Introduction to Web Clustering

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Corso di *Web Mining* e *Retrieval*
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Outline

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- Some Web Clustering engines

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- Some Web Clustering engines
- The KeySRC approach

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- Some tools for build a Web Clustering engine

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- The KeySRC approach
- Some tools for build a Web Clustering engine
  - Yahoo Search API
  - CLUTO - Family of Data Clustering Software Tools

Web data clustering - Basics

- Organize data circulated over the Web into groups / collections in order to facilitate data availability & accessing, and at the same time meet user preferences.
- The initial idea was to define the correlation distance / similarity measure between any two “elements”.

Why use Web Clustering?

Web data clustering - Basics

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Why use Web Clustering?

- *Increasing* Web information accessibility
- *Decreasing* lengths in Web navigation pathways
- *Improving* Web users requests servicing
- *Improving* information retrieval
- *Improving* content delivery on the Web
- *Understanding* users' navigation behavior
- *Integrating* various data representation standards
- *Extending* current Web information organizational practices

Web Directories vs. Web Clustering

Web Directory:

represent a widespread scenario where the most relevant web pages are classified with respect to a predefined set of categories organized into a hierarchy.
Google, *Yahoo!* are well known examples of such hierarchical organization of knowledge.

The Open Directory Project:

ODP, also known as **Dmoz** (from *directory.mozilla.org*, its original domain name), is a multilingual open content directory of *World Wide Web* links owned by Netscape that is constructed and maintained by a community of volunteer editors.

Web Directories vs. Web Clustering

Open Directory Project

ODP – Open Directory Project

dmoz open directory project

In partnership with AOL search

about dmoz | dmoz blog | suggest URL | help | link | editor login

Search advanced

Arts
Movies, Television, Music...

Business
Jobs, Real Estate, Investing...

Computers
Internet, Software, Hardware...

Games
Video Games, RPGs, Gambling...

Health
Fitness, Medicine, Alternative...

Home
Family, Consumers, Cooking...

Kids and Teens
Arts, School Time, Teen Life...

News
Media, Newspapers, Weather...

Recreation
Travel, Food, Outdoors, Humor...

Reference
Maps, Education, Libraries...

Regional
US, Canada, UK, Europe...

Science
Biology, Psychology, Physics...

Shopping
Clothing, Food, Gifts...

Society
People, Religion, Issues...

Sports
Baseball, Soccer, Basketball...

World
Català, Dansk, Deutsch, Español, Français, Italiano, 日本語, Nederlands, Polski, Русский, Svenska...

Become an Editor | Help build the largest human-edited directory of the web

Copyright © 1998-2009 Netscape

4,616,780 sites - 83,449 editors - over 590,000 categories

Web Directories vs. Web Clustering

Open Directory Project

Open Directory – Health: Fitness: ...

dmoz open directory project — In partnership with AOL search

about dmoz | dmoz blog | suggest URL | update listing | become an editor | report abuse/spam | help

Search | the entire directory

Top: Health: Fitness: News and Media *(25)* — Description

- Magazines and E-zines *(19)*

See also:

- Health: News and Media *(225)*

This category in other languages:
Italian *(5)*

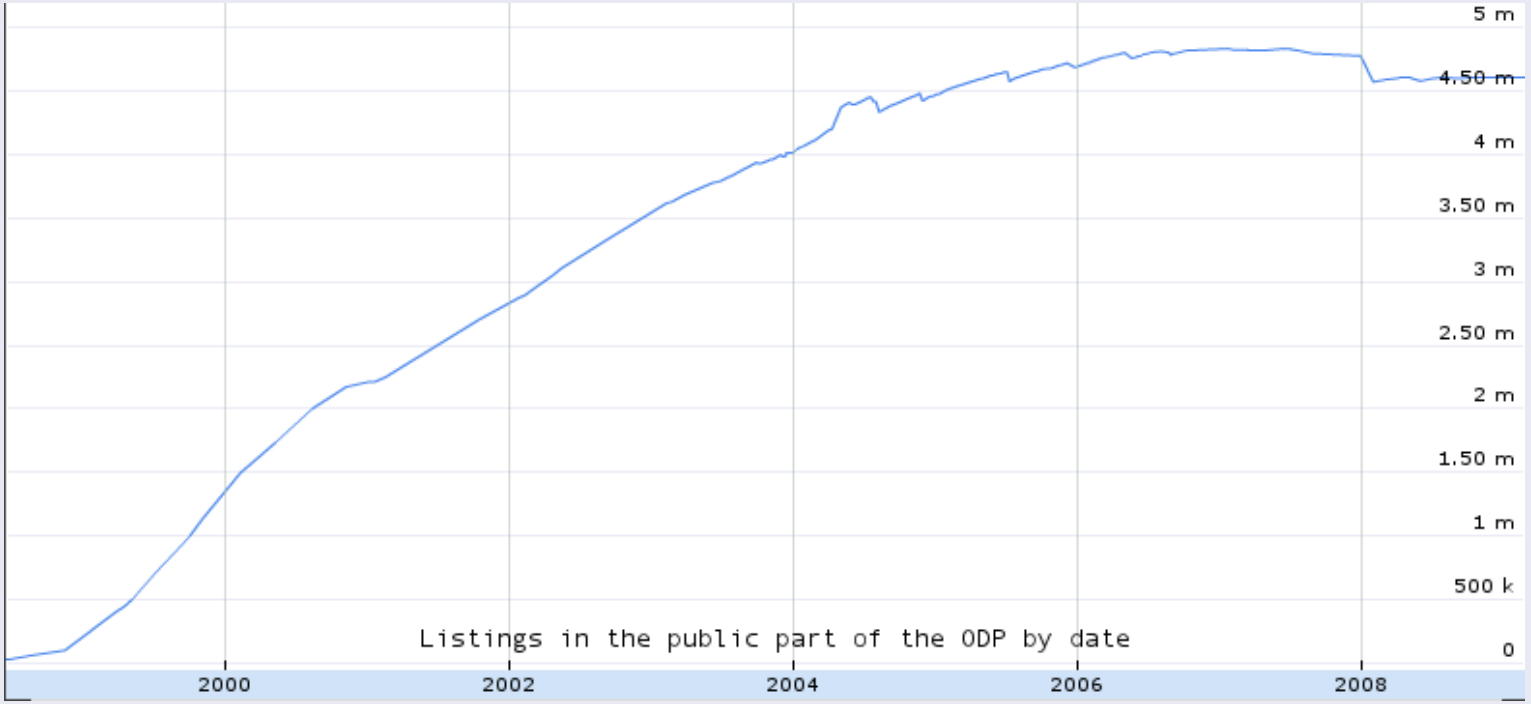
- AskMen.com - A two part article with tips on choosing the right gym.
- Body-Mind-Spirit Conference - Pilates, Yoga, Gyrotonic & NIA - Welcome to the Body Mind Expo educational conference.
- CNN's Health News: Diet and Fitness - Offering current health news, tips, on-line encyclopedia and many fitness related links.
- Fitness-Events.Com - Fitness and figure news, reports, and photos.
- Health & Fitness Business Expo and Conference - Annual show focuses on new fitness products and industry trends. Site contains information on the event, sponsorship, registration, press releases.
- Revolution Health: Fitness - Provides articles, forums, medical advice, and consumer reviews.

- "**News and Media**" search on: AltaVista - A9 - AOL - Ask - Clusty - Gigablast - Google - Lycos - MSN - Yahoo

Volunteer to edit this category.

Web Directories vs. Web Clustering

Open Directory Project



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- Clusters are dynamically generated on user needs.
- Filtering out irrelevant results.
- Need to define a label for each cluster.

