Motivation and Basics

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Weekly Objectives

- Motivate the study on
  - Machine learning, AI, Datamining….
  - Why? What?
  - Overview of the field
- Short questions and answers on a story
  - What consists of machine learning?
  - MLE
  - MAP
- Some basics
  - Probability
  - Distribution
  - And some rules…

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MOTIVATION

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Keywords

- Many floating keywords
  - Data-mining, Knowledge discovery, Machine Learning, Artificial Intelligence…
- Comes from territory, perspectives, types of problems, researchers, etc
- We are going to focus on substance, not labeling.
- I am just going to call it “Machine Learning”
  - You can call it whatever you want

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Abundance of Data

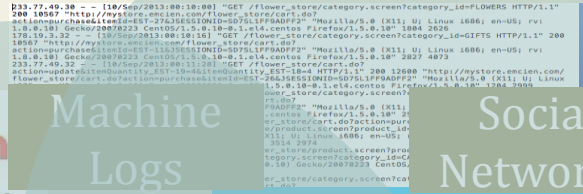
- Data are being collec rywhere

Image Data

Surveillance Data

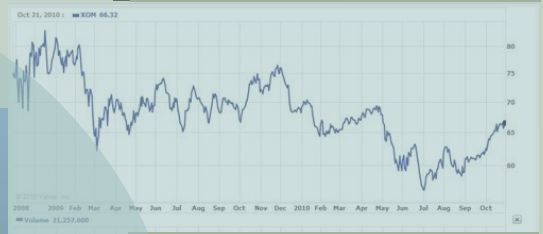
Network Data

Text Data



Machine Logs

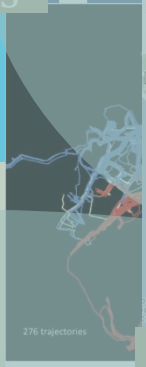
Social Networks

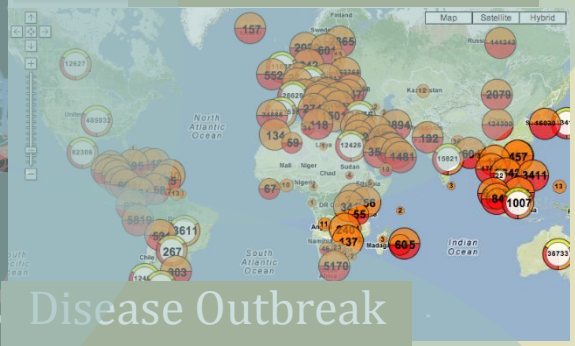


Trajectory Data

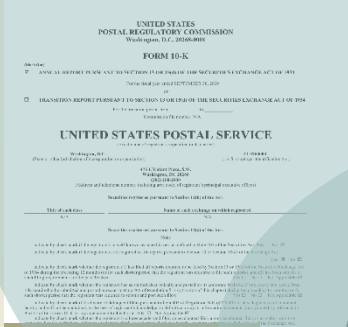
News Articles

Social Media

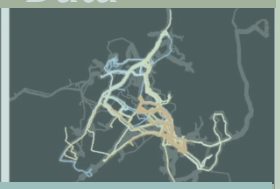




Disease Outbreak Data



10K Rep.



Time Series Data

Purchase+Review Data

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Examples of Machine Learning Applications

