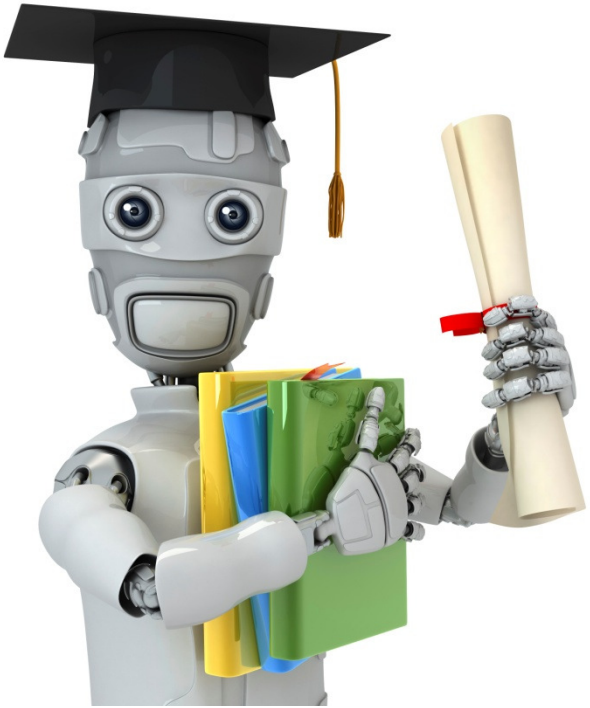

Machine Learning

Introduction

Welcome

Apple - iPhoto - New full-
www.apple.com/ilife/iphoto/
Store
Mac
iPod
iPhone
iPad
iTunes
Support
iLife '11
iPhoto
iMovie
GarageBand
Video Showcase
Resources
Upgrade Now
iPhoto '11
From your Facebook Wall to your coffee table to your best friend's inbox (or mailbox). Do more with your photos than you ever thought possible. And do it all in one place. iPhoto.
Watch the iPhoto video
MacBook Pro
What's New in iPhoto
What is iPhoto?

Andrew Ng

Machine Learning

- Grew out of work in AI
- New capability for computers

Examples:

- Database mining

  Large datasets from growth of automation/web.

  E.g., Web click data, medical records, biology, engineering

- Applications can’t program by hand.

  E.g., Autonomous helicopter, handwriting recognition, most of Natural Language Processing (NLP), Computer Vision.

Machine Learning

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- Self-customizing programs

  E.g., Amazon, Netflix product recommendations

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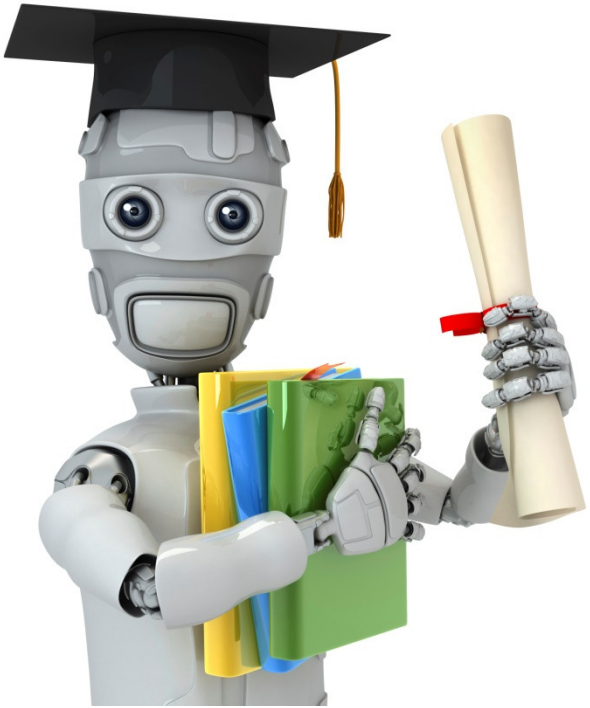
- Understanding human learning (brain, real AI).



Machine Learning

Introduction

What is machine learning

Machine Learning definition

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- Arthur Samuel (1959). Machine Learning: Field of study that gives computers the ability to learn without being explicitly programmed.