Issues for Web Clustering

- Representation for clustering

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- Representation for clustering
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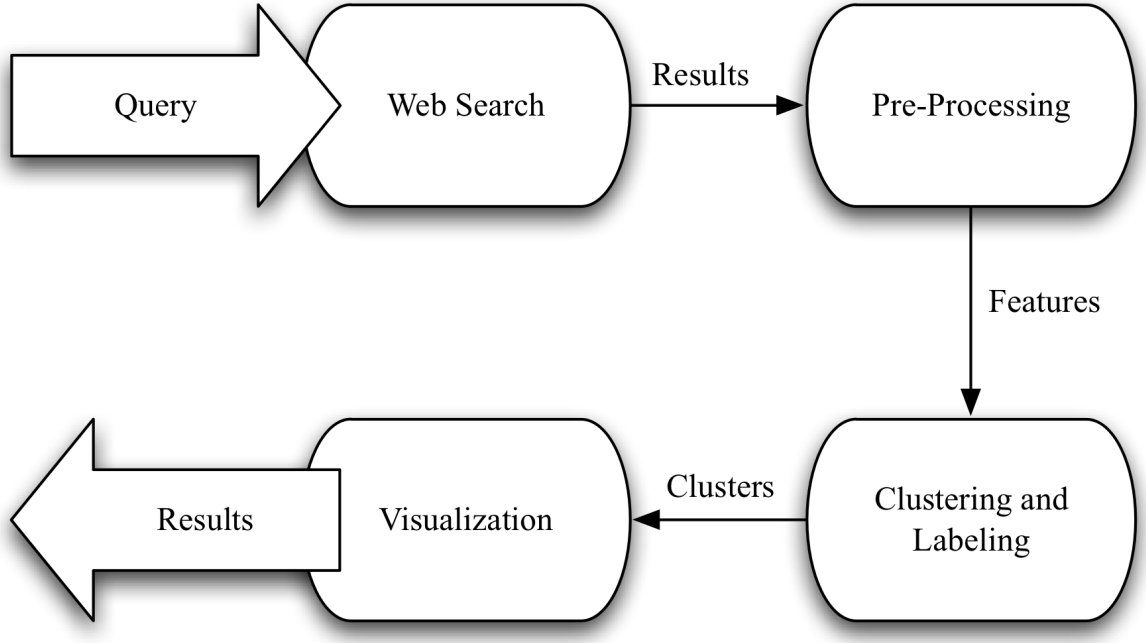
  - Need a notion of similarity/distance
- How many clusters?
  - Fixed a priori?
  - Completely data driven?
    - Avoid “trivial” clusters - too large or small

Classic Document Clustering vs. Web Clustering

Clustering type	Cluster labels	Cluster computation	Input data	Cluster number	Cluster intersection	GUI
Search results clustering	Natural language	On-line	Snippets	Variable	Overlapping	Yes
Document clustering	Centroid	Off-line	Documents	Fixed	Disjoint	No