- Machine Learning is everywhere…

Document Classification

Sports
Science
News

Stock Market Prediction

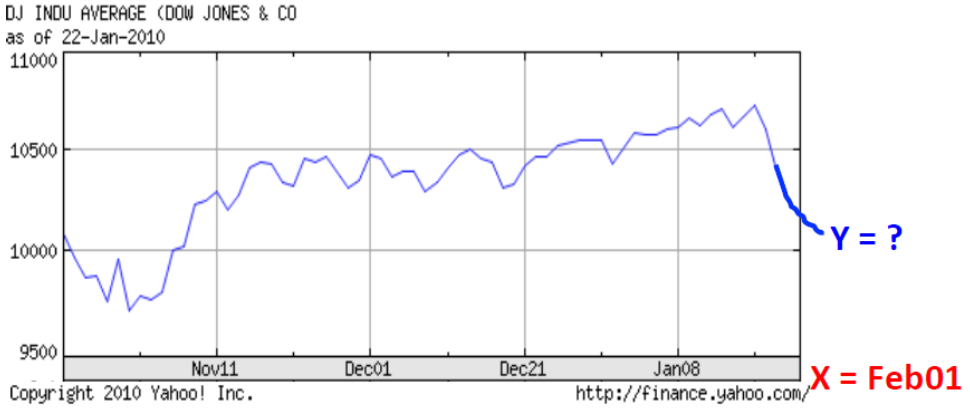
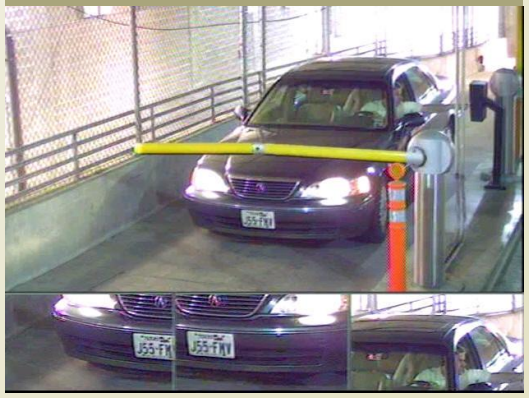
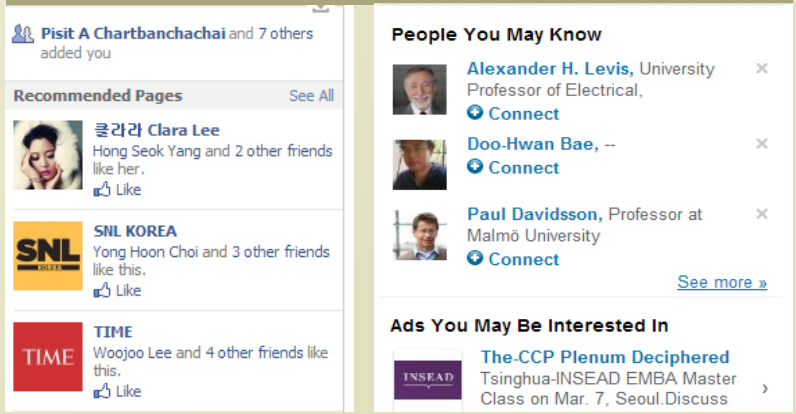


Plate Num. Recognition



SNS Recommendation



Helicopter Control

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Spam Filtering and more

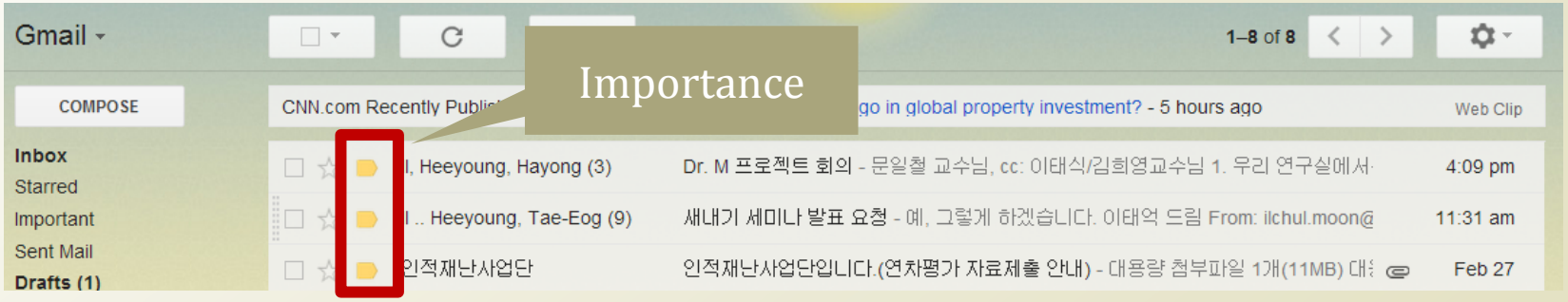


Table 2: Detailed evaluation results of SVMs with each representation scheme and varying training-set sizes. Macro-averaged MAE scores are provided with p-values, indicating the statistical significances of performance improvement over that of BF (using basic features alone). Numbers in bold fond indicate the best method for each fixed training-set size. One star indicates the p-values in (0.01, 0.05]; two stars indicate the p-values equal or less than 1%.

