Apache Mahout Making data analysis easy





Isabel Drost

Nighttime:

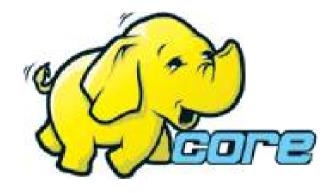
Co-Founder, committer Apache Mahout. Organiser of Berlin Hadoop Get Together.

Daytime:

Software developer. Guest lecturer at TU Berlin. Co-Organiser Berlin Buzzwords 2010.

- "Mastering Data-Intensive Collaboration and Decision Making"
- EU funded research project
 - Number of partners: 8
 - Coordinator: Research Academic Computer Technology Institute (CTI), Greece











Machine learning background?



Agenda

• Data Mining/ Machine Learning?

• Why is scaling hard?

• Going beyond simple statistics.

Data Mining Applications

- Marketing.
- Surveillance.
- Fraud Detection.
- Scientific Discovery.
- Discover items usually purchased together.

= Extracting patterns from data.

Machine Learning Applications

- E-Mail spam classification.
- News-topic discovery.
- Building recommender systems.

= Extracting prediction models from data.

Machine learning – what's that?



Image by John Leech, from: The Comic History of Rome by Gilbert Abbott A Beckett. Bradbury, Evans & Co, London, 1850s Archimedes taking a Warm Bath

Archimedes model of nature

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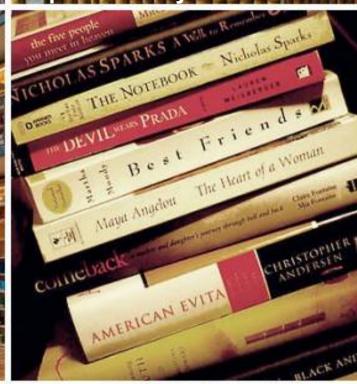




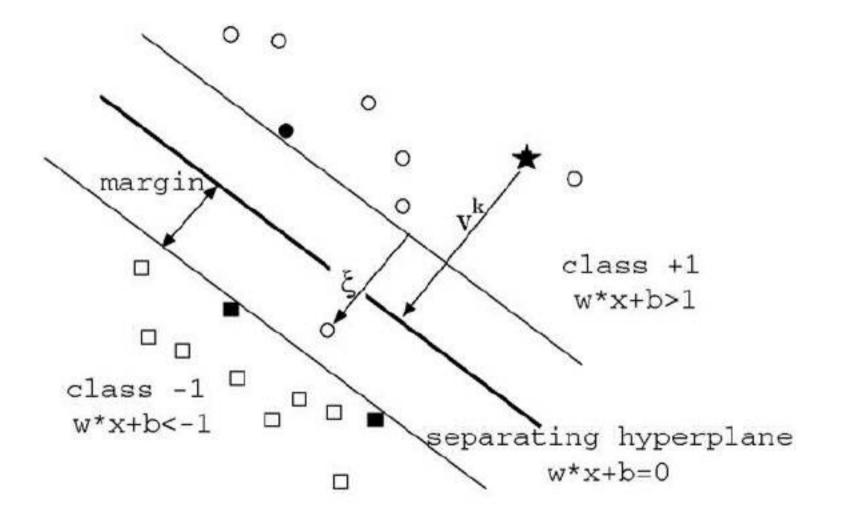




June 25, 2008 by chase-me A STREET http://www.flickr.com/photos/sasy/2609508999



An SVM's model of nature



The challenge

Mission

Provide scalable data mining algorithms.



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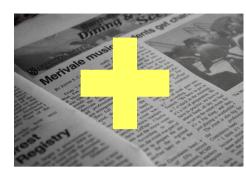
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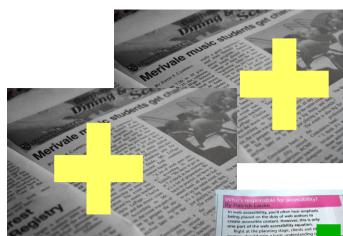
COMMUNITY NEWS

Finishing touches still to come

A glimpse of today, yesterday

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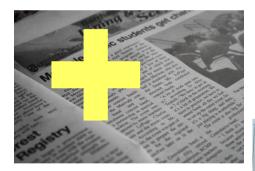






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The HDFS filesystem is not restricted to MapReduce jobs. It can be used for other applications, many of which are under way at Apache. The list includes the HBase database, the Apache Mahout machine learning system, and matrix operations.