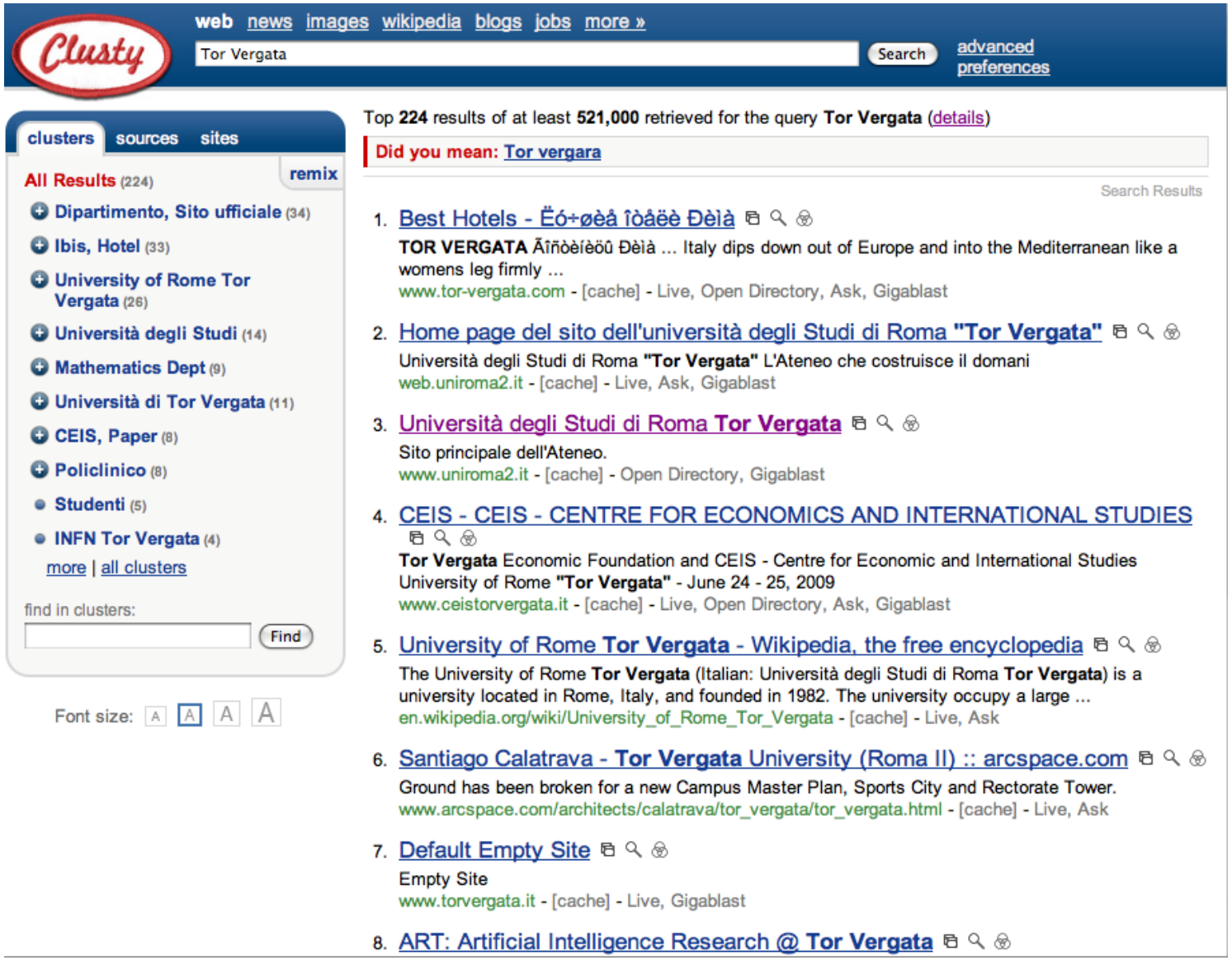
Web Clustering Architecture



Web Search API

Search engine	Protocol	Queries per day	Results per search	Terms of service
Alexa	SOAP or REST	n/a	20	Paid service (per-query).
Gigablast	REST/XML	100	10	Non-commercial use only.
Google	SOAP	1 000	10	Unsupported as of December 5, 2006. Non-commercial use only.
Google CSE	REST/XML	n/a	20	Custom search over selected sites/ domains. Paid service if XML feed is required.
MSN Search	SOAP	10 000	50	Per application-ID query limit. Non-commercial use only.
Yahoo!	REST/XML	5 000	100	Per-IP query limit. No commercial restrictions (except Local Search).

Clusty


Clusty
web news images wikipedia blogs jobs more »
Tor Vergata
Search
advanced preferences
clusters sources sites
remix
All Results (224)
Dipartimento, Sito ufficiale (34)
Ibis, Hotel (33)
University of Rome Tor Vergata (26)
Università degli Studi (14)
Mathematics Dept (9)
Università di Tor Vergata (11)
CEIS, Paper (8)
Policlinico (8)
Studenti (5)
INFN Tor Vergata (4)
more | all clusters
find in clusters:
Find
Font size:
Top 224 results of at least 521,000 retrieved for the query Tor Vergata (details)
Did you mean: Tor vergara
Search Results
1. Best Hotels - Ëó÷øèâ îòâëè Ðèìà
TOR VERGATA Ãîñòèíèöû Ðèìà ... Italy dips down out of Europe and into the Mediterranean like a womens leg firmly ...
www.tor-vergata.com - [cache] - Live, Open Directory, Ask, Gigablast
2. Home page del sito dell'università degli Studi di Roma "Tor Vergata"
Università degli Studi di Roma "Tor Vergata" L'Ateneo che costruisce il domani
web.uniroma2.it - [cache] - Live, Ask, Gigablast
3. Università degli Studi di Roma Tor Vergata
Sito principale dell'Ateneo.
www.uniroma2.it - [cache] - Open Directory, Gigablast
4. CEIS - CEIS - CENTRE FOR ECONOMICS AND INTERNATIONAL STUDIES
Tor Vergata Economic Foundation and CEIS - Centre for Economic and International Studies University of Rome "Tor Vergata" - June 24 - 25, 2009
www.ceistorvergata.it - [cache] - Live, Open Directory, Ask, Gigablast
5. University of Rome Tor Vergata - Wikipedia, the free encyclopedia
The University of Rome Tor Vergata (Italian: Università degli Studi di Roma Tor Vergata) is a university located in Rome, Italy, and founded in 1982. The university occupy a large ...
en.wikipedia.org/wiki/University_of_Rome_Tor_Vergata - [cache] - Live, Ask
6. Santiago Calatrava - Tor Vergata University (Roma II) :: arcspace.com
Ground has been broken for a new Campus Master Plan, Sports City and Rectorate Tower.
www.arcspace.com/architects/calatrava/tor_vergata/tor_vergata.html - [cache] - Live, Ask
7. Default Empty Site
Empty Site
www.torvergata.it - [cache] - Live, Gigablast
8. ART: Artificial Intelligence Research @ Tor Vergata

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  - Rome Apartments (7)
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  - History (6)
  - Travel Guide (6)
  - Roma (5)
  - Pope (4)
  - Empire (3)
  - Images (3)
  - more | show all