	BF	BF+NC		BF+SI		BF+SIP		BF+SI+NC		BF+SI+NC+SIP	
# of tr	MAE	MAE	p-value	MAE	p-value	MAE	p-value	MAE	p-value	MAE	p-value
10	0.9666	0.9063	* 0.0382	0.8837	* 0.0106	0.8968	* 0.0311	0.9112	* 0.0211	**0.8827**	** 0.0087
20	0.9720	0.8969	0.0506	**0.8596**	* 0.0315	0.9095	* 0.0435	0.9071	0.0558	0.8659	* 0.0235

SVM?

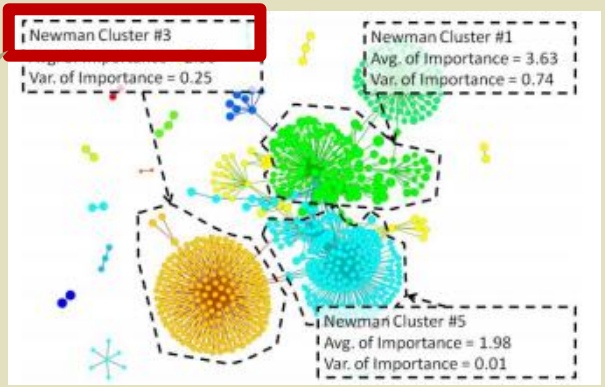
- Spam filter
- More?
  - Importance vs. Urgency
- How to predict an important email?
  - Social networks
  - Contents
- Shinjae Yoo, Yiming Yang, Frank Lin, and Il-Chul Moon, Mining Social Networks for Personalized Email Prioritization, ACM SIGKDD Conference, Paris, France, Jun, 28, 2009

Features

5.3 Features

The basic features are the tokens in the sections of *from*, *to*, *cc*, *title*, and *body text* in email messages. Let us use a v-dimensional [illegible] is the vocabulary size. We call it the *basic feature* (BF) sub-vector.

Clusters? Is this a machine learning technique?



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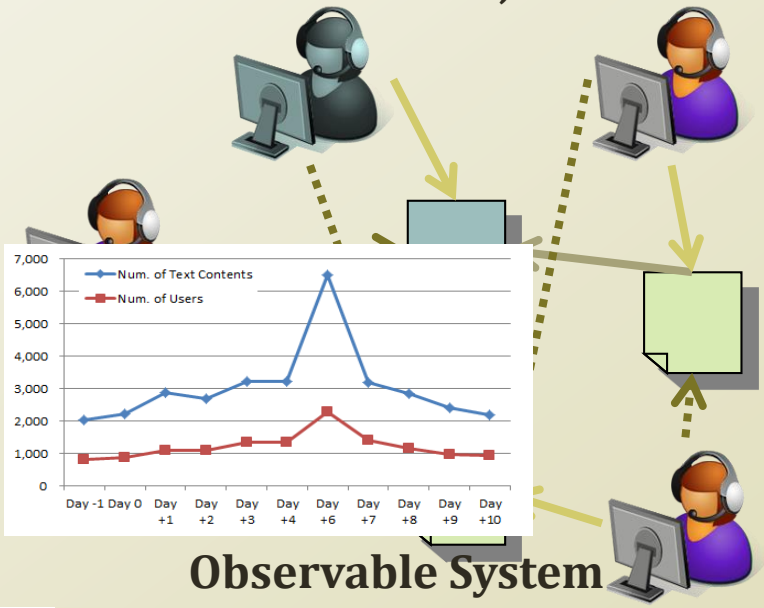
Opinion Mining and more

