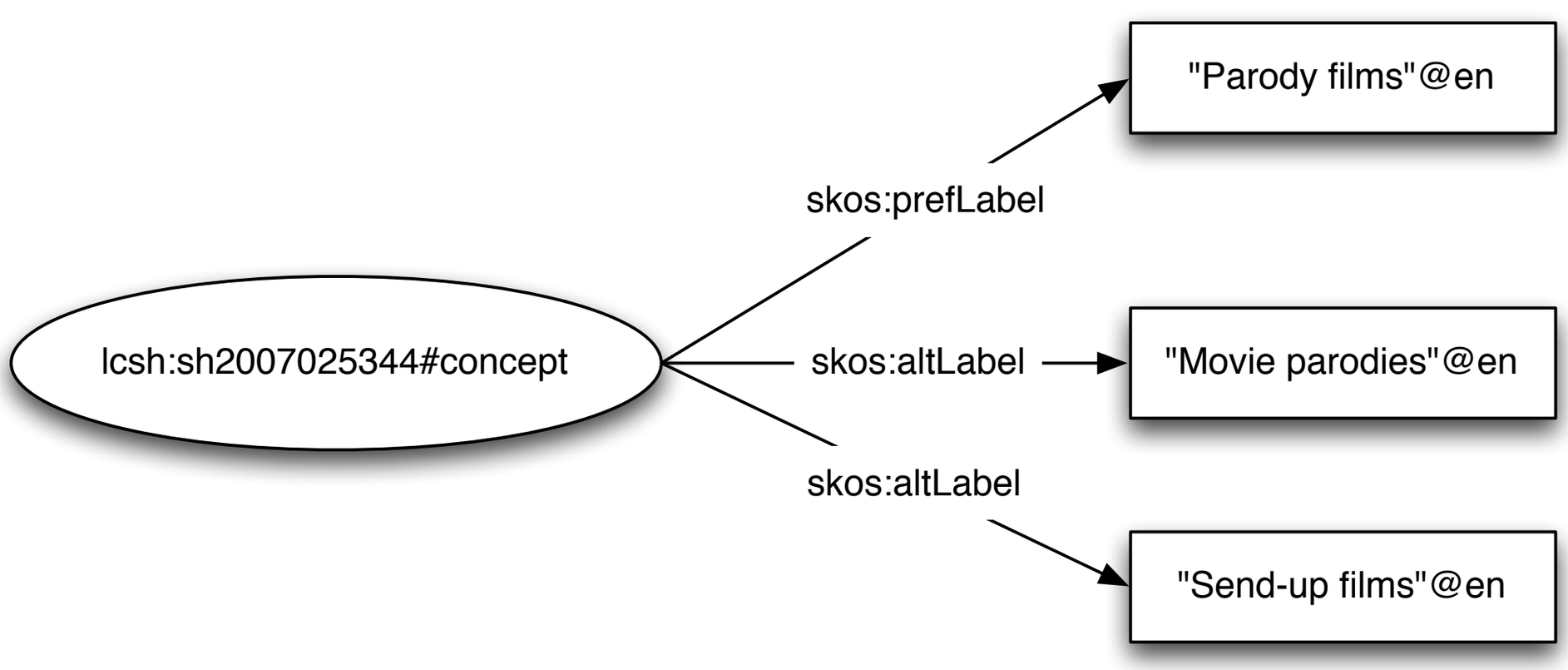
- Concepts are
  - the units of thought: ideas, meanings, categories of objects, etc.
  - abstract entities which are independent of the terms used to label them




```
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .
@prefix lcsh: <http://id.loc.gov/authorities/> .
```

