



THE UNIVERSITY of EDINBURGH  
**informatics**

# **Semantic Web Systems**

## **Introduction**

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**School of Informatics**



# The World Wide Web





# Requirements of the WWW

- The internet – already there
- HTML programmers
- Core weight of interest
- Search engines



# Why do we need the Semantic Web?

*I have a dream for the Web [in which computers] become capable of analyzing all the data on the Web – the content, links, and transactions between people and computers. ...the day-to-day mechanisms of trade, bureaucracy and our daily lives will be handled by machines talking to machines.*

Tim Berners-Lee (1999) Weaving the Web



## Scenario

What are you doing on Burns night?

⇒ Google “burns”

⇒ Wikipedia articles on Robert Burns

⇒ Amazon Listings of books by Burns

⇒ Google Maps to look at birthplace of Burns



# Google query

Google 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.

6 days ago  
 Our movie #LazerTeam will be in theaters on January 27th! Hopefully everyone will have seen Star Wars by then.

**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

**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 ...

See results about

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

# Wikipedia article

## 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 **Rabbie Burns**, the **Bard of Ayrshire** and various other names,<sup>[nb 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.

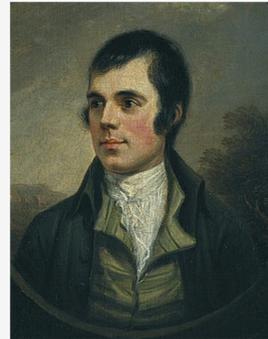
He is regarded as a pioneer of the [Romantic movement](#), and after his death he became a great source of inspiration to the founders of both [liberalism](#) and [socialism](#), and a [cultural icon](#) in Scotland and among the [Scottish diaspora](#) around the world. Celebration of his life and work 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](#)".

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  - 1.1 [Alloway](#)
  - 1.2 [Tarbolton](#)
  - 1.3 [Mauchline](#)
  - 1.4 [Love affairs](#)
  - 1.5 [Kilmarnock Edition](#)
- 2 [Edinburgh](#)
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  - 3.1 [Ellisland Farm](#)
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**Robert Burns**



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

**Born** 25 January 1759  
[Alloway, Ayrshire, Scotland](#)

**Died** 21 July 1796 (aged 37)  
[Dumfries, Scotland](#)

**Occupation** Poet · lyricist · farmer · exciseman

**Nationality** [Scottish](#)

**Literary movement** [Romanticism](#)

**Notable works** "[Auld Lang Syne](#)" · "[To a Mouse](#)" · "[A Man's a Man for A' That](#)" · "[Ae Fond Kiss](#)" · "[Scots Wha Hae](#)" · "[Tam O'Shanter](#)" · "[Halloween](#)" · "[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
- Maya Banks
- Edward Burns
- Marilyn Burns
- Cathy Burns
- James MacGregor Burns
- Elizabeth Burns
- Gordon Burn
- Tom Burns
- Paul Burns
- Jen Burns
- Jim Burns
- + See more

**Book Language**

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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 ★★★★☆ 14  
**£0.00**  
 Available for download now

Paperback  
**£8.96** Prime  
 Get it by **Wednesday, Nov 18**

More buying choices  
**£8.96 used & new** (3 offers)

---

**Author Pages**

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 RAIDER](#), [Trueno le paladin, Tome 1 : La reine sorcière d'Anubis](#).

---

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

Paperback ★★★★☆ 315  
**£3.85** Prime  
 Get it by **Tuesday, Nov 17**

More buying choices  
**£0.01 used & new** (84 offers)

