



Short introduction to the Semantic Web



Ivan Herman, W3C
Visit to Boeing, 2010-06-17


The Music site of the BBC

The screenshot shows a web browser window with the address bar containing the URL <http://www.bbc.co.uk/music/artists/618b6900-0618-4f1e-b835-bccb17f84294>. The page title is "BBC - Music - Eric Clapton". The navigation bar includes "MUSIC BETA", "GENRES", "ARTISTS", "REVIEWS", "NEWS", and "BLOG". A search box labeled "QUICK FIND" is present with the placeholder text "Enter an artist name ...". The breadcrumb trail reads "BBC Music > Artists > Eric Clapton".

Eric Clapton

Born 30 March 1945.

MOST PLAYED ON BBC RADIO 2




David Redfern/Redferns

Latest Tracks Played On The BBC

- Promises**
BBC Radio 2 | [Ken Bruce 22/02/2010](#)
- Bad Love**
BBC Radio 2 | [Alex Lester 22/02/2010](#)
- Lay Down Sally**
BBC Radio 2 | [Chris Evans Breakfast 18/02/2010](#)
- I Ain't Gonna Stand For It**
BBC Radio 2 | [Alex Lester 15/02/2010](#)
- Wonderful Tonight**
BBC Radio 2 | [Ken Bruce 10/02/2010](#)

Audio Previews From Latest Album Review



Me And Mr Johnson

- 8 Milkcow's Calf Blues
- 10 Come on in My Kitchen

Biography

Eric Patrick Clapton, CBE (born 30 March 1945) is an English blues-rock guitarist, singer, songwriter and composer. Clapton has been inducted into the Rock and Roll Hall of Fame as a solo performer, as a member of rock bands; the Yardbirds and Cream. Clapton is the only person ever to be inducted three times. Often viewed by critics and fans alike as one of the most important and influential guitarists of all time, Clapton was ranked fourth in Rolling Stone magazine's list of the "100 Greatest Guitarists of All Time" and #53 on their list of the Immortals: 100 Greatest Artists of All Time.

The Music site of the BBC

BBC - Music - Eric Clapton

http://www.bbc.co.uk/music/artists/618b6900-0618-4f1e-b835-bccb17f84294

Netvibes Feedly Social Private Mailing lists SW Python RDFa it! Bookmarks Add Zemanta bit.ly To Mendeley TinyURL To Faviki Dokuwiki

this focus, he is credited as an innovator in a wide variety of genres. These include blues-rock (with John Mayall & the Bluesbreakers and The Yardbirds) and psychedelic rock (with Cream). Clapton's chart success was not limited to the blues, with chart-toppers in Delta Blues (Me and Mr. Johnson), pop ("Change the World") and reggae (Bob Marley's "I Shot the Sheriff") (He is often credited for bringing reggae and Bob Marley to the mainstream.) Two of his most successful recordings were the hit love song "Layla", which he played with the band Derek and the Dominos, and Robert Johnson's "Crossroads", which has been his staple song since his days with Cream.

[Read more at Wikipedia...](#)

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Links & Information

LINKS

- [Official homepage at ericclapton.com](#)
- [Fanpage at whereseric.com](#)
- [Wikipedia article on Eric Clapton](#)
- [MySpace at mspace.com/ericclapton](#)
- [Last.fm page on Eric Clapton](#)
- [MusicBrainz entry on Eric Clapton](#)

MEMBER OF [Derek and the Dominos](#), [Blind Faith](#) (1968-1969), [Cream](#) (1966-1968), [John Mayall & The Bluesbreakers](#) (1965-1966), [The Yardbirds](#) (1963-1965)








COLLABORATED ON [J.J. Cale & Eric Clapton](#), [Eric Clapton & The Immediate All Stars](#), [Eric Clapton & The Impressions](#), [Eric Clapton & Jimmy Page](#), [Eric Clapton & David Sanborn](#), [Eric Clapton & Stan Webb's Chicken Shack](#), [Eric Clapton & The Powerhouse](#), [Eric Clapton & Stevie Ray Vaughan](#), [Eric Clapton & Marc Shaiman](#), [The Dirty Mac](#), [Bob Dylan](#), [Roger McGuinn](#), [Tom Petty](#), [Neil Young](#), [Eric Clapton & George Harrison](#), [Jimmie Vaughan](#), [Eric Clapton](#), [Bonnie Raitt](#), [Robert Cray](#), [B.B. King](#), [Buddy Guy](#), [Dr. John & Art Neville](#), [Elton John & Eric Clapton](#), [Michael Kamen](#), [Eric Clapton and David Sanborn](#), [B.B. King & Eric Clapton](#), [Mark Knopfler & Eric Clapton](#), [Paul McCartney & Eric Clapton](#), [Sting with Eric Clapton](#), [Steve Winwood & Eric Clapton](#)

Links and information come from MusicBrainz. You can add or edit information about [Eric Clapton at musicbrainz.org](#). Find out more about our use of this data. The BBC is not responsible for the content of external sites

Latest News Stories

Played By

Since December 2008

-  **Alex Lester**
2 BBC Radio 2
-  **Steve Wright in the Afternoon**
2 BBC Radio 2
-  **Sarah Kennedy**
2 BBC Radio 2
-  **Wake Up to Wogan**
2 BBC Radio 2
-  **Ken Bruce**
2 BBC Radio 2
-  **Steve Wright's Sunday Love Songs**
2 BBC Radio 2
-  **Jeremy Vine**
2 BBC Radio 2

Information displayed about artists played on BBC programmes is incomplete out more about this artist play count information.

How to build such a site 1.

- ▶ Site editors roam the Web for new facts
 - ▶ may discover further links while roaming
- ▶ They update the site manually
- ▶ And the site gets soon out-of-date 😞

How to build such a site 2.

- ▶ Editors roam the Web for new data published on Web sites
- ▶ “Scrape” the sites with a program to extract the information
 - ▶ I.e., write some code to incorporate the new data
- ▶ Easily get out of date again... 😞

How to build such a site 3.

- ▶ Editors roam the Web for new data via API-s
- ▶ Understand those...
 - ▶ input, output arguments, datatypes used, etc
- ▶ Write some code to incorporate the new data
- ▶ Easily get out of date again... 😞

The choice of the BBC

- ▶ Use external, public datasets
 - ▶ Wikipedia, MusicBrainz, ...
- ▶ They are available as data
 - ▶ not API-s or hidden on a Web site
 - ▶ data can be extracted using, eg, HTTP requests or standard queries

In short...

- ▶ Use the Web of Data as a Content Management System
- ▶ Use the community at large as content editors

And this is no secret...

BBC - Music - Eric Clapton

http://www.bbc.co.uk/music/artists/618b6900-0618-4f1e-b835-bccb17f84294

Netvibes Feedly Social Private Mailing lists SW Python RDFa it! Bookmarklets Add Zemanta bit.ly To Mendeley TinyURL To Faviki Dokuwiki

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Latest News Stories

NEWS FROM THE BBC

[Clapton recovering after surgery](#)
Tue 27 Oct 2009 17:46 Musician Eric Clapton is recuperating after having an operation to remove gallstones,...

[Clapton to use a slowhand to take Wyman's wicket](#)

Data on the Web

- ▶ **There are more and more data on the Web**
 - ▶ government data, health related data, general knowledge, company information, flight information, restaurants,...
- ▶ **More and more applications rely on the availability of that data**

But... data are often in isolation, “silos”



Imagine...

