IBEX: Harvesting Entities from the Web Using Unique Identifiers

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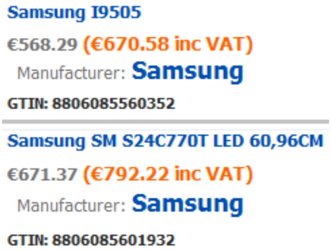
May 31st, 2015

Identifiers on the Web



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€568.29 (€670.58 inc VAT)

Manufacturer: Samsung

GTIN: 8806085560352

Samsung SM S24C770T LED 60,96CM

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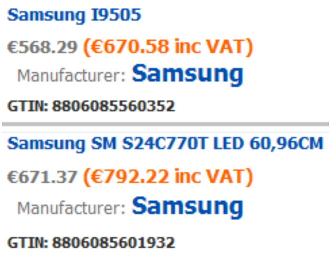

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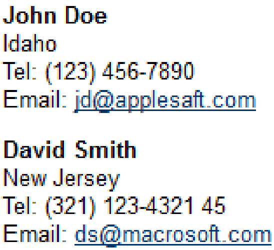

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David Smith
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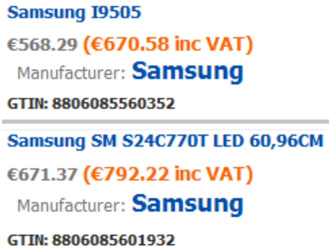

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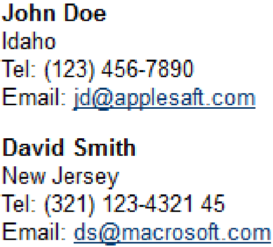

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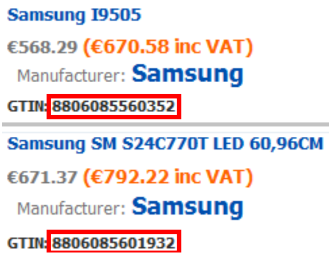

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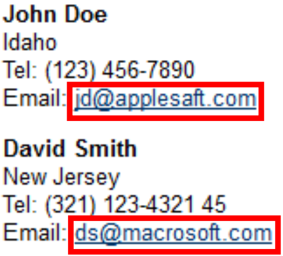

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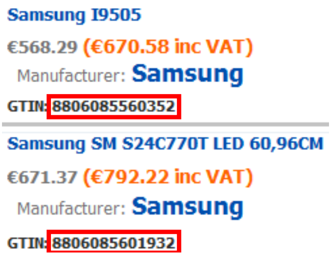

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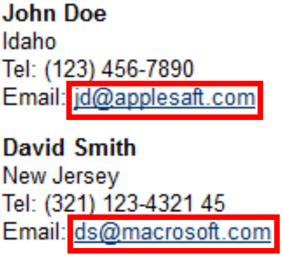

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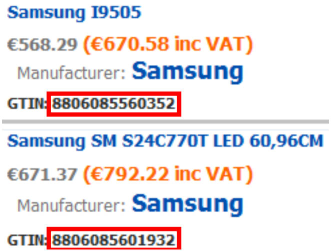
- It is tricky to extract named entities from Web pages
- Some entities have identifiers with recognizable syntax
- We focus on the following id types:
  - → GTINs (products): 8–14 digits
  - → CAS (chemicals): 8 digits
  - → DOIs (documents): numerical prefix, '/'
  - → Email addresses (people)

Names for IDs



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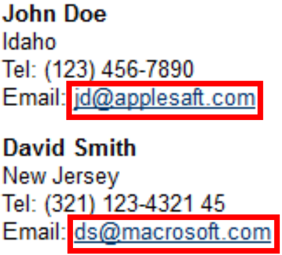

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- We also want a human-readable name

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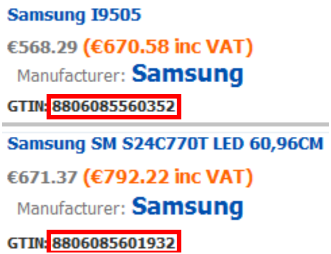

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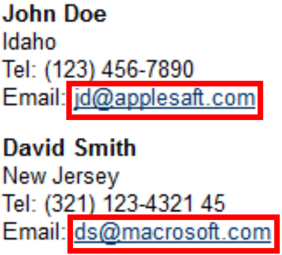

