

# RDF and the Semantic Web

Syed Gillani

Laboratoire Hubert Curien St-Etienne, France

# [ So Far ]

- ▶ XML provides a semi-structured data format
- ▶ XML schema provide the way to check if XML is well-formed

*XML Does not DO anything* and was not designed to *DO anything!*  
XML document is just pure information wrapped in XML tags.

## **We need more for THE WEB!!**

- ▶ **AAA:** anyone can say anything about anything (Tim-berners Lee)
- ▶ Integrating Semantics into the Web (What does a car means?)
- ▶ **Machine-readable Web:** things are connected such that matching can interpret information

Semantic Web is coming!!!






# [ Scenario ]

What are you doing on “burns” night?

- ▶ Google “burns”
- ▶ Check Wikipedia
- ▶ Amazon listing about “burns”
- ▶ Google Maps to look at the birthplace of Robert “burns”


# [Google Query]

 burns  

Web Images News Videos Maps More ▾ Search tools

About 233,000,000 results (0.62 seconds)


**Burns and scalds - NHS Choices**  
[www.nhs.uk/conditions/Burns-and-scalds/pages/introduction.aspx](http://www.nhs.uk/conditions/Burns-and-scalds/pages/introduction.aspx) ▾  
Burns and scalds are damage to the skin caused by heat. Both are treated in the same way. A burn is caused by dry heat. This can be caused by an iron or fire, ...

**Burnie Burns (@burnie) | Twitter**  
<https://twitter.com/burnie>   
6 days ago  
Life is grand. If you're reading this, you're probably part of what makes it that way. Thanks.







**Robert Burns - Wikipedia, the free encyclopedia**  
[https://en.wikipedia.org/wiki/Robert\\_Burns](https://en.wikipedia.org/wiki/Robert_Burns) ▾  
Robert Burns (25 January 1759 – 21 July 1796), also known as Rabbie Burns, the Bard of Ayrshire and various other names, was a Scottish poet and lyricist.  
Nationality: Scottish Literary movement: Romanticism  
Occupation: Poet; lyricist; farmer; exciseman

See results about

**Robert Burns (Bard)**  
Born: January 25, 1759, Alloway  
Died: July 21, 1796, Dumfries



**Images for burns** [Report images](#)



[More images for burns](#)

**Burns Premium Dog Food,Cat Food and Rabbit Food ...**  
[burnspet.co.uk/](http://burnspet.co.uk/) ▾  
Burns natural premium Dog Food,Cat Food and Rabbit Food.Real pet food from Burns Pet Nutrition.Pet food developed by Veterinary Surgeon John Burns for ...

# [ Wikipedia ]

## Robert Burns

From Wikipedia, the free encyclopedia

*For other people named Robert Burns, see Robert Burns (disambiguation).*

**Robert Burns** (25 January 1759 – 21 July 1796), also known as **Rabbi Burns**, the **Bard of Ayrshire** and various other names,<sup>[no 1]</sup> was a Scottish poet and lyricist. He is widely regarded as the **national poet** of Scotland and is celebrated worldwide. He is the best known of the poets who have written in the **Scots language**, although much of his writing is also in English and a light **Scots dialect**, accessible to an audience beyond Scotland. He also wrote in standard English, and in these writings his political or civil commentary is often at its bluntest.

He is regarded as a pioneer of the **Romantic movement**, and after his death he became a great source of inspiration to the founders of both **liberalism** and **socialism**, and a **cultural icon** in Scotland and among the **Scottish diaspora** around the world. Celebration of his life and work became almost a national **charismatic cult** during the 19th and 20th centuries, and his influence has long been strong on **Scottish literature**. In 2009 he was chosen as the greatest Scot by the Scottish public in a vote run by Scottish television channel **STV**.

As well as making original compositions, Burns also collected **folk songs** from across Scotland, often revising or **adapting** them. His poem (and song) "**Auld Lang Syne**" is often sung at **Hogmanay** (the last day of the year), and "**Scots Wha Hae**" served for a long time as an unofficial **national anthem** of the country. Other poems and songs of Burns that remain well known across the world today include "**A Red, Red Rose**"; "**A Man's a Man for A' That**"; "**To a Louse**"; "**To a Mouse**"; "**The Battle of Sherramuir**"; "**Tam o' Shanter**"; and "**Ae Fond Kiss**".