Top **100** results of about **106000000** for **rome**

1 **Rome** - Wikipedia, the free encyclopedia
The metropolitan area of **Rome** is estimated by OECD to have a population of 3.7 million. It is located in the central-western portion of the Italian ...
http://en.wikipedia.org/wiki/Rome [Ask, Bing, Exalead, Google, Wikipedia, Yahoo]

2 **Rome** (TV series) - Wikipedia, the free encyclopedia
Rome is an American-British-Italian historical drama television series created by Bruno Heller, John Milius, and William J. MacDonald. ...
http://en.wikipedia.org/wiki/Rome_(TV_series) [Ask, Wikipedia, Google]

3 ItalyGuides.it: Virtual tour of **Rome**, travel information and city ...
Rome tourism and travel information: transport, attractions, maps, travel advice , pictures, audio guides, airport information, activities, hotels and more ...
http://www.italyguides.it/us/roma/rome_italy_travel.htm [Ask, Google]

4 **Rome** Travel Information and Travel Guide - Italy - Lonely Planet
Rome tourism and travel information such as accommodation, festivals, transport, maps, activities and attractions in **Rome**, Italy - Lonely Planet.
http://www.lonelyplanet.com/italy/rome [Ask, Google]

5 Romaturismo
http://www.romaturismo.it/v2/en/main.asp [Ask, Google]

6 CATHOLIC ENCYCLOPEDIA: **Rome**
The significance of **Rome** lies primarily in the fact that it is the city of the pope.
http://www.newadvent.org/cathen/13164a.htm [Ask, Bing, Google]

Grokker

See how Grokker can help your business

News & Events | Blogs | Contact Us | Feedback | Help | Home

grokker

Selected Sources [2 of 3] Add/Remove

Yahoo! Wikipedia Amazon Books

clustering GROK Search Options

Outline View | Map View | 142 total results | Working List (0 items) | Email | Export

Refine Search

by keyword

exclude

by date

2001-02-09 to 2009-06-24

by source

<all sources>

by domain

<all domains>

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clustering (142 results)

- Server (11)
- Clustering Algorithms (12)
- Data Clustering (11)
- Application (9)
- Hierarchical Clustering (8)
- Clustering Algorithm (5)
- High Availability (5)
- Document Clustering (5)
- Linux (5)
- Words (5)
- Article (5)
- Dictionary (4)
- Storage Clustering (4)
- Books (4)
- Tutorial (4)
- Method (4)
- Performance (4)
- Clustering Basics (3)
- Review (3)
- Spectral Clustering (3)
- Process (3)
- Problem (3)
- Clustering Architecture (3)

Results: [1-10 of 142] « ‹ › » Show All Detail: Less Medium More

clustering

Cluster (computing) - Wikipedia, the free encyclopedia
Add to Working List | Post to del.icio.us | Email
Clustering can provide significant performance benefits versus price. ... The first commercial clustering product was ARCnet, developed by Datapoint in 1977. ...
http://en.wikipedia.org/wiki/Computer_cluster - 11 giugno 2009
Source: Yahoo!

Cluster analysis
Add to Working List | Post to del.icio.us | Email
...Cluster analysis, a method for statistical data analysis....
http://en.wikipedia.org/wiki/Cluster_analysis - 24 giugno 2009
Source: Wikipedia

Clustering Basics
Add to Working List | Post to del.icio.us | Email
Scott Schnoll's Microsoft Cluster Center is the ultimate source for Microsoft Clustering information and answers. ... Clustering can help reduce both planned ...
http://www.nwnetworks.com/basics.htm - 17 ottobre 2005
Source: Yahoo!

