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

Hello Devoxx!

Hello Devoxx!

Hello Devoxx!

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Machine learning
background?

Hello Devoxx!

Hello Devoxx!

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.

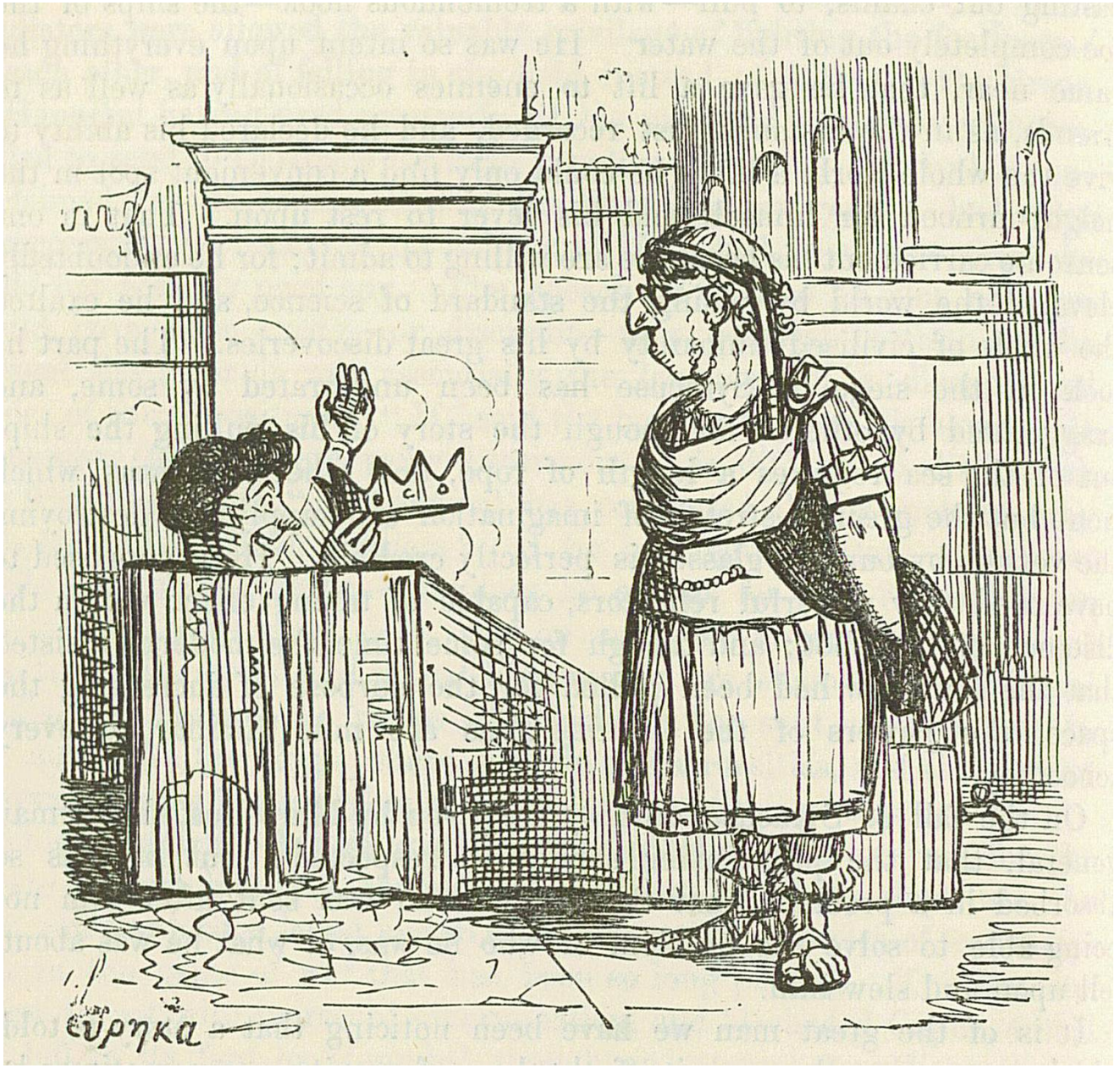
= Extracting patterns from data.

Machine Learning Applications

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

= Extracting prediction models from data.

Machine learning – what's that?



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Bradbury, Evans & Co, London, 1850s
Archimedes taking a Warm Bath

Archimedes model of nature

$$\frac{Density\ of\ Object}{Density\ of\ Fluid} = .$$

$$\frac{Weight}{Weight - Apparent\ immersed\ weight}$$

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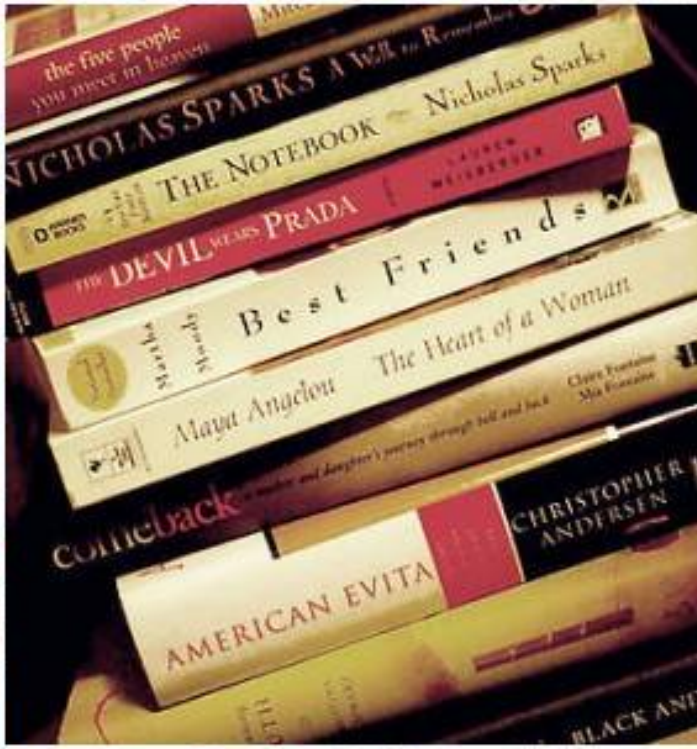
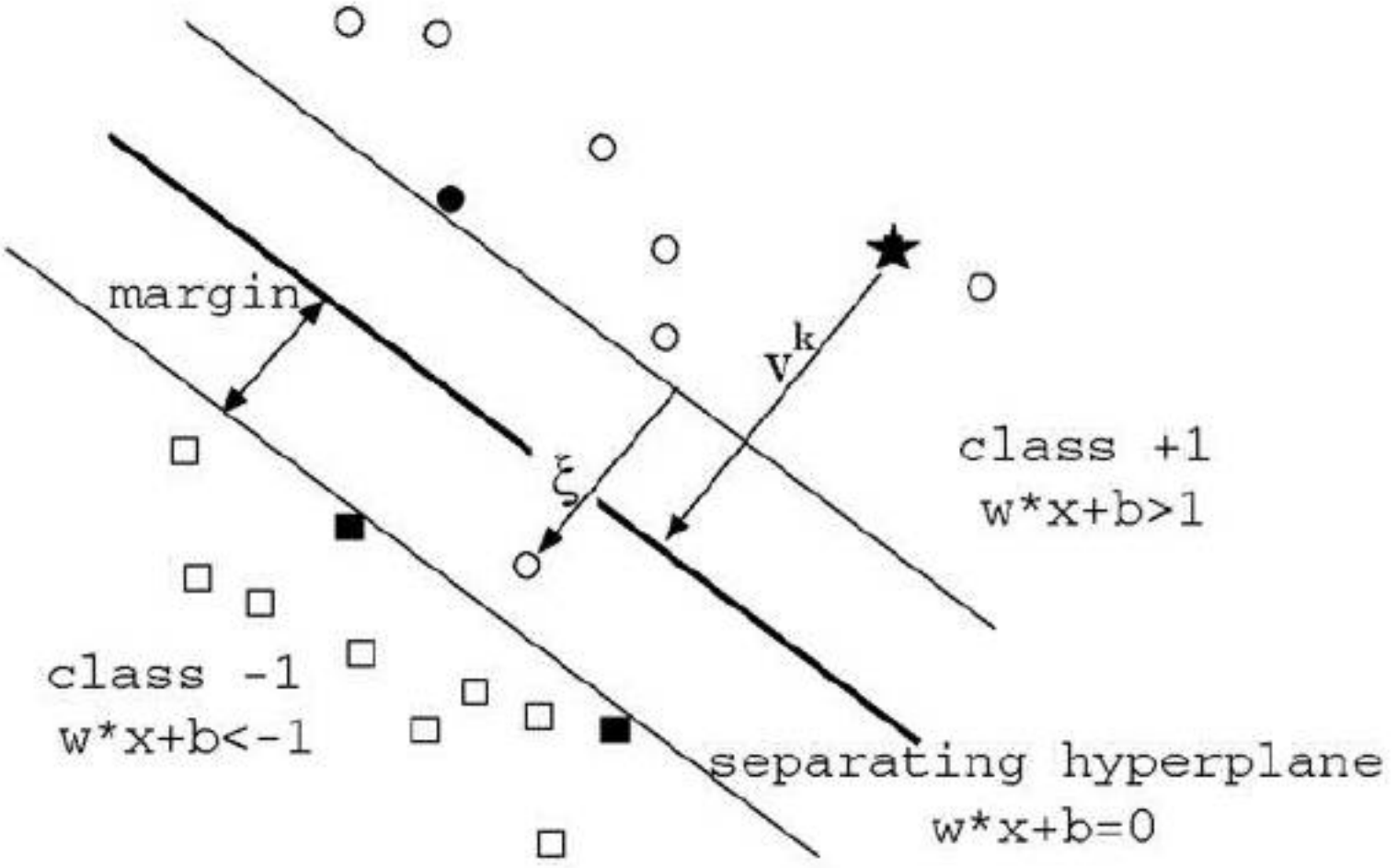