### Contents

- 1 Ayrshire
  - 1.1 Alloway
  - 1.2 Tarbolton
  - 1.3 Mauchline
  - 1.4 Love affairs
  - 1.5 Kilmarnock Edition
- 2 Edinburgh
- 3 Dumfriesshire
  - 3.1 Ellisland Farm
  - 3.2 Lyricist
  - 3.3 Failing health and death
- 4 Literary style
- 5 Influence
  - 5.1 Britain
  - 5.2 Canada
  - 5.3 United States
  - 5.4 Russia
- 6 Honours

Robert Burns



The best-known portrait of Burns, by Alexander Nasmyth, 1787 (detail)

<b>Born</b>	25 January 1759 <div>Alloway, Ayrshire, Scotland</div>
<b>Died</b>	21 July 1796 (aged 37) <div>Dumfries, Scotland</div>
<b>Occupation</b>	Poet <span> </span> <b><span>·</span></b> <span> </span> lyricist <span> </span> <b><span>·</span></b> <span> </span> farmer <span> </span> <b><span>·</span></b> <span> </span> exciseman
<b>Nationality</b>	Scottish
<b>Literary movement</b>	Romanticism
<b>Notable works</b>	"Auld Lang Syne" <span> </span> <b><span>·</span></b> <span> </span> "To a Mouse" <span> </span> <b><span>·</span></b> <span> </span> "A Man's a Man for A' That" <span> </span> <b><span>·</span></b> <span> </span> "Ae Fond Kiss" <span> </span> <b><span>·</span></b> <span> </span> "Scots Wha Hae" <span> </span> <b><span>·</span></b> <span> </span> "Tam O'Shanter" <span> </span> <b><span>·</span></b> <span> </span> "Halloween" <span> </span> <b><span>·</span></b> <span> </span> "The Battle of Sherramuir"

**Signature**

[ Amazon ]

amazon.co.uk Prime

Books - burns

Shop by Department - Jacques's Amazon Today's Deals Gift Cards Sell Help Hello, Jacques Your Account - Your Prime -

Books Advanced Search Best Sellers Top New Releases Deals in Books Best Books of the Month Gift Guide Books Outlet Children's Books Calendars & Diaries

1-16 of 47,631 results for Books : "burns" Sort by Relevance

Show results for

< Any Category

Books

Accident & Emergency Medicine (131)  
Social Sciences (908)  
Fiction Classics (119)  
Poetry (1,082)  
• See more

Refine by

Delivery Option

☐ Prime

Author


☐ Robert Burns  
☐ Paul Clay Burns  
☐ Charles Burns  
☐ David D. Burns  
☐ Mays Banks  
☐ Edward Burns  
☐ Marilyn Burns  
☐ Cathy Burns  
☐ James MacGregor Burns  
☐ Elizabeth Burns  
☐ Gordon Burn  
☐ Tom Burns  
☐ Paul Burns  
☐ Jan Burns  
☐ Jim Burns  
• See more

Book Language

...

Related Searches: burns management accounting, robert burns, robert galbraith.


Book Format: Kindle Books | Audiobooks | Hardcover | Paperback


 **Poems and Songs of Robert Burns** 12 May 2012  
by Robert Burns

Kindle Edition  
£0.00  
Available for download now

Paperback  
£3.96 ✓ Prime  
Get it by **Wednesday, Nov 18**  
More buying choices  
£3.96 used & new (3 offers)

★★★★☆ • 14

 **Amazon's Burns Page**  
Discover books, read about the author, find related products, and more. [More about Burns](#)  
Bestselling Books: The Corner: A Year in the Life of an Inner-City Neighbourhood, JUGE DREDD CONTRE RAIDERS, Truens le palatin, Tome 1 : La reine sorcière d'Anubis.

 **Burn: (Michael Bennett 7)** 4 Jun 2015  
by James Patterson

Paperback  
£3.85 ✓ Prime  
Get it by **Tuesday, Nov 17**  
More buying choices  
£0.01 used & new (84 offers)