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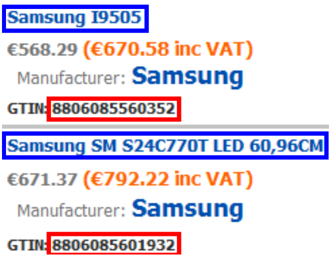

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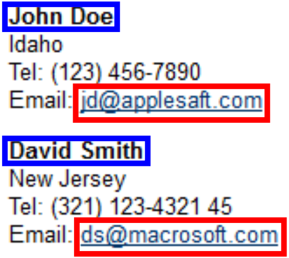

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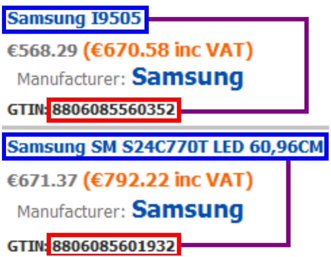

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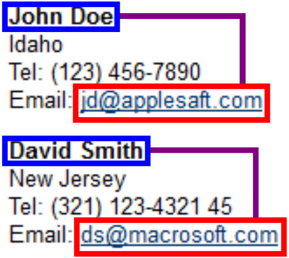

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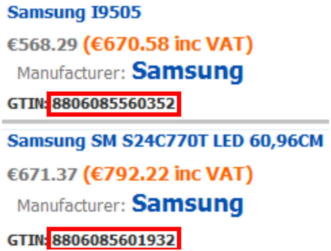

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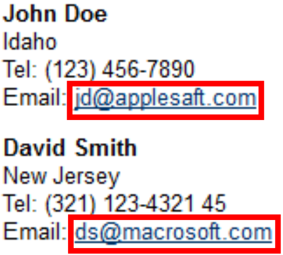

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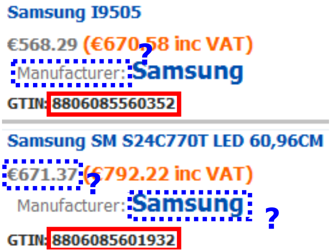

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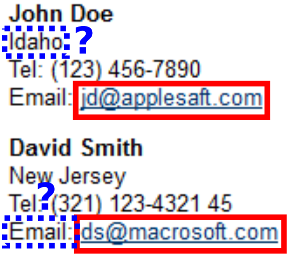

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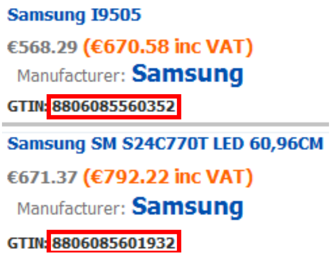

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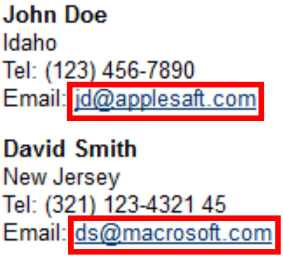

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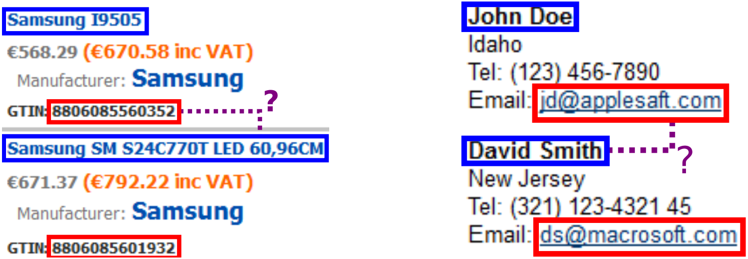

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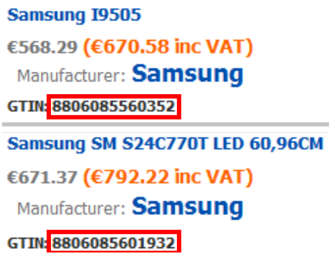

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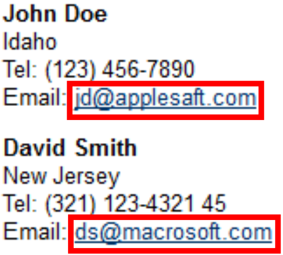