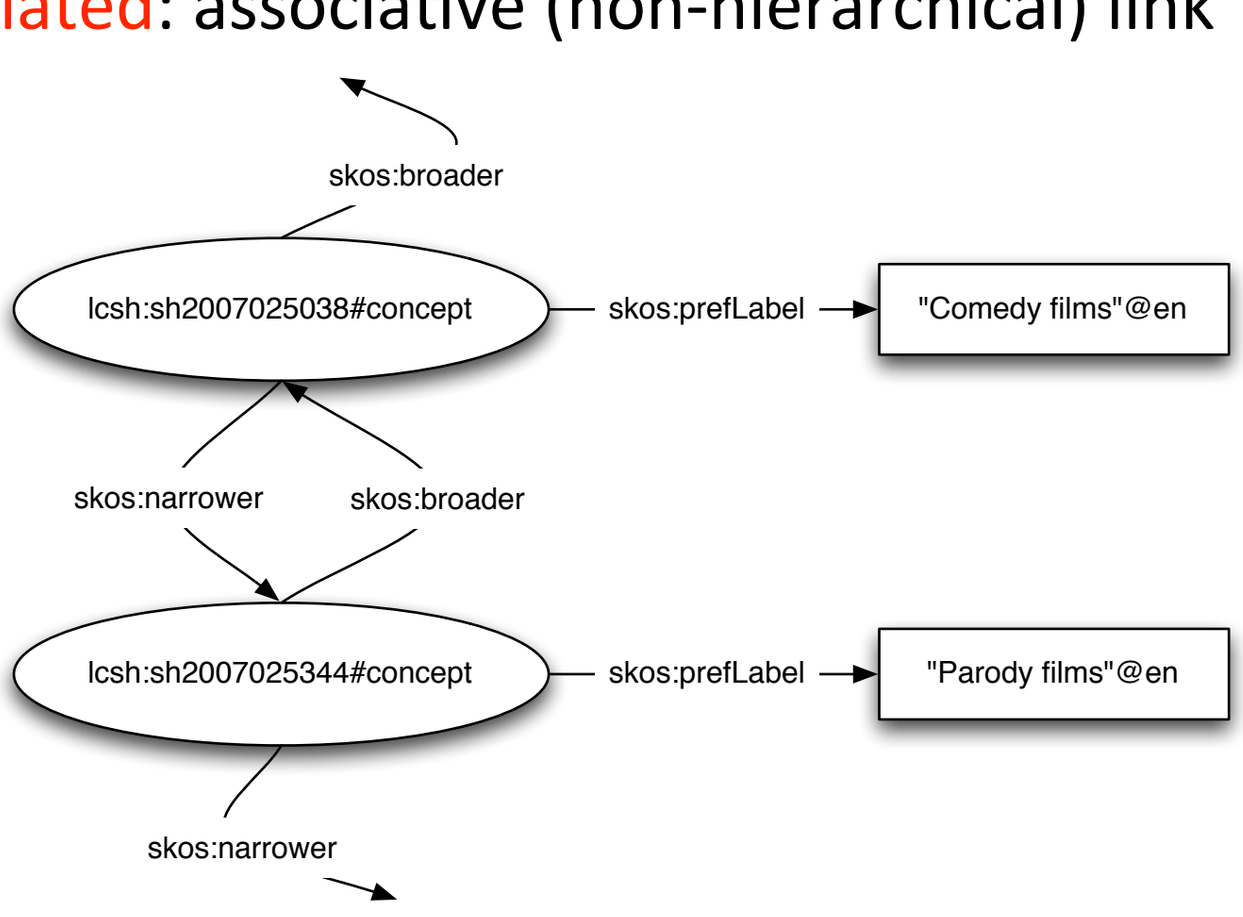
skos:(pref|alt|hidden)Label

- Labels refer to concepts' natural language(s)
  - skos:prefLabel: the preferred lexical label
  - skos:altLabel: alternative lexical labels (e.g., synonyms)
  - skos:hiddenLabel: labels useful for indexing (e.g., typos)



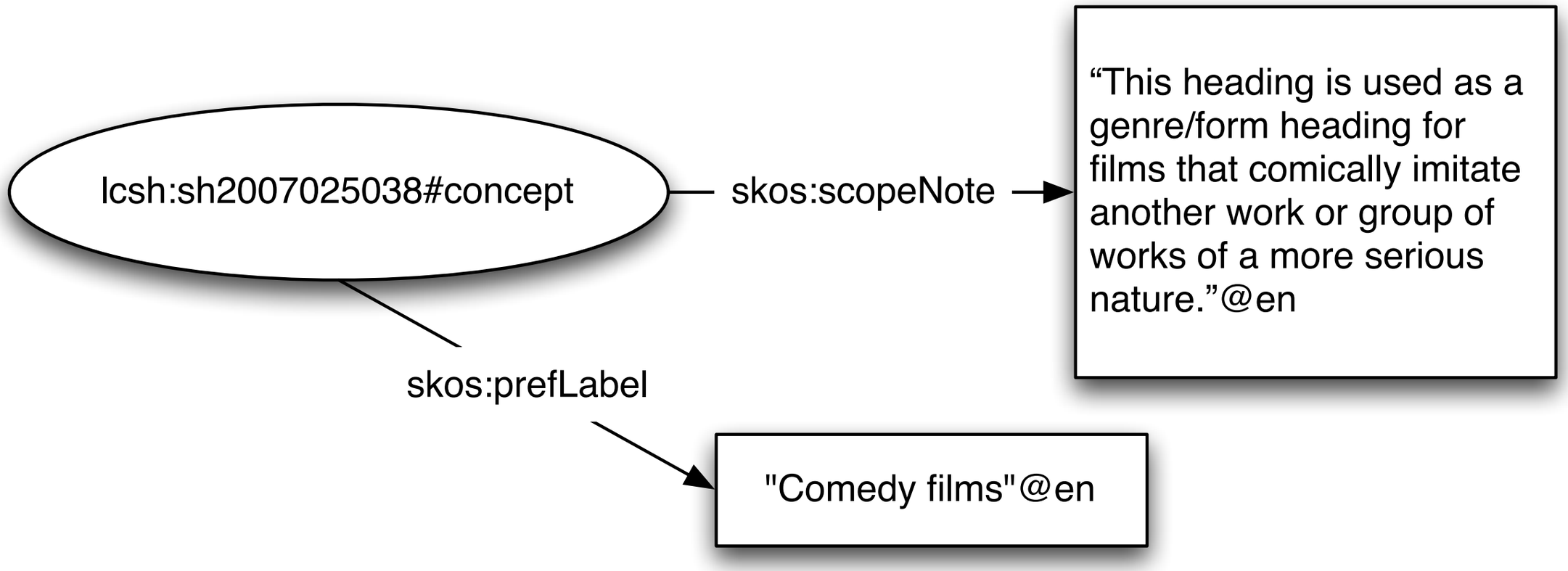
SKOS Semantic Relationships

- The meaning of a concept is also defined by its links to other concepts
  - skos:broader: hierarchical link to a more general concept
  - skos:narrower: hierarchical link to a more specific concept
  - skos:related: associative (non-hierarchical) link