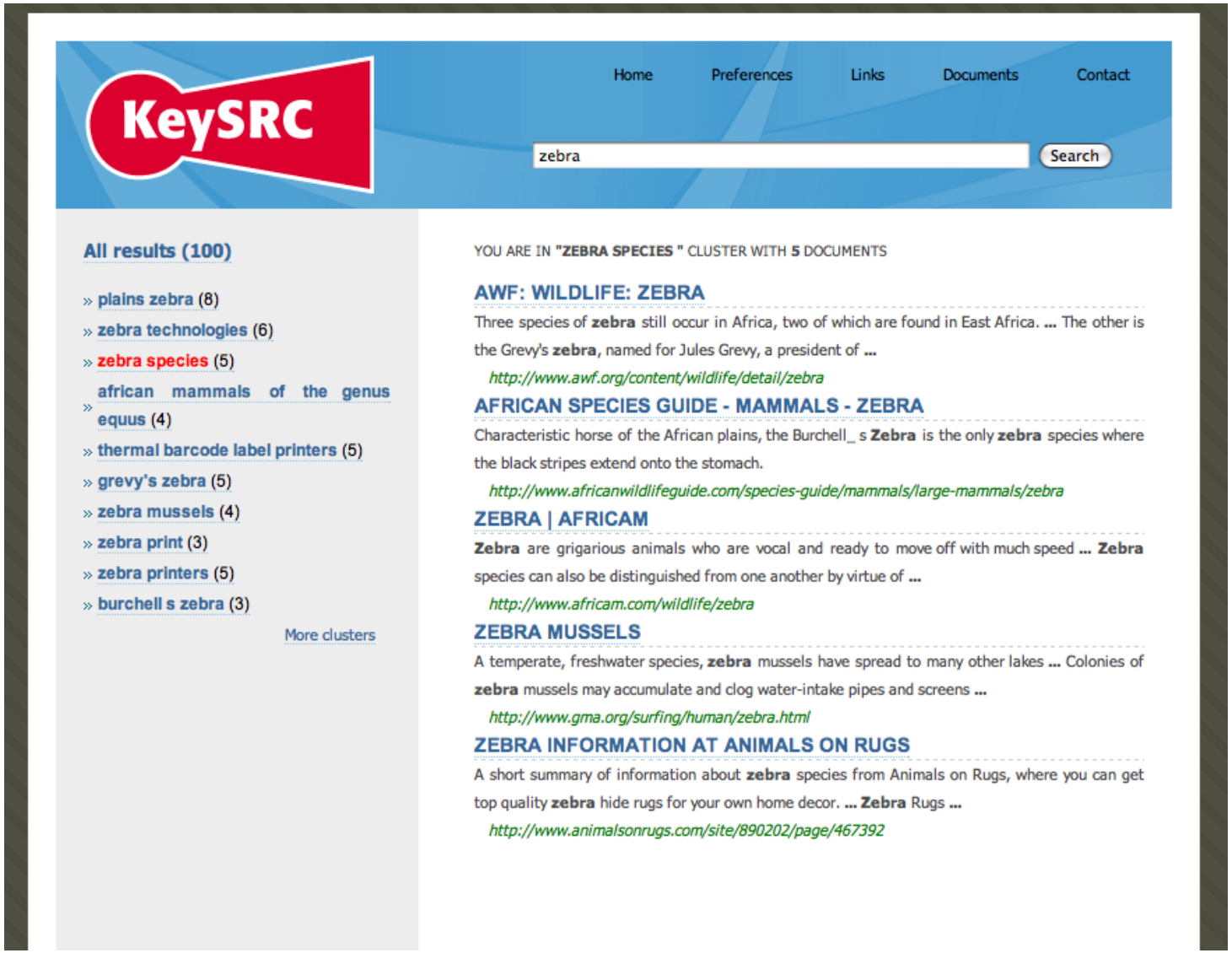
Non-profit organization
Add to Working List | Post to del.icio.us | Email
...Wikipedia® is a registered trademark of the Wikimedia Foundation, Inc., a U.S. registered 501(c)(3) tax-deductible nonprofit charity....
http://en.wikipedia.org/wiki/Non-profit_organization - 24 giugno 2009
Source: Wikipedia

Category:All disambiguation pages
Add to Working List | Post to del.icio.us | Email
All disambiguation pages
http://en.wikipedia.org/wiki/Category:All_disambiguation_pages - 24 giugno 2009
Source: Wikipedia

KartOO


OPTIONS
v5 - FR - DE - UK Version
italia
Search
KartOO
TECHNOLOGIES
www.babylon.com
www.vacanca.com
holiday
www.italia-magazine.com
magazine
www.auto-italia.co.uk
campione
en.wikipedia.org
guide
recipes
www.italiamia.com
travel
www.alitalia.com
book
www.viator.com
www.italiaguitars.com