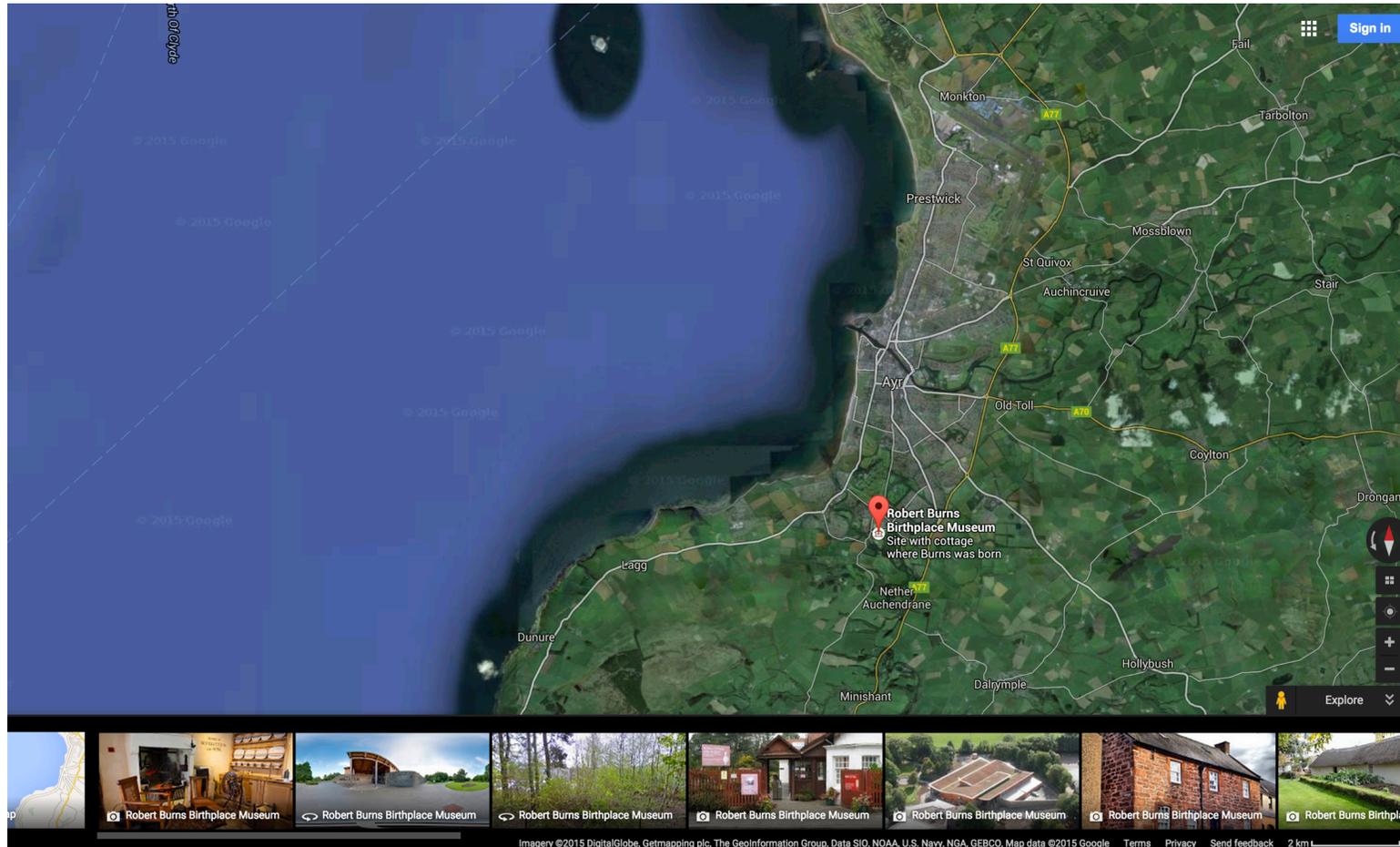
Kindle Edition  
**£4.99**  
 Whispersync for Voice-ready

