http://training.theodi.org/UnlockingData

David Tarrant · @davetaz

Open Data Science

Day 1: Discovering Data Science

Day 2: Statistics and Machine Learning

Day 3: Big data and interactive infograhics

Introductions

Your name

What interests you most about data science?

What do you want to do differently after the course?

Course aim

Equip you with the knowledge and tools to help you upskill as modern data scientists.

Session 1

Discovering Data Science

Session 2

Gathering and preparing data

Session 3

Publishing insight

Session 1

Discovering Open Data Science

Outcomes

Define open data science

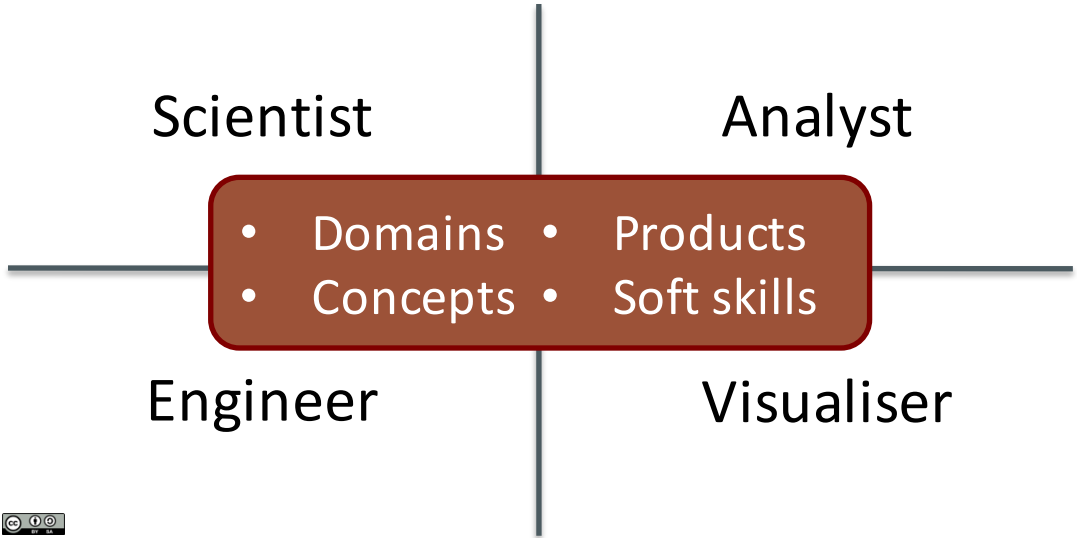
Describe a number of key data science stories

Identify the characteristics in open data science projects

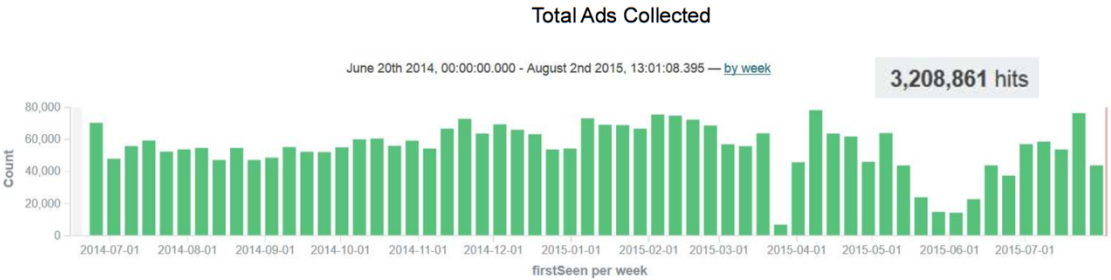
Prof. Dr. Frank Bensberg

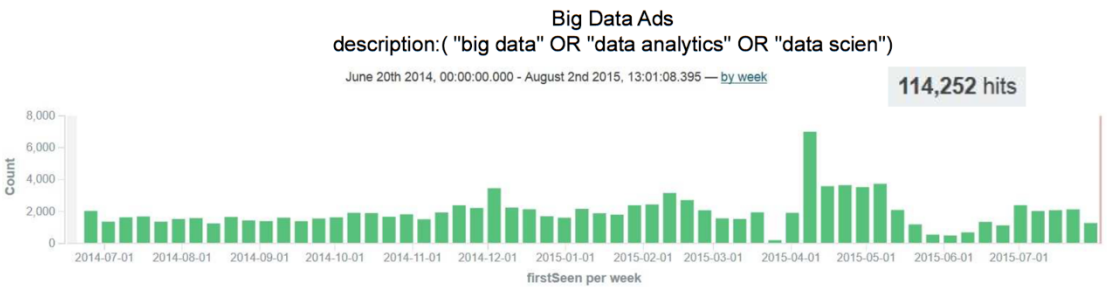
Osnabrück University of Applied Science
Faculty of Business Management & Social Sciences
Caprivistrasse 30a
D-49076 Osnabrück
F.Bensberg@hs-osnabrueck.de

List the 4 aspects of



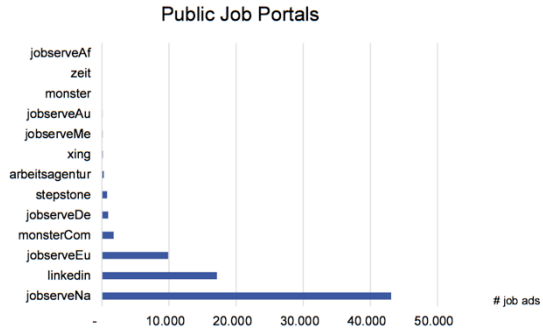
Database

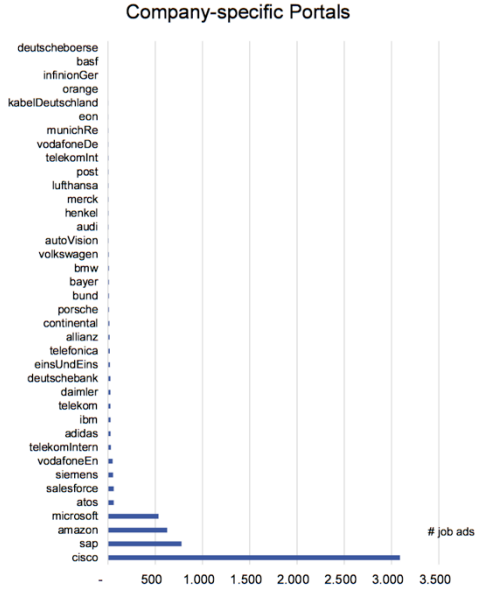

Total Ads Collected
June 20th 2014, 00:00:00.000 - August 2nd 2015, 13:01:08.395 — by week
3,208,861 hits
Count
80,000
60,000
40,000
20,000
0
2014-07-01
2014-08-01
2014-09-01
2014-10-01
2014-11-01
2014-12-01
2015-01-01
2015-02-01
2015-03-01
2015-04-01
2015-05-01
2015-06-01
2015-07-01
firstSeen per week


Big Data Ads
description:("big data" OR "data analytics" OR "data scien")
June 20th 2014, 00:00:00.000 - August 2nd 2015, 13:01:08.395 — by week
114,252 hits
Count
8,000
6,000
4,000
2,000
0
2014-07-01
2014-08-01
2014-09-01
2014-10-01
2014-11-01
2014-12-01
2015-01-01
2015-02-01
2015-03-01
2015-04-01
2015-05-01
2015-06-01
2015-07-01
firstSeen per week

Data Set

- Basic data pool comprises about 3m of job ads for the ICT sector collected since June 2014
- Job ads are periodically collected from public job portals (jobserve, monster, …) and from company-specific portals (Cisco, SAP, …)
- Selection of job ads which contain at least one of the keywords *big data*, *data science, data scientist*, *smart data* or *fast data* (n=80.014)





Data Scientist

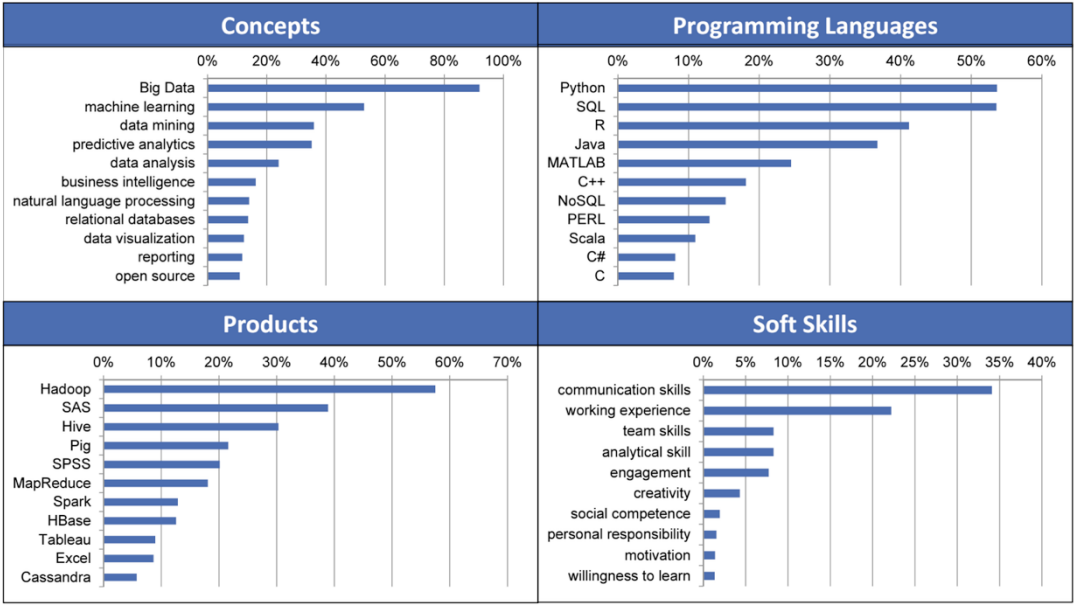
Data Set

# Job Ads	1.942	**Sample Job Titles**
Organizations (Top 10)	Liberty Personnel Services; Opus Recruitment Solutions Ltd; BigR.io; Career Brokers; Next Ventures Ltd; ITBM Consulting Inc;A3Logics US;Engage3;All In Analytics;Alivia technology	Data Scientist Big Data Scientist Senior Data Scientist Principal Data Scientist (R, Matlab, […], Spark) Senior Data Scientist (Python, Matlab, R, SQL)