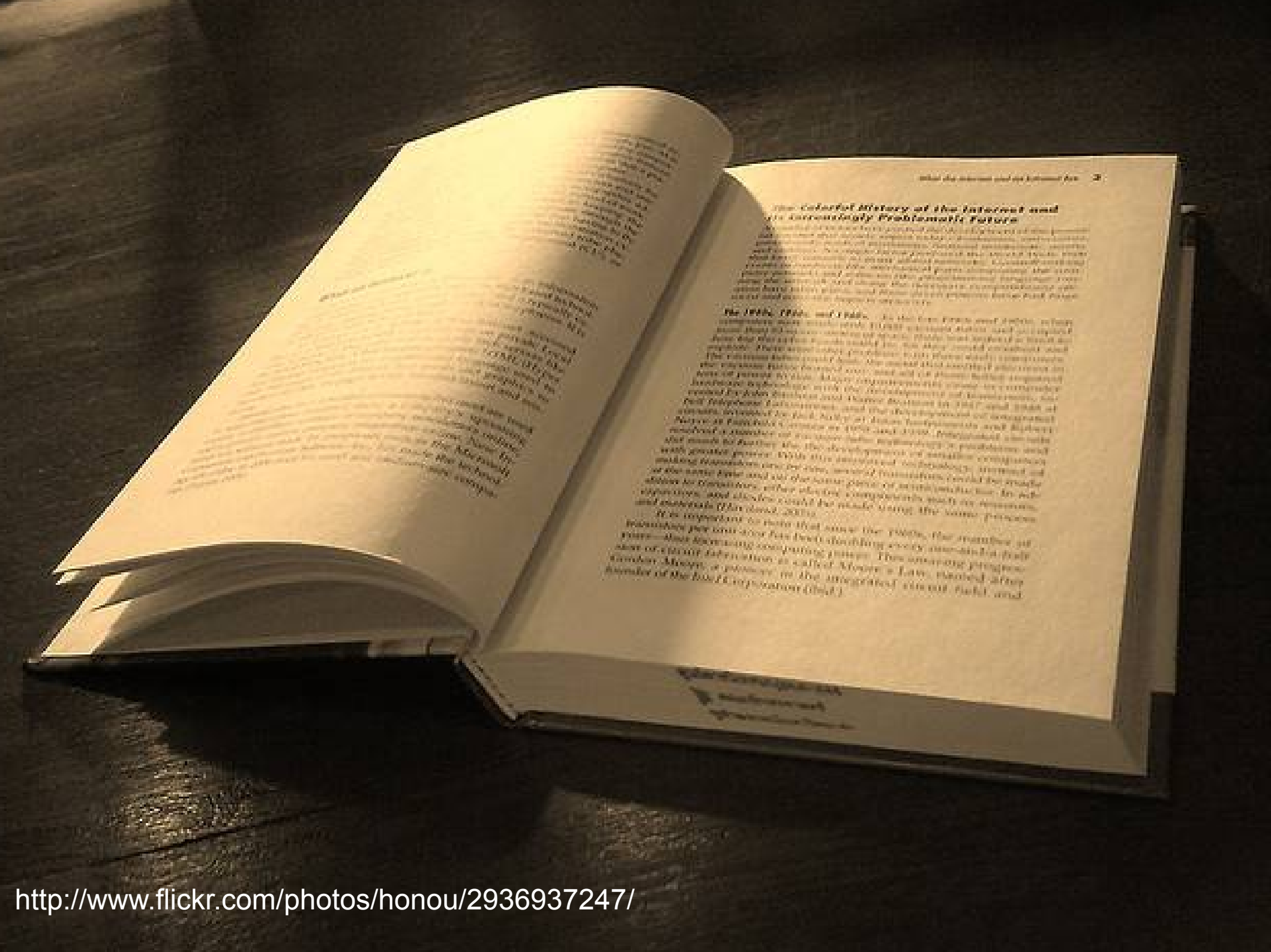
An SVM's model of nature



The challenge

Mission

Provide scalable data mining algorithms.



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HowTo: From data to information.

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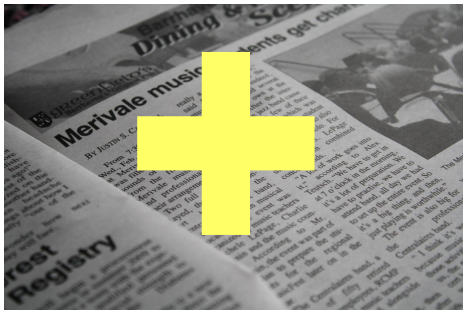

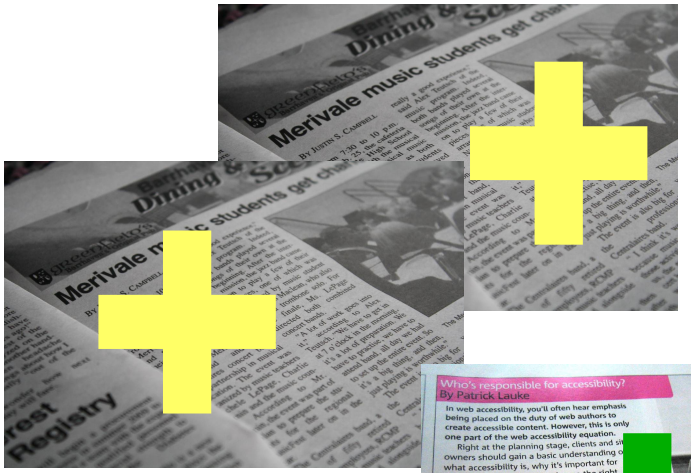

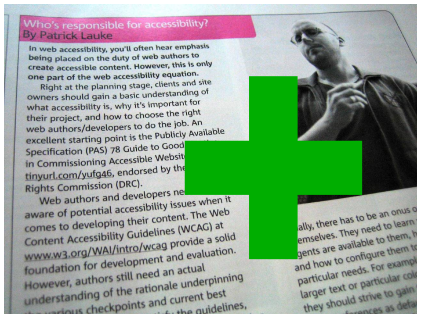

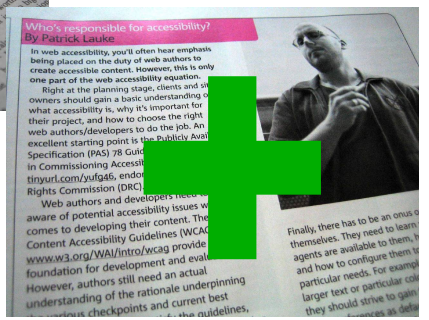

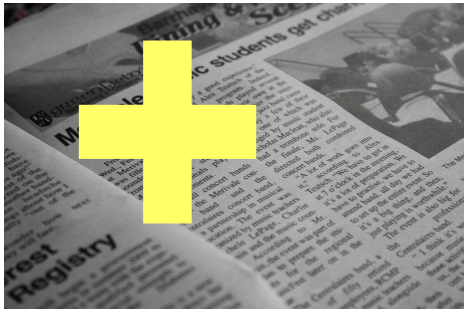

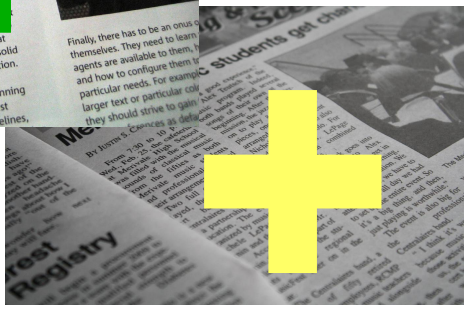

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The **HDFS filesystem** is not restricted to **MapReduce jobs**. It can be used for other applications, many of which are under way at Apache. The list includes the **HBase database**, the **Apache Mahout machine learning system**, and **matrix operations**.

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In Berlin demonstrierten tausende Demonstranten für mehr Datenschutz

Rund 7500 Demonstranten nahmen an dem Protestzug unter dem Motto "Freiheit statt Angst – Stoppt den Überwachungswahn" in Berlin teil.

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3. GEDEN Ressen
4. BUNDESLIGA Der BVB und die Freiburger siegen
5. DAAD Das Ende der Ära Bode

ANZEIGE

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Who's respons
By Patrick Lauke

Merivale mus
By Justin S. Campbell
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The National Aquatics Center lies on the

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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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Rund 7500 Demonstranten nahmen an dem Protestzug unter dem Motto "Freiheit statt Angst – Stoppt den Überwachungswahn" in Berlin teil.