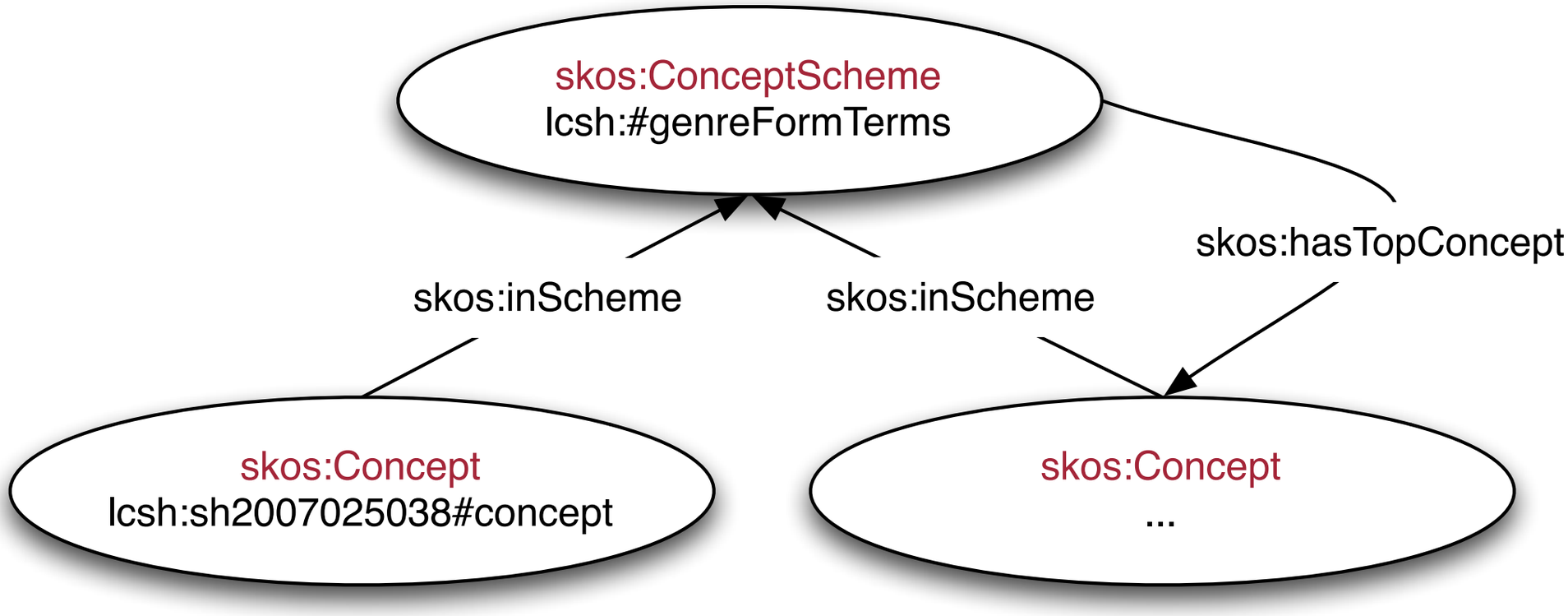
SKOS Documentary Notes

- Add further human-readable documentation
  - skos:scopeNote: info about intended meaning
  - skos:definition: complete explanation of meaning
  - skos:example: example concept use



skos:ConceptScheme

- Allow the organization of skos:Concepts in some Knowledge Organization Scheme (KOS)