Professional Activities

Position	Freq	Object	Activities
1	39%	analytics	work, develop, use, include, provide, require, deliver, create, apply
2	39%	model	work, develop, provide, include, unite, use, deliver, look, analyze, create
3	37%	analysis	work, develop, use, provide, deliver, look, create, design, apply
4	35%	statistic	work, develop, use, provide, require, deliver, analyze, apply, solve
5	27%	algorithm	work, develop, use, provide, solve, apply, require, deliver, build
6	27%	machine learning	work, develop, use, apply, solve, build, design, deliver
7	24%	data set	work, develop, use, include, analyze,provide, require, design, deliver, create
8	11%	decision tree	develop, work, design, create, join, require, provide, utilize, deliver, grow
9	10%	data source	work, use, develop, require, provide, apply, help, prefer, understand
10	4%	data analysis	work, use, develop, provide, require, bring, build, drive, apply

Data Scientist



Data Analyst

Data Set

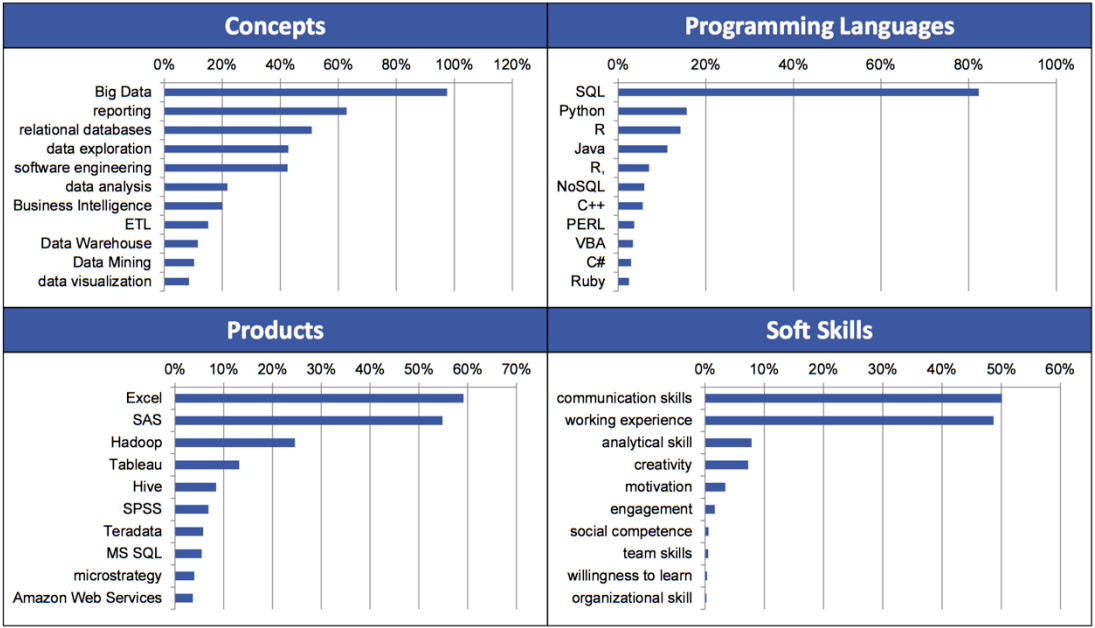
# Job Ads	1.690	**Sample Job Titles**
Organizations (Top 10)	MedeAnalytics, Liberty Personnel Services, FILD, TalentRISE, R Square, Libertyjobs.com, LS Direct Marketing, The Judge Group, UnitedHealth Group Cognius	Business Data Analyst - Health Plan Solutions Data Analyst Senior Data Analyst Big Data Analyst Data Analyst (BIG DATA - Finance Analytics)

Professional Activities

Position	Freq	Object	Activities
1	59%	analytics	work, develop, use, provide, require, support, deliver, solve, look, make, apply
2	55%	model	use, work, provide, develop, analyze, support, make, deliver, apply, require
3	53%	statistic	work, use, provide, develop, require, look, deliver, solve, analyze, make
4	48%	decision	make, analyze, develop, deliver, apply, require, solve, leverage, gather
5	46%	dataset	work, provide, develop, use, deliver, support, amke, apply, require, look, solve
6	44%	workflow	use, provide, analyze, develop, deliver, make, apply, gather, look, leverage
7	43%	risk	analyze, identify, reduce, look, plan, improve, change, demonstrate
8	42%	data exploration	use, develop, help, apply, provide, solve, offer, demonstrate, support, make

Annotation: data set shows a strong sectoral bias (Healthcare).

Data Analyst



Data Engineer

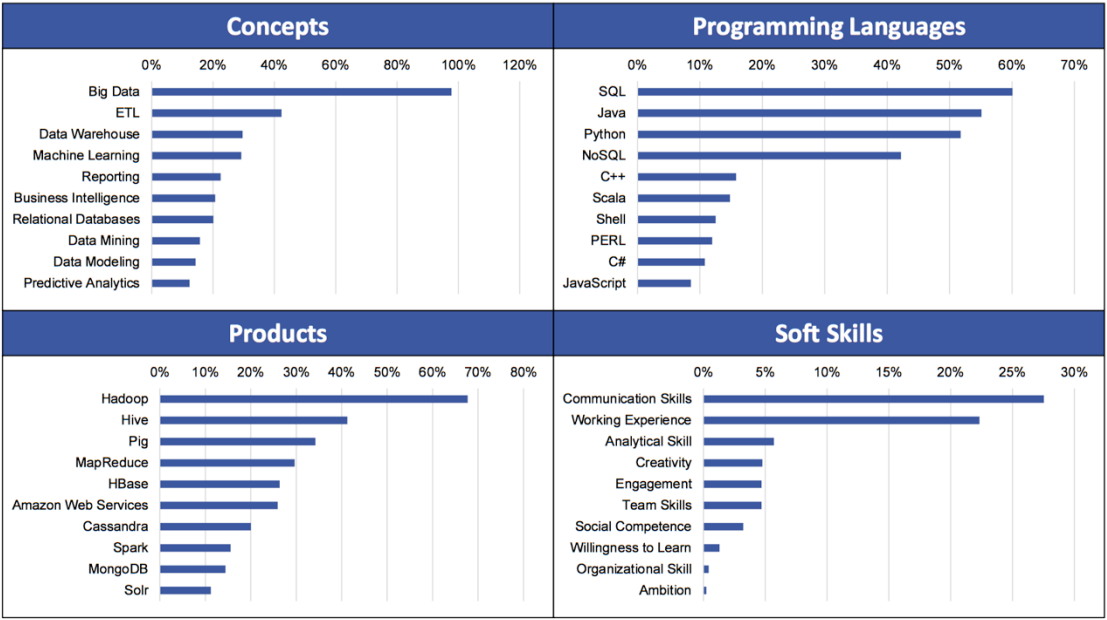
Data Set

# Job Ads	1.613*	**Sample Job Titles**
Organizations (Top 10)	FILD, Prosum, Liberty Personnel Services, Praedicat, Libertyjobs, Emprise Technologies, Amazon, Teradata, ColdLight, ARC IT Recruitment	Big Data Engineer Data Engineer Senior Data Engineer Senior Big Data Engineer Director of Data Engineering

Professional Activities

Position	Freq	Object	Activities
1	29%	Analytics	work, develop, include, use, design, build, provide, implement, grow
2	28%	ETL	work, develop, design, unite, provide, include, build, implement, create
3	21%	Machine Learning	work, unite, use, develop, design, build, include, grow, create, implement, provide
4	20%	Algorithm	work, use, develop, build, unite, include, create, grow, design, analyze, implement
5	16%	Data Set	work, use, develop, design, unite, include, build, process, create, grow, make, implement, analyse, provide
6	15%	Large Data	work, use, develop, unite, process, create, design, grow, build
7	13%	Unstructured Data	work, develop, include, design, use, unite, build, create, analyze, provide
8	11%	Data Platform	develop, design, work, unite, support, analyze, build, implement, grow, provide
9	11%	Predictive Analytics	work, build, develop, create, use, unite, grow