- ▶ A “Web” where
 - ▶ documents are available for download on the Internet
 - ▶ but there would be no hyperlinks among them

And the problem is real...

The image shows three overlapping web browser windows. The background window is 'CoCoDat - Collation of Cortical Data - Mozilla Firefox', displaying a page with the title 'CoCoDat: Collation of Cortical [microcircuitry] Data' and a list of properties like Morphology, Firing properties, etc. The middle window is 'Cell Centered Database - Mozilla Firefox', showing a 'Cell Centered Database Gallery' with navigation links and image thumbnails. The foreground window is 'NeuronDB - Thalamic relay neuron - Overview (A) () - Mozilla Firefox', displaying a detailed overview of a 'Thalamic relay neuron' with a diagram and a list of parts like 'Equivalent dendrite', 'Distal equivalent dendrite', etc., each with a 'Show other' button.

Data on the Web is not enough...

- ▶ We need a proper infrastructure for a real Web of Data
 - ▶ data is available on the Web
 - ▶ accessible via standard Web technologies
 - ▶ data are interlinked over the Web
 - ▶ ie, data can be integrated over the Web
- ▶ This is where Semantic Web technologies come in

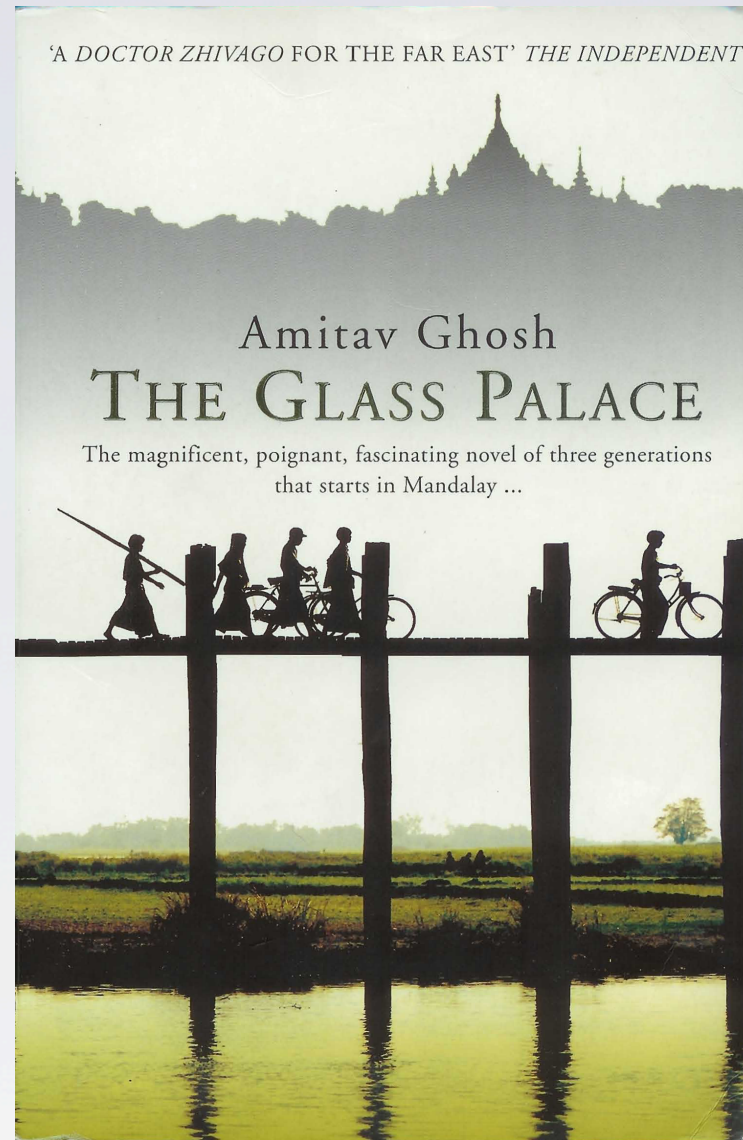
In what follows...

- ▶ We will use a simplistic example to introduce the main Semantic Web concepts

The rough structure of data integration

- ▶ **Map the various data onto an abstract data representation**
 - ▶ make the data independent of its internal representation...
- ▶ **Merge the resulting representations**
- ▶ **Start making queries on the whole!**
 - ▶ queries not possible on the individual data sets

We start with a book...



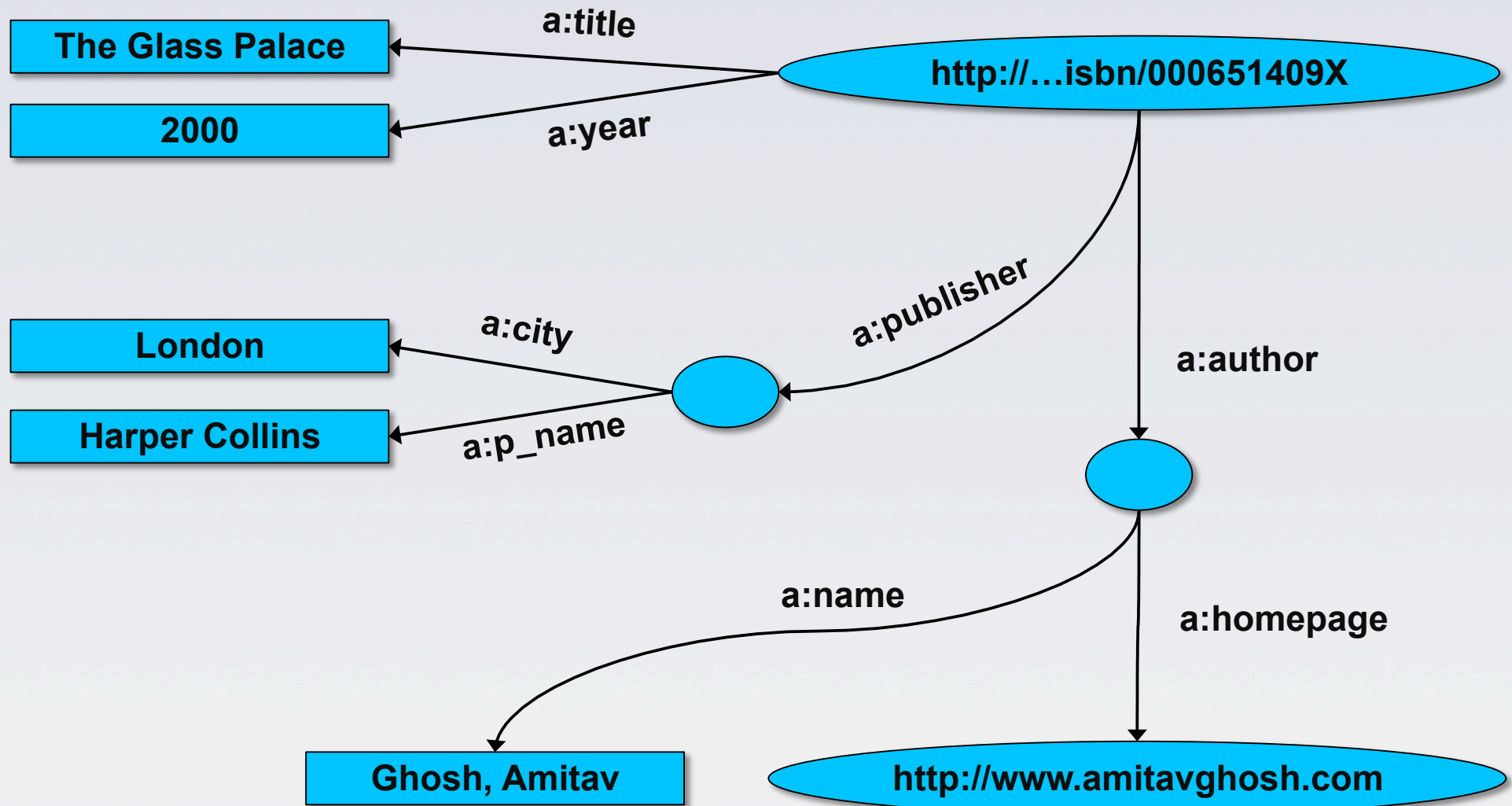
A simplified bookstore data (dataset “A”)