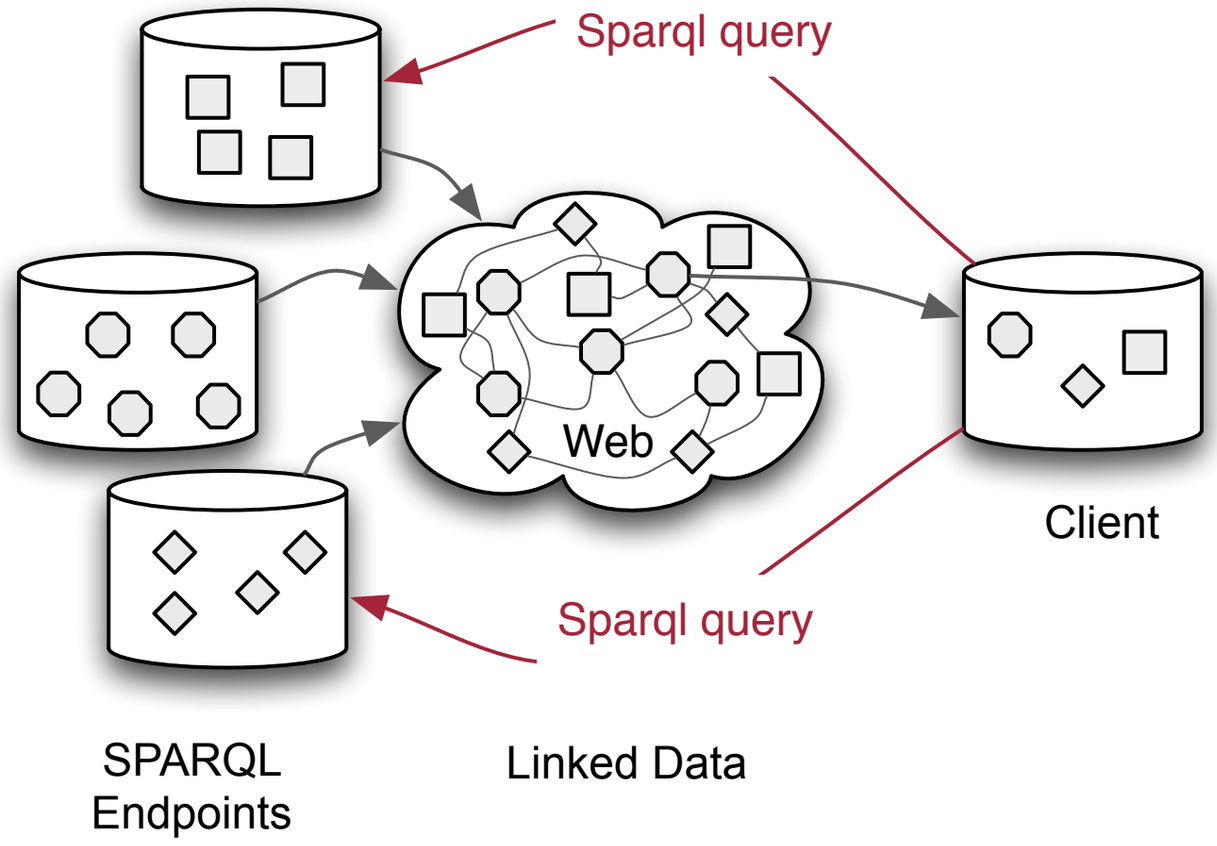
A Real-World Example

- NY Times topics: http://topics.nytimes.com/
- Dereference and analyze "Jack Nicholson" @ New York Times
  - http://data.nytimes.com
  - http://data.nytimes.com/N57614112774312665 13

SPARQL

What is SPARQL?

- SPARQL is a query language for accessing RDF data
- SPARQL is a protocol that defines how queries and results can be transported over a network



Example Dataset

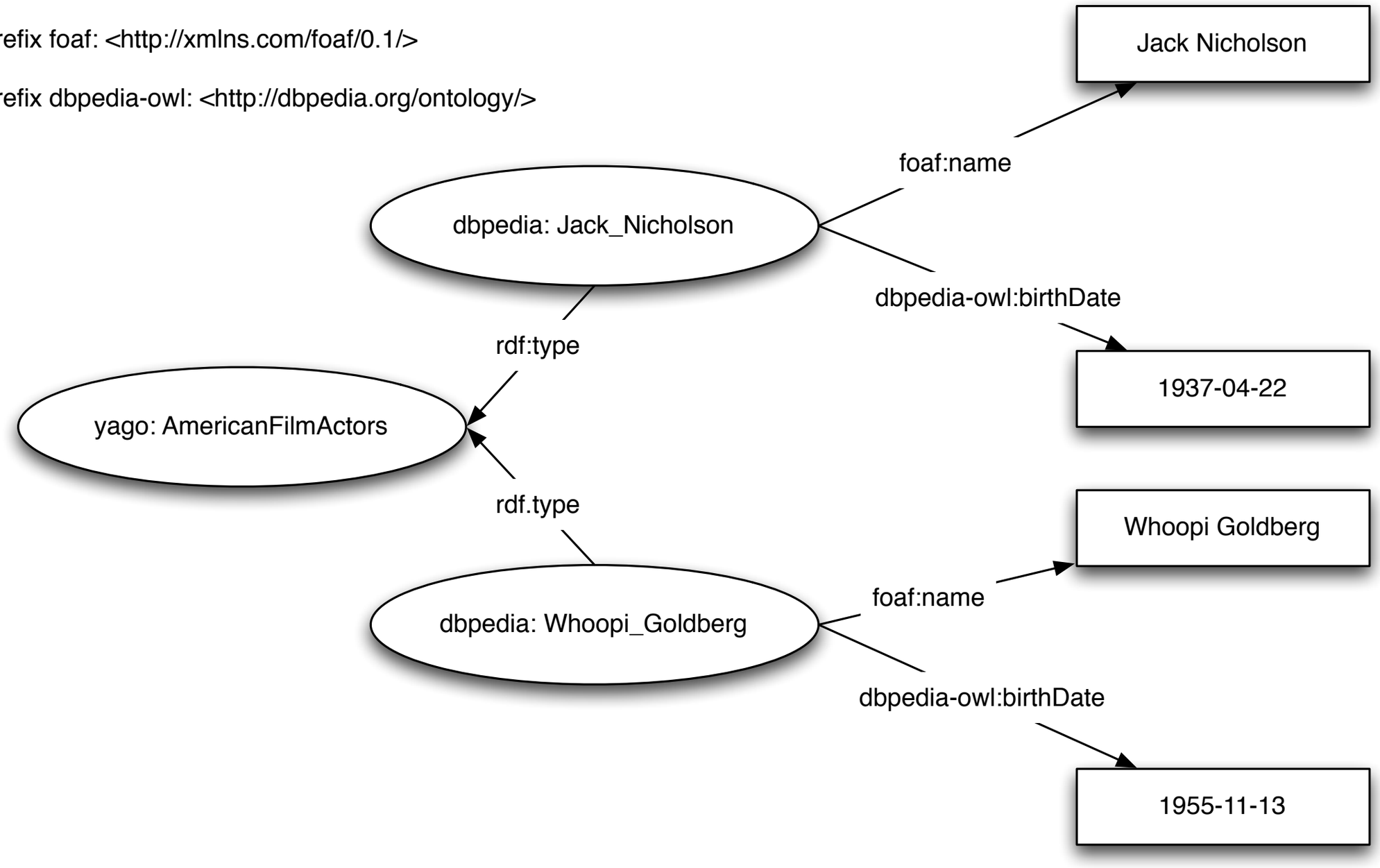
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>