Data Engineer



Visualization Engineer

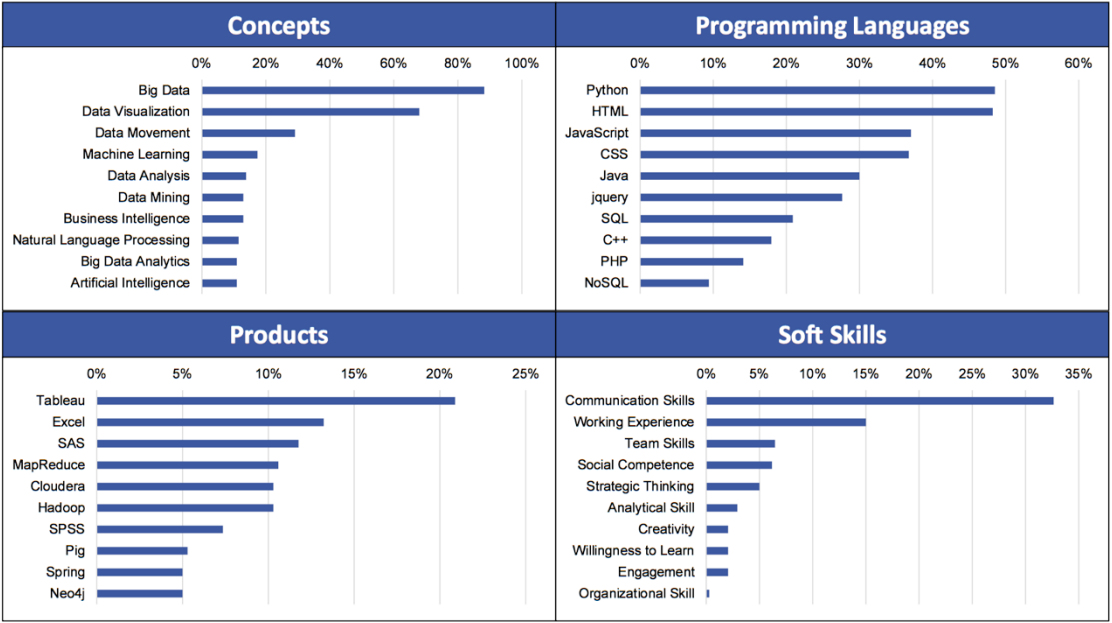
Data Set

# Job Ads	340	**Sample Job Titles**
Organizations (Top 10)	BigR.io, Infinite Resources, MGRS Group, FILD, Analyze Corporation, Opus Recruitment, TASC, Splunk, N-Tier Solutions, Globys, AT&T	Data Visualization Engineer Software Engineer - Data Visualization/Graphic Design Java Visualization Software Eng. JavaScript Engineer - Python - Data Visualization - Big Data Challenge Visual & UI Designer - Adobe Creative, HTML, CSS

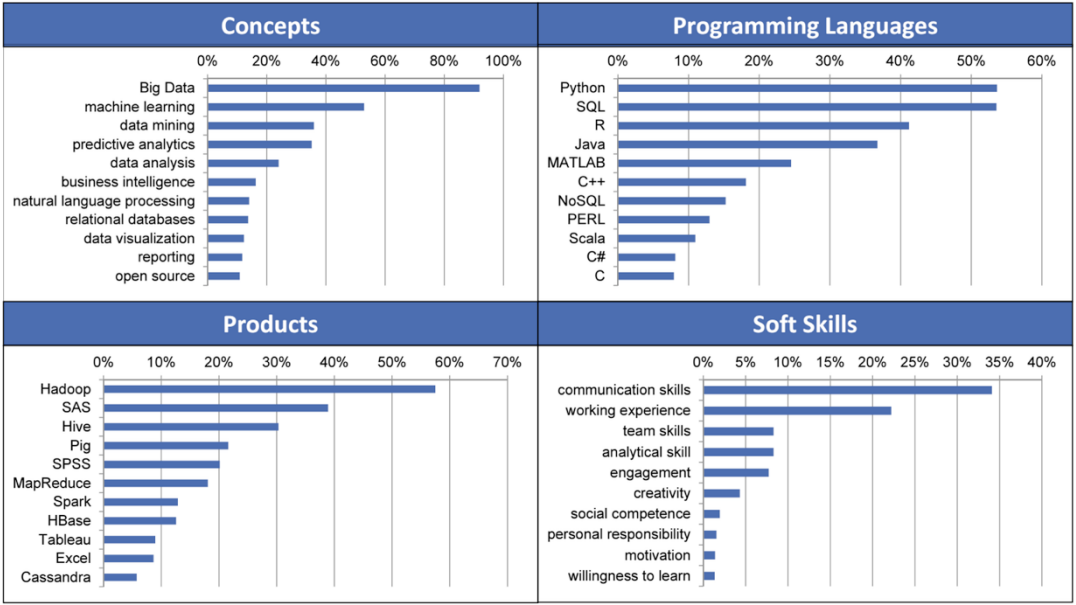
Professional Activities

Position	Freq	Object	Activities
1	44%	analytics	work, use, help, unite, develop, deliver, provide, focus, bring
2	42%	data visualization	work, use, develop, build, deliver, provide
3	31%	interface	provide, deliver, focus, use, bring, poise
4	26%	data model	use, deliver, unite, look, help, work, provide
5	22%	complex data	work, unite, deliver, provide, use
6	22%	chart	use, deliver, provide, build, bring, focus
7	21%	performance data	pinpoint, assure, dig, detail
8	15%	machine learning	develop, work, use
9	14%	interaction	work, develop, design, provide
10	9%	artificial intelligence	program, develop, design, conceptualize, implement

Visualization Engineer



Data Scientist

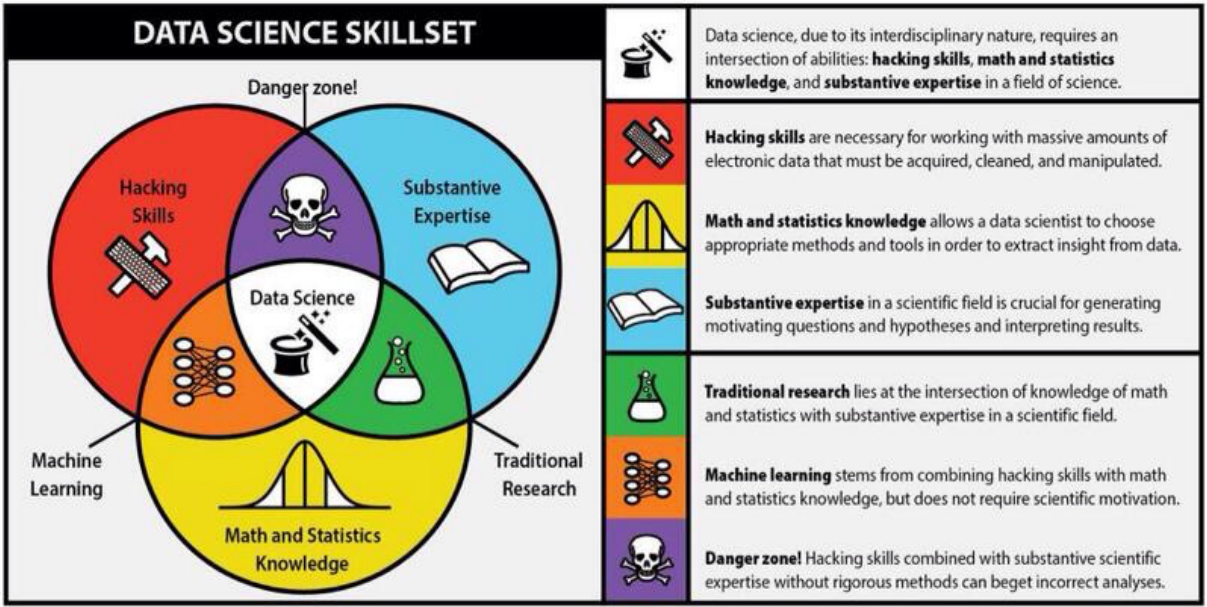


Key areas

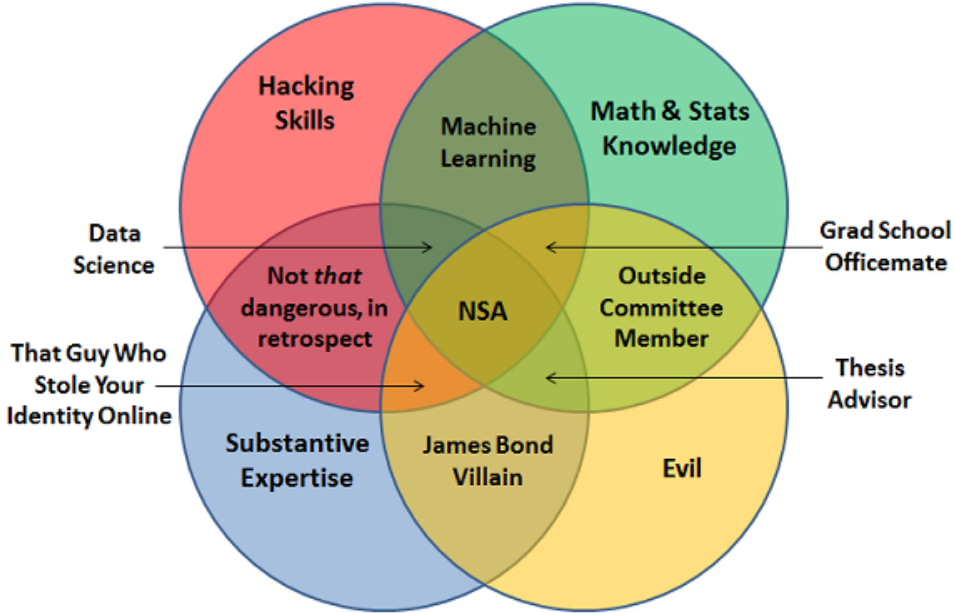
1) Big Data
2) Machine Learning and Prediction
3) Data Collection and Analysis
4) Maths and Statistics
5) Interpretation and Visualisation
6) Advanced Computing and Programming
7) *Business Intelligence and Domain Expertise*
8) Open Source Tools and Concepts