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ANZEIGE

• Remove noise.

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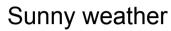
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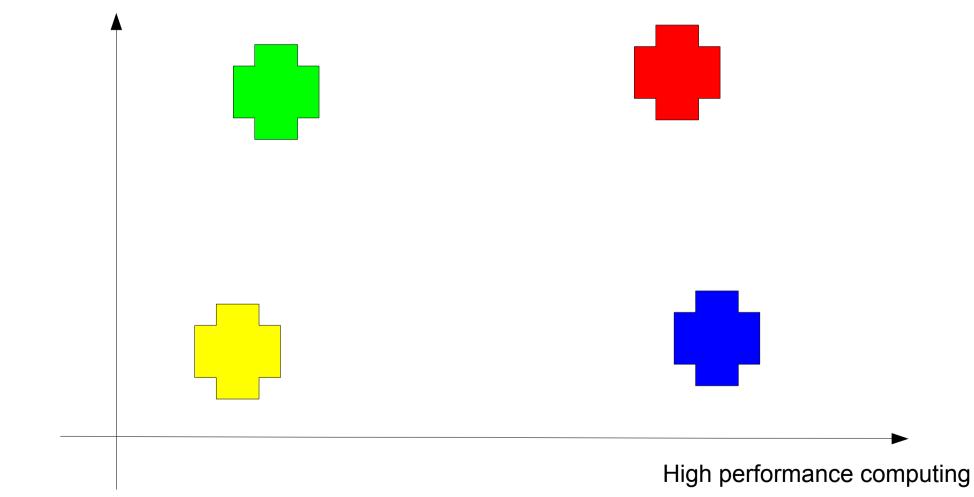
• Remove noise.

• Convert text to vectors.

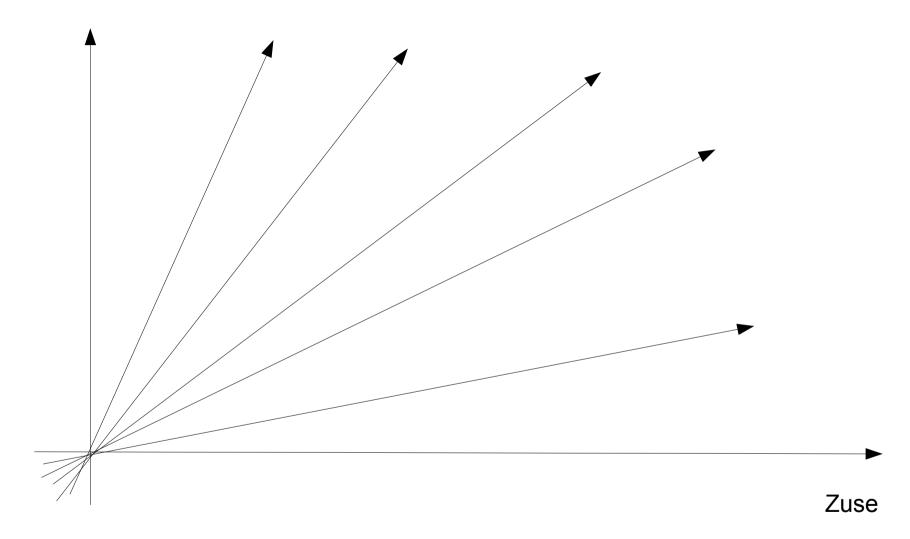
From texts to vectors

If we looked at two words only:









Binary bag of words

- Imagine a n-dimensional space.
- Each dimension = one possible word in texts.
- Entry in vector is one, if word occurs in text.

$$b_{i,j} = \begin{cases} 1 \forall x_i \in d_j \\ 0 \, else \end{cases}$$

- Problem:
 - Number of word occurrences not accounted for.

Term Frequency

- Imagine a n-dimensional space.
- Each dimension = one possible word in texts.
- Entry in vector equal to the words frequency.

$$b_{i,j} = n_{i,j}$$

- Problem:
 - Common words dominate vectors.

TF with stop wording

- Imagine a n-dimensional space.
- Each dimension = one possible word in texts.
- Filter stopwords.
- Entry in vector equal to the words frequency.

$$b_{i,j} = n_{i,j}$$

- Problem:
 - Common and uncommon words with same weight.