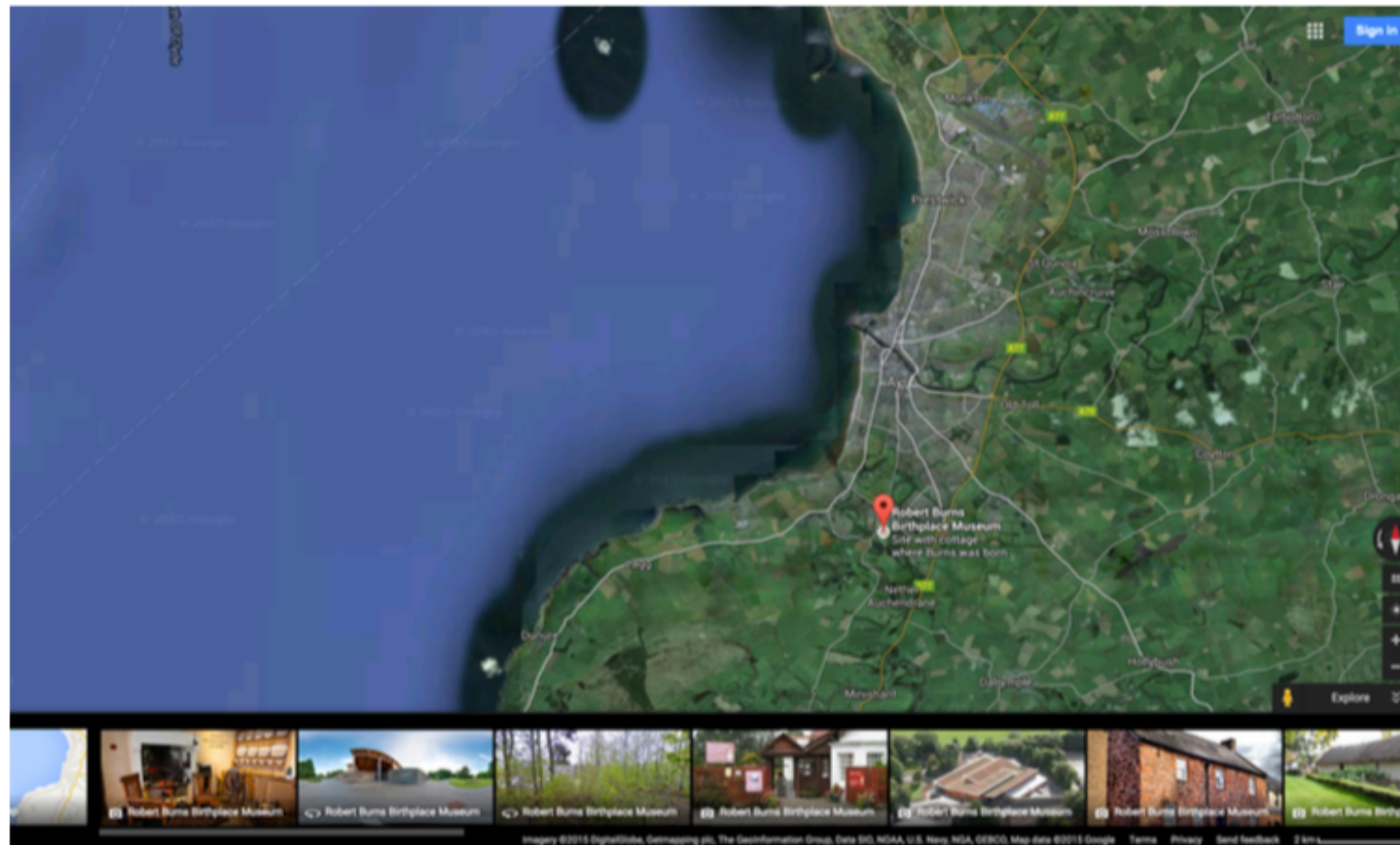
Kindle Edition  
£4.99  
Whispersync for Voice-ready

Other Formats: [Audio CD](#), [Hardcover](#)

★★★★☆ • 315

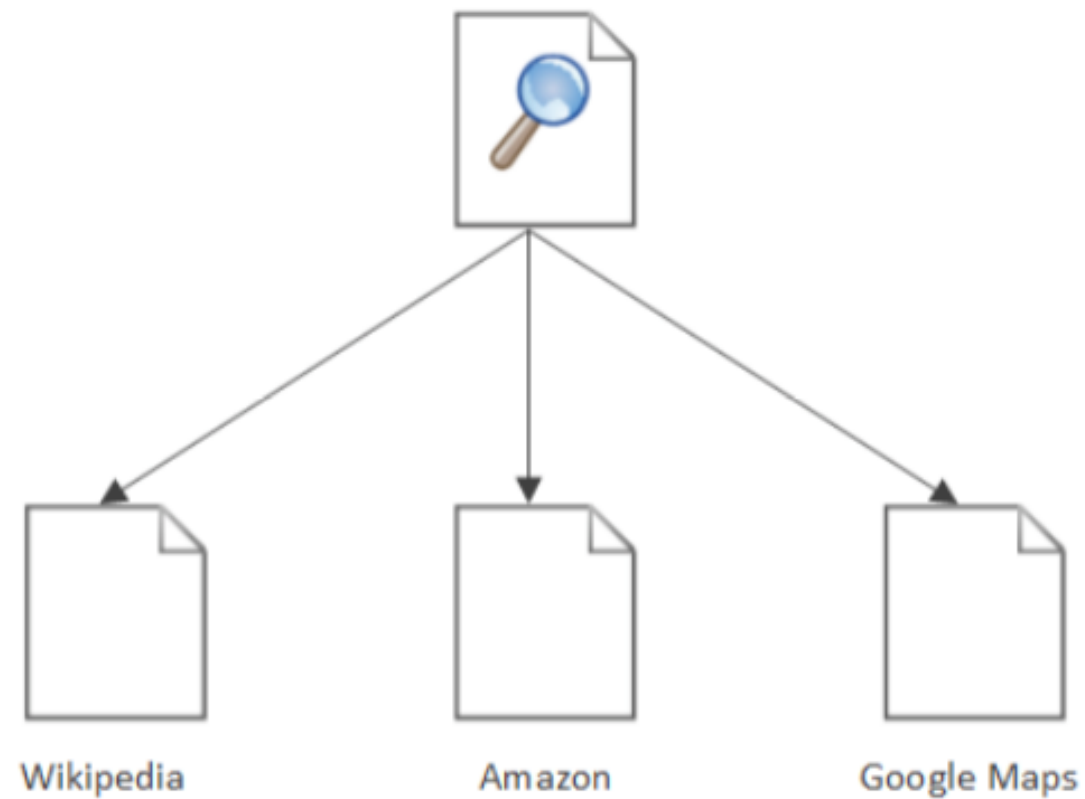


# [Google Maps]





# [Combining Information]



Is it possible with semi-structured/structured data models?