| ID | Author | Title | Publisher | Year |
|---------------------|---------------|------------------|------------------|-------------|
| ISBN 0-00-6511409-X | id_xyz | The Glass Palace | id_qpr | 2000 |

| ID | Name | Homepage |
|-----------|---------------|---|
| id_xyz | Ghosh, Amitav | http://www.amitavghosh.com |

| ID | Publisher's name | City |
|-----------|-------------------------|-------------|
| id_qpr | Harper Collins | London |

1st: export your data as a set of relations



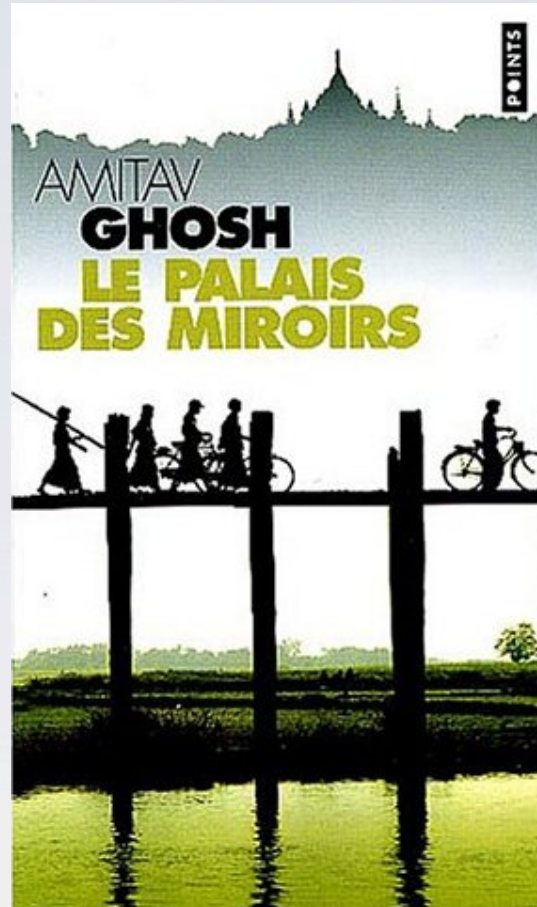
Some notes on the exporting the data

- ▶ **Relations form a graph**
 - ▶ the nodes refer to the “real” data or contain some literal
 - ▶ how the graph is represented in machine is immaterial for now

Some notes on the exporting the data

- ▶ **Data export does not necessarily mean physical conversion of the data**
 - ▶ relations can be generated on-the-fly at query time
 - ▶ via SQL “bridges”
 - ▶ scraping HTML pages
 - ▶ extracting data from Excel sheets
 - ▶ etc.
- ▶ **One can export part of the data**

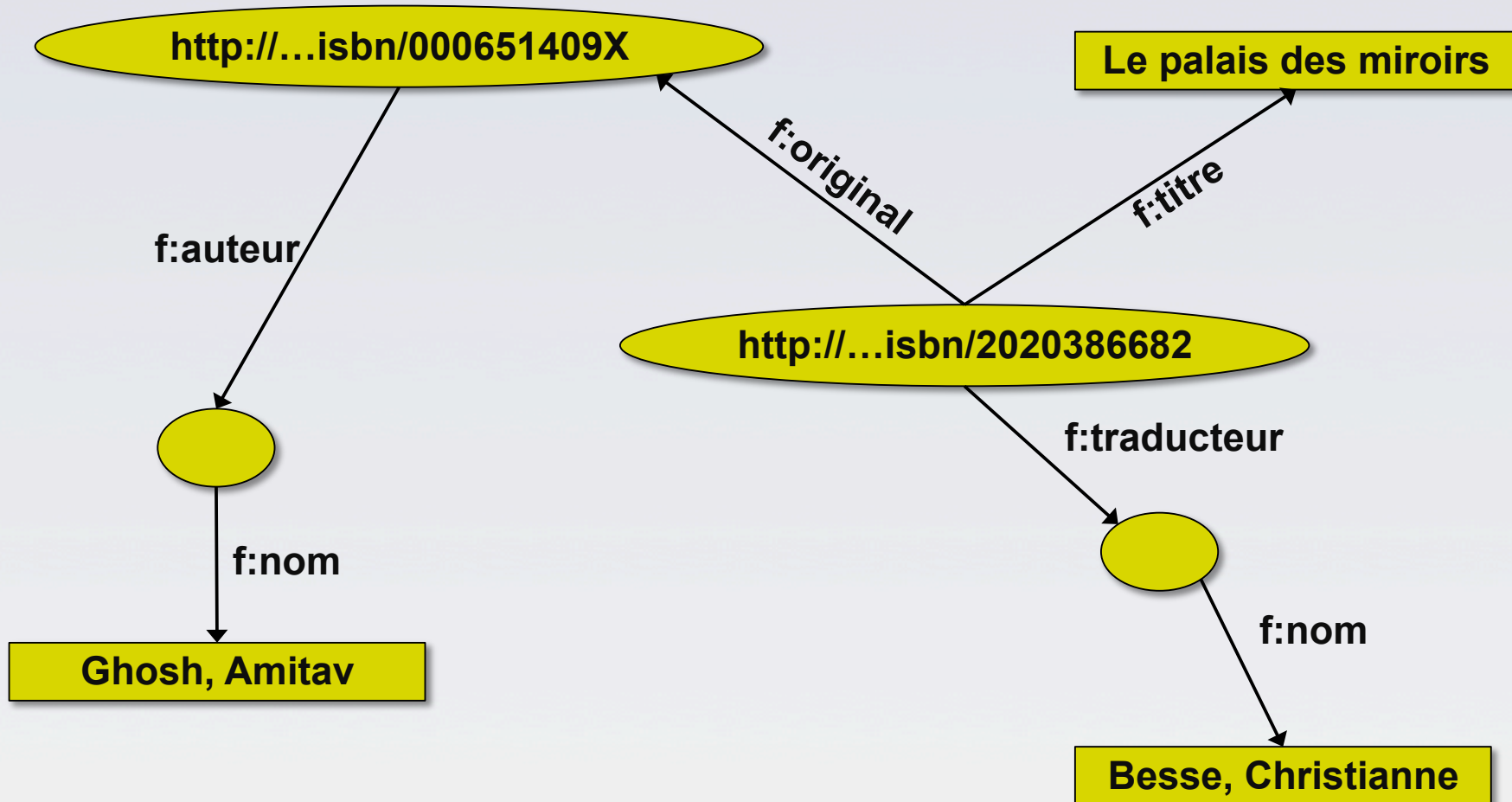
Same book in French...