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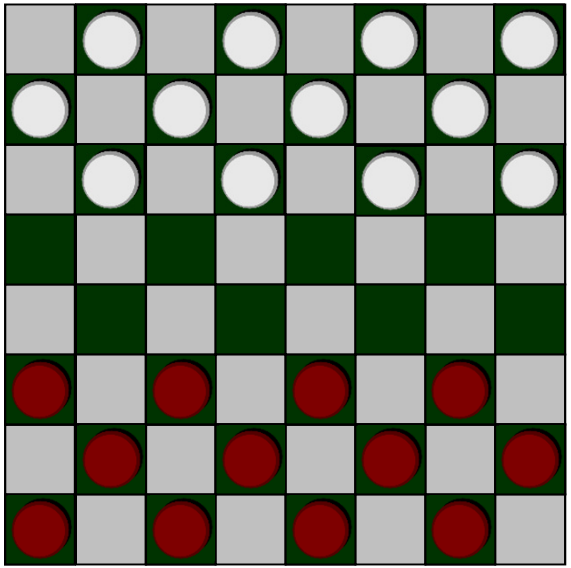


Machine Learning definition

- Arthur Samuel (1959). Machine Learning: Field of study that gives computers the ability to learn without being explicitly programmed.
- Tom Mitchell (1998) Well-posed Learning Problem: A computer program is said to *learn* from experience E with respect to some task T and some performance measure P, if its performance on T, as measured by P, improves with experience E.

"A computer program is said to *learn* from experience E with respect to some task T and some performance measure P, if its performance on T, as measured by P, improves with experience E."

Suppose your email program watches which emails you do or do not mark as spam, and based on that learns how to better filter spam. What is the task T in this setting?

- Classifying emails as spam or not spam.
- Watching you label emails as spam or not spam.
- The number (or fraction) of emails correctly classified as spam/not spam.
- None of the above—this is not a machine learning problem.