Die Demonstranten wandten sich unter anderem gegen die Volkszählung

DATUM 11.9.2010 - 17:20 Uhr
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SCHLAGWORTE Datenschutz | Demonstration | Datensicherheit | Medienpolitik

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3. URHEBERRECHTE "Wir haben als Kind gelernt, Teilen ist gut"
4. SPAM AUF FACEBOOK "Ein iPad umsonst, ich halte es in den Händen"
5. IPHONE & IPAD APPS Mehr Freiheit im App-Store

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2. CDU Union streitet über konservatives Profil
3. GEDENKTAG 9/11 Obama warnt vor religiösen Ressentiments
4. BUNDESLIGA Der BVB und die Freiburger siegen
5. DAAD Das Ende der Ära Bode

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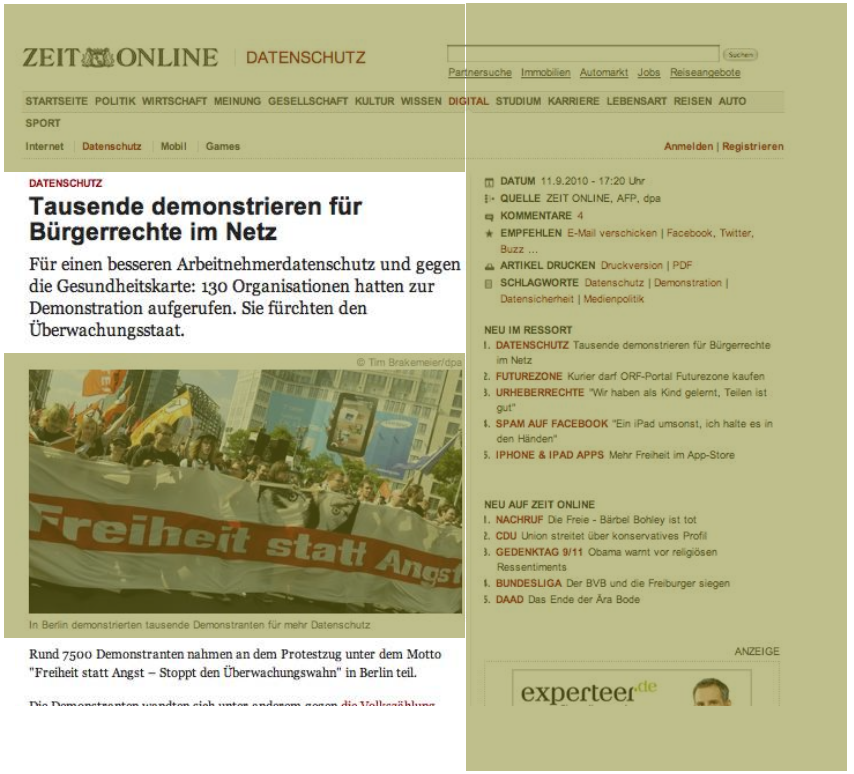
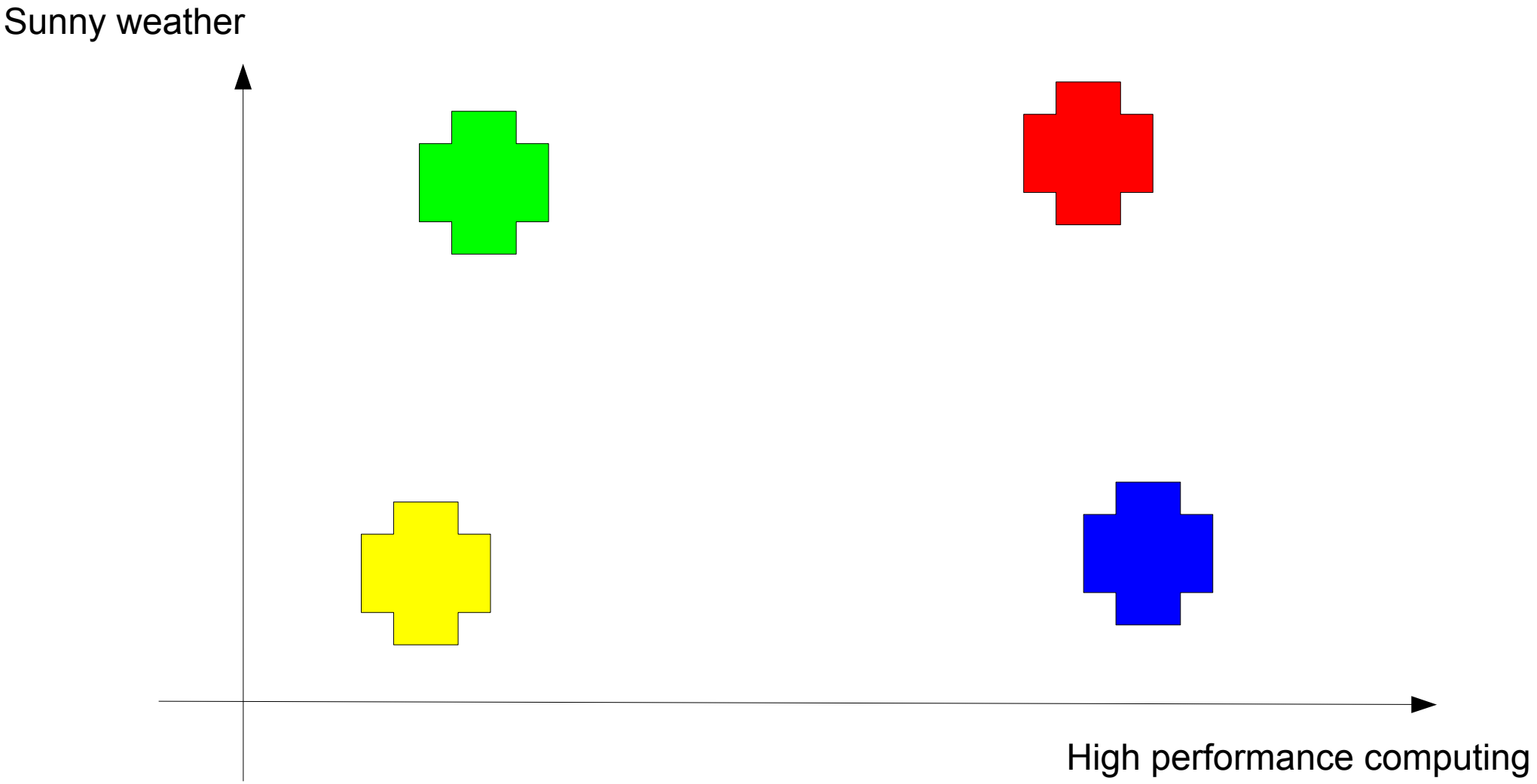


- Remove noise.

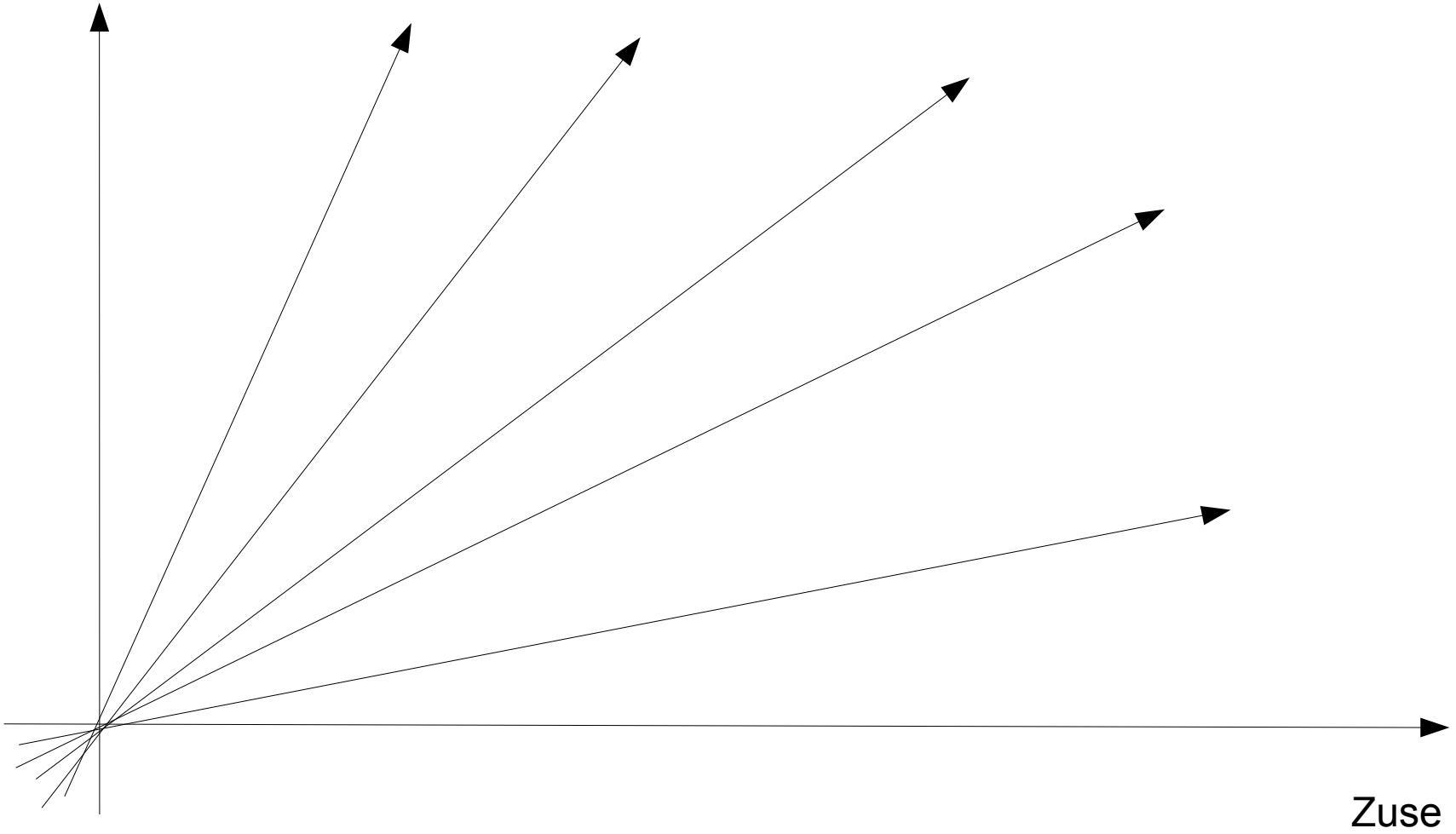
- Remove noise.
- Convert text to vectors.