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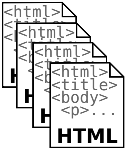

GTIN	CAS	email
`nnnnnnnnnnnnn`	`nnnnn-pp-q`	`xxx@yyy.zzz`

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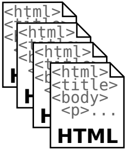

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→ Find out the IDs that occur in the crawl

→ Find out the right name for each of them

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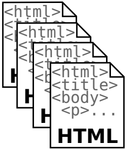

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GTIN	8806085601932	Samsung SM S24C770T
CAS	10049-04-4	Chlorine dioxide
email	`jd@applesaft.com`	John Doe
email	`ds@macrosoft.com`	David Smith

Related work

Named Entity Recognition. Cannot figure out the ID–name map

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→ Relying on IDs will make our life easier!

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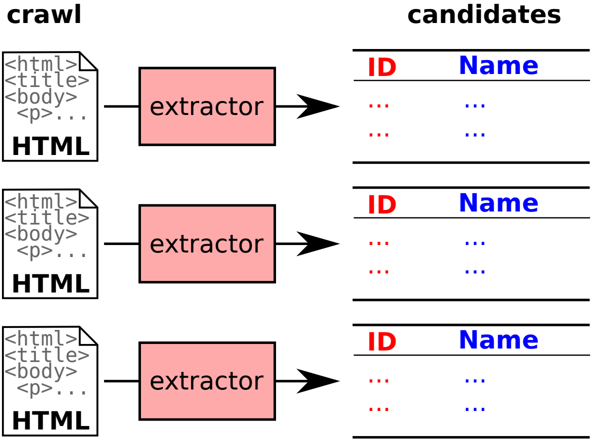
Task description

Extract candidate name–ID pairs from pages in parallel:



HTML parsing

```
<body><h1>Galaxy S6</h1>
  <p>Id:  <b>8806
 <h1>Gear
  <h2>S6 Cable</h2>
  4047          </body>
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- Custom DOM parser
- Knowledge on tag nestings
- Regoup headers and content

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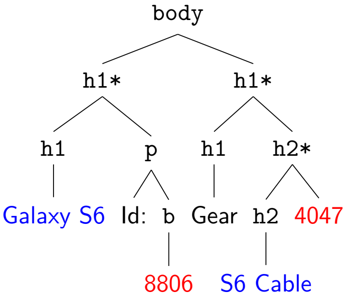

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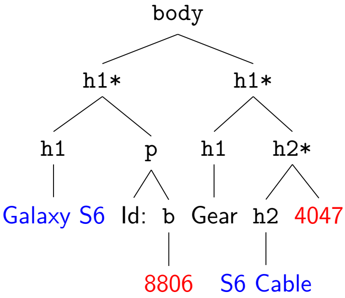


- Custom DOM parser
- Knowledge on tag nestings
- Regoup headers and content

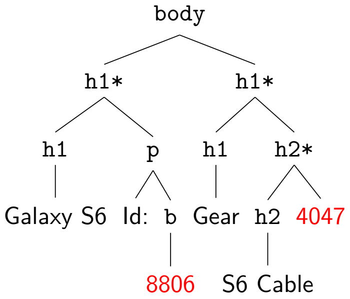
→ Fast (Web-scale)

→ Agnostic (no assumptions)

→ Resilient (real HTML sucks)

→ Simple (clean up later)

Extracting pairs



ID	Name

- Use the pattern to find IDs
- Record: maximal subtree containing only one ID
  → Detail record (one)
  → Free record (many)
- Leaves in each record are the name candidates

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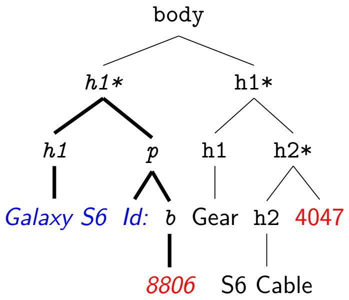

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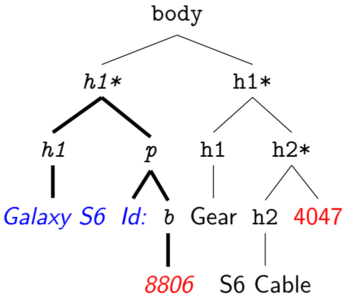

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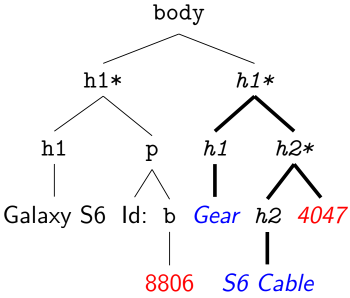

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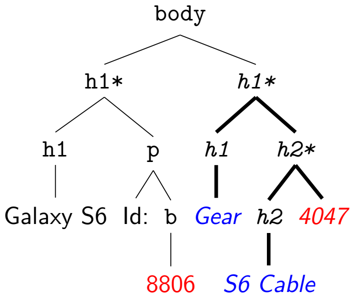

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Task description

Clean up the junk in ID–name pairs

Page	ID	Name
page1.html	9780261102361	The Two Towers
page1.html	9780261102361	J. R. R. Tolkien
page1.html	9780261102354	The Fellowship of the Ring
page1.html	9780261102354	J. R. R. Tolkien
page2.html	9780261102354	The Lord of the Rings (Part 1)