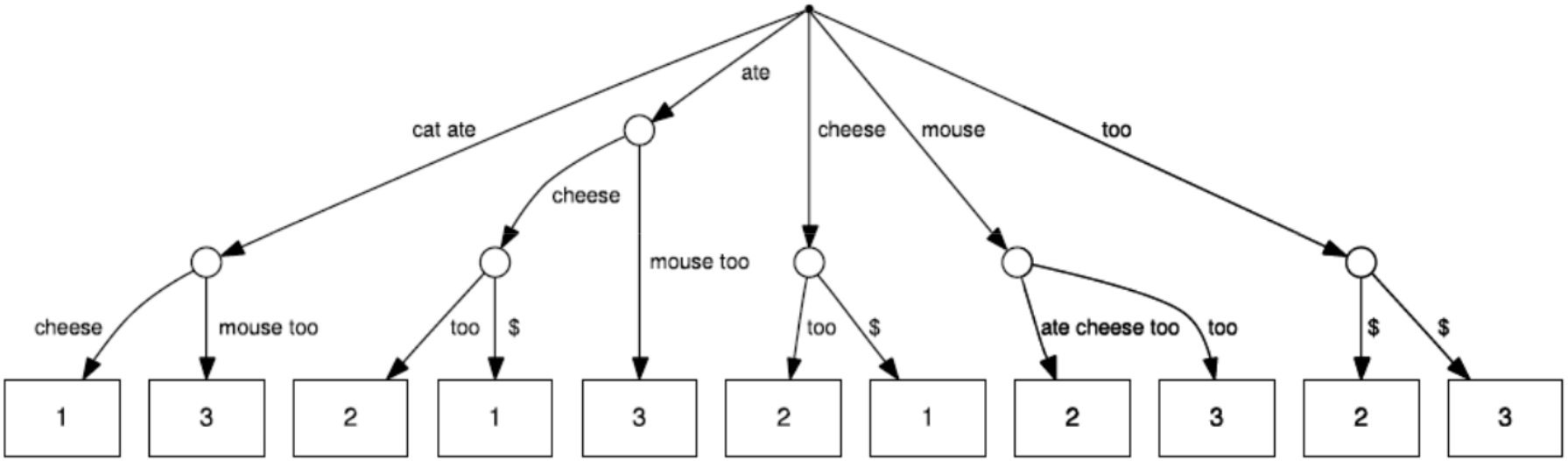
KeySRC


KeySRC
Home
Preferences
Links
Documents
Contact
zebra
Search
All results (100)
» plains zebra (8)
» zebra technologies (6)
» zebra species (5)
» african mammals of the genus equus (4)
» thermal barcode label printers (5)
» grevy's zebra (5)
» zebra mussels (4)
» zebra print (3)
» zebra printers (5)
» burchell s zebra (3)
More clusters
YOU ARE IN "ZEBRA SPECIES " CLUSTER WITH 5 DOCUMENTS
AWF: WILDLIFE: ZEBRA
Three species of zebra still occur in Africa, two of which are found in East Africa. ... The other is the Grevy's zebra, named for Jules Grevy, a president of ...
http://www.awf.org/content/wildlife/detail/zebra
AFRICAN SPECIES GUIDE - MAMMALS - ZEBRA
Characteristic horse of the African plains, the Burchell_ s Zebra is the only zebra species where the black stripes extend onto the stomach.
http://www.africanwildlifeguide.com/species-guide/mammals/large-mammals/zebra
ZEBRA | AFRICAM
Zebra are grigarious animals who are vocal and ready to move off with much speed ... Zebra species can also be distinguished from one another by virtue of ...
http://www.africam.com/wildlife/zebra
ZEBRA MUSSELS
A temperate, freshwater species, zebra mussels have spread to many other lakes ... Colonies of zebra mussels may accumulate and clog water-intake pipes and screens ...
http://www.gma.org/surfing/human/zebra.html
ZEBRA INFORMATION AT ANIMALS ON RUGS
A short summary of information about zebra species from Animals on Rugs, where you can get top quality zebra hide rugs for your own home decor. ... Zebra Rugs ...
http://www.animalsonrugs.com/site/890202/page/467392

Some Web Clustering Engines

System name (algorithm alias)	Year	Text features	Cluster labels	Clustering method	On-line demo	Clusters structure	Source code
Grouper (STC)	1998	single words, phrases	phrases	STC	yes (dead)	flat, concept cloud	no
Lassi	2000	lexical affinities	lexical affinities	AHC	no (desktop)	hierarchy	no
CIIRarchies	2001	single words	word sets	language model/ graph analysis	yes (dead)	hierarchy	no
WICE (SHOC)	2002	single words, phrases	phrases	SHOC	yes (dead)	hierarchy	no
Carrot^2 (Lingo)	2003	frequent phrases	phrases	Lingo	yes	flat	yes
Carrot^2 (TRSC)	2004	words, tolerance rough sets	n-grams (of words)	TRSC	yes	flat (optional hierarchy)	yes
WebCat	2003	single words	words	k-Means	yes (dead)	flat	no
AISearch	2004	single words	word sets	AHC + weighted centroid covering	yes (dead)	hierarchy	no
CREDO	2004	single words	word sets	concept lattice	yes	graph	no
DisCover	2004	single words, noun phrases	phrases	incremental cove-rage optimization	no	hierarchy	no
SnakeT	2004	approximate sentences	phrases	approx. sent. coverage	yes	hierarchy	no
SRC	2004	n-grams (of words)	n-grams (of words)	SRC	yes	flat (paper) hierarchy (demo)	no
EigenCluster	2005	single words	three salient terms	divide-merge (hybrid)	yes	flat (optional hierarchy)	no
WhatsOnWeb	2006	single words	phrases	edge connectivity	yes	graph	no