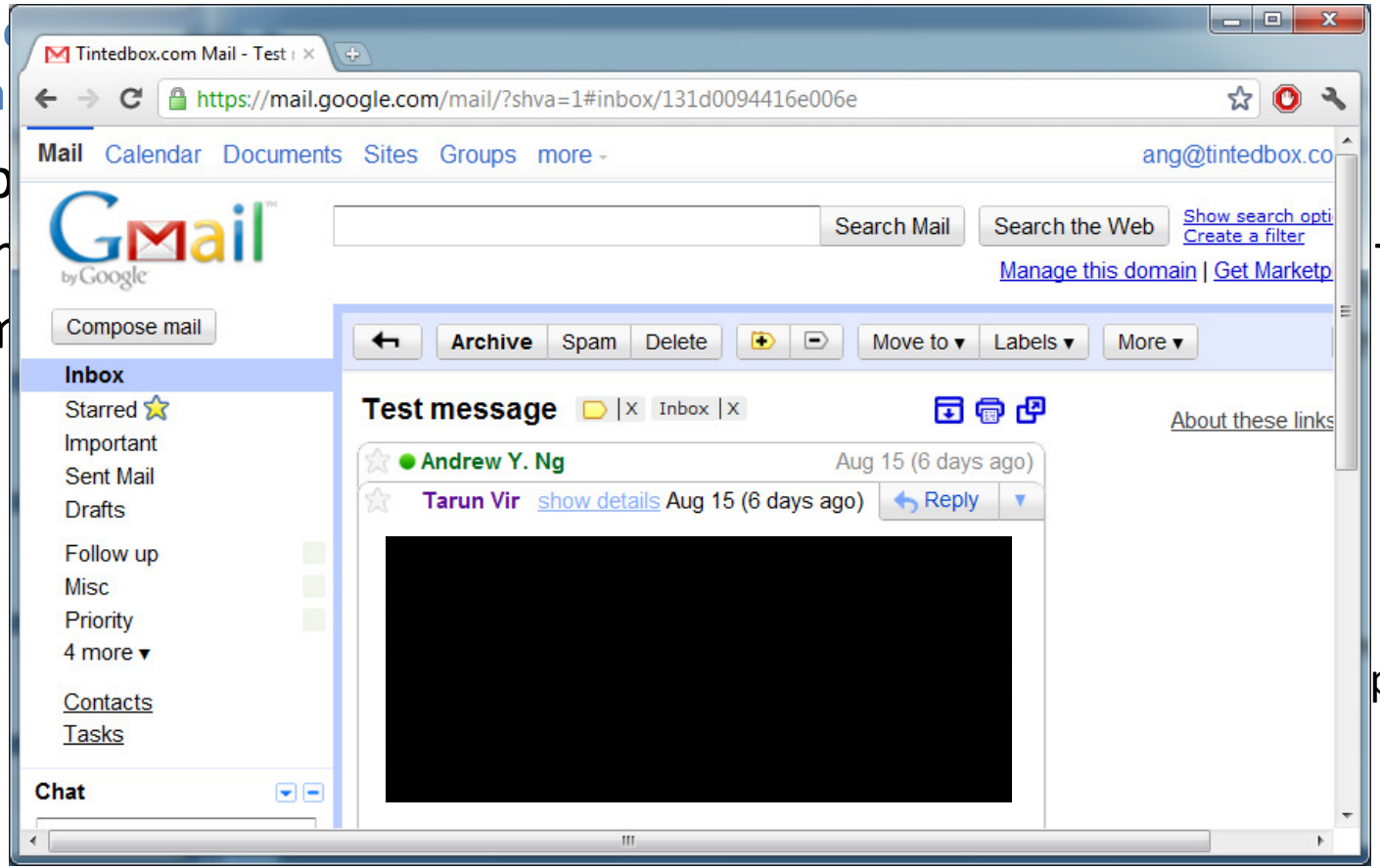
T ←

E ←

P ←

"A computer program is said to *learn* from experience E with respect to s on T, a

Supp or do not r filter spam



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T ←

E ←

P ←

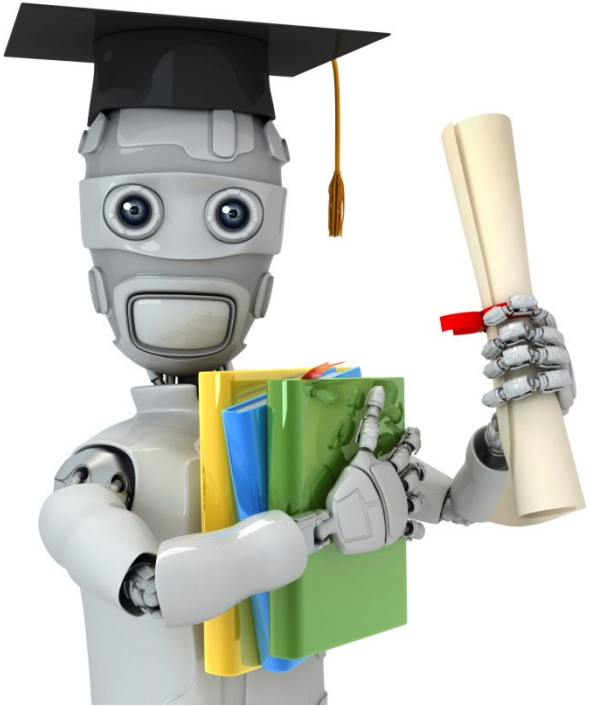
Machine learning algorithms:

- Supervised learning
- Unsupervised learning

✓ 重点

Others: Reinforcement learning, recommender systems.

Also talk about: Practical advice for applying learning algorithms.