@prefix dbpedia: <http://dbpedia.org/resource/>

@prefix yago: <http://dbpedia.org/class/yago/>

@prefix foaf: <http://xmlns.com/foaf/0.1/>

@prefix dbpedia-owl: <http://dbpedia.org/ontology/>



A Simple SPARQL Query

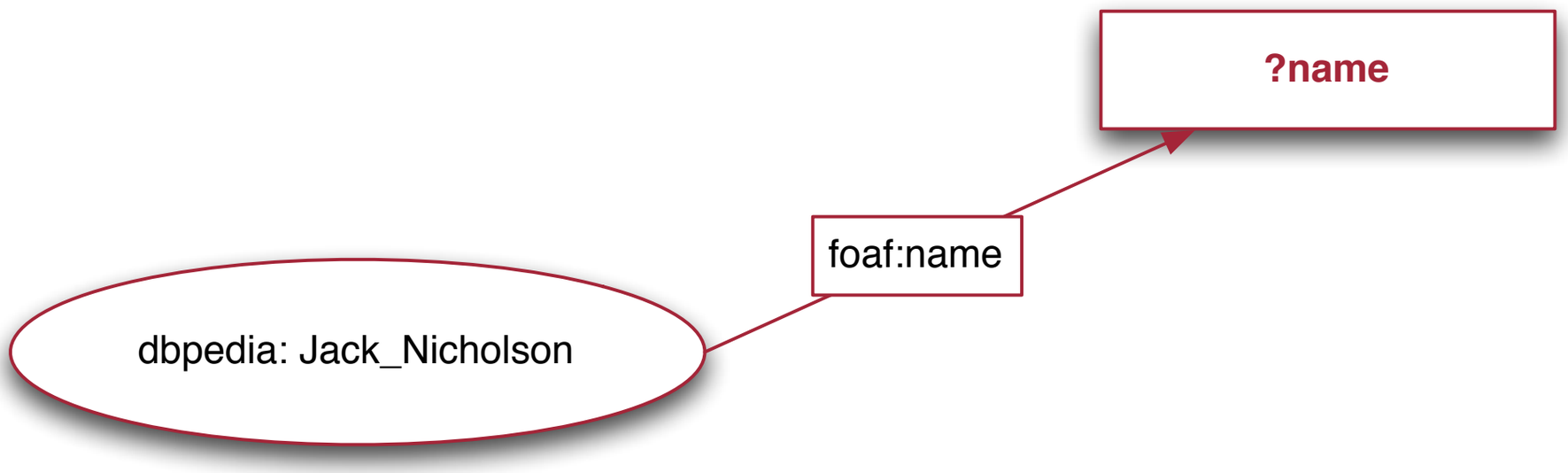
```
SELECT ?name
WHERE {
    dbpedia:Jack_Nicholson foaf:name ?name
}
```

name
“Jack Nicholson”