Generalized suffix tree (from Zamir and Etzioni, 1998)



1) Cat ate cheese
2) Mouse ate cheese too
3) Cat ate mouse too

The KeySRC algorithm

1. Search results preprocessing
2. Construction of Generalized Suffix Tree (GST)
3. Extraction of keyphrases from GST Extraction of keyphrases from GST (internal nodes of GST + $\leq$ 4 words + POS tagging)
4. Keyphrases clustering and Label assignment
5. Cluster ranking

Yahoo! search apis Example

Mozilla Firefox

http://api.search.yahoo.com/WebSearchService/V1/webSearch?appid=YahooDemo&query=rome&results=2

Più visitati My Home Page Traduttori Varie Negozi Mail Uni Software Editor HTML Dottorato Mac WebSpace

Disable Cookies CSS Forms Images Information Miscellaneous Outline Resize Tools View Source Options

http://api.sear...=rome&results=2

Il file XML specificato apparentemente non ha un foglio di stile associato. L'albero del documento è mostrato di seguito.


```
– <ResultSet xsi:schemaLocation="urn:yahoo:srch http://api.search.yahoo.com/WebSearchService/V1/WebSearchResponse.xsd" type="web"
  totalResultsAvailable="375000000" totalResultsReturned="2" firstResultPosition="1" moreSearch="/WebSearchService/V1/webSearch?query=rome&
  appid=YahooDemo&region=us">
  – <Result>
      <Title>Rome, Italy - Wikipedia</Title>
    – <Summary>
        Includes history, geography, climate, economy, demographics, religion, culture, transportation, events, sister cities, and references about the Italian capital, Rome.
      </Summary>
      <Url>http://en.wikipedia.org/wiki/Rome</Url>
      <ClickUrl>http://en.wikipedia.org/wiki/Rome</ClickUrl>
      <DisplayUrl>en.wikipedia.org/wiki/Rome</DisplayUrl>
      <ModificationDate>1244876400</ModificationDate>
      <MimeType>text/html</MimeType>
    – <Cache>
      – <Url>
          http://uk.wrs.yahoo.com/_ylt=A0WTecwZKENKw8wABzPdmMwF;_ylu=X3oDMTBwZTdwbWtkBGNvbG8DZQRwb3MDMQRzZWMDc3IEdnRpZAM-/SIG=15lbig26q
          /EXP=1246001561/**http%3A//74.6.239.67/search/cache%3Fei=UTF-8%26appid=YahooDemo%26query=rome%26results=2%26u=en.wikipedia.org
          /wiki/Rome%26w=rome%26d=aB1snRlMS-4f%26icp=1%26.intl=us
        </Url>
        <Size>268140</Size>
      </Cache>
    </Result>
```

CLUTO: Clustering High-Dimensional Datasets

About CLUTO

It is a software package for clustering low- and high-dimensional datasets and for analyzing the characteristics of the various clusters.

Consists of both stand-alone programs and a library via which an application program can access directly the various clustering and analysis algorithms implemented in CLUTO.

- Multiple classes of clustering algorithms:
  - partitional, agglomerative and graph-partitioning based.
- Multiple similarity/distance functions:
  - Euclidean distance, cosine, correlation coefficient, extended Jaccard, user-defined.
- Numerous novel clustering criterion functions and agglomerative merging schemes.
- Traditional agglomerative merging schemes:
  - single-link, complete-link, UPGMA
- Extensive cluster visualization capabilities and output options:
  - postscript, SVG, gif, xfig, etc.
- Multiple methods for effectively summarizing the clusters:
  - most descriptive and discriminating dimensions, cliques, and frequent itemsets.
- Can scale to very large datasets containing hundreds of thousands of objects and tens of thousands of dimensions.