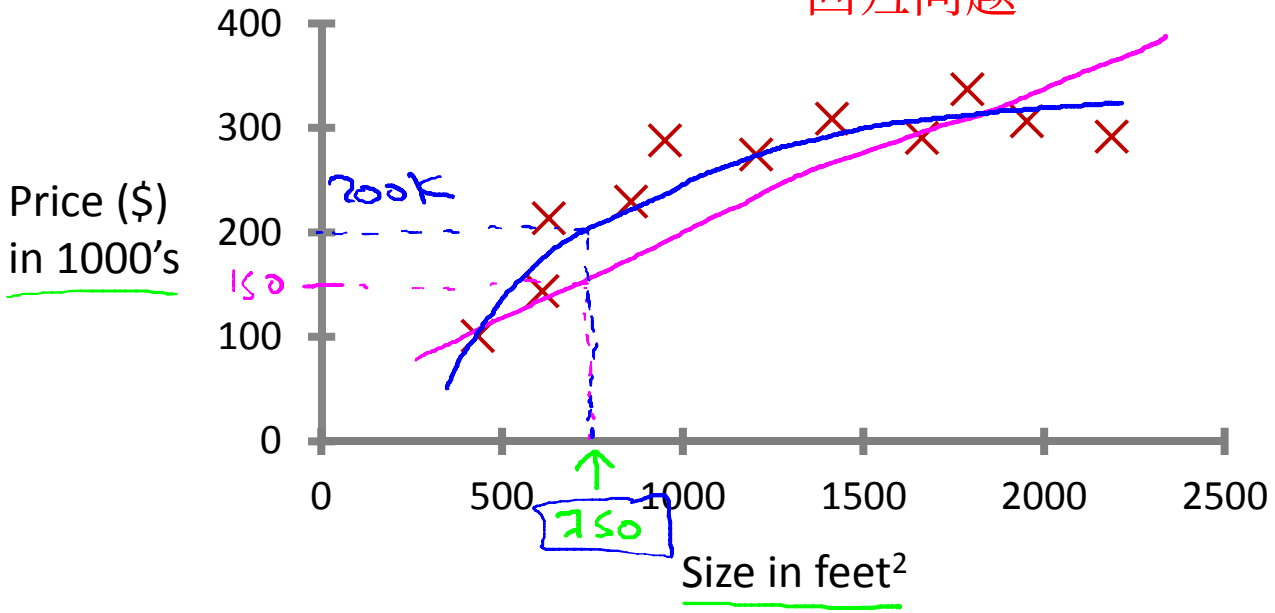
Machine Learning

Introduction

Supervised Learning

Housing price prediction.