Simple Query Illustrated

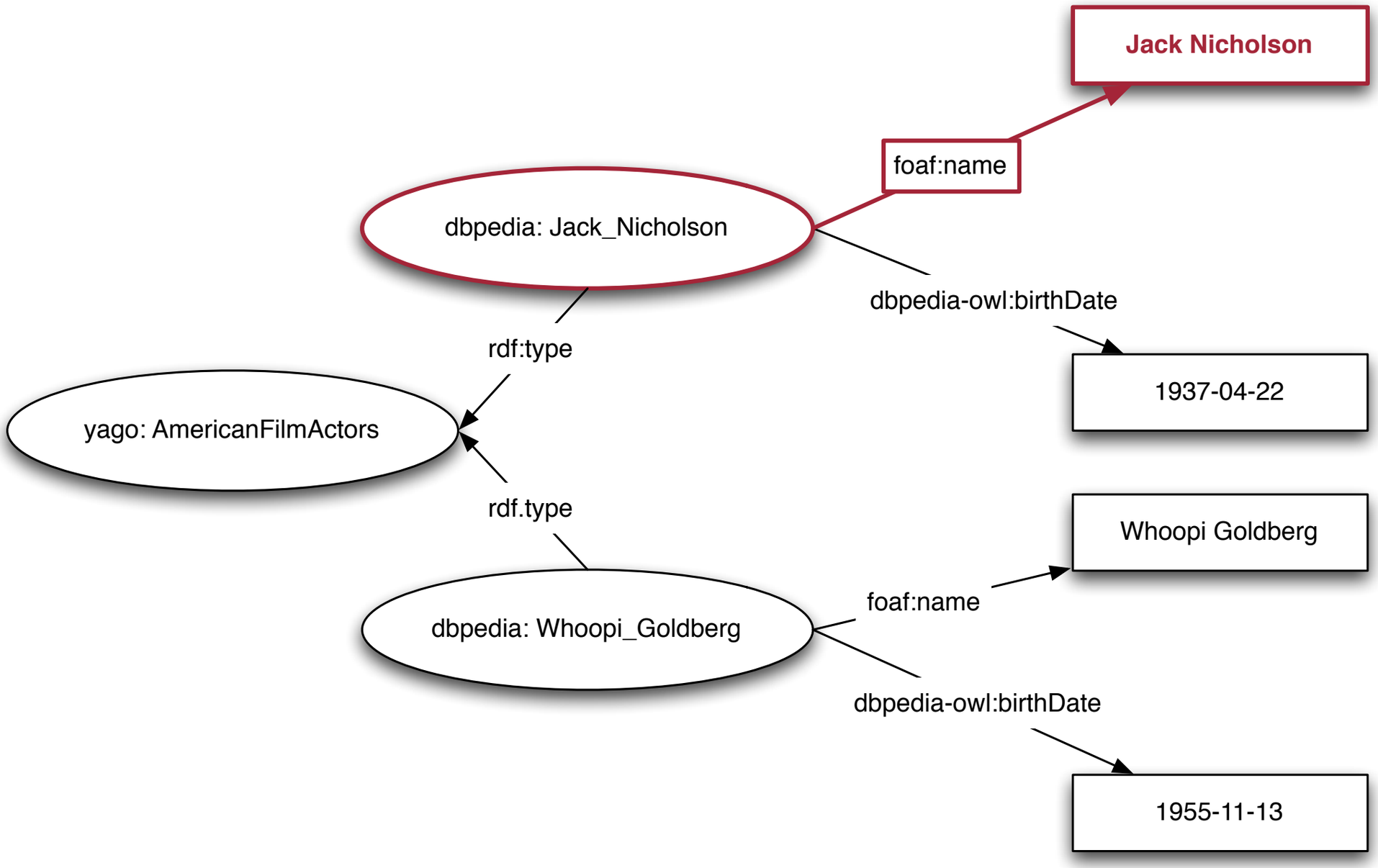
- In SPARQL we formulate triple/graph patterns

```
SELECT ?name
WHERE {
      dbpedia:Jack Nicholson foaf:name ?name
}
```



Simple Query Illustrated

- Patterns are matched against the dataset



Querying Multiple Values

```
SELECT ?name ?birthdate
WHERE {
      ?x rdf:type yago:AmericanFilmActors .
      ?x foaf:name ?name .
      ?x dbpedia-owl:birthDate ?birthdate .
}
```

name	birthdate
“Jack Nicholson”	1937-04-22
“Whoopi Goldberg”	1955-11-13

```
SELECT ?name ?birthdate
WHERE {
     ?x rdf:type yago:AmericanFilmActors .
     ?x foaf:name ?name .
     ?x dbpedia-owl:birthDate ?birthdate .
}
```

Exercise: draw the graph pattern

Prefixes in SPARQL queries

- The DBPedia SPARQL Web interface knows about prefix/namespace mappings
- But in general SPARQL endpoints don't

```
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
PREFIX dbpedia: <http://dbpedia.org/resource/>

SELECT ?name
WHERE {
    dbpedia:Jack_Nicholson foaf:name ?name
}
```

SPARQL Filters

- ...restrict the solutions of a graph pattern match according to a given expression
- ...eliminate solutions that, when substituted into the expression, result in boolean false

```
SELECT ?name
WHERE {
     ?x foaf:name ?name .
     FILTER regex(?name, “Nicholson”)
}
```

name
“Jack Nicholson”

SPARQL Filters Example

```
SELECT ?name ?birthdate
WHERE {
     ?x rdf:type yago:AmericanFilmActors .
     ?x foaf:name ?name .
     ?x dbpedia-owl:birthDate ?birthdate .
     FILTER(?birthdate > "1950-01-01T00:00:00Z"^^xsd:dateTime)
}
```