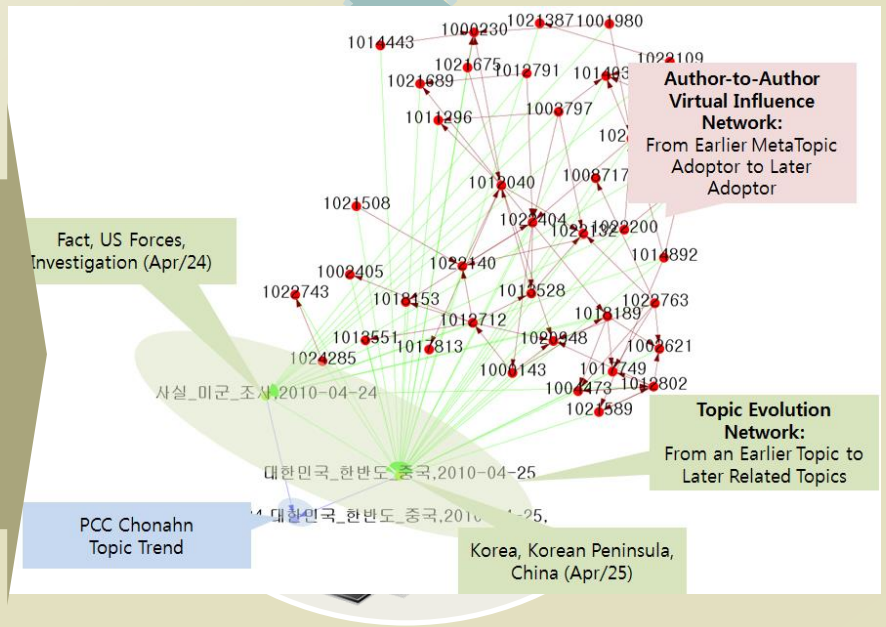
PCC Cheonan Sank on Mar 26, 2010

Finding out consensus of the population
- Mining population's perception of the event
- Mining key opinion buried in a data chunk
- Estimating future polarity of the population
- Strategy to maintain the unity of the population