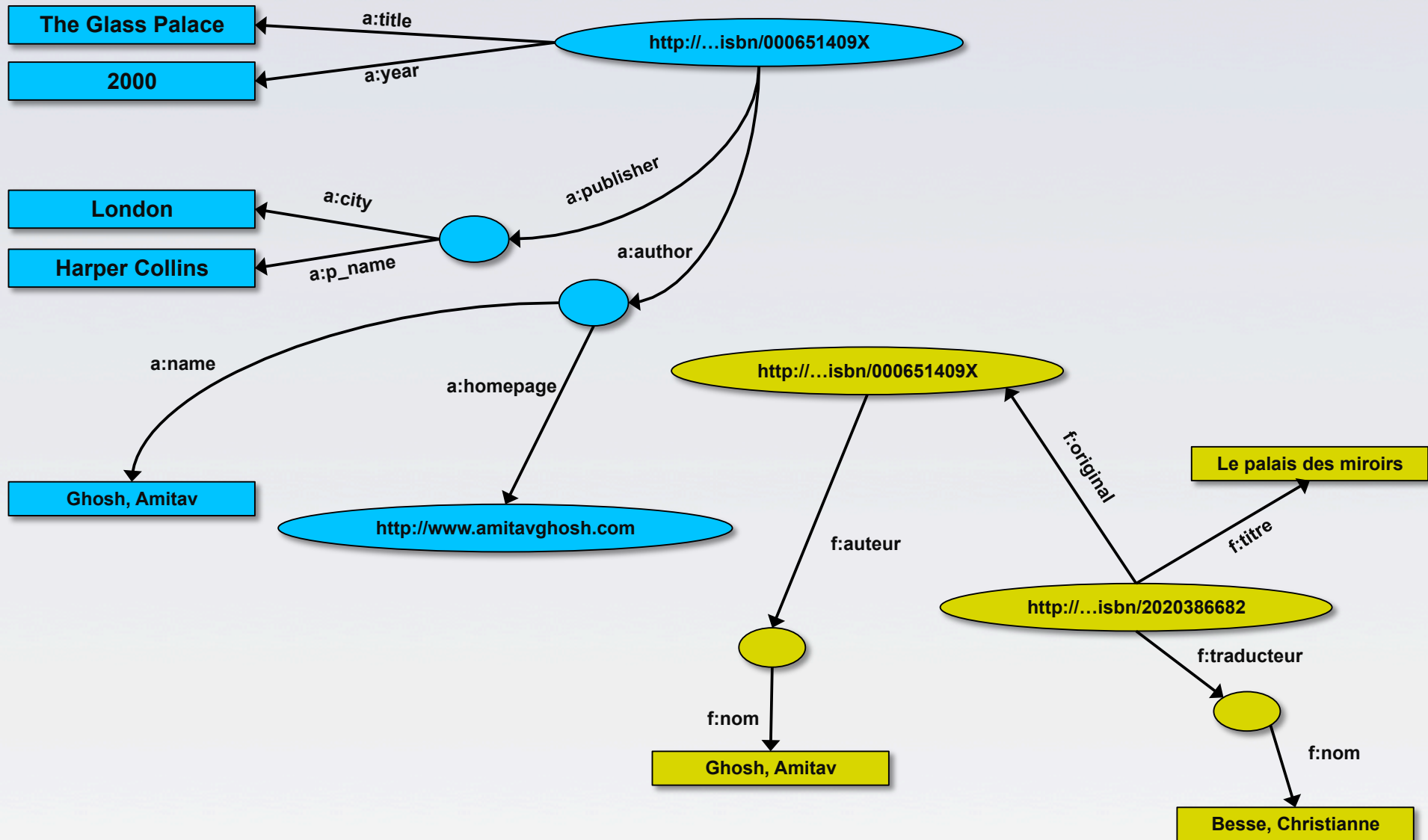
Another bookstore data (dataset “F”)

| A | B | C | D | |
|----|---------------------|-----------------------|-------------------|---------------------|
| 1 | ID | Titre | Traducteur | Original |
| 2 | ISBN 2020286682 | Le Palais des Miroirs | \$A12\$ | ISBN 0-00-6511409-X |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | ID | Auteur | | |
| 7 | ISBN 0-00-6511409-X | \$A11\$ | | |
| 8 | | | | |
| 9 | | | | |
| 10 | Nom | | | |
| 11 | Ghosh, Amitav | | | |
| 12 | Besse, Christianne | | | |