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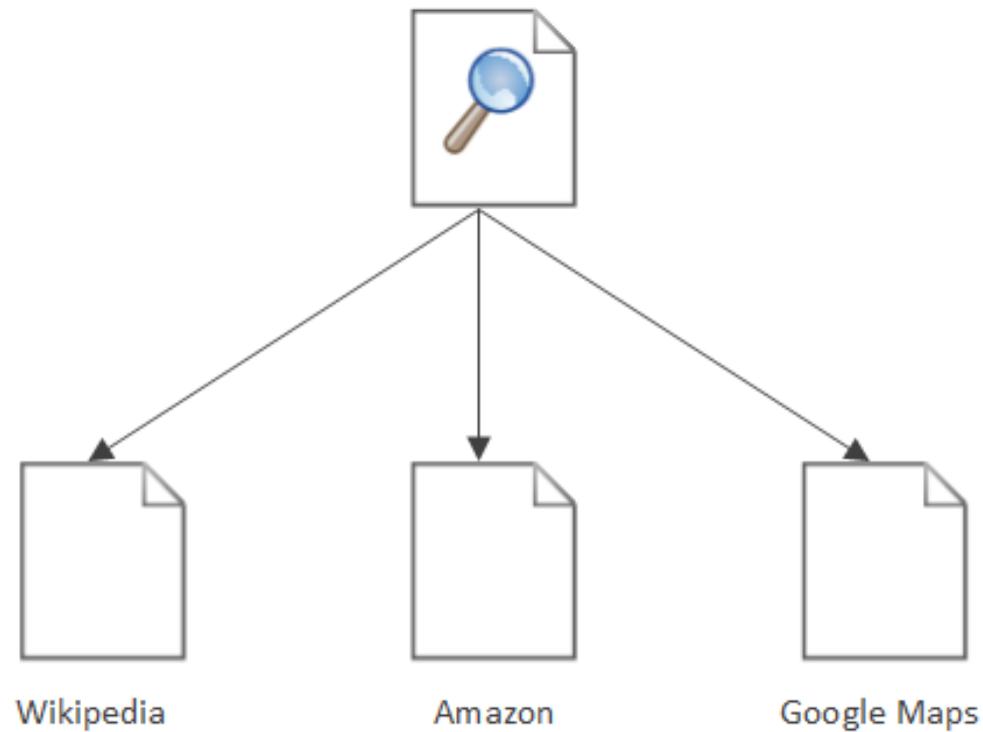


# Google maps





# Combining Information



# Combining data from one source with a service from another

The screenshot shows a web browser window displaying the Wild Swim Map UK website. The browser's address bar shows the URL: [www.wildswimming.co.uk/wild-swim-map-uk/?multi\\_region=wild-swim-map-uk](http://www.wildswimming.co.uk/wild-swim-map-uk/?multi_region=wild-swim-map-uk). The page title is "Wild Swim Map UK". Below the title, there is a breadcrumb trail: "Home > Wild Swim Map UK".

The main content area contains two paragraphs of text. The first paragraph describes the map: "Explore and contribute to the UK **wild swimming map**. The map has been created from selected places from the **Wild Swimming** books plus hundreds of additional entries and photos contributed by the wonderful wild swimmers of the UK. Click on the expand button (top left corner of map) to view the wild swim map in full screen mode." The second paragraph provides instructions on how to use the map: "The original wild swimming map was launched as a Google community map in 2007 and has received over a million visits since. We've recently moved over to this new site and are in the process of transferring across all the entries. Use the search boxes on the top right of this page to enter your post code or address, to find places close to you. Use the 'Explore by...' menu to choose wild swim map areas, counties or activity themes to explore by (we're planning to include events, places to camp by water, places to hire boats etc). Click here to **add a new swim** to the wild swimming map, add a photo or leave a rating, comment or review. Or choose 'Add a Listing' from the menu above, and choose an appropriate category. You can also add information about local events, campaigns and clubs, or recommendations for a lovely campsite or cafe near a swim."

Below the text, there are social media sharing buttons for Facebook (Like), Twitter (Tweet), Pinterest (Pin it), Email, and a Share button.

On the right side of the page, there is a map of the United Kingdom. The map is titled "United Kingdom" and shows various cities and regions. Numerous blue location pins are scattered across the map, indicating wild swimming spots. The map interface includes a search bar at the bottom right with the placeholder text "Title or Keyword", a "Map" button, and a "Satellite" button. The map data is attributed to "Map data ©2015 Google".