From texts to vectors

If we looked at two words only:



Aaron



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.
- Problem:
  - Long texts get larger values.

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

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.
- Problem:
  - Additional domain knowledge ignored.

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

Reality

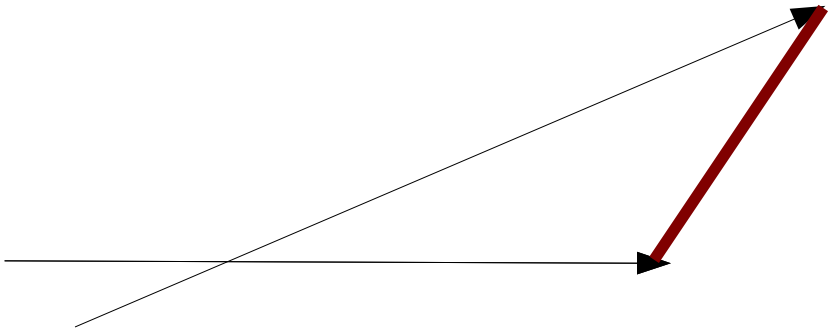
- There are a few more words in news.
- Use all relevant features/ signals available.
  - Words.
  - Header fields.
  - Characteristics of publishing url.
  - …
- Usually pipeline of feature extractors.

From data to information.

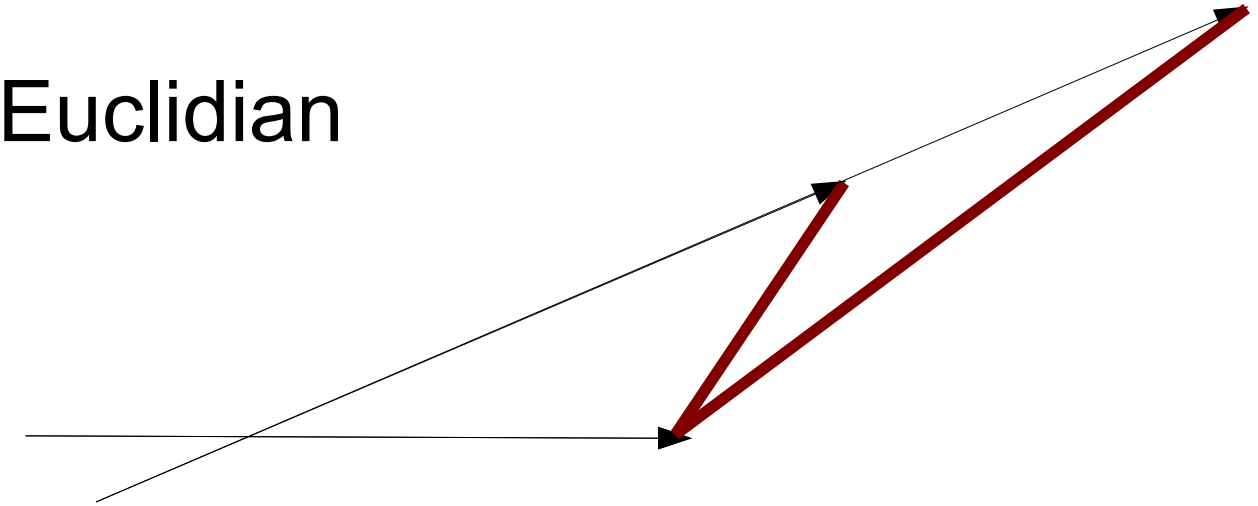
- Collect data and define your learning problem.
- Data preparation.
- Training a prediction model.
- Checking the performance of your model.