Observable System

Data-mining on SNS and Texts



Implicit System

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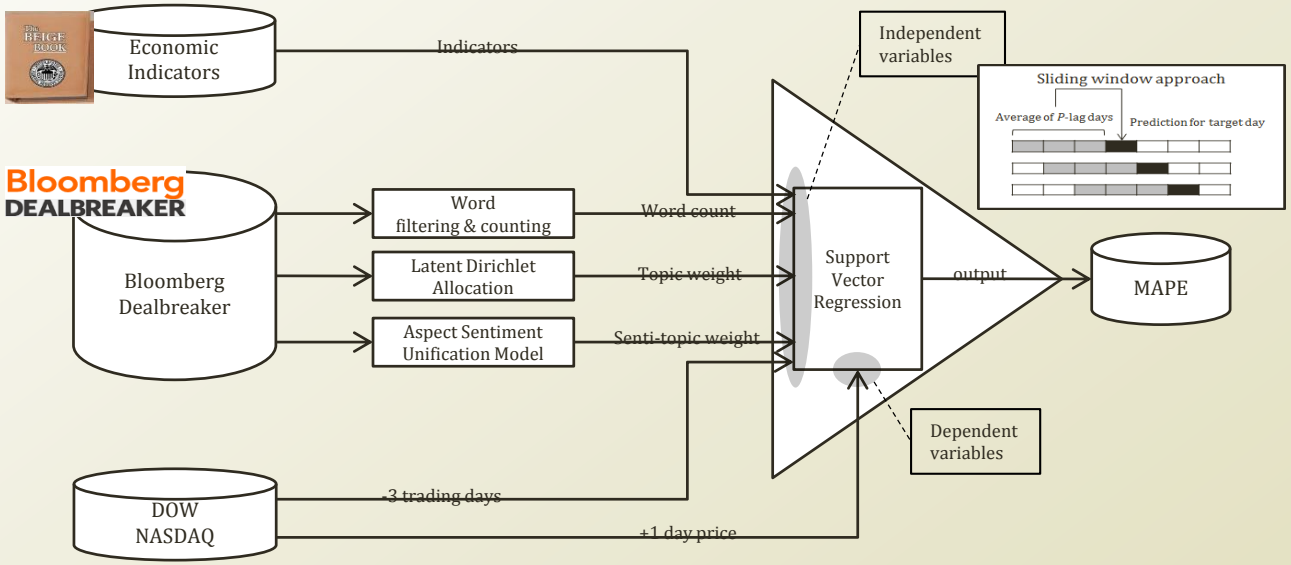
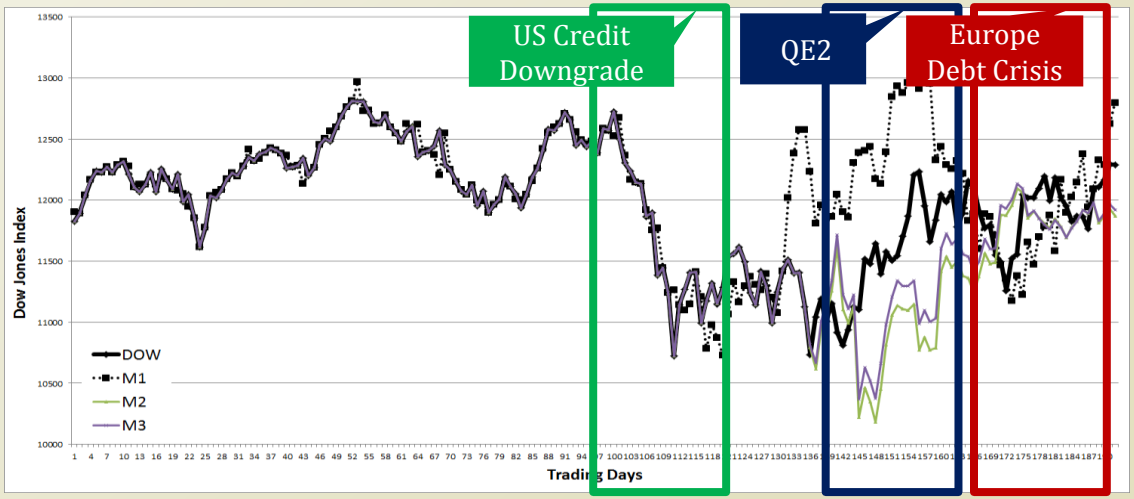
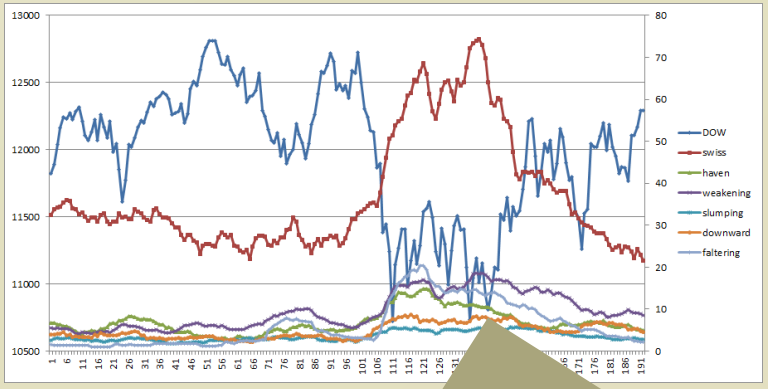
Stock Market Prediction and more



High Coefficients on Prediction

TopicWeight 26	TopicWeight 1	TopicWeight 7
-0.609	0.520	0.508
notes	obama	jun
moodys	republican	pence
swaps	republicans	na
treasuries	congress	swiss
versus	senate	chg
ratings	bill	francs
auction	barack	spa
default	lawmakers	fullyear
strategist	administration	nv
franc	democrats	dividend
twoyear	taxes	firstquarter
samp	white	ks
currencies	workers	paris
yen	democrat	reporting
swiss	obamas	tech