# [The Semantic Web]

- ▶ Invented by Tim-Berners-Lee and other. W3C recommendations
  - ✓ Web of machine-readable data
- ▶ Semantic Web aims
  - ✓ Automated query answering
  - ✓ Automated use of the data (reasoning, planning, acting, etc.)

## **WWW vs Semantic Web**

- ▶ WWW is a **web of documents**
- ▶ SW is a **web of data**
- ▶ WWW documents are **human** readable
- ▶ SW data is **machine** readable (at-least in theory)

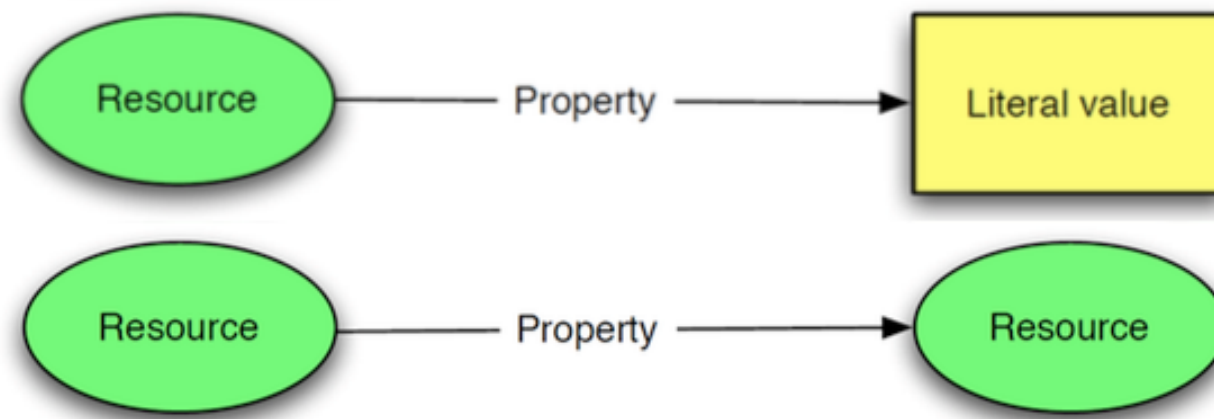
# [The Semantic Web]

- ▶ Provide Syntax, i.e. arrangements of symbols
- ▶ Provide Semantics, i.e. relations between symbols and the world: what things actually means

## **How?**

- ▶ Syntax: RDF data model (schema-less and cyclic/trees/whatever you want it to be)
- ▶ Semantics: Ontologies/schemas

# [RDF Data Model]



- ▶ **RDF statements** identify a resource being described, a specific property and value of the property.
- ▶ Terminology:
  - ✓ Subject (e.g. **Sam**)
  - ✓ Predicate/Property (e.g. **has-a-car**)
  - ✓ Object (e.g. **Prius**)

# [ XML vs RDF ]

## XML

```
<bibliography>
  <book>  <title> Foundations... </title>
           <author> Abiteboul </author>
           <author> Hull </author>
           <author> Vianu </author>
           <publisher> Addison Wesley </publisher>
           <year> 1995 </year>
        </book>
  ...
</bibliography>
```