TF- IDF

- Imagine a n-dimensional space.
- Each dimension = one possible word in texts.
- Filter stopwords.
- Entry in vector equal to the weighted frequency.

$$b_{i,j} = n_{i,j} \times \log\left(\frac{|D|}{|[d:t_i \in d]|}\right)$$

- Problem:
 - Long texts get larger values.

Normalized TF- IDF

- Imagine a n-dimensional space.
- Each dimension = one possible word in texts.
- Filter stopwords.
- Entry in vector equal to the weighted frequency.
- Normalize vectors.

$$b_{i,j} = \frac{n_{i,j}}{\sum_{k} n_{k,j}} \times \log\left(\frac{|D|}{|[d:t_i \in d]|}\right)$$

- Problem:
 - Additional domain knowledge ignored.

Reality

- There are a few more words in news.
- Use all relevant features/ signals available.
 - Words.
 - Header fields.
 - Characteristics of publishing url.
 - •
- Usually pipeline of feature extractors.

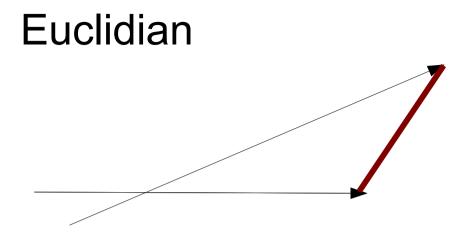
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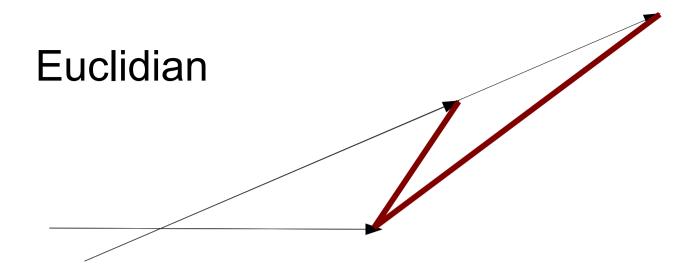
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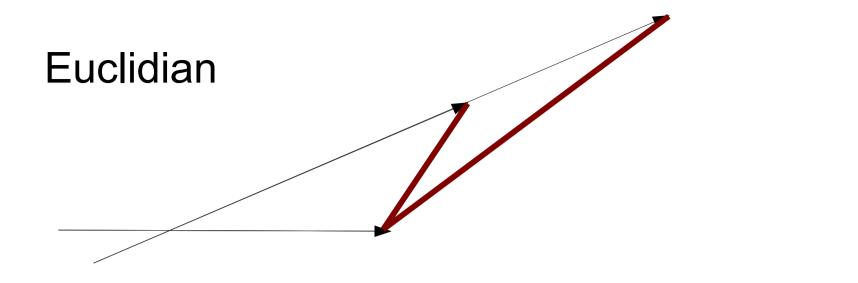
• Training a prediction model.

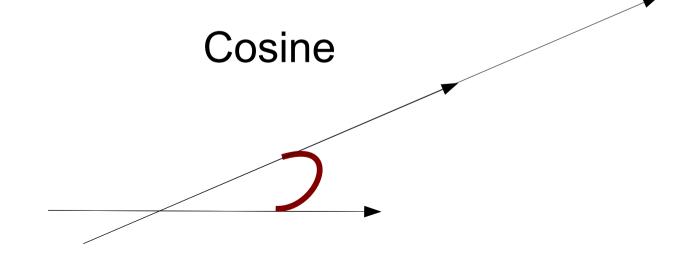
• Checking the performance of your model.