Step 2: Similarity

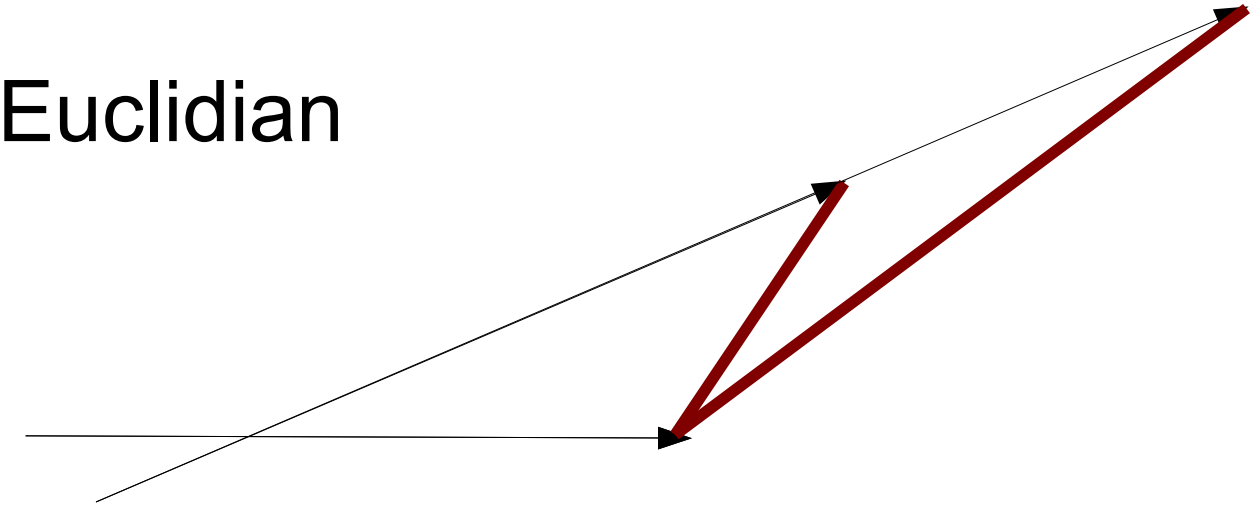
Euclidian



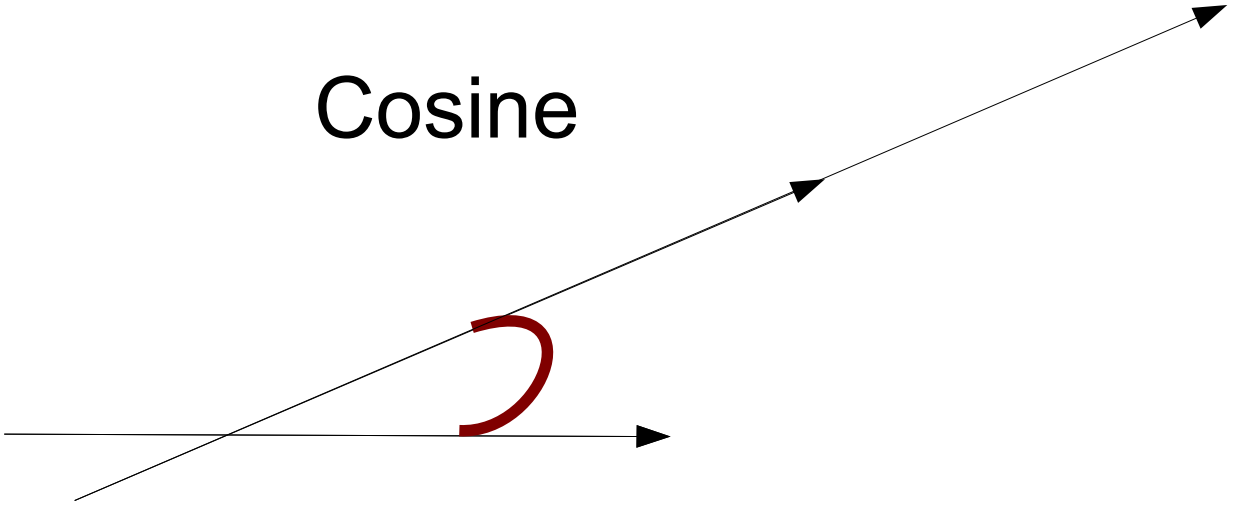
Euclidian



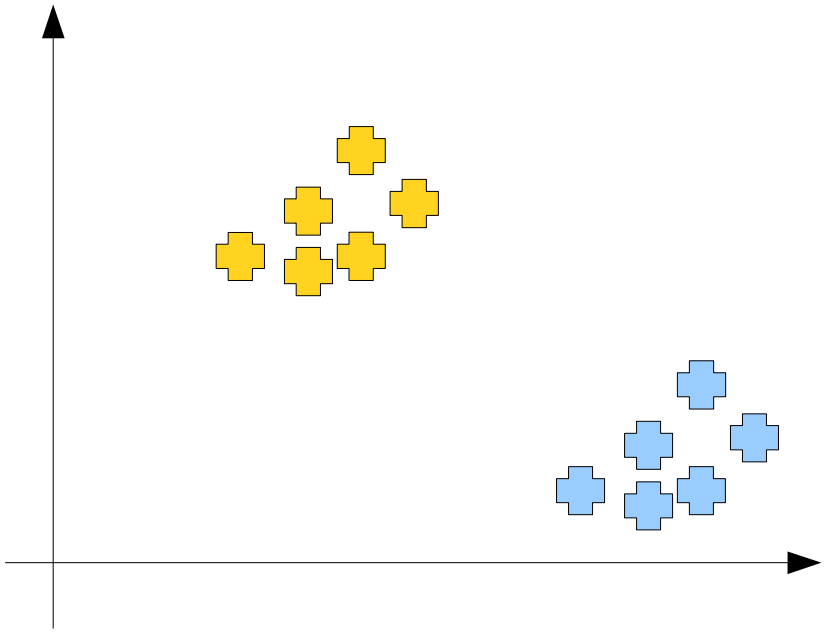
Euclidian

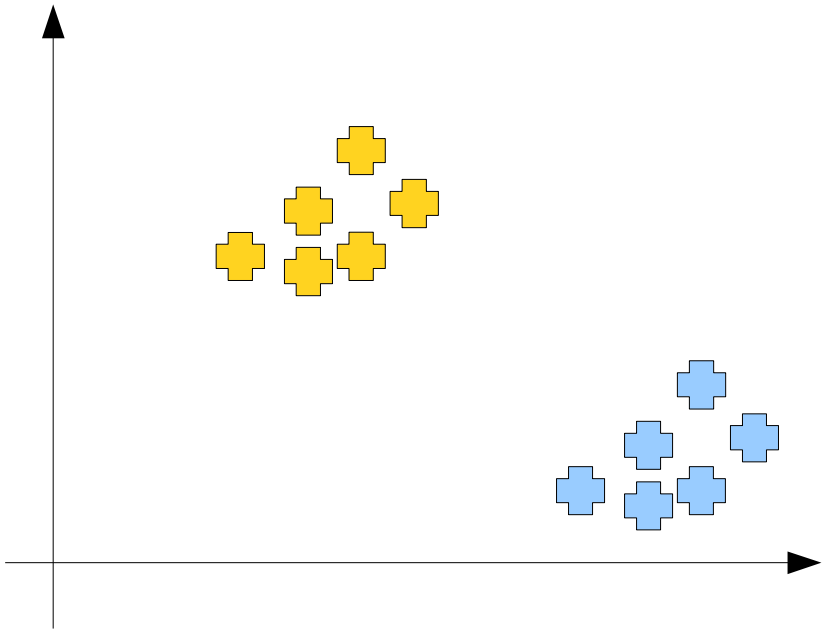


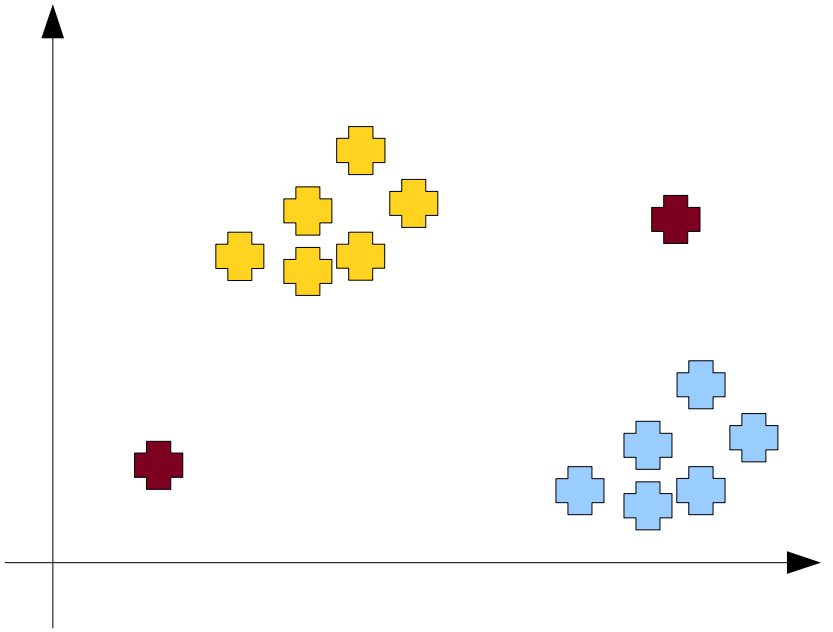
Cosine

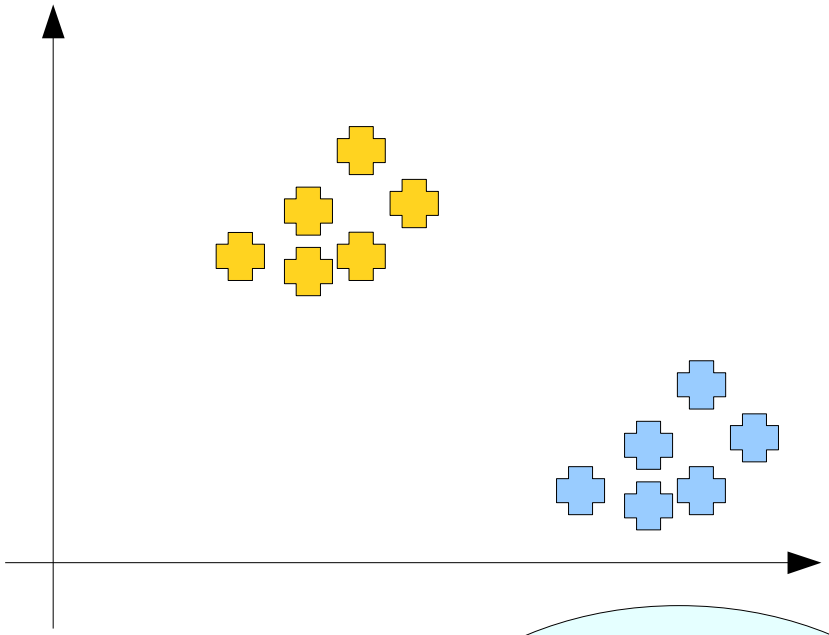


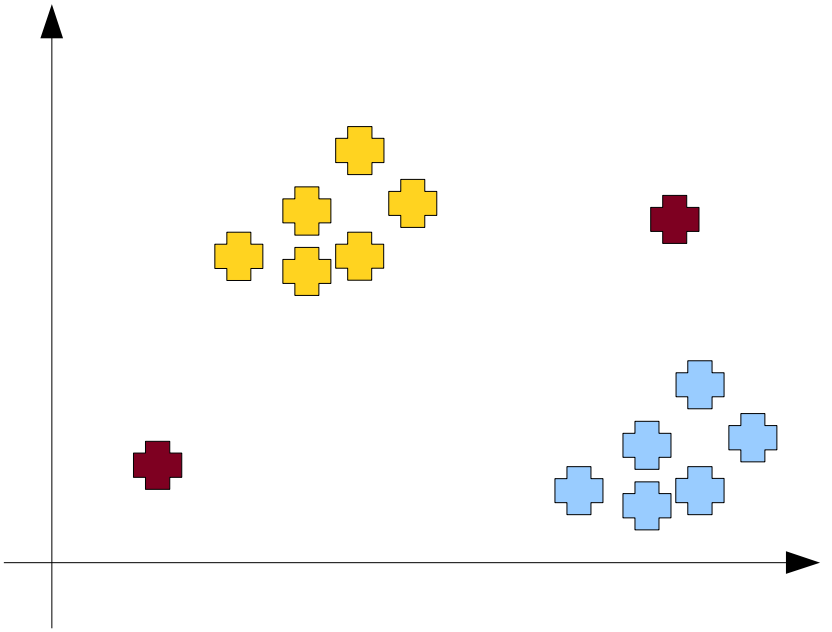