## RDF

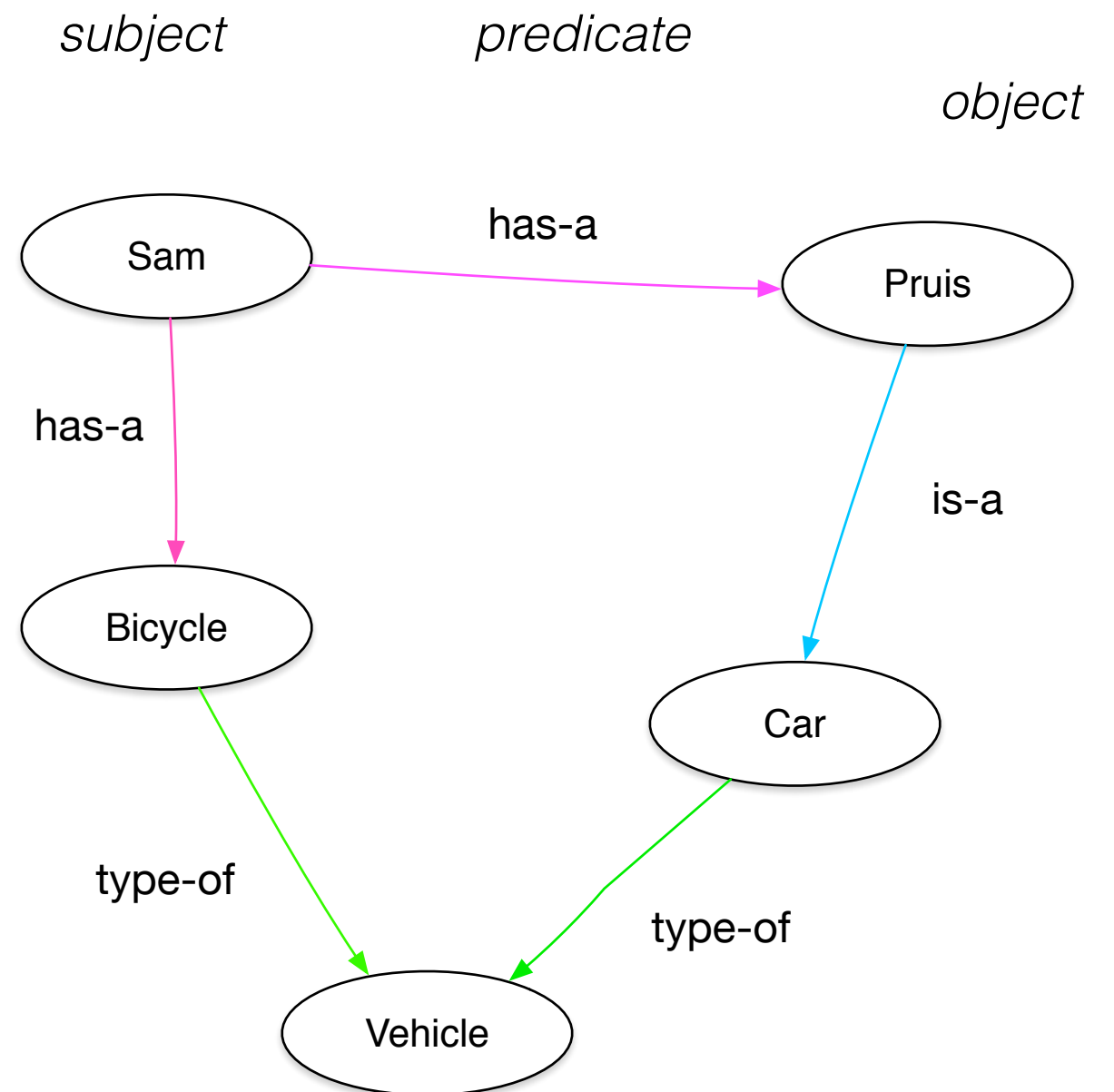
```
Lib:book  Title "Foundations"
Lib:book  Author "Abiteboul"
Lib:book  Author "Hull"
Lib:book  Publisher "Addison Wesley"
Lib:book  year "1995"
```

Lib = <http://www.st-etienne-library.com/>

# [RDF Data Model]

## ► Facts

- Sam has a Pruis
- Pruis is a type of car
- car is a type of vehicle
- Sam has a bicycle
- Bicycle is a type of vehicle



# [RDF Data Model]

- ▶ Issues:
  - ▶ Who is Sam?
  - ▶ Properties of vehicle, car, bicycle,

What is the point of RDF data model, if I can't distinguish a specific Sam, and if I can't get the information about Pruis?



# [ URIs ]

*Use URIs to represent a resource*

- ▶ Uniform Resource Identifier (URI): a simple and extensible means for identifying a resource

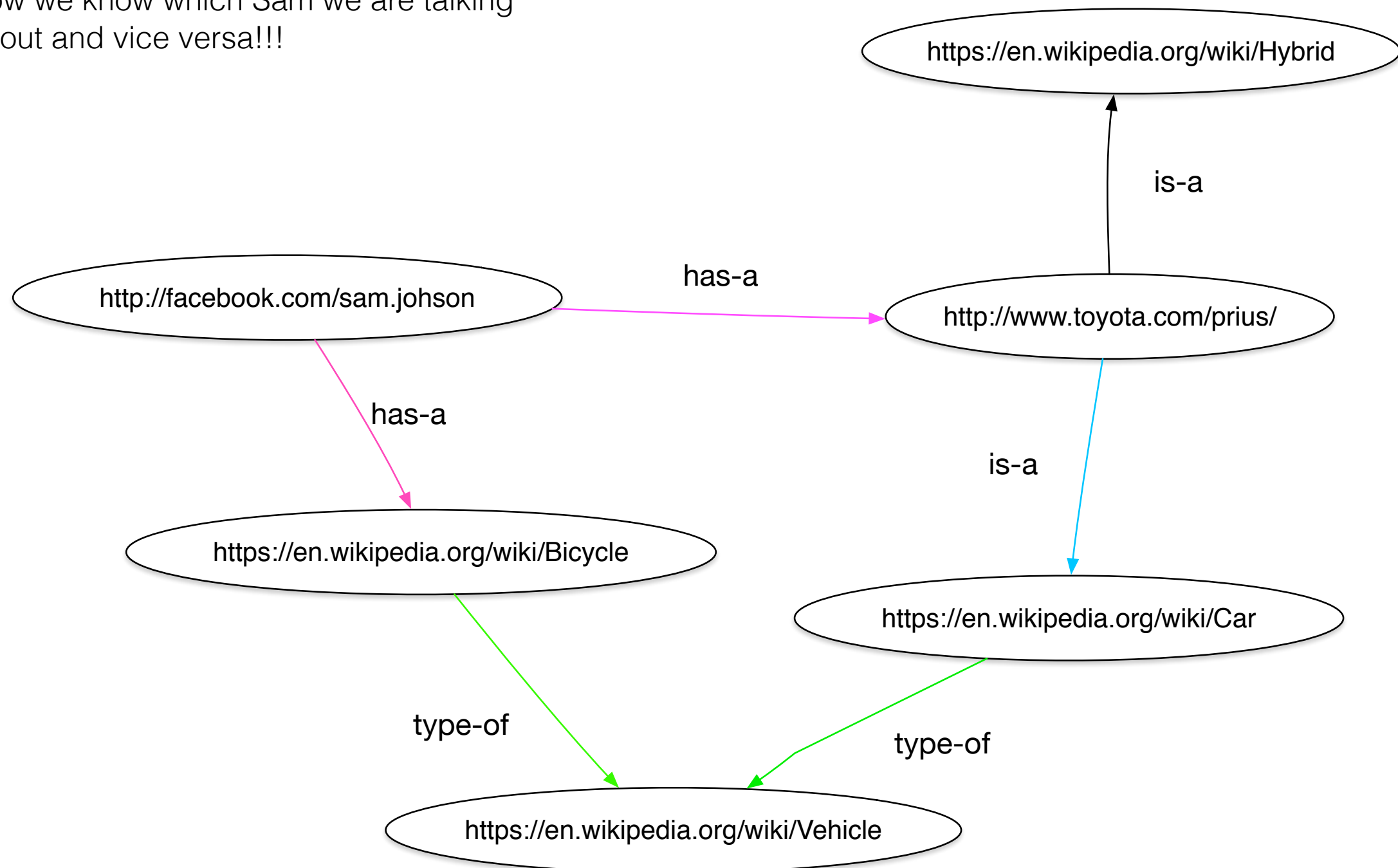
“<http://www.facebook.com/>”      +      “sam.johnson”