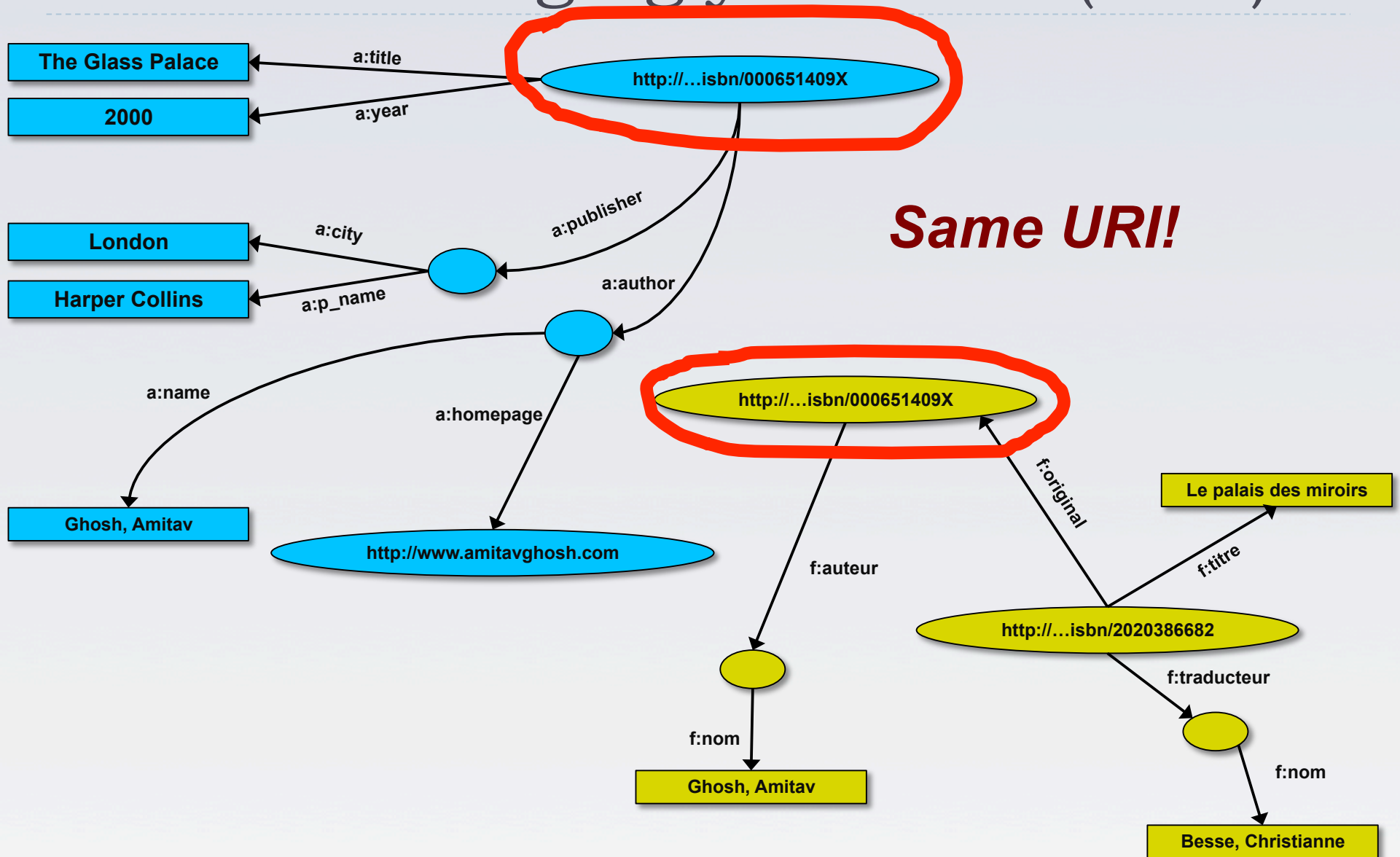
2nd: export your second set of data



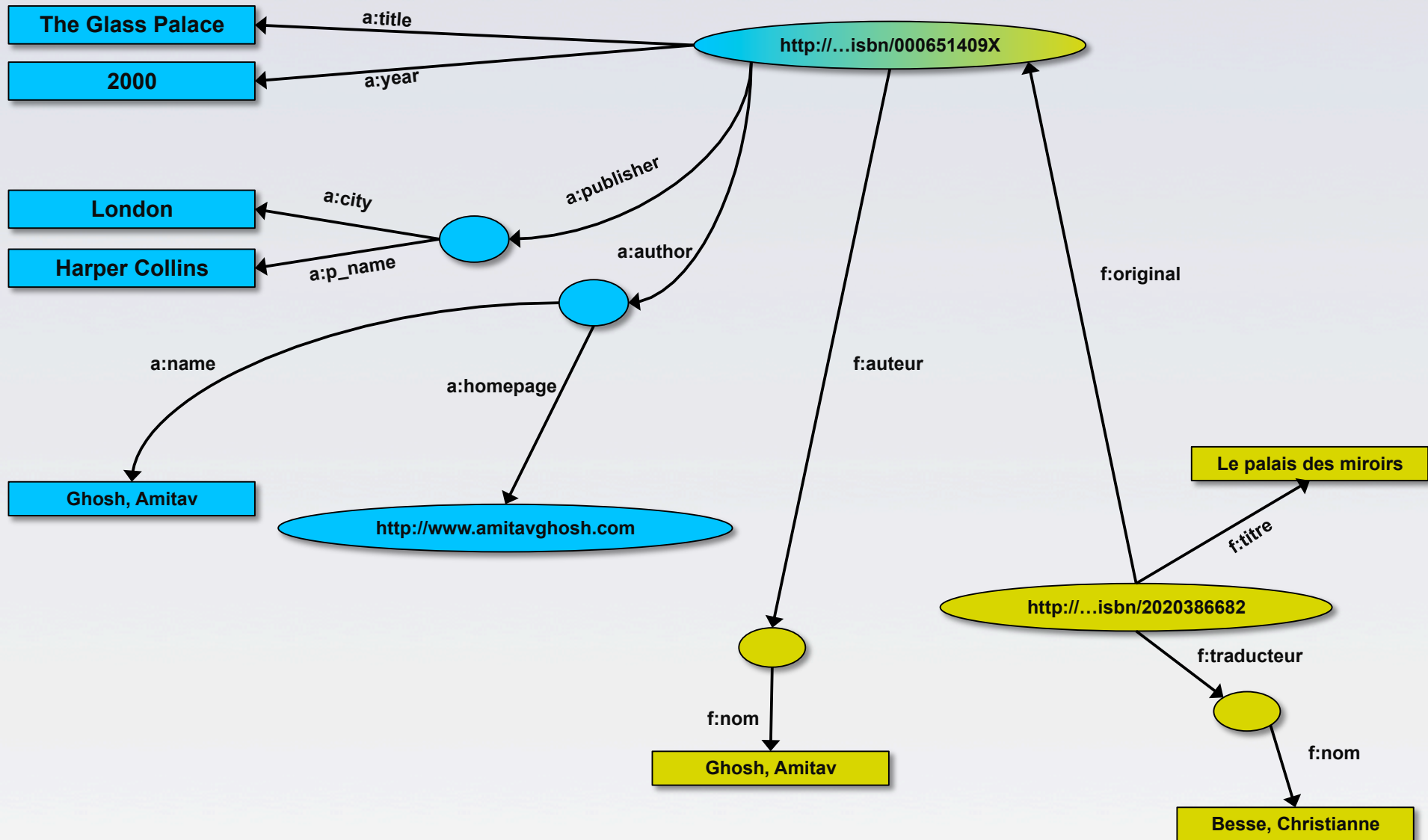
3rd: start merging your data



3rd: start merging your data (cont)

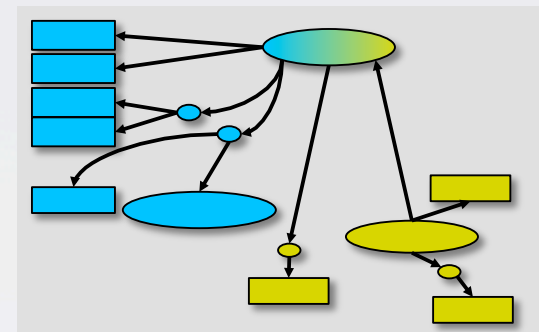


3rd: start merging your data



Start making queries...