Step 3: Clustering

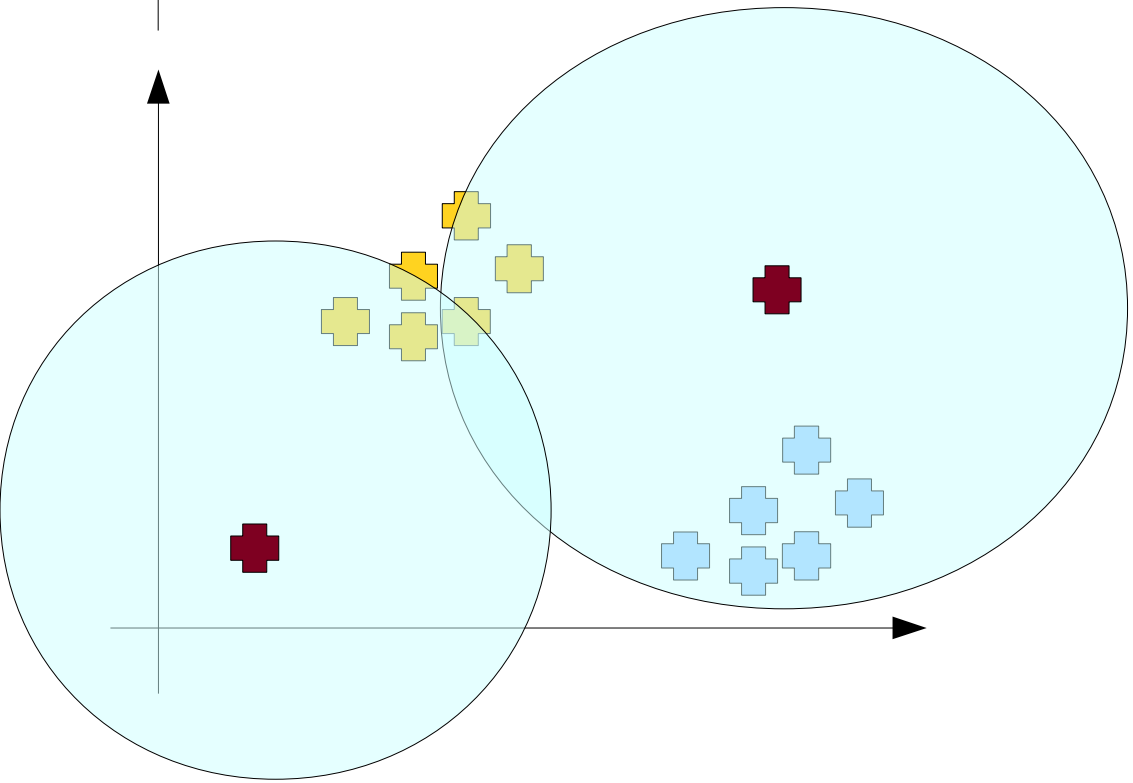


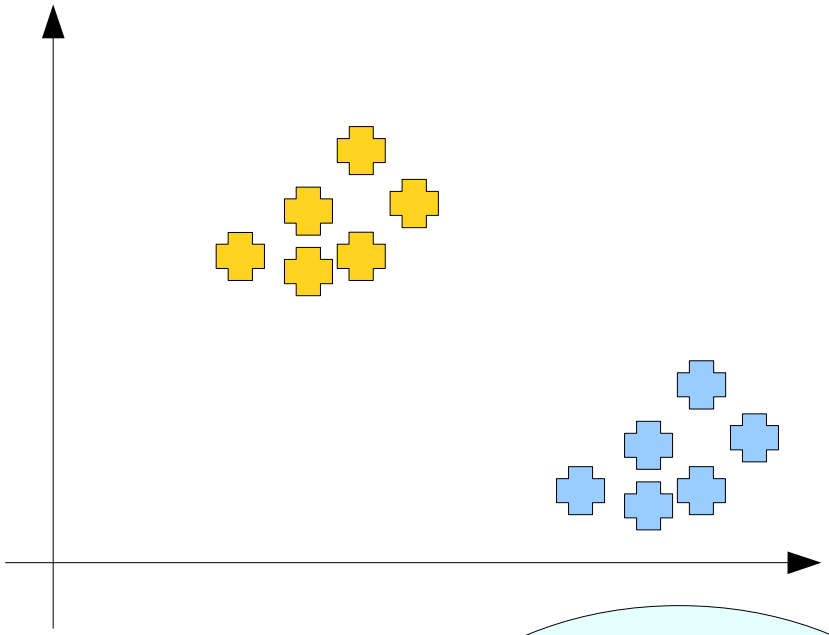


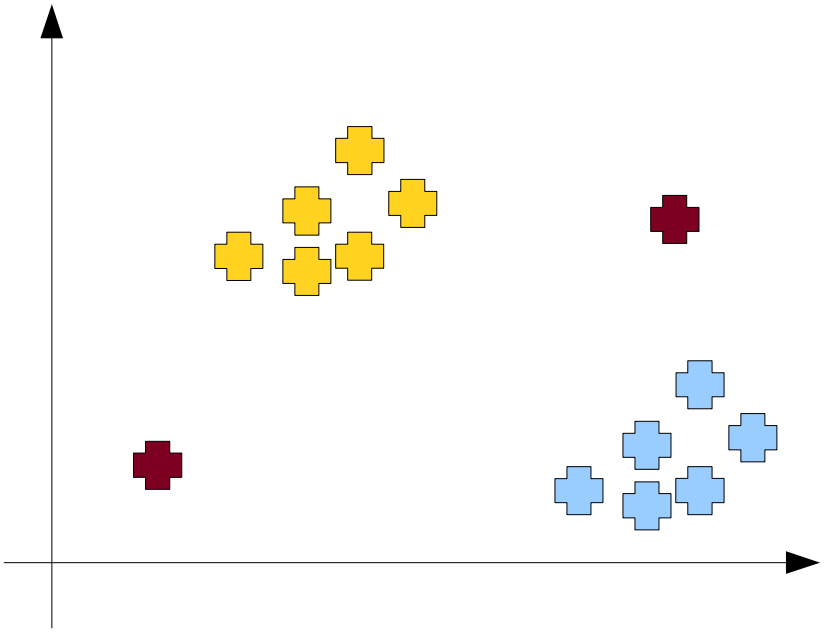


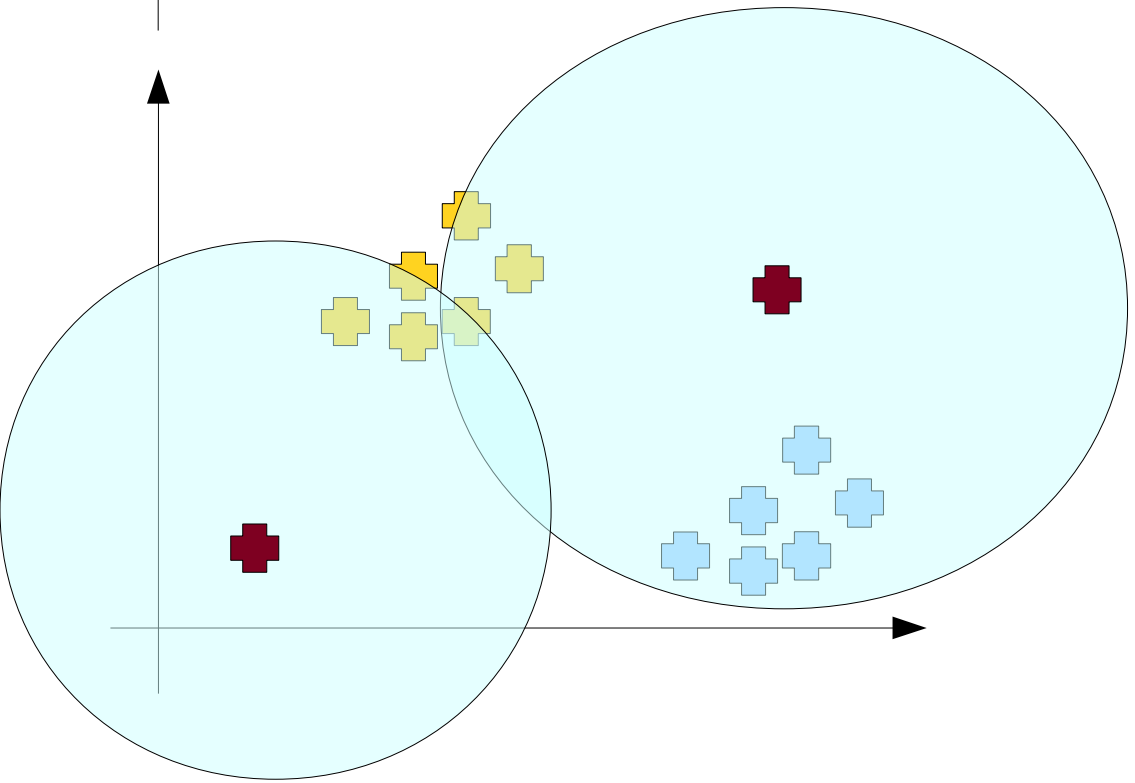


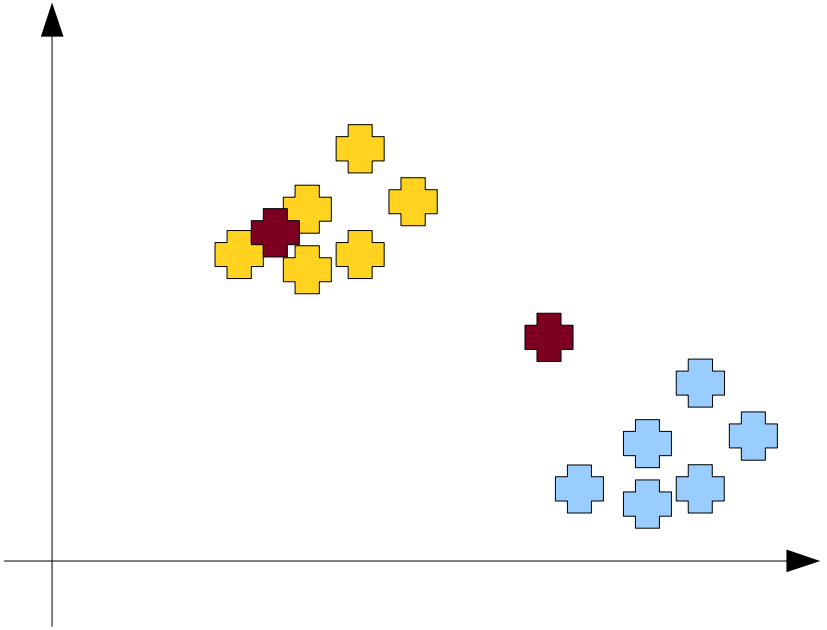


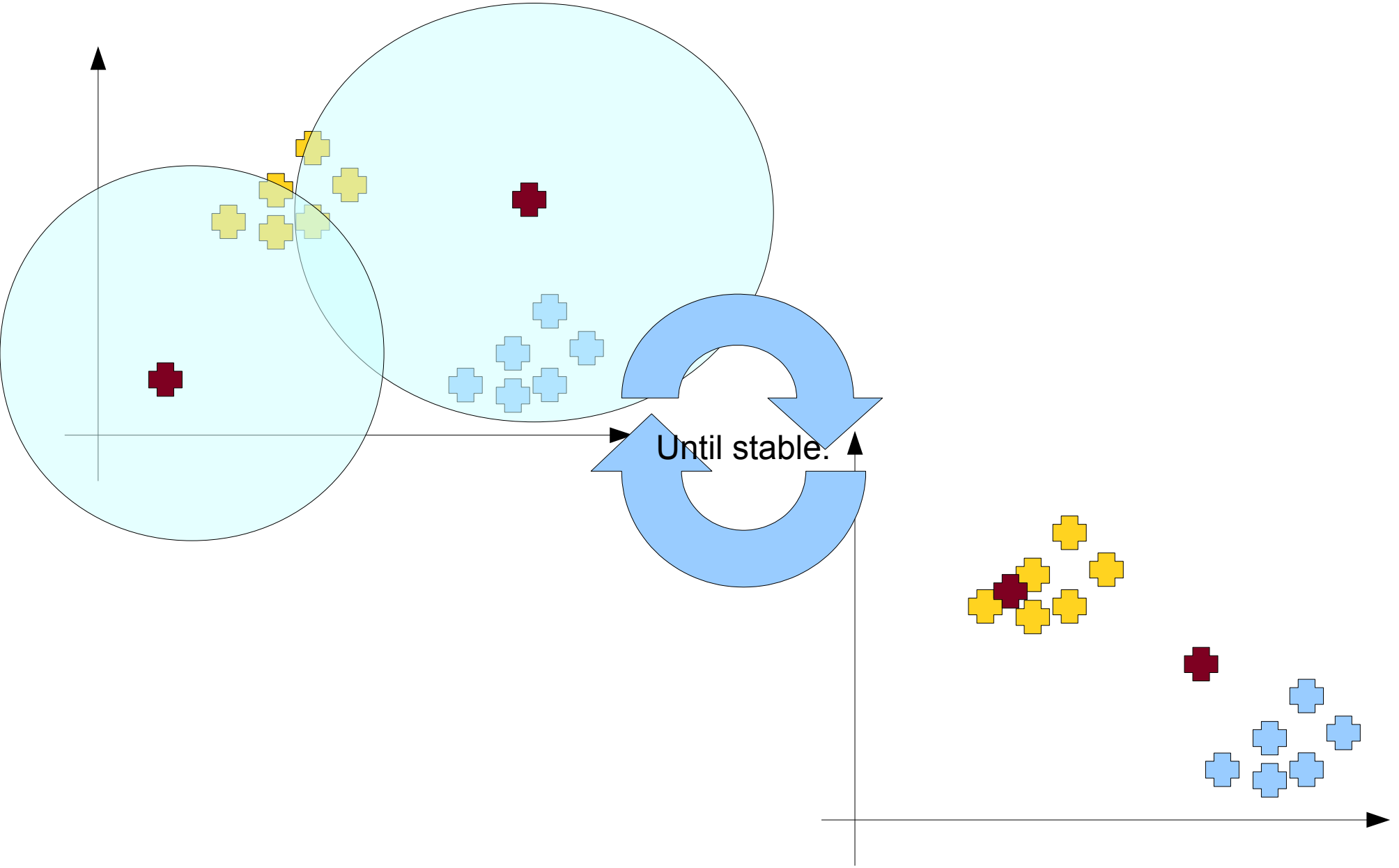











Until stable.