Step 2: Similarity

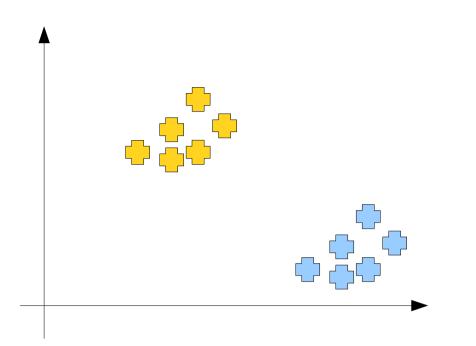


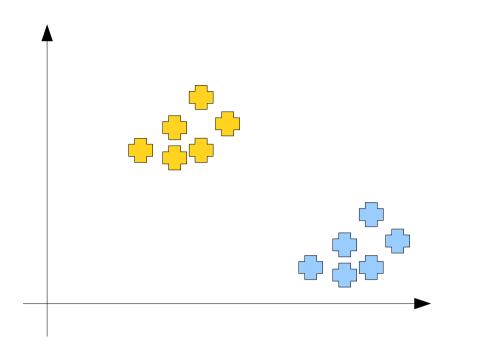


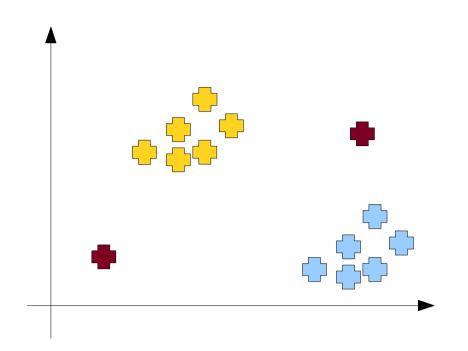


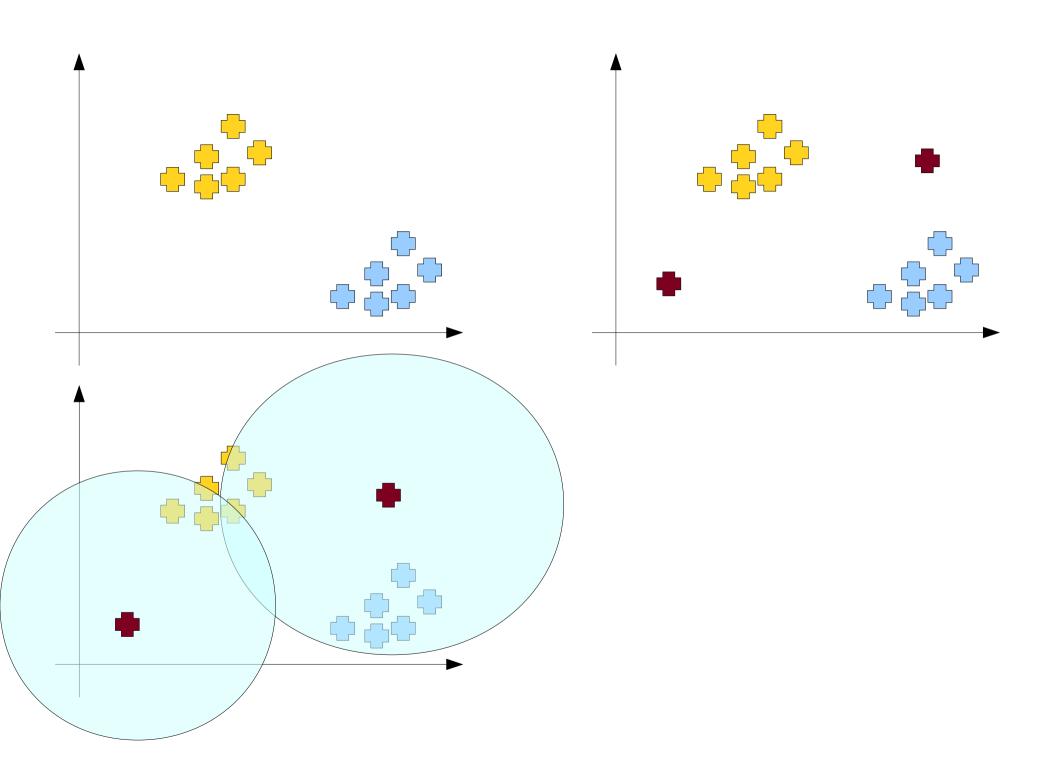