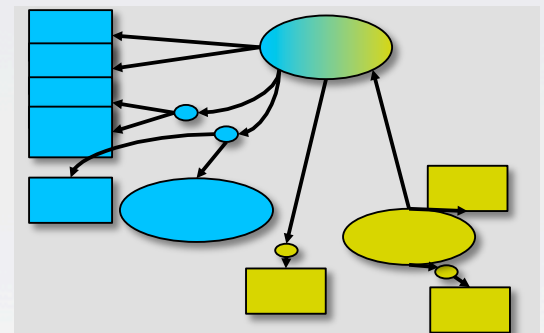
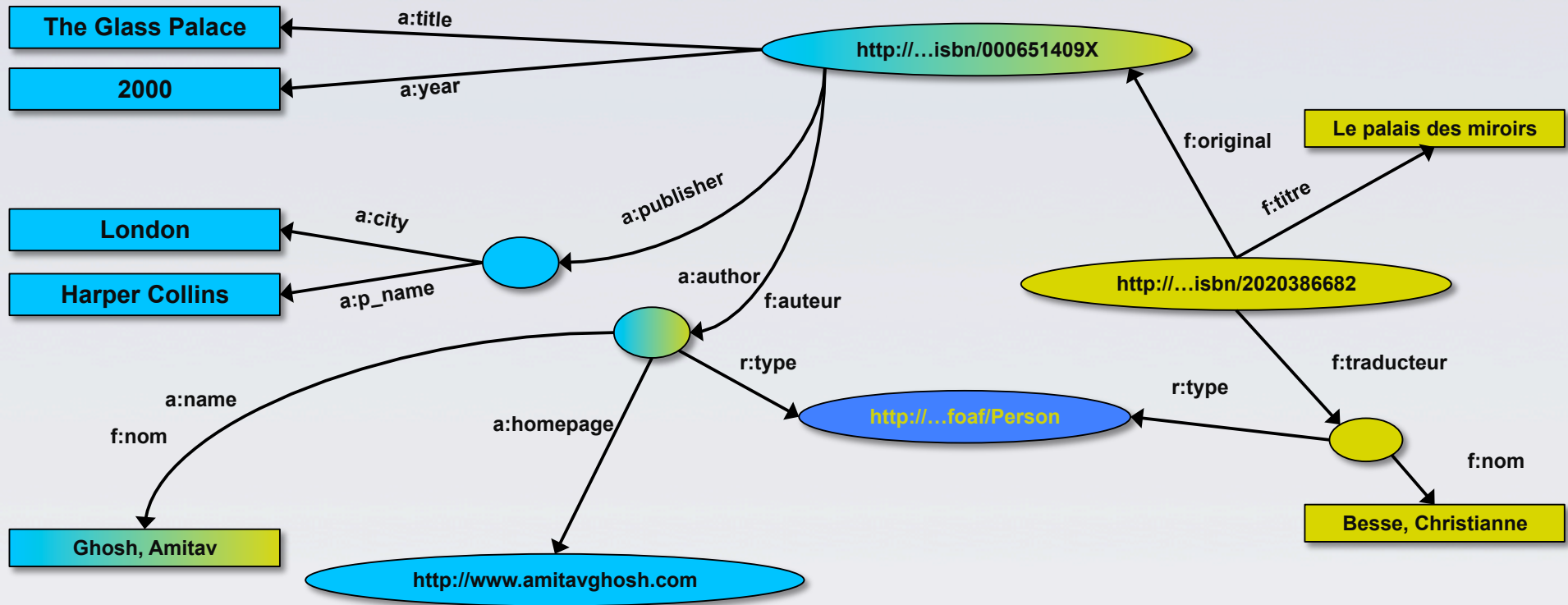
- ▶ User of data “F” can now ask queries like:
 - ▶ “give me the title of the original”
 - ▶ well, ... « donnes-moi le titre de l’original »
- ▶ This information is not in the dataset “F”...
- ▶ ...but can be retrieved by merging with dataset “A”!



However, more can be achieved...

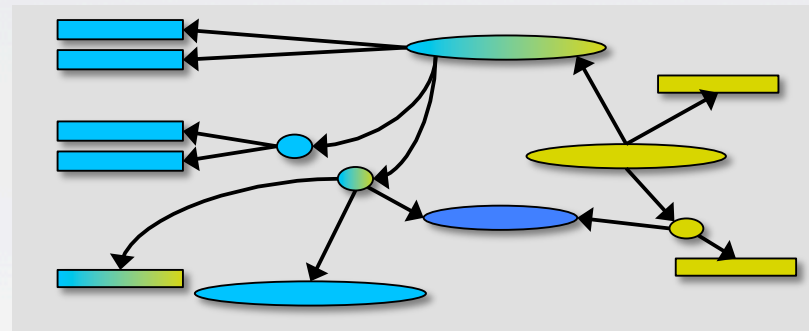
- ▶ We “feel” that a:author and f:auteur should be the same
- ▶ But an automatic merge does not know that!
- ▶ Let us add some extra information to the merged data:
 - ▶ a:author same as f:auteur
 - ▶ both identify a “Person”
 - ▶ a term that a community may have already defined:
 - ▶ a “Person” is uniquely identified by his/her name and, say, homepage
 - ▶ it can be used as a “category” for certain type of resources

3rd revisited: use the extra knowledge



Start making richer queries!

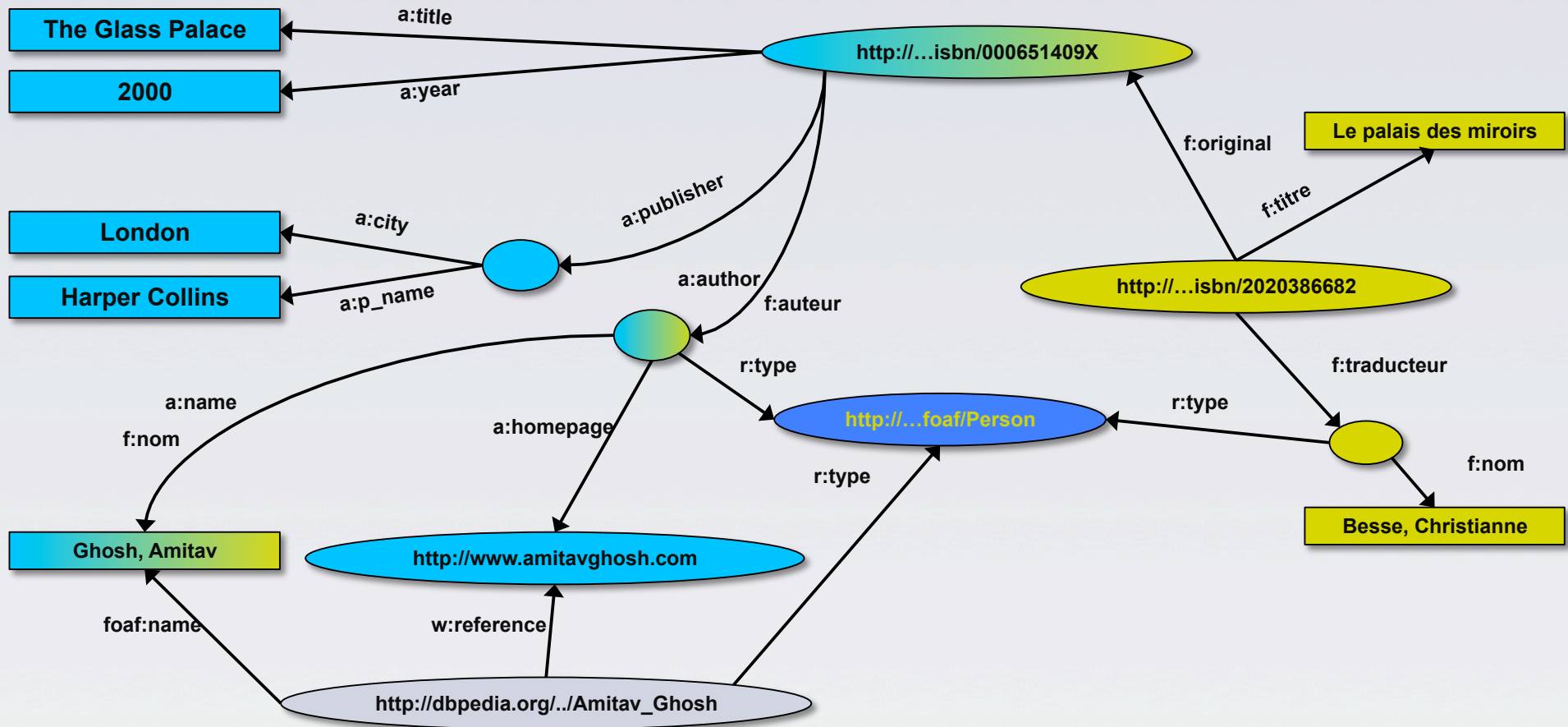
- ▶ User of dataset “F” can now query:
 - ▶ “donnes-moi la page d’accueil de l’auteur de l’original”
 - ▶ well... “give me the home page of the original’s ‘auteur’”
- ▶ The information is not in datasets “F” or “A”...
- ▶ ...but was made available by:
 - ▶ merging datasets “A” and datasets “F”
 - ▶ adding three simple extra statements as an extra “glue”