page3.html	9780261102354	The Fellowship of the Ring

→ Idea: unlike real names, bad names are not specific to an ID

Filtering names

- Group by name
- Consider the IDs for each name

Name	ID	Page
J. R. R. Tolkien	9780261102361	page1.html
J. R. R. Tolkien	9780261102354	page1.html
The Fellowship of the Ring	9780261102354	page1.html
The Fellowship of the Ring	9780261102354	page3.html
The Two Towers	9780261102361	page1.html
The Lord of the Rings (Part 1)	9780261102354	page2.html

Filtering names

- Group by name
- Consider the IDs for each name

Name	ID	Page
~~J. R. R. Tolkien~~	~~9780261102361~~	~~page1.html~~
~~J. R. R. Tolkien~~	~~9780261102354~~	~~page1.html~~
The Fellowship of the Ring	9780261102354	page1.html
The Fellowship of the Ring	9780261102354	page3.html
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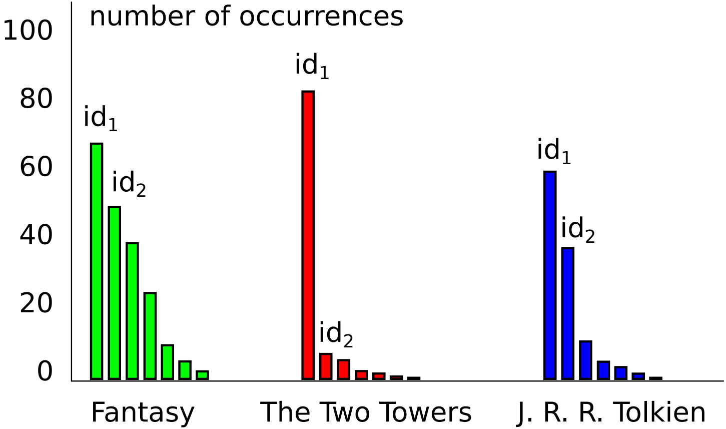
Deciding specificity

For each name, consider the histogram of ID occurrences:



→ most frequent ID id$_1$ must be much more frequent than id$_2$

→ id$_1$ must be sufficiently frequent overall

Putting it together

- We have eliminated unspecific names

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The Fellowship of the Ring	9780261102354	page1.html
The Fellowship of the Ring	9780261102354	page3.html
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- Some IDs may still have multiple names
  - → Group by ID
  - → Keep the most popular name

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Putting it together

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→ We have our final result: IDs and their name