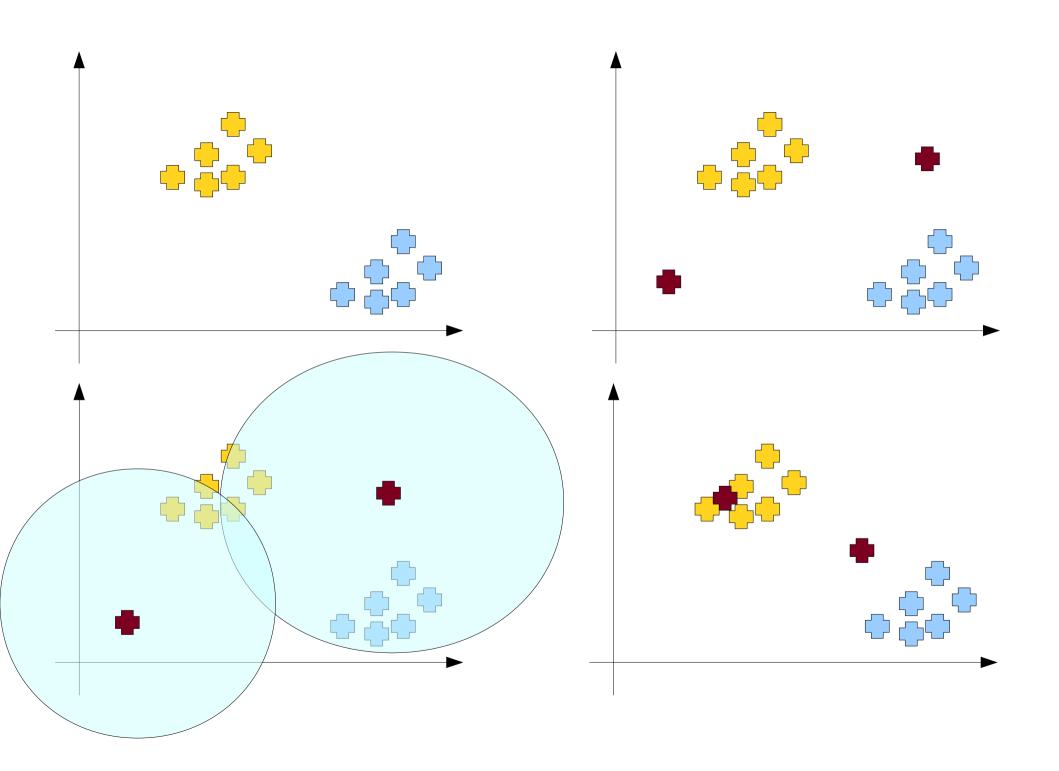
Step 3: Clustering

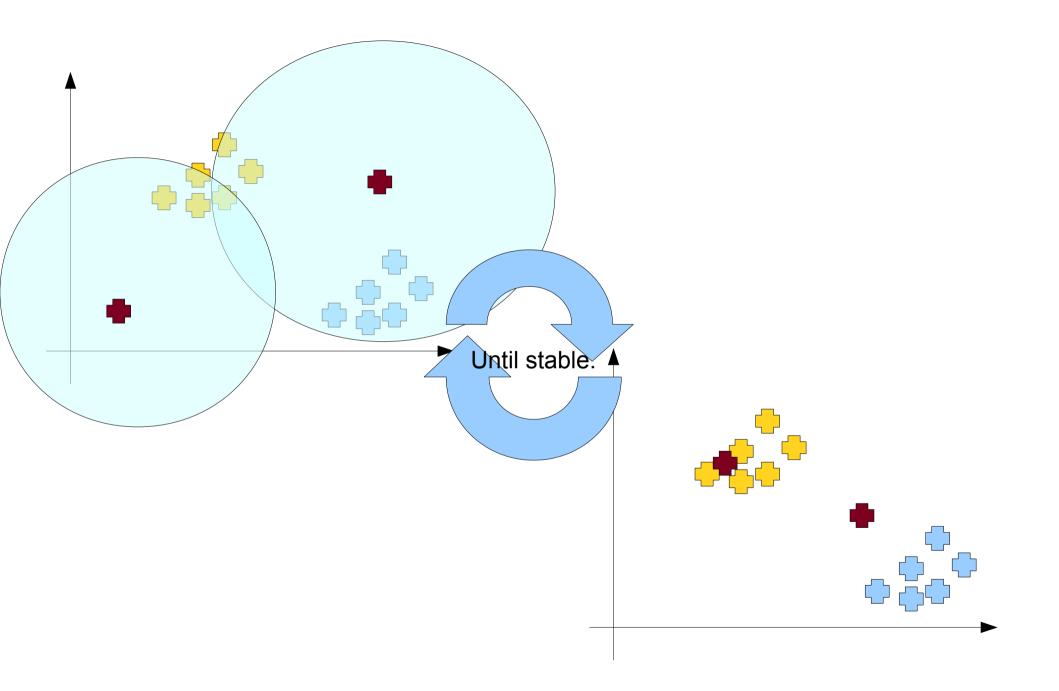












Reality

• Seed selection.

• Choice of initial k.