Key areas

1) Big Data
2) Machine Learning and Prediction
3) **Data Collection and Analysis**
4) Maths and Statistics
5) **Interpretation and Visualisation**
6) **Advanced Computing and Programming**
7) *Business Intelligence and Domain Expertise*
8) Open Source Tools and Concepts



Courtesy of Natalia Bilenko, modified from Drew Conway (the Data Science Venn Diagram)


Hacking Skills
Machine Learning
Math & Stats Knowledge
Data Science
Grad School Officemate
Not *that* dangerous, in retrospect
NSA
Outside Committee Member
That Guy Who Stole Your Identity Online
Thesis Advisor
Substantive Expertise
James Bond Villain
Evil

Data Science

“part analyst, part artist”

-- Anjul Bhambhri (VP for Big Data, IBM)

Outcomes

Define open data science

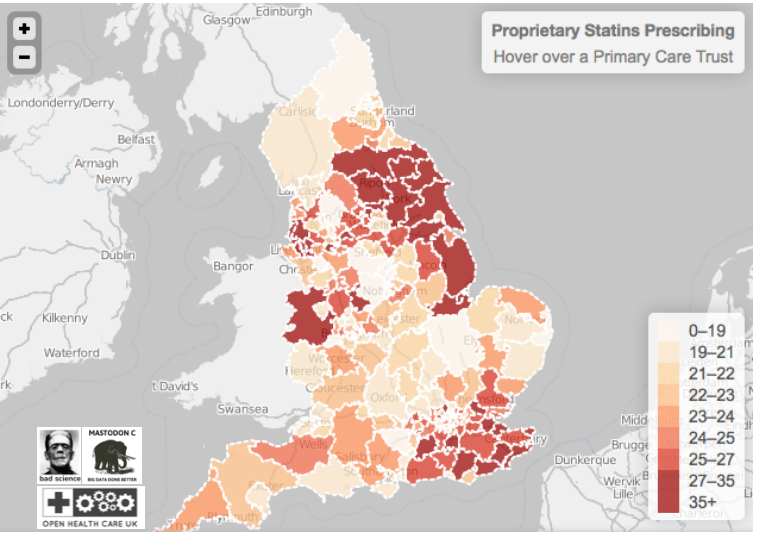
Describe a number of key data science stories

Identify the processes in open data science projects

Stories that combine areas?

1) Big Data
2) Machine Learning and Prediction
3) Data Collection and Analysis
4) Maths and Statistics
5) Interpretation and Visualisation
6) Advanced Computing and Programming
7) Business Intelligence and Domain Expertise
8) Open Source Tools and Concepts

£200m potential saving identified in 6 weeks



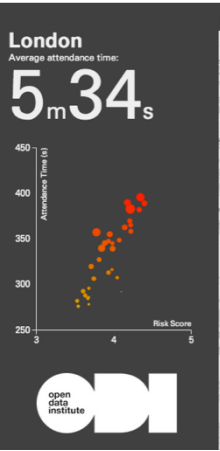
Convened domain-experts
+ health & data analytics
+ communications

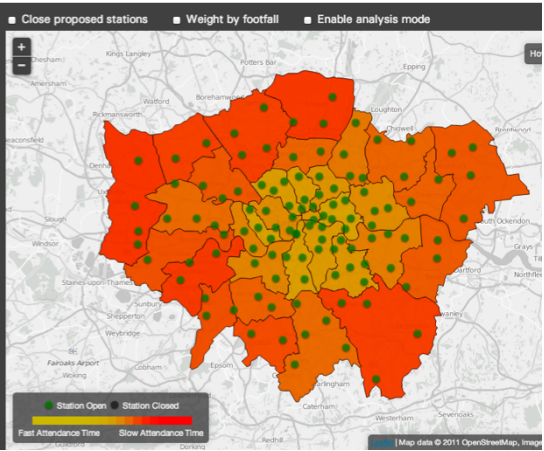
Analysed 35m records
+ all the data & clinical facts

National & international reach
+ Economist & FT
+ broadsheets & tabloid press
+ cited in G8 & govt. reports

Scalable to £1bn pa

Tools that aid policy makers and are open to the public



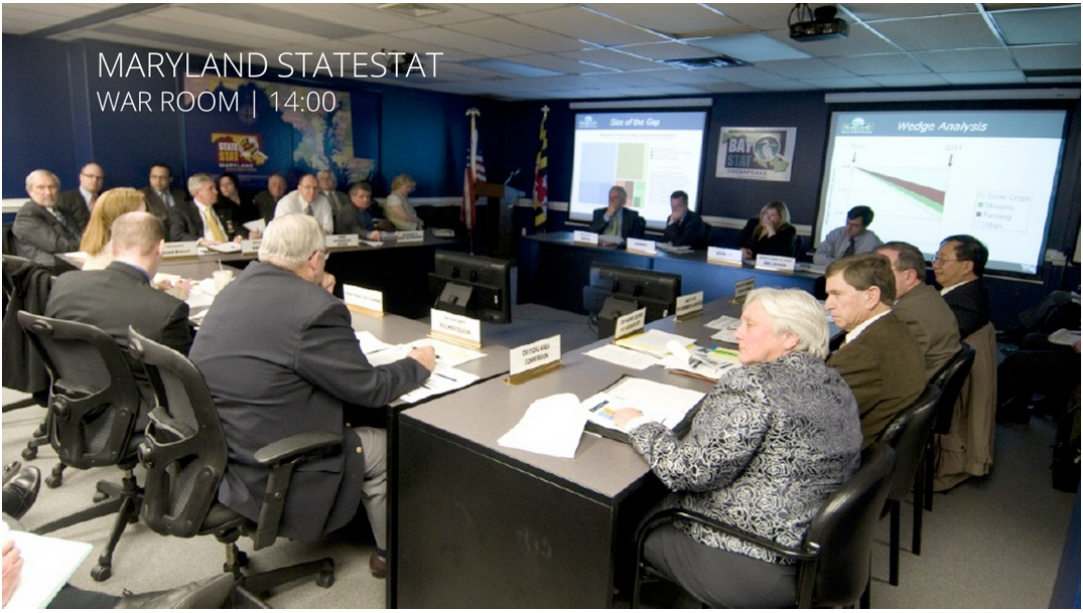


Convened domain experts
+ Fire service
+ Smart-steps intelligence (Telefonica)
+ Data analytics (ODI)

Real-time big data processing
+ 509,000 incidents over (4y+)
+ 120,000 network stations
+ 600,000,000 location records

1 expert analysis tool
+ Making cities smarter
+ View impact on people, the borough, and whole city

http://theodi.org/stories


MARYLAND STATESTAT
WAR ROOM | 14:00
Size of the Gap
Wedge Analysis
BAY STAT

Outcomes

Define open data science

Describe a number of key data science stories

Identify the processes in open data science projects

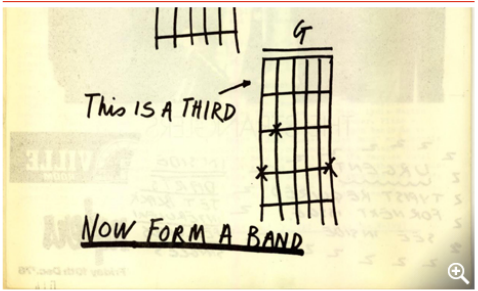
DATABLOG
Facts are sacred

Previous | Blog home | Next

Anyone can do it. Data journalism is the new punk

Can anyone be a data journalist? **Simon Rogers** on what we can learn from a 1977 diagram

• Another view: What data can and cannot do by Jonathan Gray



Page two of Sideburns, January 1977

> This is a chord… this is another… this is a third. NOW FORM A BAND

Posted by
Simon Rogers
Thursday 24 May 2012
13.00 BST
theguardian.com
Jump to comments (8)

Article history

Media
Data journalism · Open journalism

Technology

http://www.theguardian.com/news/datablog/2012/may/24/data-journalism-punk

The 80/20 of data

In **any data project** you will spend 80% of your time preparing, analysing, cleaning, enriching etc… and 20% of the time actually producing the output.

Guardian data blog takes a 70/30 view, but the point remains:
http://www.theguardian.com/news/datablog/2011/apr/07/data-journalism-workflow

Data percolation: The stages of data analysis

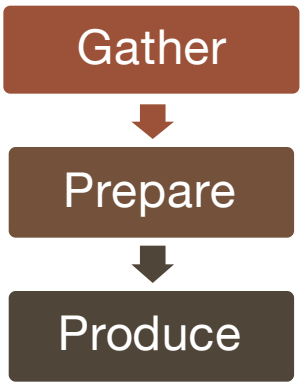
Gather

Prepare

Produce

See also: the Data Journalism Handbook

How should I budget my time?



1.1 **FIND** reliable data sources

1.2 Understand your **RIGHTS**

1.3 Visualise and **UNDERSTAND** your data

2.1 **CLEAN** your data

2.2 **TRANSFORM** it where useful

2.3 **COMBINE** it with other data sets

3.1 **REDUCE** and find the story

3.2 Think and understand the **CONTEXT**

3.3 Do your results pass a **SENSE-CHECK**?

Session 1

Discovering Data Science

Session 2

Gathering and preparing data

Session 3

Publishing insight

Session 2

Gathering and preparing data

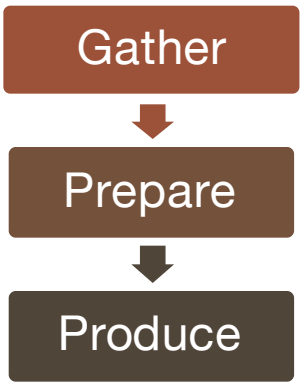
Outcomes

Analyse websites to identify sources of data

Use a number of tools to obtain data from the web

Clean a dataset ready for use

How should I budget my time?