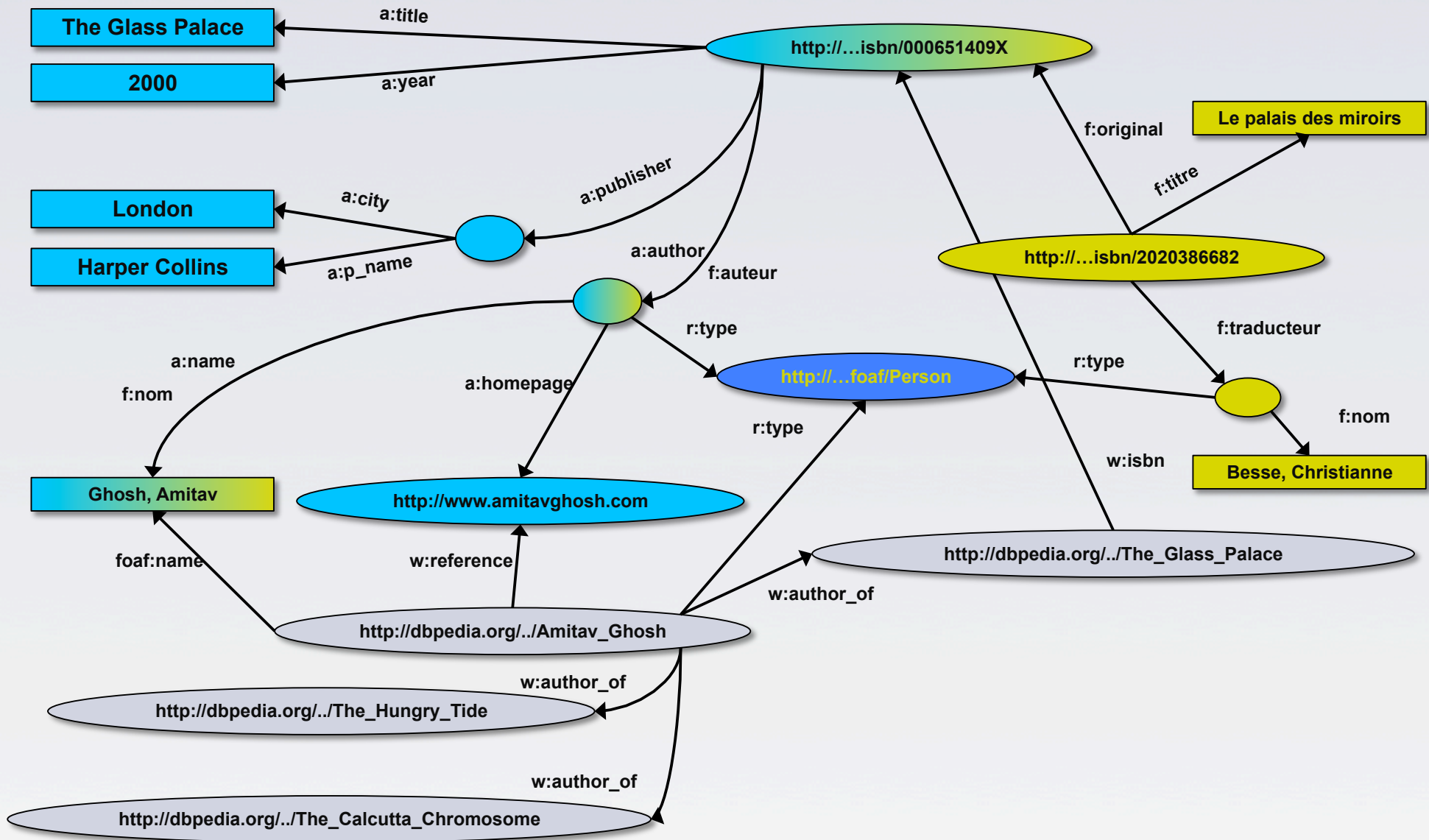
Combine with different datasets

- ▶ Using, e.g., the “Person”, the dataset can be combined with other sources
- ▶ For example, data in Wikipedia can be extracted using dedicated tools
 - ▶ e.g., the “[dbpedia](#)” project can extract the “infobox” information from Wikipedia already...

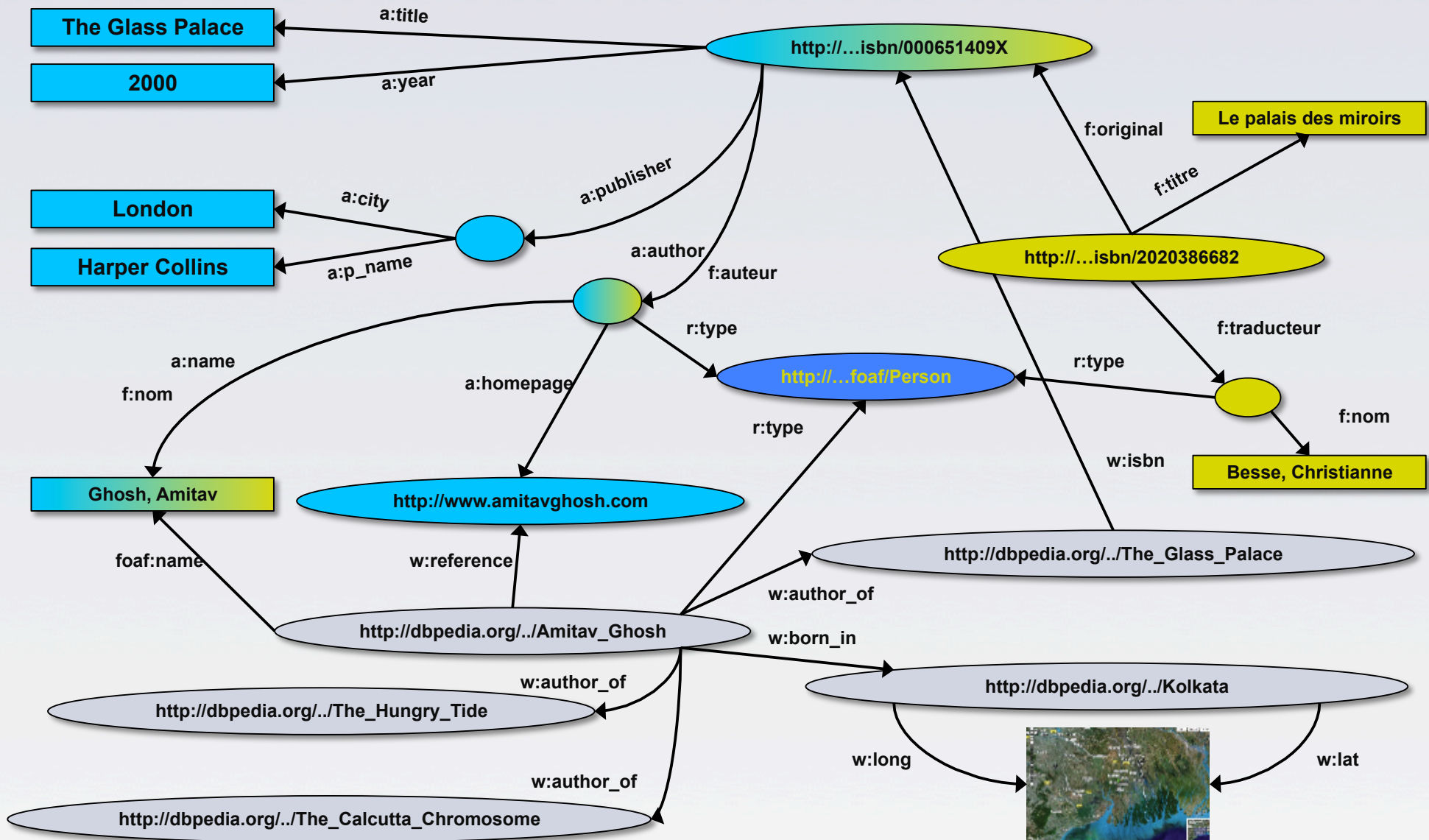
Merge with Wikipedia data



Merge with Wikipedia data



Merge with Wikipedia data



Is that surprising?