Examples of resources:

*“an electronic document, an image, a source of information with a consistent purpose (e.g. “today’s weather report for Los Angeles”), a service (e.g. an HTTP-to-SMS gateway), a collection of other resources”*

# [RDF Data Model]

Now we know which Sam we are talking about and vice versa!!!



# [ Processing RDF ]

- ▶ RDF is designed to make machine-processable statements
- ▶ Two things required:
  - ✓ A machine-processable syntax for expressing RDF statements
  - ✓ A machine-processable system for unambiguously identifying subjects, predicates and objects (URIs) + plus the query language (next lecture)
- ▶ DIY: Read about various syntax for representing RDF (Turtle, N3, RDF/XML, etc.) [Check course website for more info!!]

# [ Semantics with RDF ]

## ► Facts

- Sam has a Pruis
- Pruis is a type of car
- Car is a type of vehicle
- Sam has a bicycle
- Bicycle is a type of vehicle

**Inference by human judgment:** Sam is an environmentalist

**Inference by subsumption:** Sam has two vehicles

# [ RDF Schema ]

A set of Classes and Properties  
defined in RDF namespace

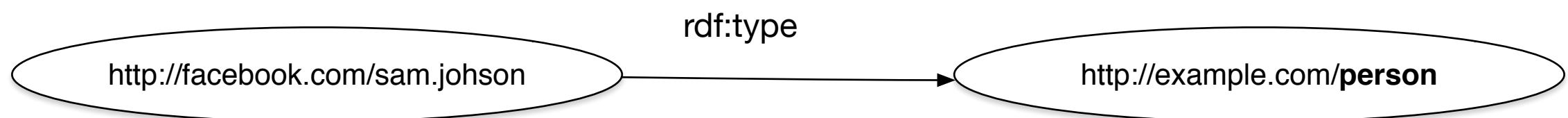
(<http://www.w3.org/1999/02/22-rdf-syntax-ns#>)

## ► Classes (or Types)

- ✓ **rdf:Resource** : everything that can be identified (with a URI)
- ✓ **rdf:Property** : specialisation of a resource expressing a binary relation between two resources
- ✓ **rdf:statement** : a triple with properties **rdf:subject**, **rdf:predicate**, **rdf:object**

## ► Properties

- ✓ **rdf:type** : subject is an instance of that category or class defined by the
- ✓ **rdf:subject**, **rdf:predicate**, **rdf:object** : relate elements of statement tuple to a resource of type statement



# [ RDF Schema ]

## ► **Issues:**

- No localised domain and range constraints
  - ✓ Can't say the range of hasChild is person in context of persons and elephants in context of elephants
- No existence/cardinality constraints
  - ✓ Can't say that all instances of persons have a mother that is also a person
  - ✓ Can't say that persons have exactly two biological parents

So, we need a more expressive and well-grounded ontology language for RDF

# [Ontology]

Originally: a definitive account of what exists  
(derived from metaphysics)