• Continuous updates.

• Regular addition of clusters.

From data to information.

Collect data and define your learning problem. Data preparation. Training a prediction model.

• Checking the performance of your model.

Evaluation

• Compare against gold standard.

• Use quality measures.

• Manual inspection.

From data to information.

Collect data and define your learning problem. Data preparation. Training a prediction model. Checking the performance of your model.

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What else does Mahout have to offer.

Identify dominant topics

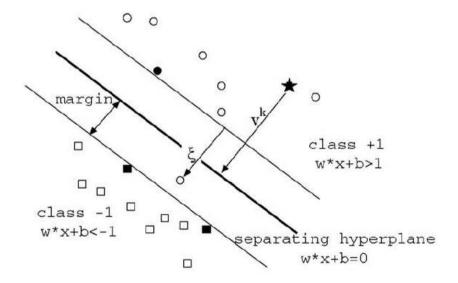
• Given a dataset of texts, identify main topics.

Algorithms: Parallel LDA

- Examples:
 - Dominant topics in set of mails.
 - Identify news message categories.

Assign items to defined categories.

• Given pre-defined categories, assign items to it.



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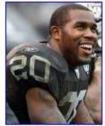


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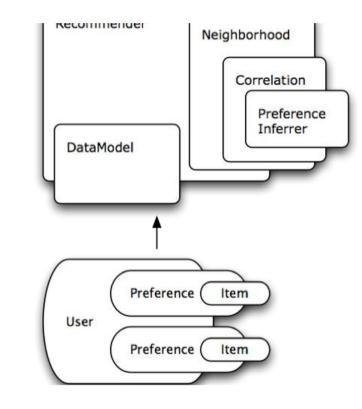
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Recommendation mining.

• Collaborative filtering.

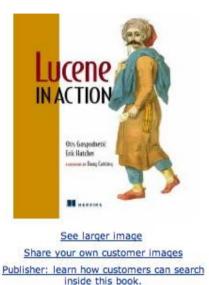


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~ <u>Otis Gospodnetic</u> (Author), <u>Erik Hatcher</u> (Author)

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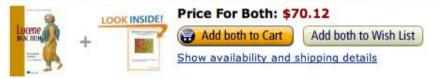
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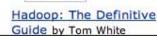
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Recommending places

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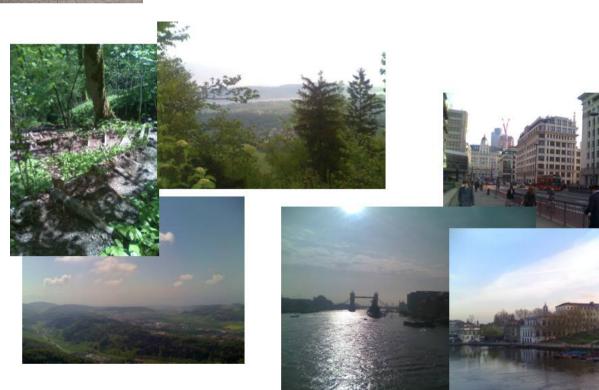








Thanks to Falko Menge for the pictures of Brussels.



Recommending people









Recommendation mining.

- Online collaborative filtering on single machine.
- Offline Map/Reduce based version.
- Content similarity can be integrated.

• Based on former Taste project.

Frequent pattern mining

 Given groups of items, find commonly cooccurring items.

- Examples:
 - In shopping carts find items bought together.
 - In query logs find queries issued in one session.



rypto/3201254932/sizes/l/

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Requirements to get started

March 14, 2009 by Artful Magpie http://www.flickr.com/photos/kmtucker/3355551036/





• AWS	• Products	• Developers	··· Community	Y Support	🗸 Account	
Products & Services	 Amazon 	Elastic Compu	te Cloud (Amazo	on EC2)		
Amazon EC2 Details		Amazon Elastic Compute Cloud (Amazon EC2) is a web service that provides resizable compute capacity in the cloud. It is designed to make web-scale				
EC2 Overview	· · · · · · · · · · · · · · · · · · ·	ier for developers.	-	446 (1977)). 		
FAQs	Amazon EC2's	simple web service interfa	ice allows you to obtain and			
Amazon EC2 SLA	configure capa	configure capacity with minimal friction. It provides you with complete control of your computing resources and lets you run on Amazon's proven computing environment. Amazon EC2 reduces the time required to obtain				
EC2 Instance Types						