name	birthdate
“Whoopi Goldberg”	1955-11-13

More SPARQL Filters

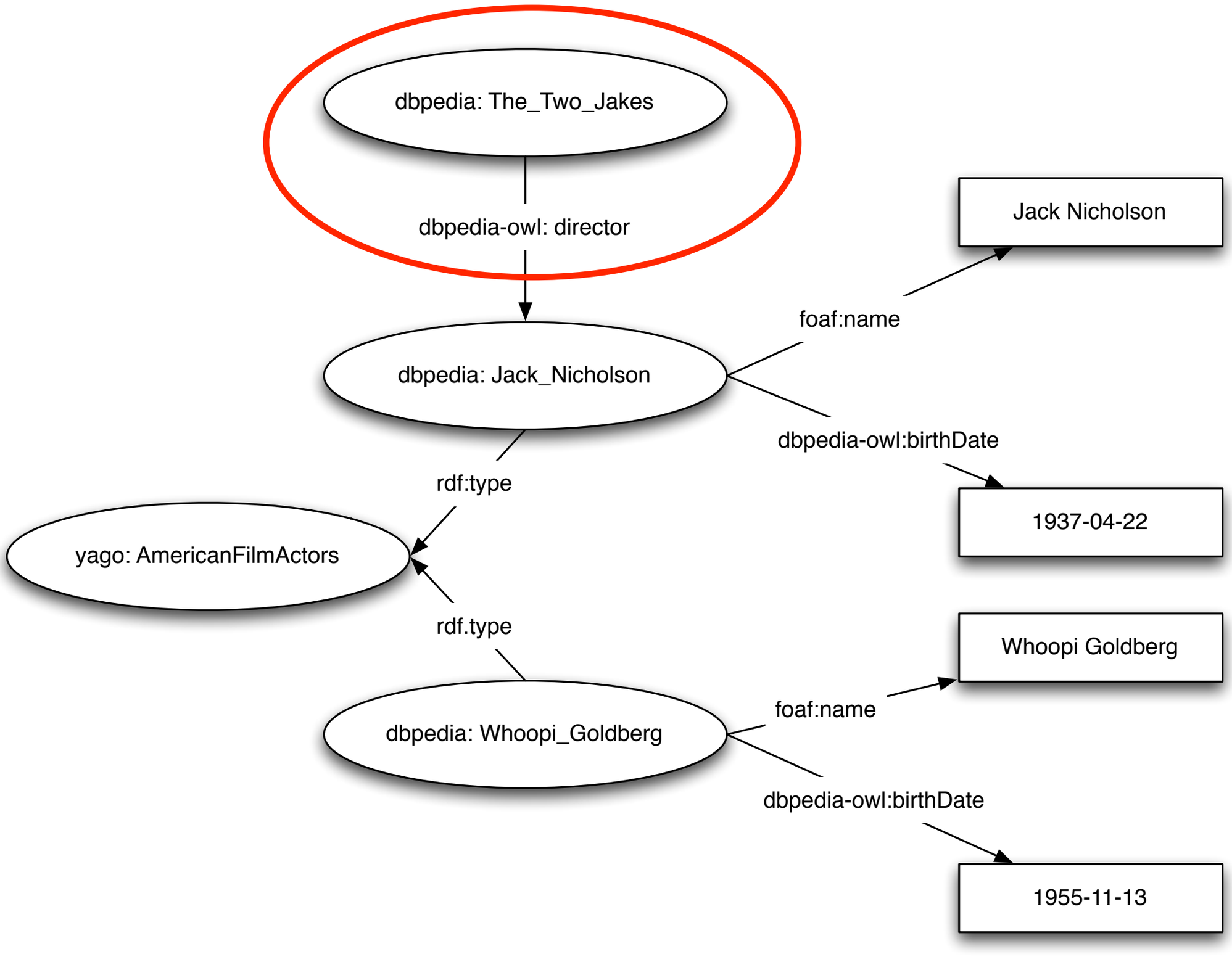
- SPARQL offers lots of FILTERing possibilities
  - Boolean operators ! || &&
  - Comparison operators = != > < >= <=
  - Arithmetic operators * / - +
  - RDF element operators bound(), isURI(), LANG(), STR()

further info: http://www.w3.org/TR/rdf-sparql-query/#tests

Optional Graph Patterns

- In a standard SPARQL query the entire graph pattern must match in order to retrieve a result
- But we cannot always assume complete structures
  - not all actors have birthdays
  - not all movies have actors
- SPARQL allows to formulate queries that include information in the solution if it is available, but does not reject the solution if parts are missing

Optional Graph Patterns



Optional Graph Patterns

```
SELECT ?name ?directed_movie
WHERE {
      ?x rdf:type yago:AmericanFilmActors .
      ?x foaf:name ?name .
      ?directed_movie dbpedia-owl:director ?x .
}
```

name	directed_movie
"Jack Nicholson"	dbpedia:The_Two_Jakes

Exercise: we lost Whoopi. Why?

Optional Graph Patterns

```
SELECT ?name ?directed_movie
WHERE {
      ?x rdf:type yago:AmericanFilmActors .
      ?x foaf:name ?name .
      OPTIONAL {
            ?directed movie dbpedia-owl:director ?x .
      }
}
```

name	directed_movie
“Jack Nicholson”	dbpedia:The_Two_Jakes
“Whoopi Goldberg”	

SPARQL UNION

- Sometimes you want to express „or“ in a graph pattern
- „The graph should match this OR that pattern“
- With the UNION keyword we can define alternative matching graph patterns

SPARQL UNION Example

```
SELECT ?name ?directed_movie
WHERE {

    {?x rdf:type yago:AmericanFilmActors }
    UNION
    {?x rdf:type yago:GermanFilmActors }

    ?x foaf:name ?name .

    OPTIONAL {
        ?directed_movie dbpedia-owl:director ?x .
    }
}
```

SPARQL Solution Modifiers

- The results returned by a query are by default unordered
- SPARQL defines the following solution modifiers
  - ORDER BY - reorder the solution sequence
  - DISTINCT - avoid duplicate solutions
  - OFFSET - start after a certain number of solutions
  - LIMIT - limit the output to a number of solutions

SPARQL Solution Modifiers

```
SELECT ?name
WHERE {
     ?x a foaf:Person .
     ?x foaf:name ?name .
}
LIMIT 100
```