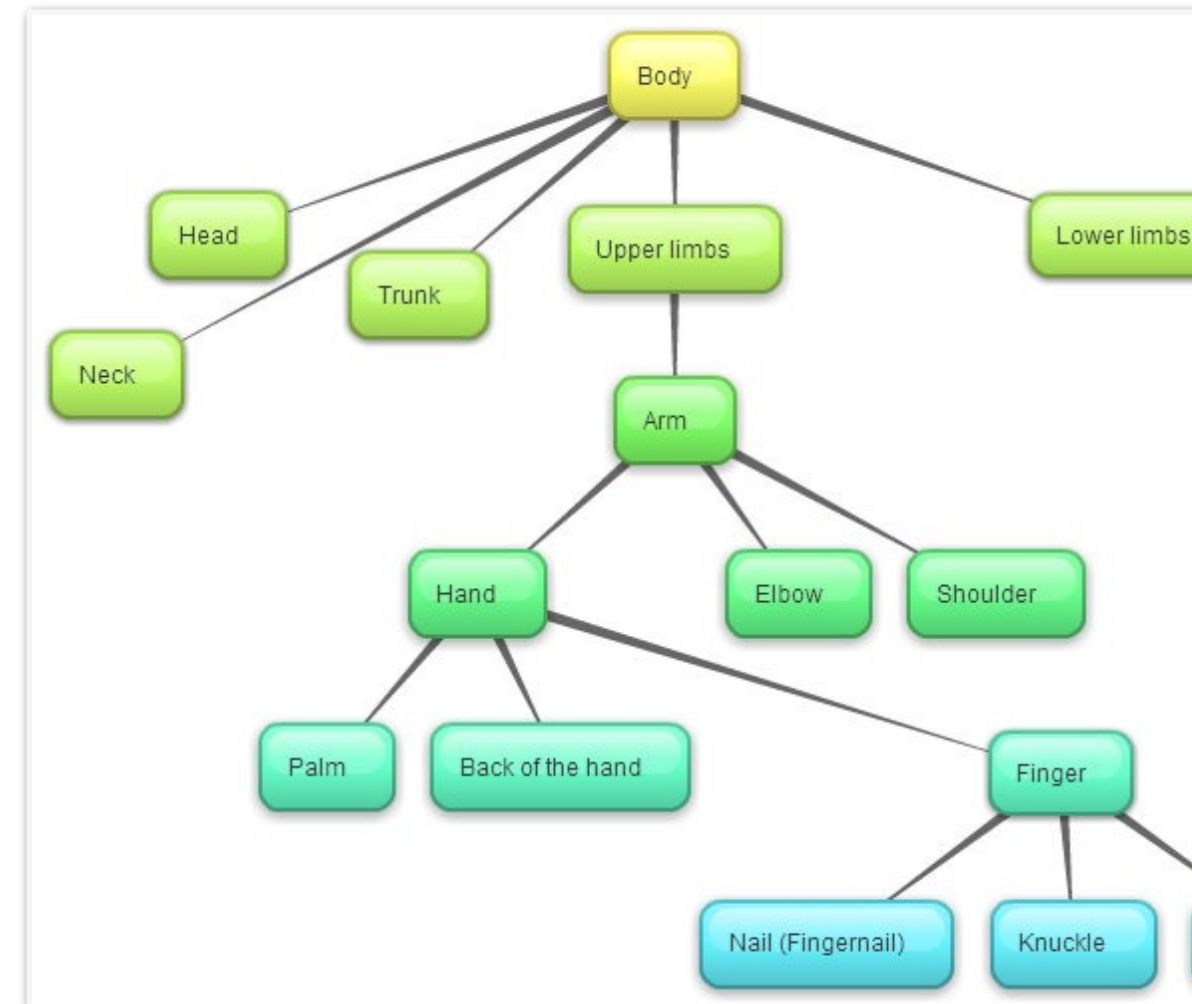
# [Ontology]

## ► What is an Ontology:

- ✓ A formal specification of conceptualisation shared in a community
- ✓ Vocabulary for defining a set of things that exist in a world view
- ✓ Formalisation allows communication across application systems and extension


## ► Components of an Ontology

- Vocabulary (concepts)
- Structure (attributes of concepts and hierarchy)
- Relationships between concepts
- Logical characteristics of relationships
  - ✓ Domain and range restrictions
  - ✓ Properties of relations (symmetry, transitivity)
  - ✓ Cardinality of relations