---- 回归问题



Supervised Learning

"right answers" given

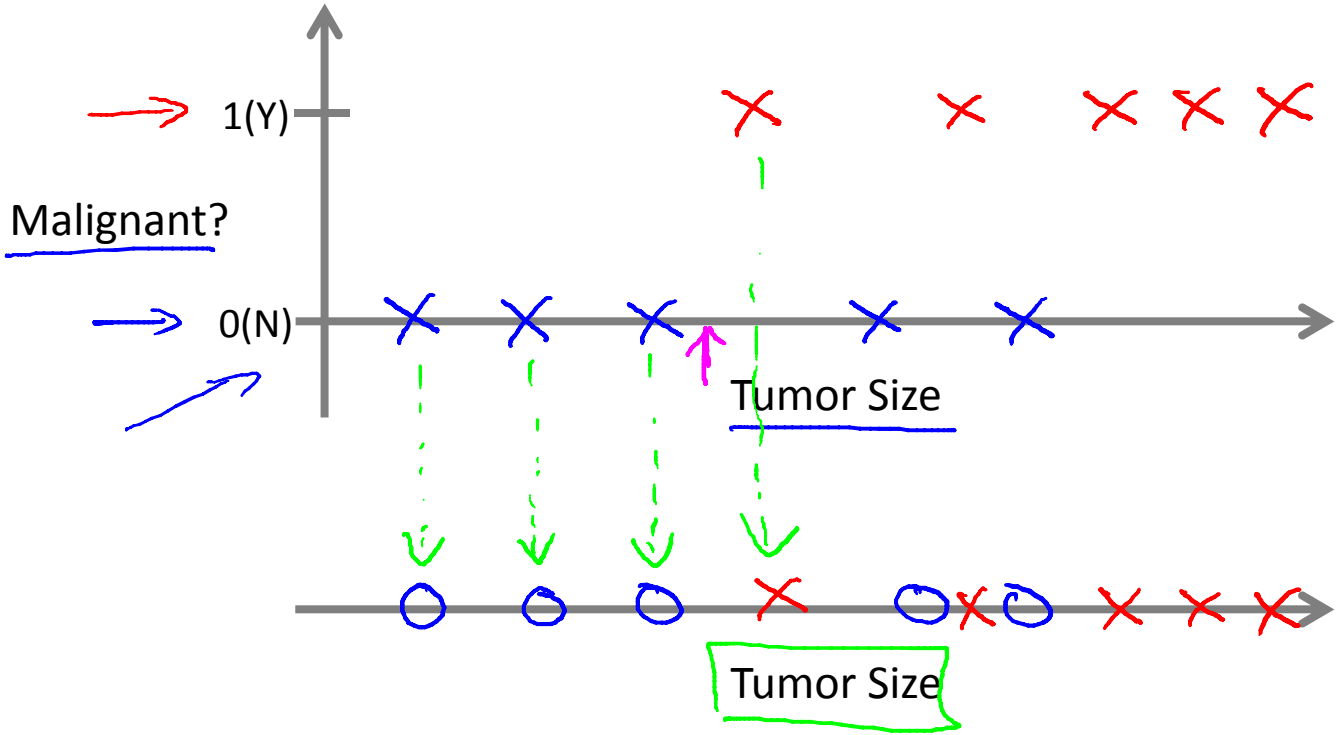
训练集

Regression: Predict continuous valued output (price)

测试集

Breast cancer (malignant, benign)

--- 分类问题



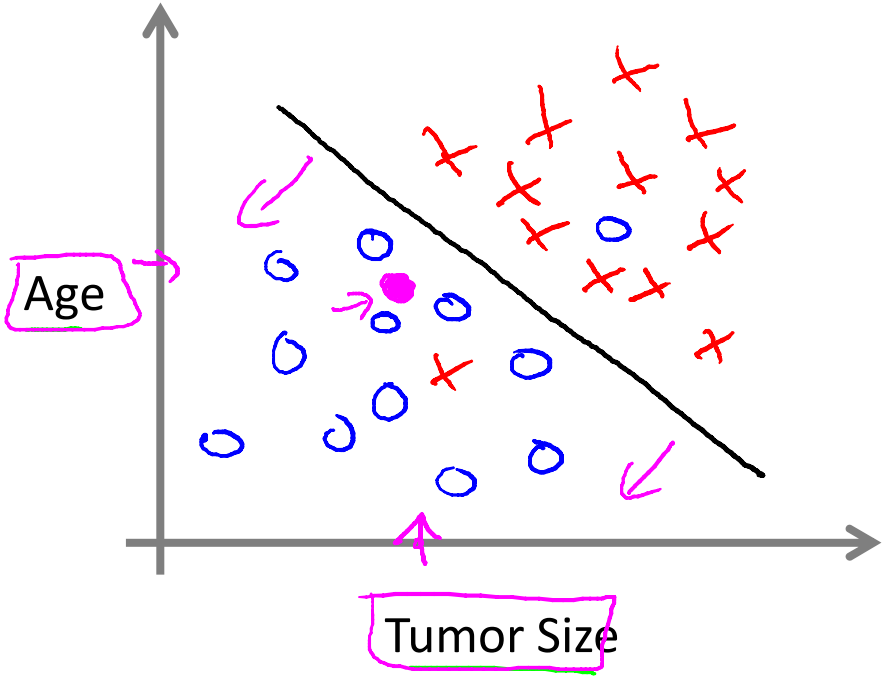
Classification

Discrete valued output (0 or 1)

0, 1, 2, 3

benign

type 1 Cancer



- Clump Thickness
- Uniformity of Cell Size
- Uniformity of Cell Shape

...