# Web APIs

- A large and growing number of web data sources provide program-accessible interfaces (APIs)
- Website [programmableweb.com](http://programmableweb.com) currently lists over 14 000 (December 2015).
- Most popular APIs (November 2015):

## MOST POPULAR APIs

1. NetImpact

[Track this API](#)

2. OverDrive Ch...

[Track this API](#)

3. GoSquared Ec...

[Track this API](#)

4. Orange User...

[Track this API](#)

5. XigniteBonds...

[Track this API](#)

6. GuideStar Ch...

[Track this API](#)

7. JustVisual F...

[Track this API](#)

8. Mendix Deplo...

[Track this API](#)

9. IEEE

[Track this API](#)

10. FullContact...

[Track this API](#)



## Limitations of Web APIs

- The interfaces are non-uniform – REST, RPC (e.g. SOAP) and hybrid
- The results are returned in variety of formats – XML, JSON, Atom
- The data schemas tend to be provider-specific
- Militates against the development of portable, generic methods of accessing and using data



# The Semantic Web

- Invented by Tim Berners-Lee and others. W3C driving organisation.

## Web of machine-readable data

- What are the main aims of the SW?
  - 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 (in theory at least)



## Why the *Semantic Web*?

*I don't think [the Semantic Web is] a very good name but we're stuck with it now. The word semantics is used by different groups to mean different things ...I think we could have called it the Data Web. ...it connects all applications together or gives [people] access to data across the company ...*

Tim Berners-Lee (2007), Interview in *Business Week*





## Why the *Semantic Web*?

- Syntax / semantics distinction: long history in philosophy of language, linguistics, formal logic
- **Syntax** concerned with arrangement of symbols
- **Semantics** concerned with the relation between symbols strings and the world: what things actually *mean*



# What can the Semantic Web actually do?

## Query answering

IBM's Watson: beats human competitors at Jeopardy

**but**

- It was specifically trained for this task (including looking at decades' worth of past Jeopardy answers)
- It is sort of cheating (reaction times means it always gets first go!)



# What can the Semantic Web actually do?

## Query answering

Wolfram-alpha: does complex query-answering and solves mathematical problems

## **but**

- Hand-curated database – *not* the Semantic Web
- Hugely labour-intensive to develop and cannot take advantage of new knowledge



# What can the Semantic Web actually do?

## Query answering

### Other systems:

- There has been considerable progress
- Current state-of-the-art is extremely useful

## **But**

- The general case is **hard!**



# What can the Semantic Web actually do?

## Automated use of data

- Works well in constrained circumstances:
  - For example: Google maps can automatically combine information about maps, speed limits, current road usage, etc. to get estimates of journey time
- Very hard in unconstrained circumstances:
  - Classic SW example of an automated travel agent is still far from achievable



# What are the requirements of the Semantic Web?

- **Large** numbers of users to make their data:
  - available
  - in an appropriate machine-readable format

*This is happening now: open government data (esp. in the UK and the US) and many other organisations and individuals*

- Good query-answering systems
- The ability to automatically interpret and use data



# This course



# This course is

- About:
  - The Semantic Web foundations, trends and future
  - Fundamental concepts
  - Principles
  - Tools and technologies
- Both theoretical understanding and practical experience
  - Lectures + Guest lectures
  - Practical lab
  - Exercises