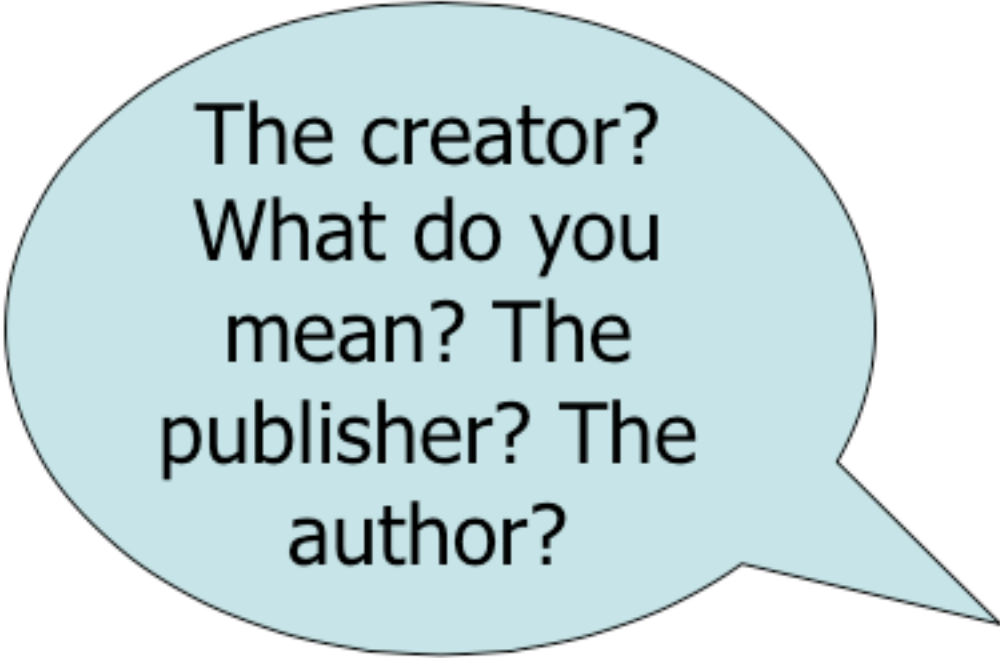


# [Why Semantic Web Ontologies?]

## ►Data Integration



Who is the  
creator of  
Crime and  
Punishment?



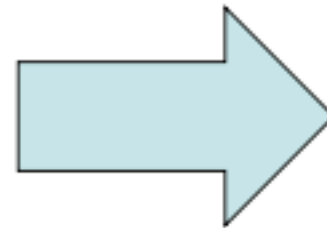
The creator?  
What do you  
mean? The  
publisher? The  
author?

# [Why Semantic Web Ontologies?]

## ► Inference

William Burnes is the  
father of Robert Burns.  
...  
...

Father is a subclass of  
Parent.  
...  
...



William Burnes is the  
parent of Robert Burns.

# [Examples of Ontologies]

	Language	Swoogle hits	Revised
Dublin Core	RDF	1,364,337	28 October 2006
FOAF	OWL DL	1,194,871	27 July 2005
TrackBack	RDF	502,401	
MetaVocab	RDF	441,790	16 February 2002
Basic Geo Vocabulary	RDF Schema	248,130	1 February 2006
BIO	RDF	220,228	5 March 2004
RSS 1.0	RDF Schema	201,786	6 December 2000
VCard RDF	RDF	181,962	22 February 2001
Creative Commons metadata	RDF Schema	112,216	
WOT	OWL DL	97,292	23 February 2004
SIOC	OWL DL	42,911	11 April 2008
GoodRelations	OWL DL	5,000	1 October 2011
DOAP	RDF Schema	1,442	5 November 2005
Programmes Ontology	OWL 2	943	7 September 2009
Music Ontology	OWL 2	646	14 February 2010
Pedagogical diagnosis	OWL DL	1	1 April 2012
DILIGENT Argumentation Ontology	OWL 2	1	13 September 2006
OpenGUID	RDF Schema	1	24 September 2008
Provenance Vocabulary	OWL DL	1	25 August 2009

<http://semanticweb.org/wiki/Ontology>

# [ Exercise ]

## Tags on Flickr

Create an ontology  
based on the tags

### Hot tags

#### In the last 24 hours

feb23, whitenight, whitenightmelbourne, farligt, avstand, facedowntuesday, encuentros, whenigrowup, dp3merrill, whitenightmelb, fdt, northplatterealestate, fencefriday, benchmonday, genomskinlig, myvalentine, tva, dp3, happyvalentines, leicammonochrom

#### Over the last week

focuspocus, location4, sotu, wildgoosechase, locspring2013, whitenightmelbourne, ds106photoblitz, rosenmontagszug, myattic, kl112, londonicesculptingfestival, stroll1302, bemyflickrvalentine, week8, australianaday2013, week5theme, wolfmoon, whitenight, a4p, giornodellamemoria

Jump to:

GO

### All time most popular tags

animals architecture **art** asia australia autumn baby band barcelona **beach** berlin bike bird birds  
birthday black blackandwhite blue bw **california** canada **canon** car cat chicago  
china christmas church **city** clouds color concert dance day de dog england  
**europe** fall **family** fashion festival film florida flower flowers food football  
france friends fun garden geotagged germany girl graffiti green halloween hawaii holiday  
house india **instagramapp** iphone **iphoneography** island italia italy  
**japan** kids la lake landscape light live london love macro me mexico model museum  
music nature new newyork newyorkcity night **nikon** nyc ocean old paris  
park party people photo photography photos portrait raw red river rock san  
sanfrancisco scotland sea seattle show sky snow spain spring **square**  
**squareformat** street summer sun sunset taiwan texas thailand tokyo  
travel tree trees trip uk unitedstates urban **usa** vacation vintage washington **water**  
**wedding** white winter woman yellow zoo

[ Exercise ]

Now create an XSD based on  
the ontology from previous slide

[ Fin ]

★Acknowledgments: *Jacques Fleuriot, University of Edinburgh*