1.1 **FIND** reliable data sources

1.2 Understand your **RIGHTS**

1.3 Visualise and **UNDERSTAND** your data

2.1 **CLEAN** your data

2.2 **TRANSFORM** it where useful

2.3 **COMBINE** it with other data sets

3.1 **REDUCE** and find the story

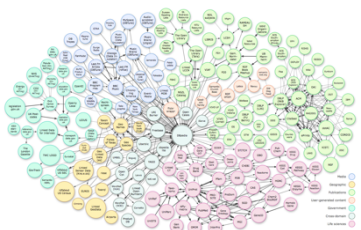
3.2 Think and understand the **CONTEXT**

3.3 Do your results pass a **SENSE-CHECK**?

Approaches to publishing data

ON the web

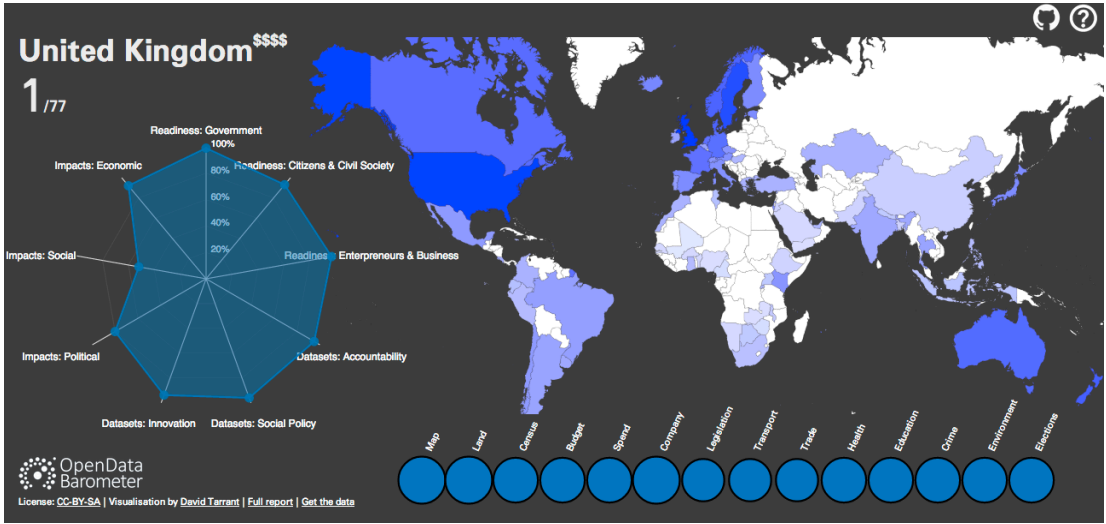
IN the web



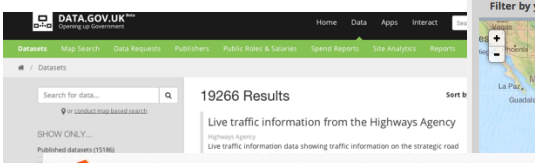
Finding data on the web **(of documents)**

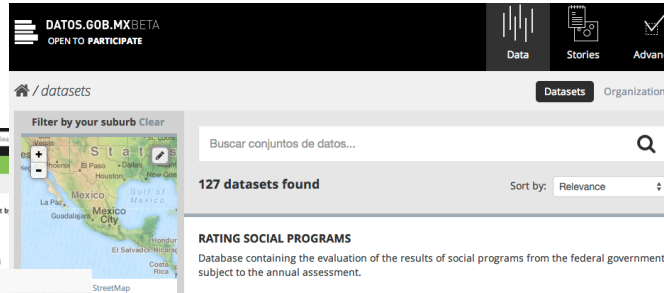
- Government data
- Private sector data
- Google advanced
- Aggregators and portals
- Scraping

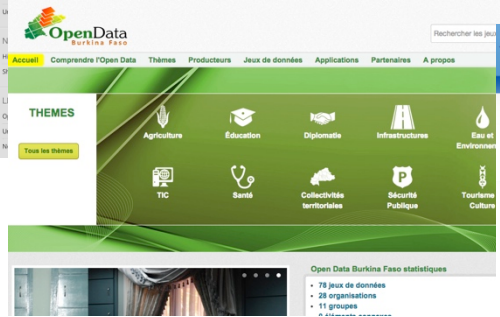
Government data

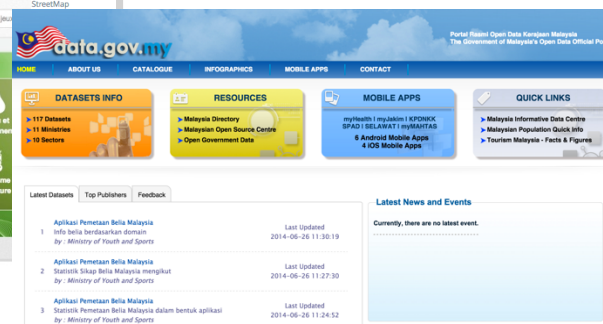


data.gov.XX

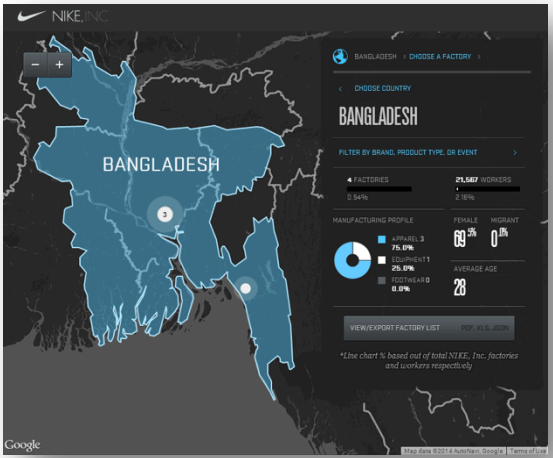

DATA.GOV.UK
Home
Data
Apps
Interact
Datasets
Map Search
Data Requests
Publishers
Public Roles & Salaries
Spend Reports
Site Analytics
Reports
Search for data...
19266 Results
Live traffic information from the Highways Agency
SHOW ONLY...
Published datasets (15186)


DATOS.GOB.MXBETA
OPEN TO PARTICIPATE
Data
Stories
Advances
/ datasets
Datasets
Organizations
Filter by your suburb Clear
Buscar conjuntos de datos...
127 datasets found
Sort by: Relevance
RATING SOCIAL PROGRAMS
Database containing the evaluation of the results of social programs from the federal government subject to the annual assessment.
StreetMap


OpenData
Burkina Faso
Accueil
Comprendre l'Open Data
Thèmes
Producteurs
Jeux de données
Applications
Partenaires
A propos
THEMES
Tous les thèmes
Agriculture
Éducation
Diplomatie
Infrastructures
TIC
Santé
Collectivités territoriales
Sécurité Publique
Open Data Burkina Faso statistiques
78 jeux de données
28 organisations
11 groupes


data.gov.my
Portal Rasmi Open Data Kerajaan Malaysia
The Government of Malaysia's Open Data Official Portal
HOME
ABOUT US
CATALOGUE
INFOGRAPHICS
MOBILE APPS
CONTACT
DATASETS INFO
117 Datasets
11 Ministries
10 Sectors
RESOURCES
Malaysia Directory
Malaysian Open Source Centre
Open Government Data
MOBILE APPS
myHealth I myJakim I KPDNKK
SPAD I SELAWAT I myMAHTAS
6 Android Mobile Apps
4 iOS Mobile Apps
QUICK LINKS
Malaysia Informative Data Centre
Malaysian Population Quick Info
Tourism Malaysia - Facts & Figures
Latest Datasets
Top Publishers
Feedback
Aplikasi Pemetaan Belia Malaysia
Info belia berdasarkan domain
by : Ministry of Youth and Sports
Last Updated
2014-06-26 11:30:19
Aplikasi Pemetaan Belia Malaysia
Statistik Sikap Belia Malaysia mengikut
by : Ministry of Youth and Sports
Last Updated
2014-06-26 11:27:30
Aplikasi Pemetaan Belia Malaysia
Statistik Pemetaan Belia Malaysia dalam bentuk aplikasi
by : Ministry of Youth and Sports
Last Updated
2014-06-26 11:24:52
Latest News and Events
Currently, there are no latest event.

Suppliers



OPEN DATA

http://manufacturingmap.nikeinc.com/#

Google advanced

site: Get results only from certain sites or domains

link: Find pages that link to a certain page

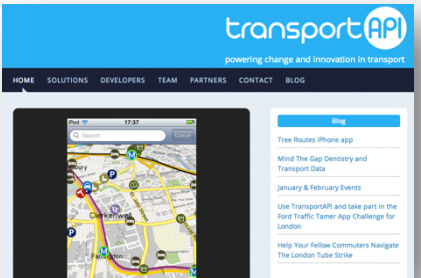
related: Find sites similar to one you already know

filetype: Find certain file types only

Aggregators and portals

Collect together data from across the web into one place.