Amazon Elastic MapReduce

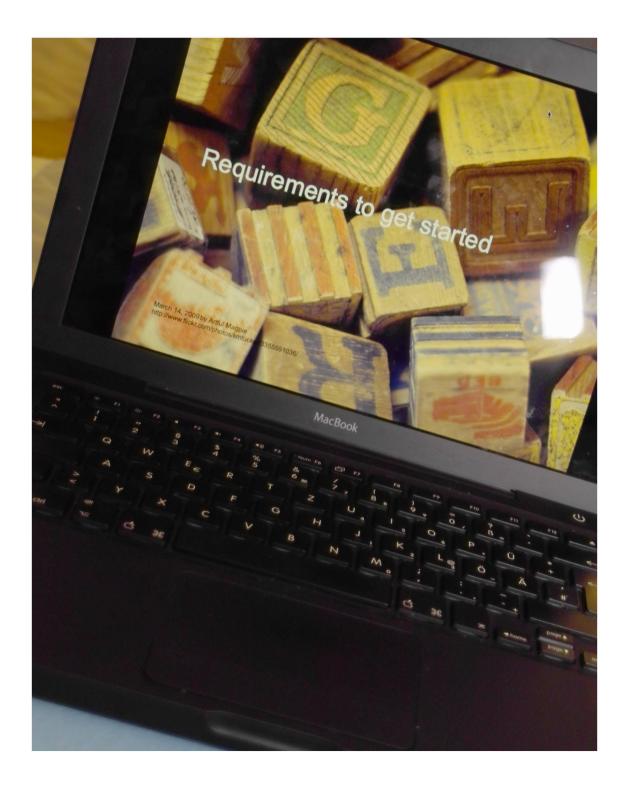
Amazon Elastic MapReduce is a web service that enables businesses, researchers, data analysts, and developers to easily and cost-effectively process vast amounts of data. It utilizes a hosted Hadoop framework running on the web-scale infrastructure of Amazon Elastic Compute Cloud (Amazon EC2) and Amazon Simple Storage Service (Amazon S3).

Using Amazon Elastic MapReduce, you can instantly provision as much or as little capacity as you like to perform data-intensive tasks for applications such as web indexing, data mining, log file analysis, machine learning, financial



(Thanks to Thilo for helping set up the cluster, Thanks to packet and masq for two of the three machines.)





Why go for Apache Mahout?

Jumpstart your project with proven code.

January 8, 2008 by dreizehn28 http://www.flickr.com/photos/1328/2176949559

Discuss ideas and problems online.

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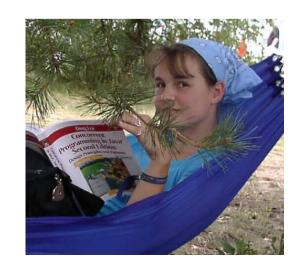




Become a committer.















Sebastian Schelter Jake Mannix Benson Margulies Robin Anil David Hall AbdelHakim Deneche Karl Wettin Sean Owen Grant Ingersoll Otis Gospodnetic Drew Farris Jeff Eastman Ted Dunning Isabel Drost



Become a committer: Of Apache Mahout







Emeritus:

Niranjan Balasubramanian Erik Hatcher Ozgur Yilmazel Dawid Weiss *-user@mahout.apache.org *-dev@mahout.apache.org



Image by: Patrick McEvoy

Interest in solving hard problems. Being part of lively community. Engineering best practices.

Bug reports, patches, features. Documentation, code, examples.



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Accepted devrooms

We were very pleased with the devroom proposals we received, as many were collaborative proposals with ample opportunity for cross-pollination between projects. As a side effect, this did make the decision process even harder.

Data Analytics

Open Source tools for Data Analytics. This includes Machine Learning, Text Mining and Natural Language Processing, Computer Vision, Recommender Engines, Visualisation, Data Mining, Large Scale and distributed data processing, etc.

Thanks to Tim Lossen et. al for taking amazing pictures of the conf.

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Herzlich Willkommen!

l love lelvetik a

Berlin Buzzwords 2011

Search/ Store/ Scale

May/ June 2011

Thanks to Tim Lossen et. al for taking amazing pictures of the conf.

*-user@mahout.apache.org *-dev@mahout.apache.org



Image by: Patrick McEvoy

Interest in solving hard problems. Being part of lively community. Engineering best practices.

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