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.

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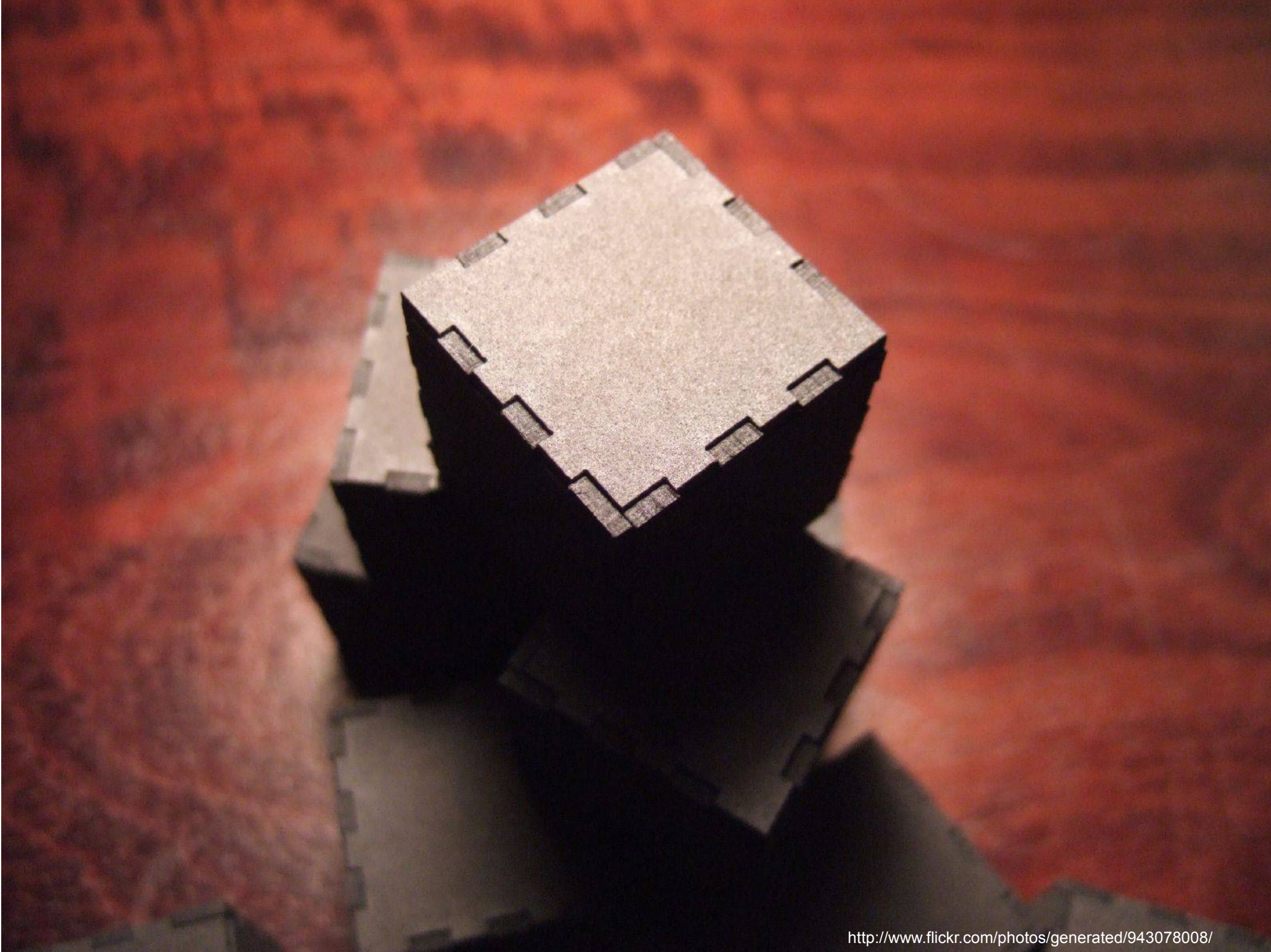
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What else does Mahout have to offer.

Identify dominant topics

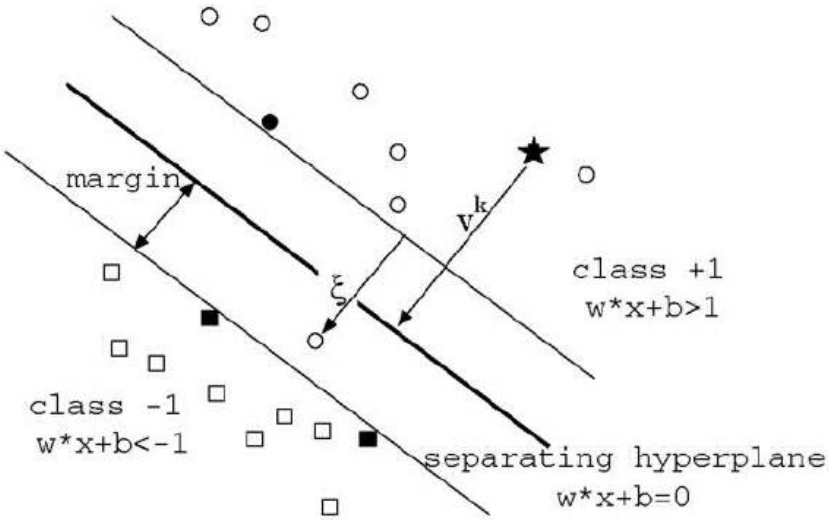
- Given a dataset of texts, identify main topics.