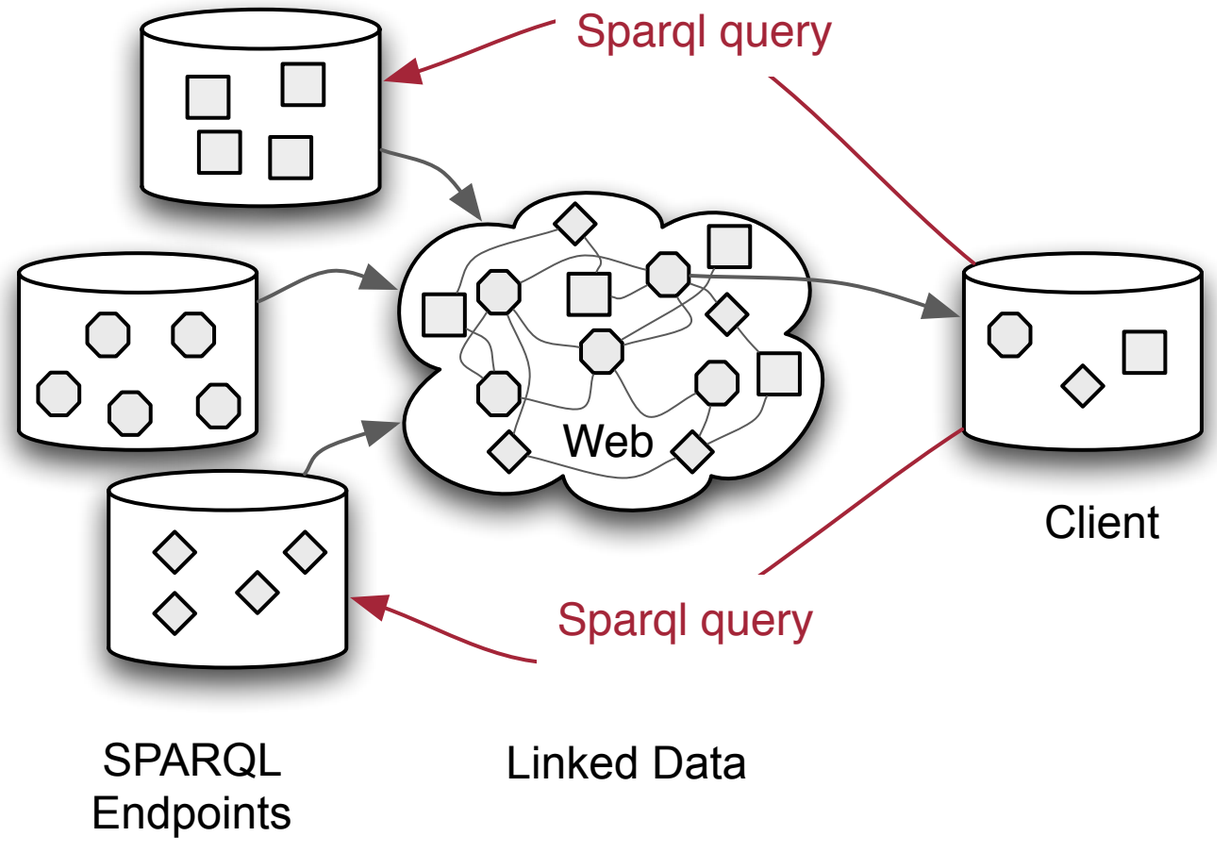
```
SELECT ?person (count(DISTINCT ?spouse) as ?spouses)
where {
     ?person a yago:AmericanFilmActors .
     ?person dbpprop:spouse ?spouse .
}
ORDER BY DESC(?spouses)LIMIT 100
```

Further SPARQL features

- We only covered SELECT
- There are also the CONSTRUCT, ASK, and DESCRIBE query forms
- The other forms are useful in practice!
- Please read the SPARQL Primer: http://www.w3.org/TR/rdf-sparql-query/

What is SPARQL?

- SPARQL is a query language for accessing RDF data
- SPARQL is a protocol that defines how queries and results can be transported over a network



SPARQL Protocol for RDF

- SPARQL also defines how queries and and results can be transported over a network
- Bindings for HTTP
  http://www.w3.org/TR/rdf-sparql-protocol/

SPARQL Protocol - HTTP

- Queries are sent to an endpoint using
  - HTTP GET (default)
  - HTTP POST (if encoded query string exceed limits)
- Results are returned either as
  - SPARQL Results Document (SELECT and ASK)
  - Serialized RDF Graph (CONSTRUCT and DESCRIBE)

SPARQL Protocol - Example

```
SELECT ?name
WHERE {
    dbpedia:Jack_Nicholson foaf:name ?name
}
```

URI-encoded query string (`EncodedQuery`)

```
SELECT%20?name%0AWHERE%20%7B%0A
%20%20%20%20dbpedia:Jack_Nicholson
%20foaf:name%20?name%0A%7D
```

SPARQL Protocol - Example

```
GET /sparql/?query=EncodedQuery HTTP/1.1
Host: dbpedia.org
```

Using CURL:

```
curl -v http://dbpedia.org/sparql/?
query=SELECT%20?name%0AWHERE%20%7B%0A
%20%20%20%20dbpedia:Jack_Nicholson
%20foaf:name%20?name%0A%7D
```

SPARQL Protocol - Example

```
<sparql xmlns="...”>
<head>
    <variable name="name"/>
</head>
<results distinct="false" ordered="true">
    <result>
        <binding name="name">
            <literal xml:lang="en">
            Jack Nicholson
            </literal>
        </binding>
    </result>
</results>
```

QUESTIONS?