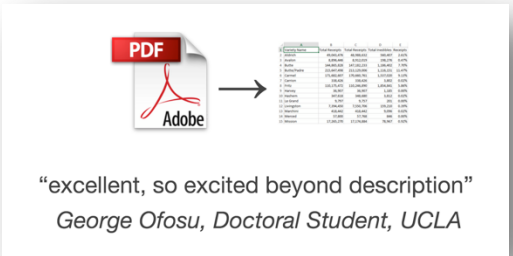
enigma.io



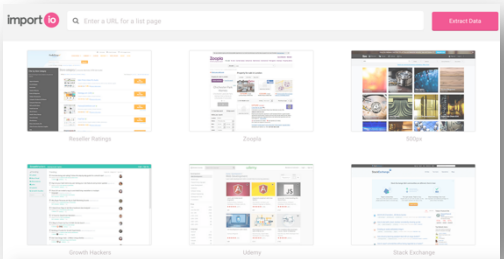
transportAPI

Scraping

If you can't obtain usable data (csv, xls) then you may have to resort to scraping.



pdftables.com



magic.import.io

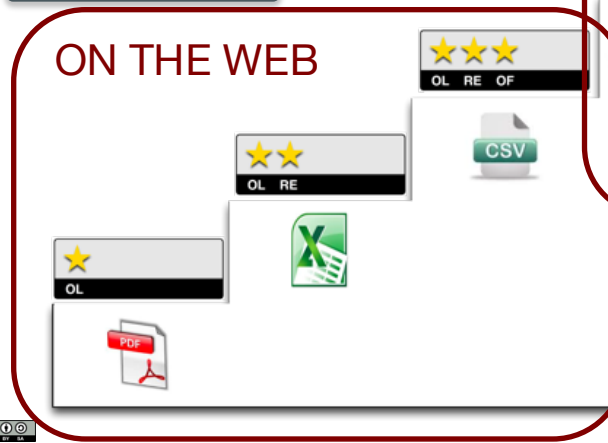
Exercise

Explore some of the tools and methods to discover new data on the **web of documents** relevant to you.

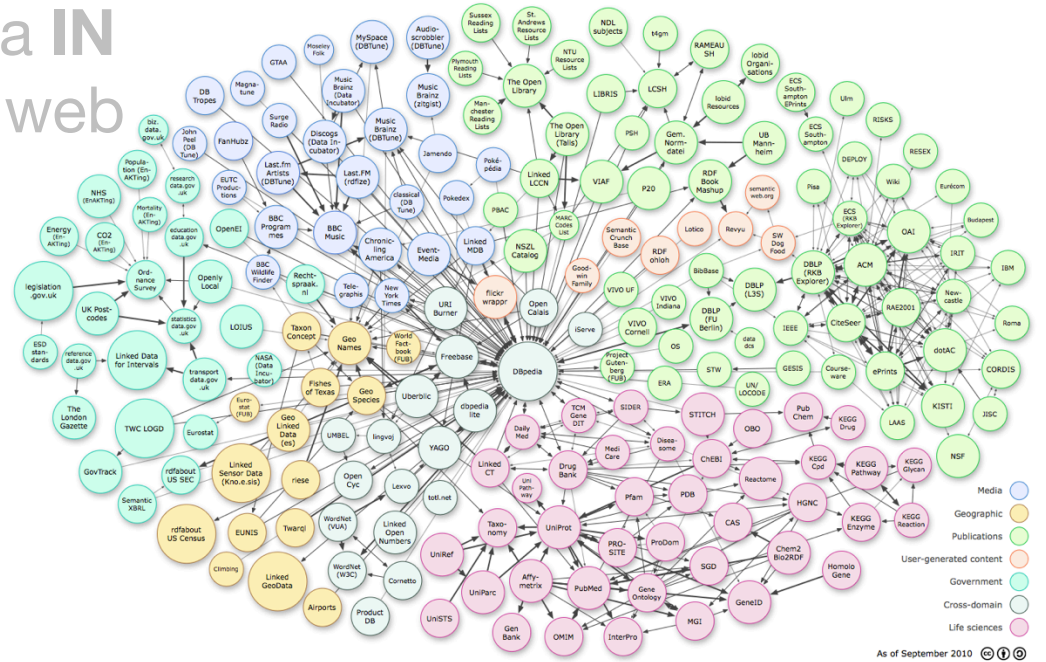
10 mins

5-Stars

http://5stardata.info/



Data **IN** the web



Finding data on the web (of data)

1. Add random extensions (.xml, .json, .csv etc)
2. Look for alternative links (rss feeds etc)
3. Look for embedded data IN THE WEB
4. Do some content negotiation
5. Spot the API
6. Scrape (or search google again)

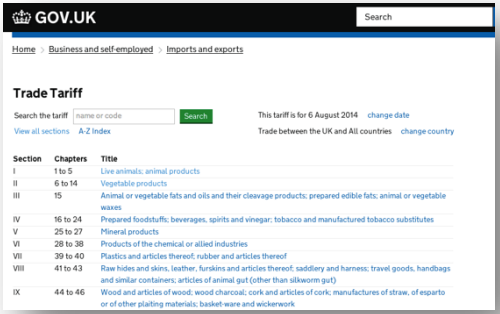
How the web should work, but people forgot that Tim put this in when he invented it!

Duck typed data

If it looks like a duck
and quacks like a duck,
then it's probably a duck.

Basically, keep an eye out for tables,
lists and other stuff that looks like data.

1. Adding random extensions

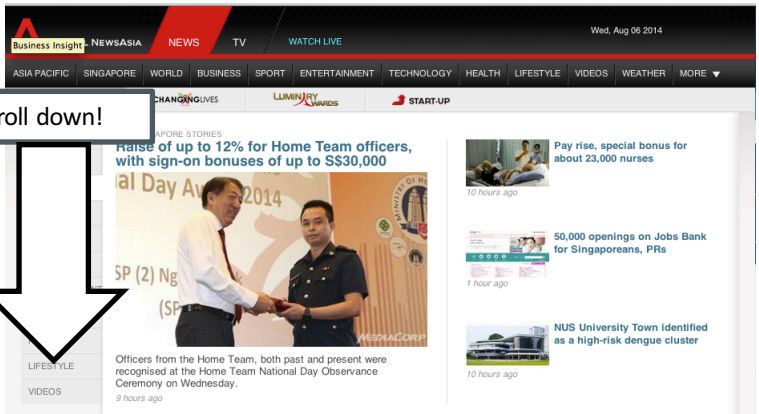


UK Trade Tariff

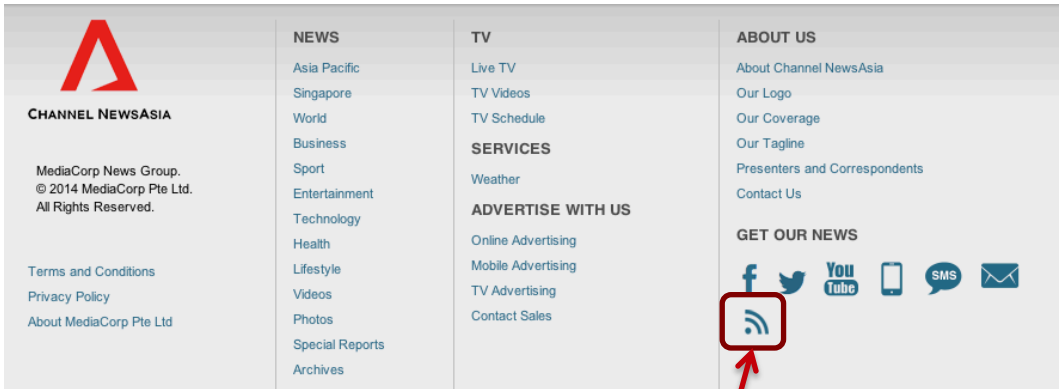
BBC Music and Programmes

Try using the following: .csv .json .xml .rss .rdf

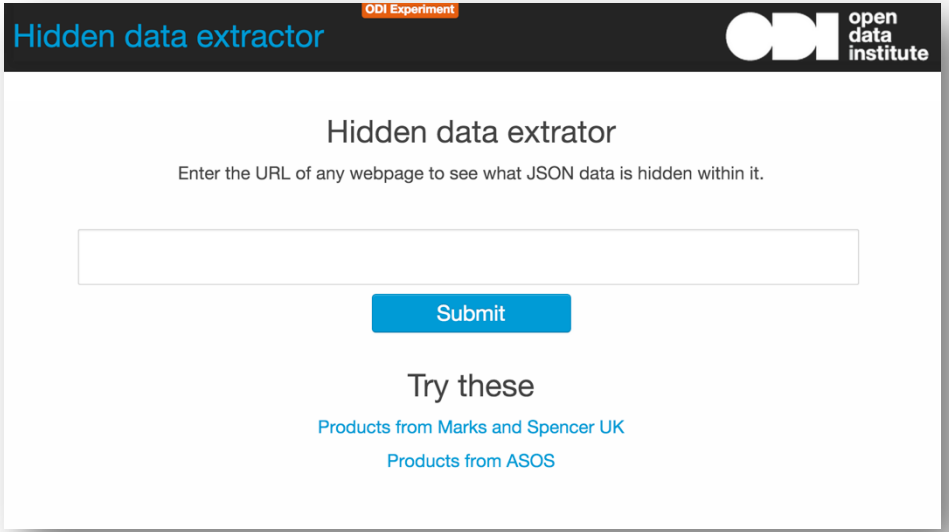
2. Look for alternative links



2. Look for alternative links



3. Look for embedded data



Finding data on the web **(of data)**

1. Add random extensions (.xml, .json, .csv etc)
2. Look for alternative links (rss feeds etc)
3. Look for embedded data
4. Do some content negotiation
5. **Spot the API**
6. Scrape (or search google again)

Exercise

What is an API?