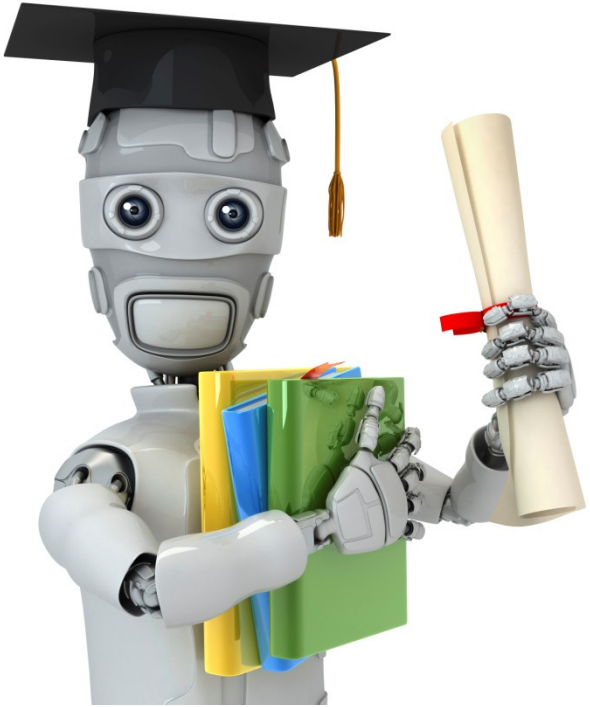
You're running a company, and you want to develop learning algorithms to address each of two problems.

Problem 1: You have a large inventory of identical items. You want to predict how many of these items will sell over the next 3 months.

Problem 2: You'd like software to examine individual customer accounts, and for each account decide if it has been hacked/compromised.

Should you treat these as classification or as regression problems?

- Treat both as classification problems.
- Treat problem 1 as a classification problem, problem 2 as a regression problem.
- Treat problem 1 as a regression problem, problem 2 as a classification problem.
- Treat both as regression problems.