Heavy negative correlation between *"swiss"* and DJIA

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Types of Machine Learning

Machine Learning

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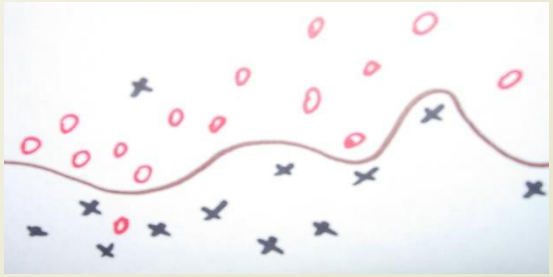
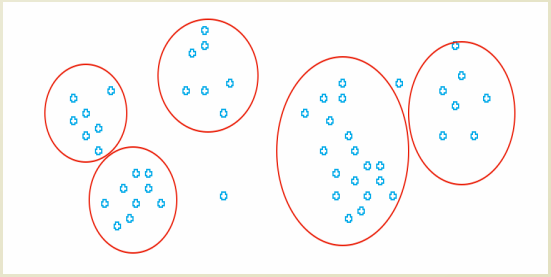
Supervised Learning

You know the true answers of some of instances



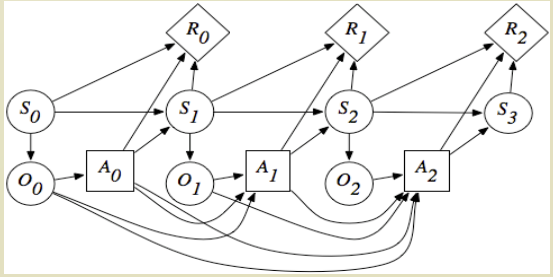
Unsupervised Learning

You do not know the true answers of instances



Reinforcement Learning

You do know the objective, but you do not know how to achieve



- ***You*** can
  - Machine learning
  - Dataset provider
  - Machine learning users
  - etc

- Various classifications by different professors
  - Purpose, data types, etc
- Other learning classifications also exist

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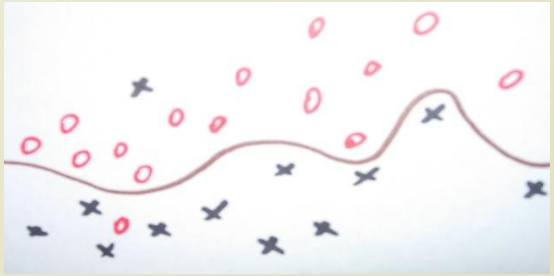
Supervised Learning

Supervised Learning

You know the true answers of some of instances



- **You know the true value, and you can provide examples of the true value.**
- Cases, such as
  - Spam filtering
  - Automatic grading
  - Automatic categorization
- Classification or Regression of
  - Hit or Miss: Something has **either disease or not.**
  - Ranking: Someone received **either A+, B, C, or F.**
  - Types: An article is **either positive or negative.**
  - Value prediction: The price of this artifact is **X.**
- Methodologies
  - Classification: estimating a discrete dependent value from observations
  - Regression: estimating a (continuous) dependent value from observations

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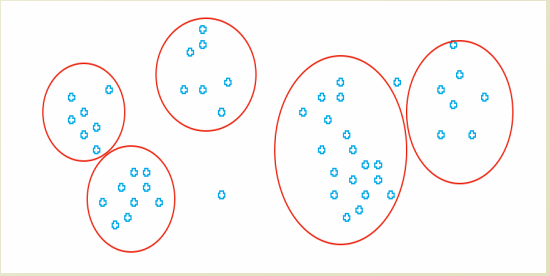
Unsupervised Learning

Unsupervised Learning

You **do not know the true answers of instances**



- **You don't know the true value, and you cannot provide examples of the true value.**
- Cases, such as
  - Discovering clusters
  - Discovering latent factors
  - Discovering graph structures
- Clustering or filtering or completing of
  - Finding **the representative topic words from text data**
  - Finding **the latent image from facial data**
  - Completing the incomplete **matrix of product-review scores**
  - Filtering the **noise from the trajectory data**
- Methodologies
  - Clustering: estimating sets and affiliations of instances to the sets
  - Filtering: estimating underlying and fundamental signals from the mixture of signals and noises

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