Any examples?

What is an API

Defines how one application can **consistently** interact with another.

Teaching nerds passion

```
function makeOut(passionLevel, partsOfBody) {
 for (each partOfBody in partsOfBody) {
   partOfBody.kiss(passionLevel);
   lookIntoEyes();
   sighDeeply();
 }
 moanDaintily();
 sleep();
}
```


Thanks to Pamela Fox (blog.pamelafox.org)

Making your call

```
function makeOut(passionLevel, partsOfBody) {
 for (each partOfBody in partsOfBody) {
   partOfBody.kiss(passionLevel);
   lookIntoEyes();
   s
 }
 moanDaintily();
 sleep();
}
```

```
makeOut(10, ["neck", "ear", "mouth"]);
```


Thanks to Pamela Fox (blog.pamelafox.org)

The Webs API

```
class Photos {
    function search(api_key, tags) {
        if (!validKey(api_key)) {return(401);}
        ...
        ...
        return results;
    }
}
```

Using the Webs API

http://api.flickr.com/services/rest/**?**method=flickr.photos.search&api_key=a8c42ef2ac8d88aed7e351f95e93160f&tags=fox

http://api.flickr.com/services/rest/

?method=flickr.photos.search

&api_key=a8c42ef2ac8d88aed7e351f95e93160f

&tags=fox

A better solution?

```
https://www.flickr.com/photos/{user}/{photo}/comments
                                                /tags
                                                /licence

https://www.flickr.com/search?tags=…
```

http://docs.transportapi.com/

```
http://fcc.transportapi.com/{api_version}/
      /uk/train/station/{station_code}/live.json
      /uk/train/station/{station_code}/{date}/{time}/t
imetable.json
```

Exercise

Explore some of the tools and methods to discover new data on the **web of data** relevant to you.

15 mins

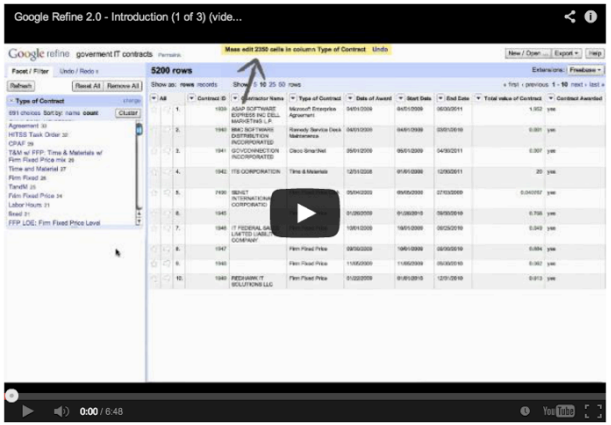
Outcomes

Analyse websites to identify sources of data

Use a number of tools to obtain data from the web

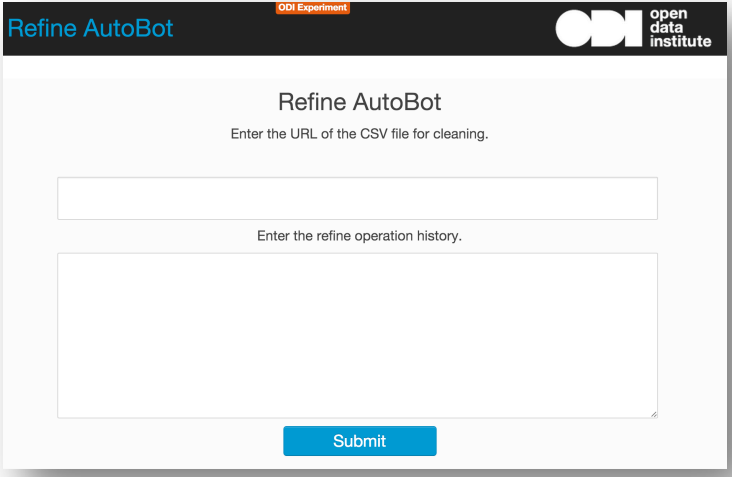
Clean a dataset ready for use

Introducing Open Refine



http://openrefine.org

Data processing pipelines



http://theodi.github.io/refine-autobot/

Session 1

Discovering Data Science

Session 2

Gathering and preparing data

Session 3

Publishing insight

Session 3

Publishing insight

Outcome

Build simple web pages that bring together a number of datasets to reveal new insight

World Wide Web

The WorldWideWeb (W3) is a wide-area hypermedia information retrieval initiative aiming to give universal access to a large universe of documents.

Everything there is online about W3 is linked directly or indirectly to this document, including an executive summary of the project, Mailing lists , Policy , November's W3 news , Frequently Asked Questions .

What's out there?
Pointers to the world's online information, subjects , W3 servers, etc.

Help
on the browser you are using

Software Products
A list of W3 project components and their current state. (e.g. Line Mode ,X11 Viola , NeXTStep , Servers , Tools , Mail robot , Library)

Technical
Details of protocols, formats, program internals etc

Bibliography
Paper documentation on W3 and references.

People
A list of some people involved in the project.

History
A summary of the history of the project.

How can I help ?
If you would like to support the web..

Getting code
Getting the code by anonymous FTP , etc.

Question

What is significant about the first web page?

What actually did Tim invent?

World Wide Web

The WorldWideWeb (W3) is a wide-area hypermedia information retrieval initiative aiming to give universal access to a large universe of documents.

Everything there is online about W3 is linked directly or indirectly to this document, including an executive summary of the project, Mailing lists , Policy , November's W3 news , Frequently Asked Questions .

What's out there?
Pointers to the world's online information, subjects , W3 servers, etc.

Help
on the browser you are using

Software Products
A list of W3 project components and their current state. (e.g. Line Mode ,X11 Viola , NeXTStep , Servers , Tools , Mail robot , Library)

Technical
Details of protocols, formats, program internals etc

Bibliography
Paper documentation on W3 and references.

People
A list of some people involved in the project.

History
A summary of the history of the project.

How can I help ?
If you would like to support the web..

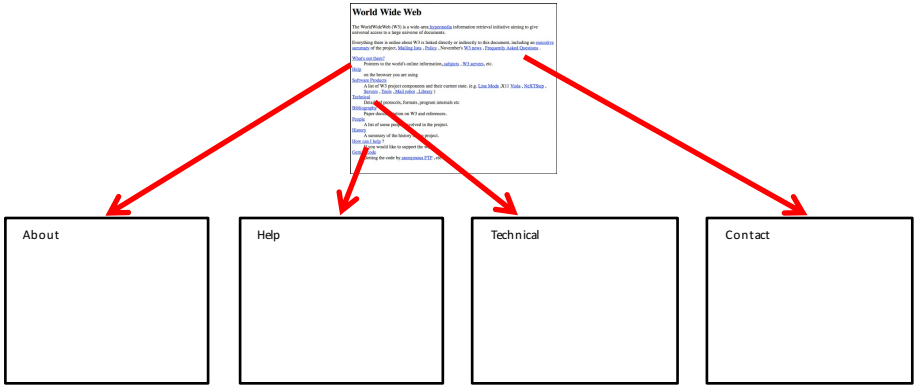
Getting code
Getting the code by anonymous FTP , etc.