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2. Extracting candidates
3. Cleaning up candidates
4. Experimental results
5. Conclusion

Experimental setup

- English portions of ClueWeb09 and ClueWeb12
  → 35 TB of data
  → 1.2 billion Web pages

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→ Only 10 hours processing time

Evaluation

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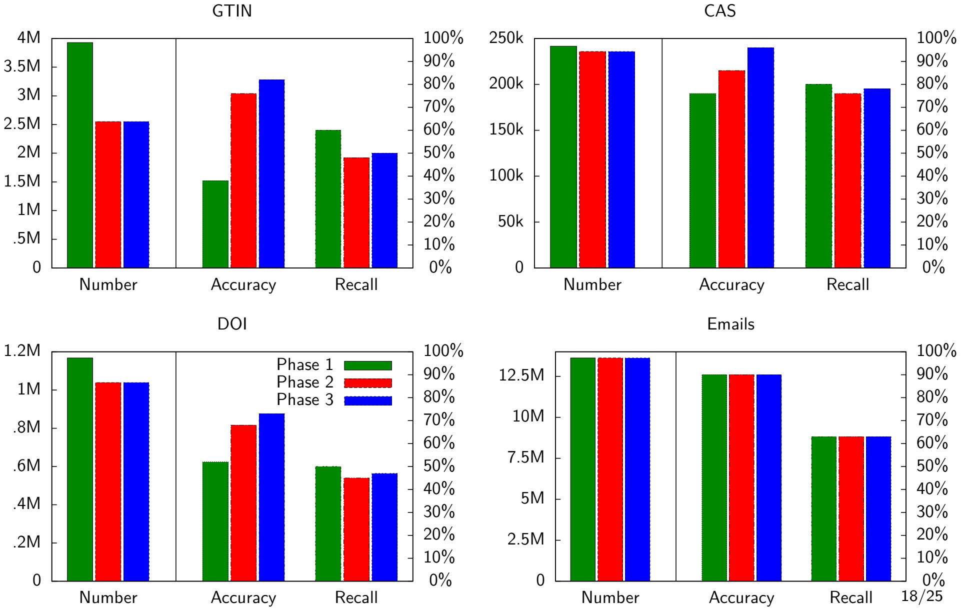
→ In phase 1 and 2, we choose one random name per id

Overall results



Results: richest sources by type and email domains

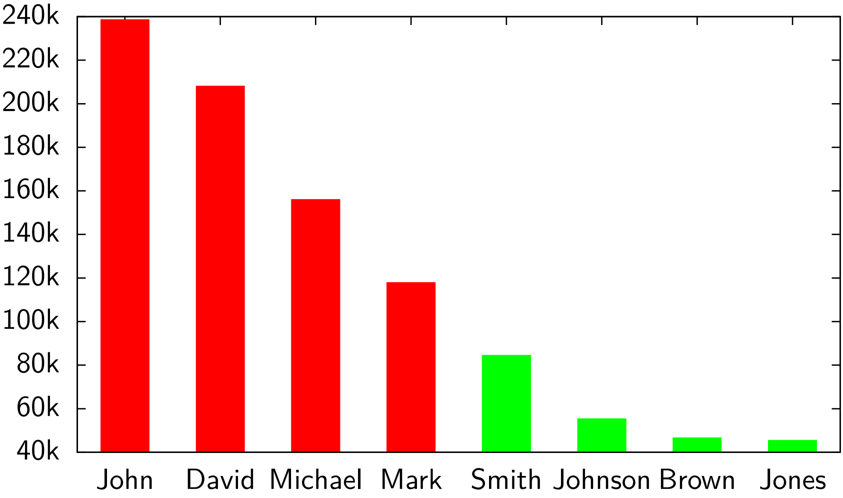
Product sources	Items
www2.loot.co.za	304,431
www.books-by-isbn.com	50,683
gtin13.com	26,834
en.wikipedia.org	21,873
www.buchhandel.de	18,264

Chemical sources	Items
www.chembuyersguide.com	129,211
www.chemnet.com	22,061
www.lookchem.com	12,354
www.seekchemicals.com	7,326
www.tradingchem.com	4,769

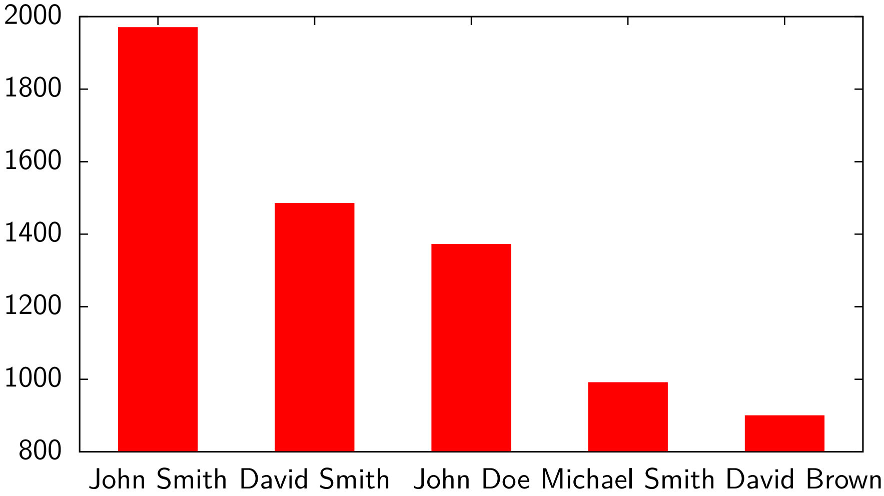
Document sources	Items
wwwtest.soils.org	20,635
www.plosone.org	19,261
www.citeulike.org	13,491
www.astm.org	10,020
bja.oxfordjournals.org	9,030

Domain name	Email addresses
gmail.com	304,236
yahoo.com	290,292
hotmail.com	281,498
aol.com	259,769
comcast.net	95,983

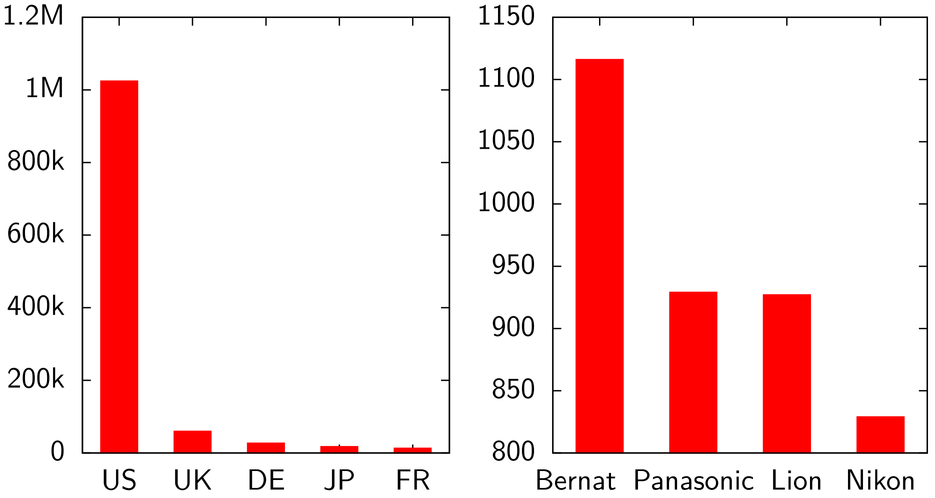
Results: first and last names



Results: full names

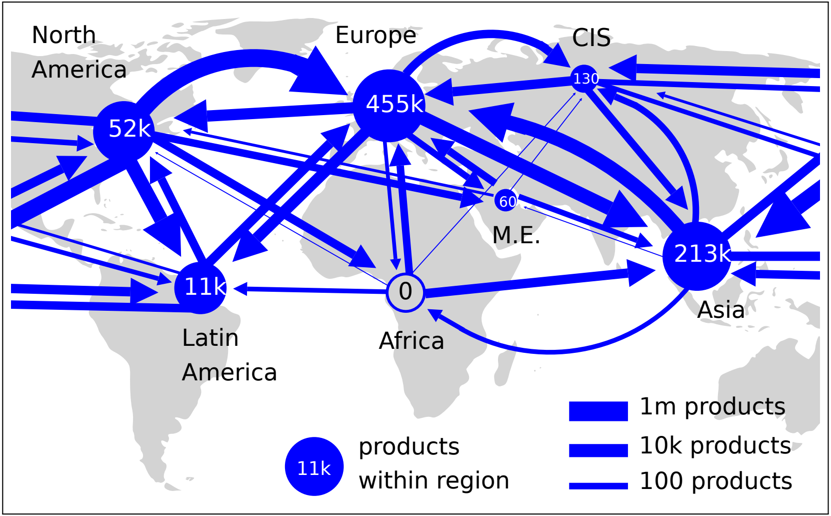


Number of products by country, by company



Analyses: world trade

Products produced somewhere (GTIN) but sold elsewhere (URL).



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Thanks for your attention!

These slides are inspired from an earlier presentation by Aliaksandr Talaika.