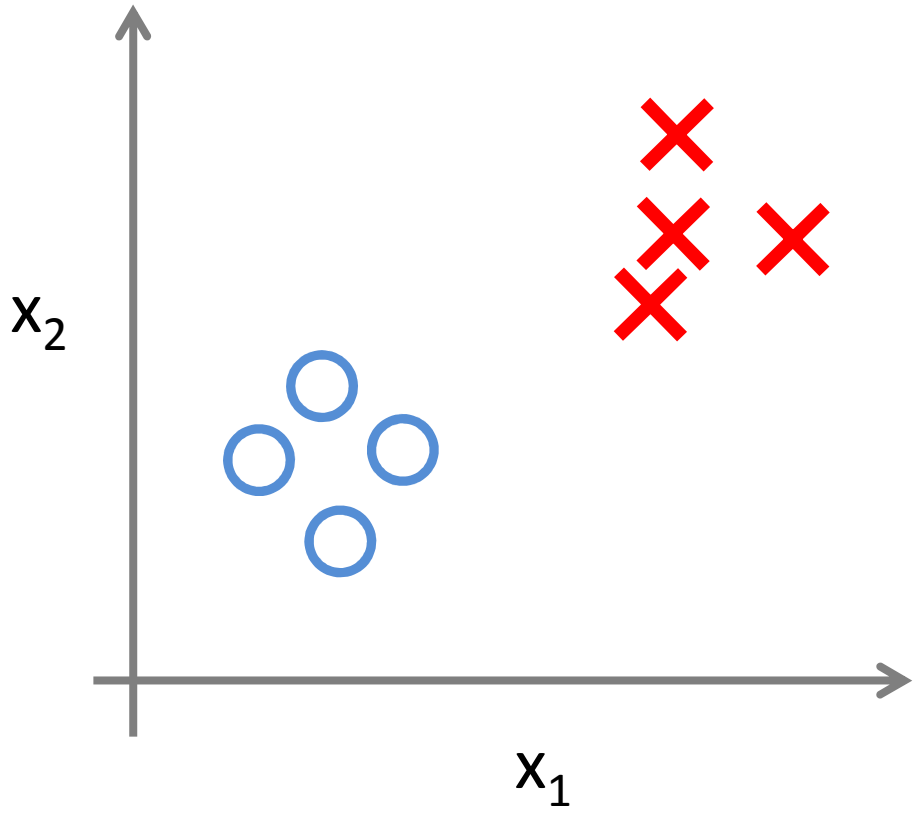


Machine Learning

Introduction

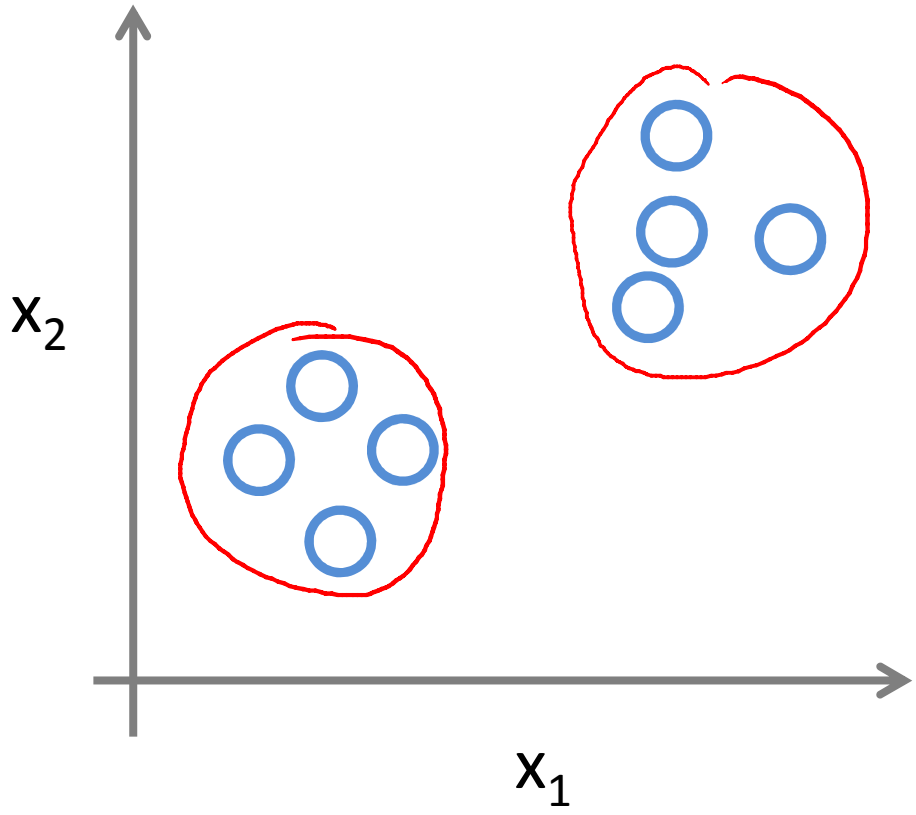
Unsupervised Learning

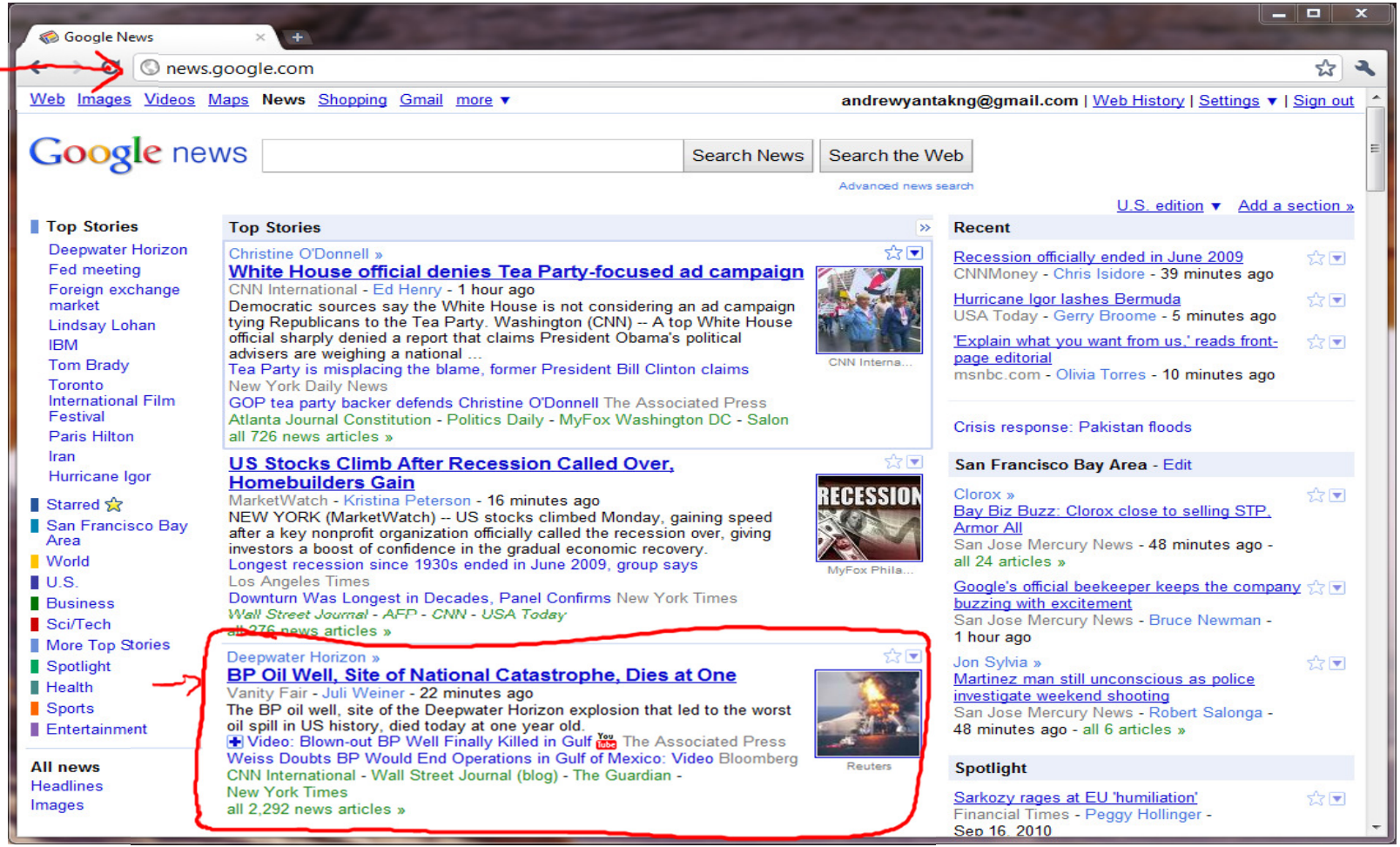
Supervised Learning



Unsupervised Learning

---- 聚类算法

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Lindsay Lohan
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NEW YORK (MarketWatch) -- US stocks climbed Monday, gaining speed after a key nonprofit organization officially called the recession over, giving investors a boost of confidence in the gradual economic recovery.