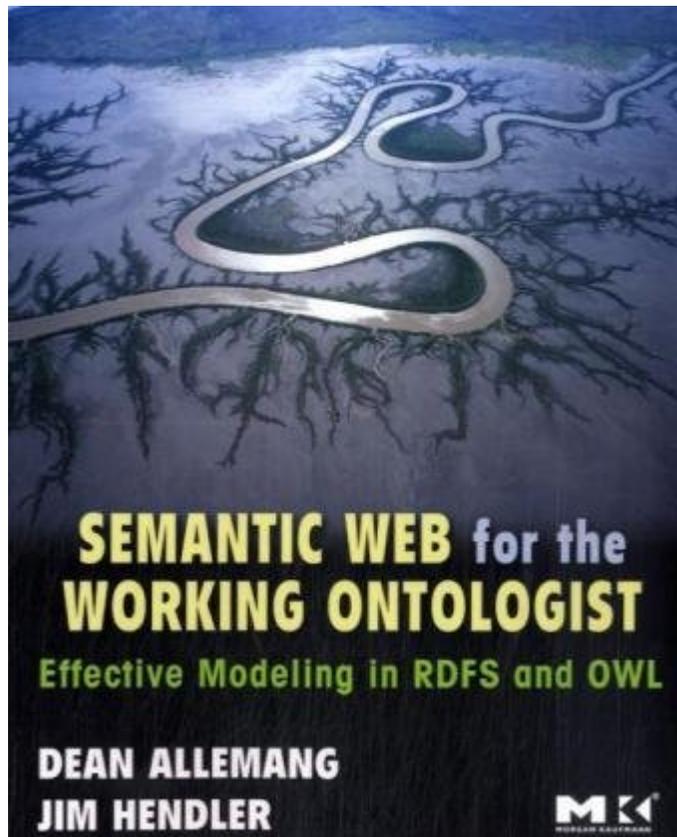
# This course

will cover:

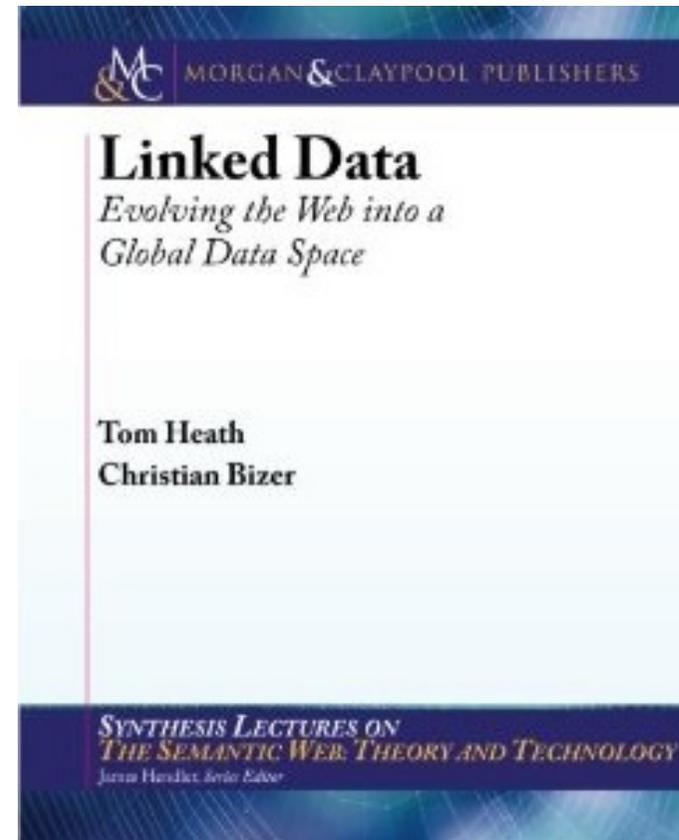
- Fundamentals of knowledge representation:
  - Ontologies and databases
  - Formats: RDF, RDFS, DL and OWL
- Data querying
- Linked Open Data (LOD)
- Services
- The aims and goals of the Semantic Web, and their plausibility



# Textbooks



SWWO





# Coursework

What	Weight	Submission Deadline
Assignment 1	50%	Monday 29 <sup>th</sup> February, 4pm
Assignment 2	50%	Friday 25 <sup>th</sup> March, 4pm

- Each counts towards 30% of your final grade.
- Start work on this as early as possible: it will help your understanding of the course, as well as improve your work.
- Deadlines are non-negotiable.
- TA: Paolo Pareti    Marker: Can Cui

## Finding out more

- Recommended reading can be found on the course website:

<http://www.inf.ed.ac.uk/teaching/courses/sws>

- Useful pointers on the (old but useful) MASWS wiki.
- There is a lot of relevant literature online – try to explore it.
- Also a lot of informal discussion on Twitter, blogs, YouTube, etc.





## Reading

- Chapter 1 in SWWO.
- *The Semantic Web* by Tim Berners-Lee, James Hendler and Ora Lassila. Scientific American, May 2001.