Markup

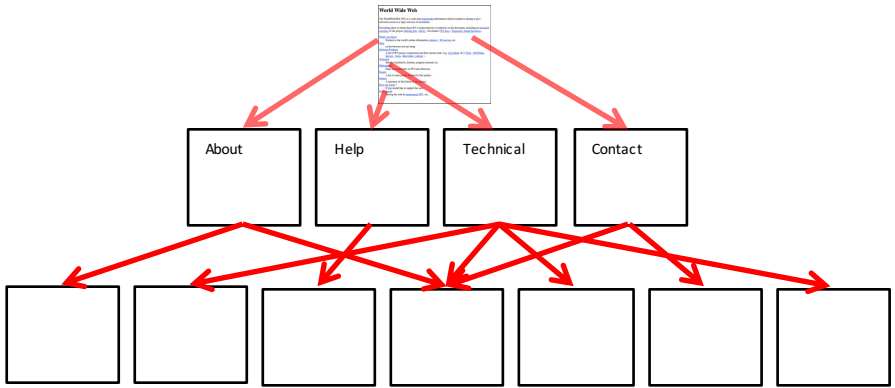
Links & Tags

Markup Links & Tags

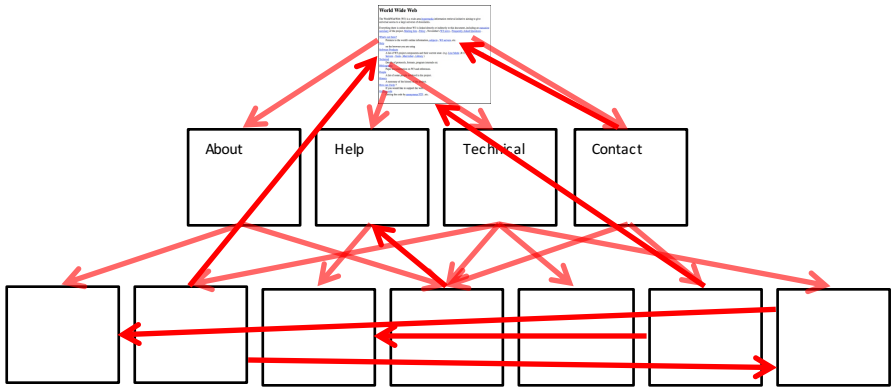
Nodes and Links



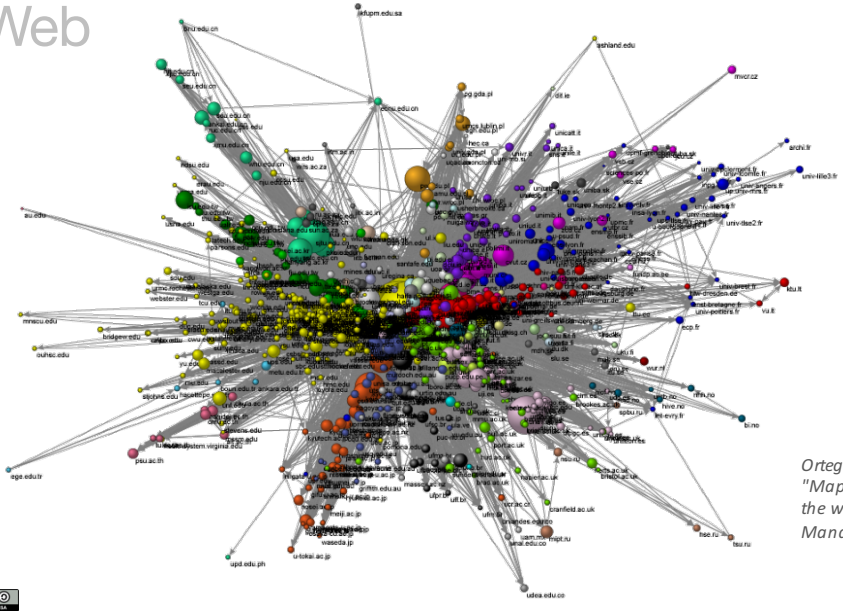
Nodes and Links



Nodes and Links



A Web



Ortega, Jose Luis, and Isidro F. Aguillo. "Mapping world-class universities on the web." Information Processing & Management 45.2 (2009): 272-279.

HyperText (Links) Markup Language

Here is some **really important** text!

Remember that in the morning we start at <time>9:30am</time>

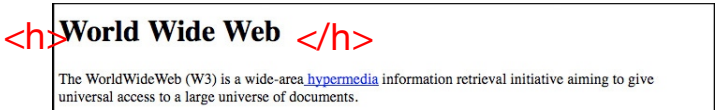
<blink>

This text is likely to annoy you.

</blink>

<marquee>

HTML



<h1>This is heading 1</h1>

<h2>This is heading 2</h2>

<h3>This is heading 3</h3>

<h4>This is heading 4</h4>

<h5>This is heading 5</h5>

<h6>This is heading 6</h6>

A Link

Link to BBC News

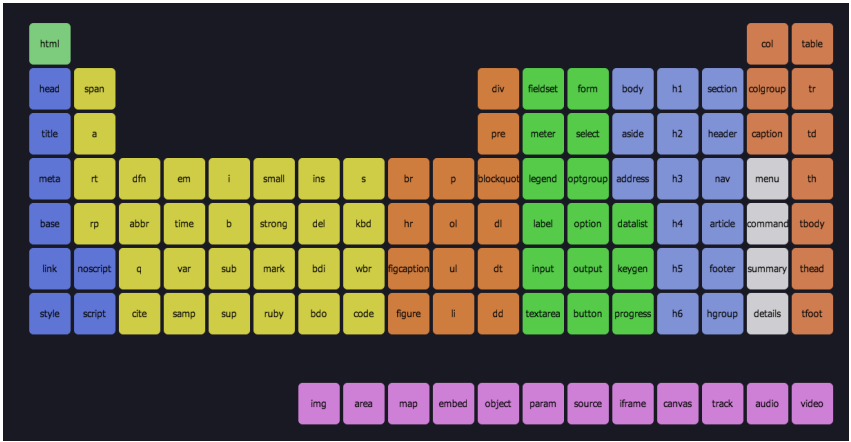
HTML 5

<menu>
<figure>
<nav>
<input>
<header>
<section>
<footer>

<summary>
<details>
<legend>
<label>
<title>
<option>
<a>

~~<blink>~~
~~<marquee>~~

HTML 5


html
col
table
head
span
div
fieldset
form
body
h1
section
colgroup
tr
title
a
pre
meter
select
aside
h2
header
caption
td
meta
rt
dfn
em
i
small
ins
s
br
p
blockquote
legend
optgroup
address
h3
nav
menu
th
base
rp
abbr
time
b
strong
del
kbd
hr
ol
dl
label
option
datalist
h4
article
command
tbody
link
noscript
q
var
sub
mark
bdi
wbr
figcaption
ul
dt
input
output
keygen
h5
footer
summary
thead
style
script
cite
samp
sup
ruby
bdo
code
figure
li
dd
textarea
button
progress
h6
hgroup
details
tfoot
img
area
map
embed
object
param
source
iframe
canvas
track
audio
video


HTML5

Why Markup?

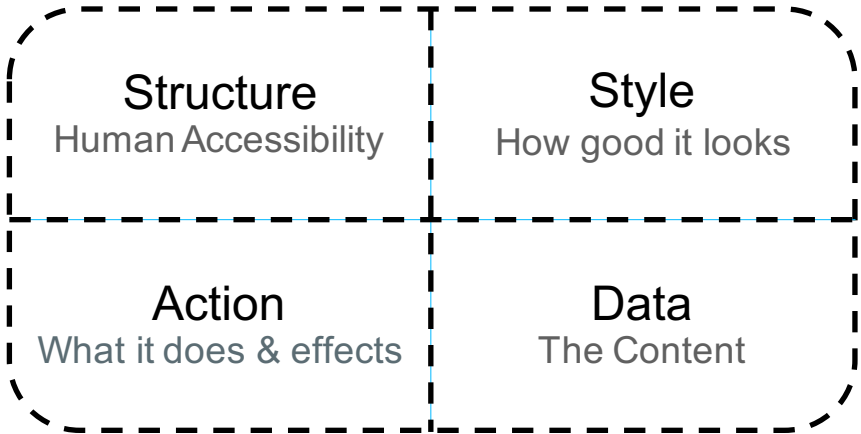
Aids your browser to render the page

Critical for screen readers!

Adds semantics about importance of elements.

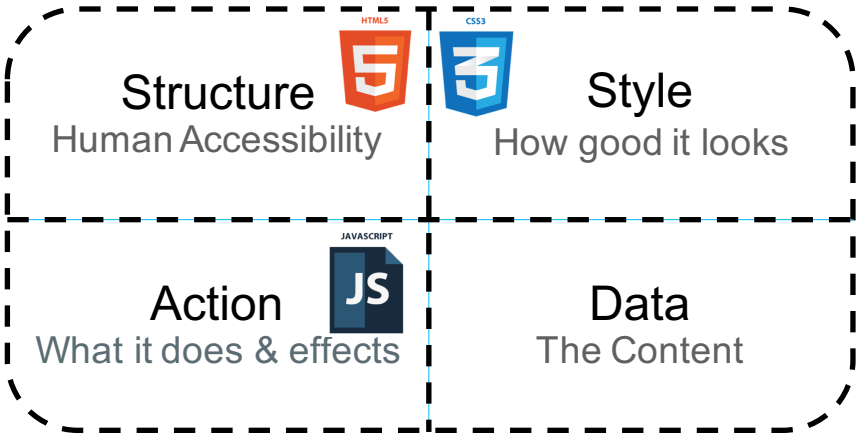
Aids search engines

Building Blocks

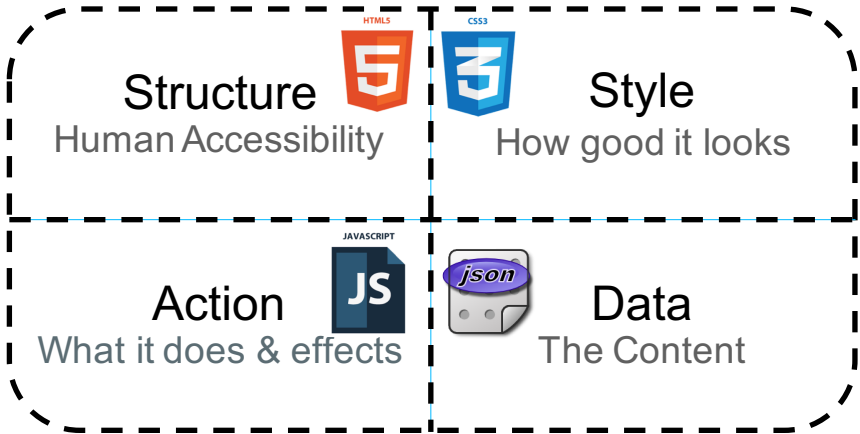


The Language of the Web

Building Blocks



JSON: A Natural Fit



Last exercise

Build a web page that shows the time and platform for your train home*.

http://training.theodi.org/UnlockingData/

* I've made a massive assumption that someone catches a train home.

Session 1

Discovering Data Science

Session 2

Gathering and preparing data

Session 3

Publishing insight

Outcomes

Define open data science

Describe a number of key data science stories

Identify the characteristics in open data science projects

Outcomes

Analyse websites to identify sources of data

Use a number of tools to obtain data from the web

Clean a dataset ready for use

Outcome

Build simple web pages that bring together a number of datasets to reveal new insight

Homework

Complete your web page and then build a new one to consume other data from another service and display it.


Thank-you