- ▶ It may look like it but, in fact, it should not be...
- ▶ What happened via automatic means is done every day by Web users!
- ▶ The difference: a bit of extra rigour so that machines could do this, too

What did we do?

- ▶ We combined different datasets that
 - ▶ are somewhere on the web
 - ▶ are of different formats (mysql, excel sheet, etc)
 - ▶ have different names for relations
- ▶ We could combine the data because some URI-s were identical (the ISBN-s in this case)

What did we do?

- ▶ We could add some simple additional information (the “glue”), also using common terminologies that a community has produced
- ▶ As a result, new relations could be found and retrieved

It could become even more powerful

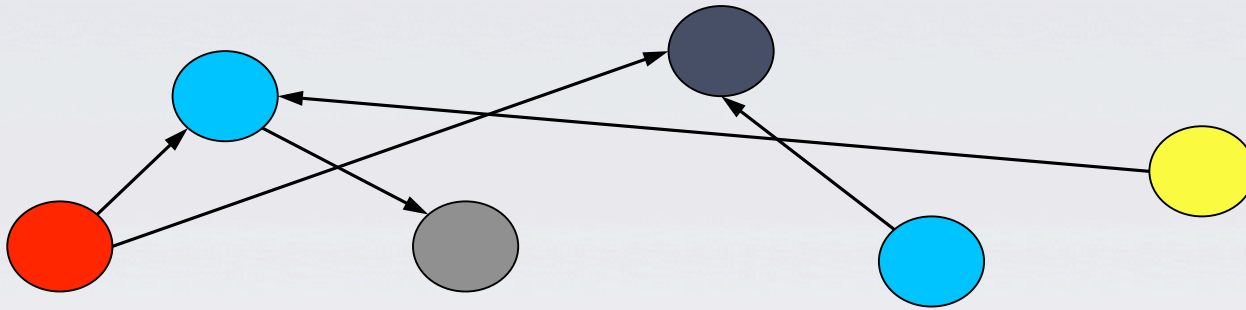
- ▶ We could add extra knowledge to the merged datasets
 - ▶ e.g., a full classification of various types of library data
 - ▶ geographical information
 - ▶ etc.
- ▶ This is where ontologies, extra rules, etc, come in
 - ▶ ontologies/rule sets can be relatively simple and small, or huge, or anything in between...
- ▶ Even more powerful queries can be asked as a result

What did we do? (cont)



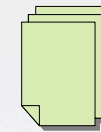
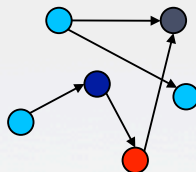
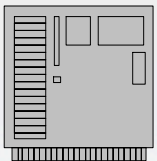
Applications

Manipulate
Query
...



Data represented in abstract format

Map,
Expose,
...



Data in various formats

The abstraction pays off because...

- ▶ ... the graph representation is independent of the exact structures
- ▶ ... a change in local database schema's, XHTML structures, etc, do not affect the whole
 - ▶ “schema independence”
- ▶ ... new data, new connections can be added seamlessly

The network effect

- ▶ Through URI-s we can link any data to any data
- ▶ The “network effect” is extended to the (Web) data
- ▶ “Mashup on steroids” become possible

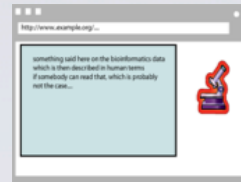
So where is the Semantic Web?

- ▶ The Semantic Web provides technologies to make such integration possible!

Details: many different technologies

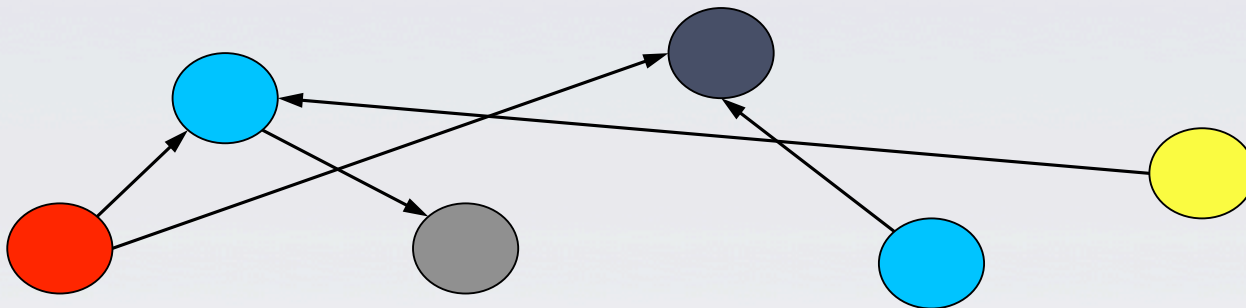
- ▶ an abstract model for the relational graphs: **RDF**
- ▶ add/extract RDF information to/from XML, (X)HTML: **GRDDL, RDFa**
- ▶ a query language adapted for graphs: **SPARQL**
- ▶ characterize the relationships and resources: **RDFS, OWL, SKOS, Rules**
 - ▶ applications may choose among the different technologies
- ▶ reuse of existing “ontologies” that others have produced (FOAF in our case)

Using these technologies...



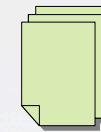
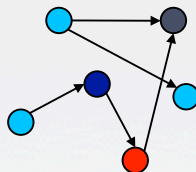
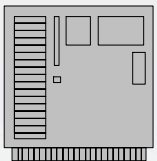
Applications

SPARQL,
Inferences
...



Data represented in RDF with extra knowledge (RDFS, SKOS, RIF, OWL,...)

RDB ⇔ RDF,
GRDL, RDFa,
...



Data in various formats

Where are we today (in a nutshell)?

- ▶ The technologies are in place, lots of tools around
 - ▶ there is always room for improvement, of course
- ▶ Large datasets are “published” on the Web, ie, ready for integration with others
- ▶ Large number of vocabularies, ontologies, etc, are available in various areas

Everything is not rosy, of course...

- ▶ **Tools have to improve**
 - ▶ scaling for very large datasets
 - ▶ quality check for data
 - ▶ etc
- ▶ **There is a lack of knowledgeable experts**
 - ▶ this makes the initial “step” tedious
 - ▶ leads to a lack of understanding of the technology

There are also R&D issues

- ▶ What does query/reasoning means on Web scale data?
- ▶ How does one incorporate uncertainty information?
- ▶ What is the granularity for access control, security, privacy...
- ▶ What types of user interfaces should we have for a Web of Data?
- ▶ etc.

Thank you for your attention!

These slides are also available on the Web:



<http://www.w3.org/2010/Talks/0617-Boeing-IH/Slides.{pdf,pptx}>