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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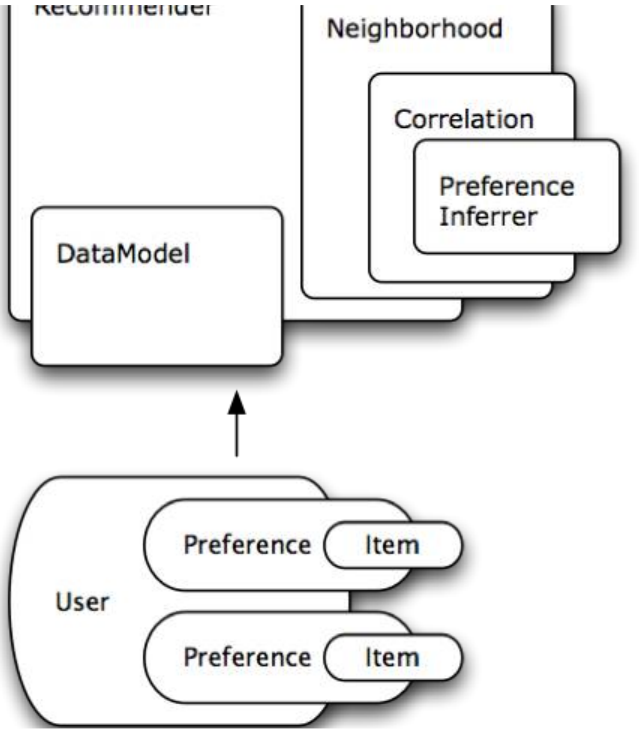
Recommendation mining.

- Collaborative filtering.



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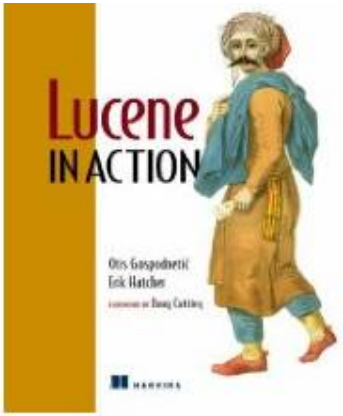

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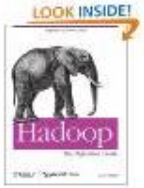
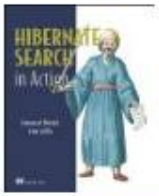


Hadoop: The Definitive Guide by Tom White



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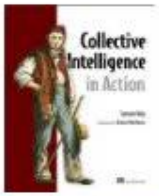
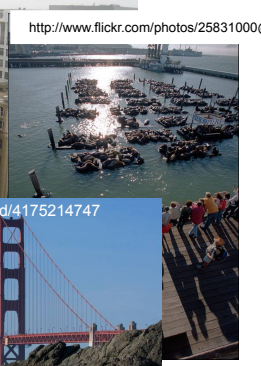
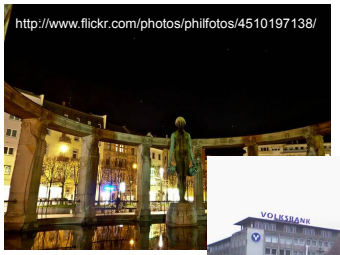
Introduction to Information Retrieval by

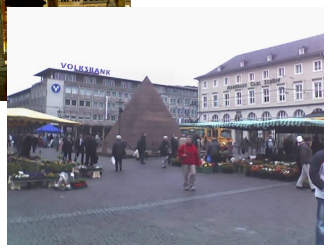


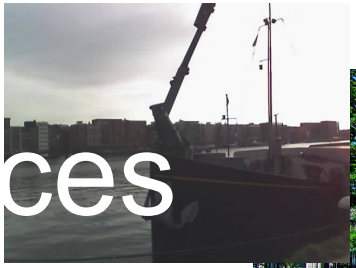
Collective Intelligence in Action by Satnam Alag

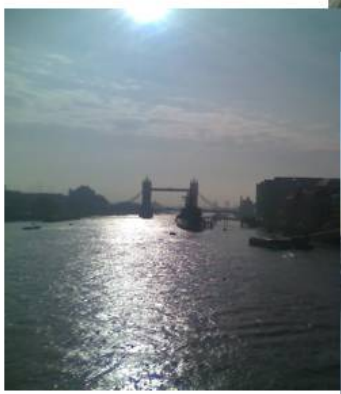
Recommending places

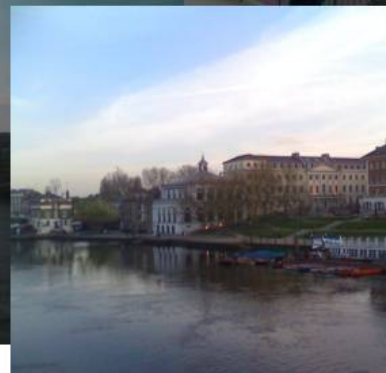












Thanks to Falko Menge for the pictures of Brussels.

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 co-occurring items.

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

By libraryman, http://www.flickr.com/photos/libraryman/78337046/sizes/l/

rypto/3201254932/sizes/l/

By quinnanya, http://www.flickr.com/photos/quinnanya/2806883231/

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

Products & Services

Amazon Elastic Compute Cloud (Amazon EC2)

Amazon EC2 Details

- **EC2 Overview**
- FAQs
- Amazon EC2 SLA
- EC2 Instance Types

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 computing easier for developers.

Amazon EC2's simple web service interface allows you to obtain and 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

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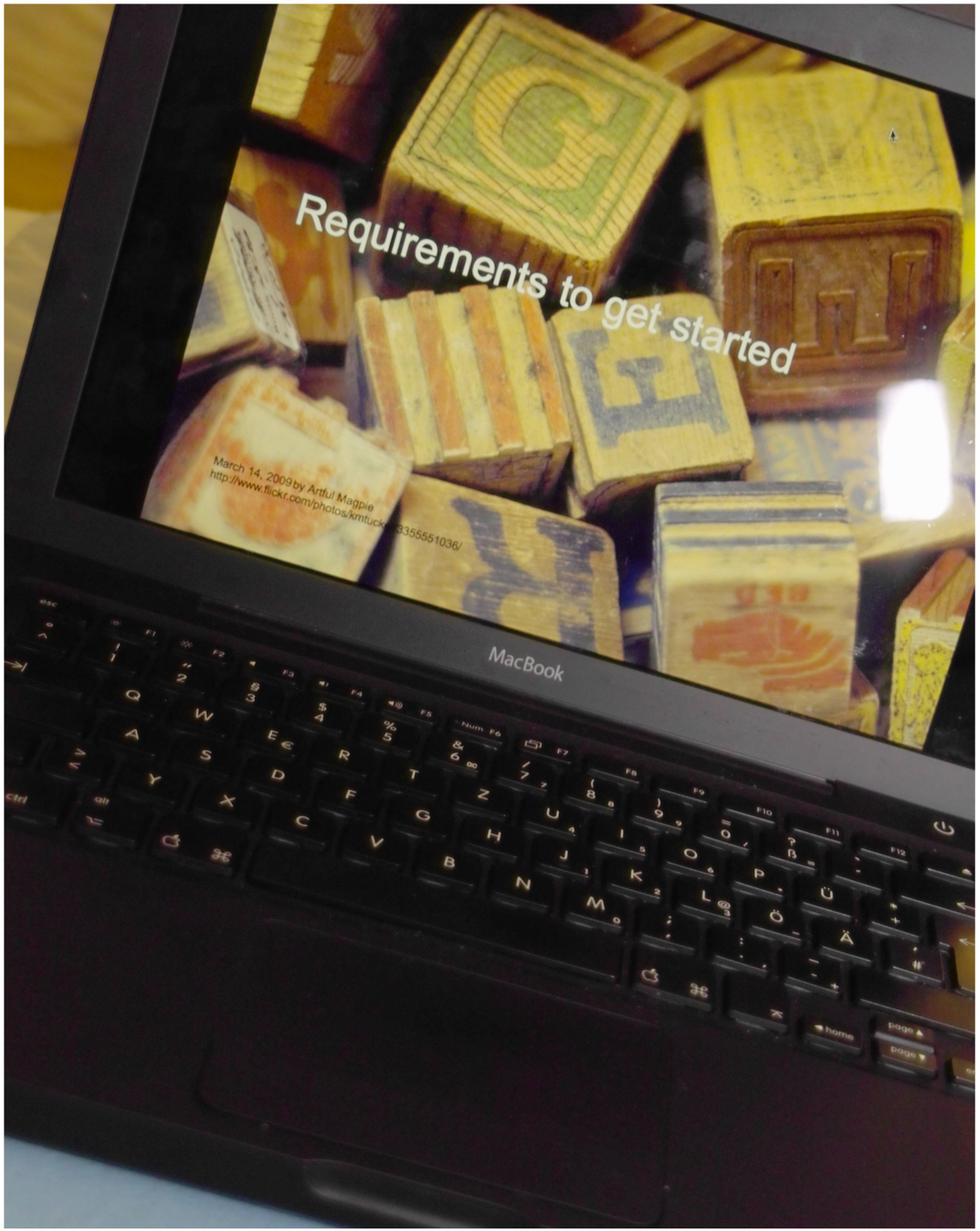
Amazon Elastic MapReduce

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.)


Requirements to get started
March 14, 2009 by Artful Magpie
http://www.flickr.com/photos/kmfuck
3355551036/
MacBook

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.
November 16, 2005 [phil h]
http://www.flickr.com/photos/hi-phi/64055296

http://www.flickr.com/photos/whassupbud55/4581192168

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.

FOSDEM
FREE AND OPEN SOURCE SOFTWARE DEVELOPERS' EUROPEAN MEETING
Search
FOSDEM is the biggest free and non-commercial event organized by and for the community. Its goal is to provide Free and Open Source developers a place to meet. No registration necessary.
Front page
About
FOSDEM
Sponsors
Contact
Home
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.

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

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

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