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Downturn Was Longest in Decades, Panel Confirms New York Times
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Weiss Doubts BP Would End Operations in Gulf of Mexico: Video Bloomberg
CNN International - Wall Street Journal (blog) - The Guardian - New York Times
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Financial Times - Peggy Hollinger - Sep 16, 2010

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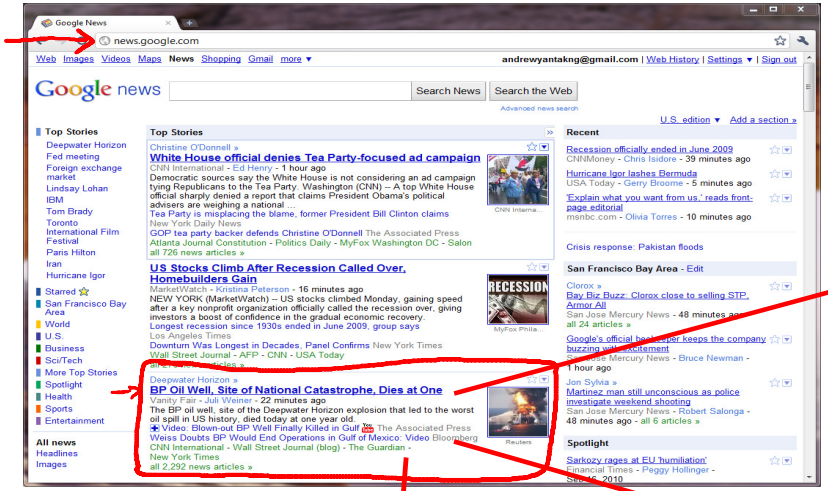
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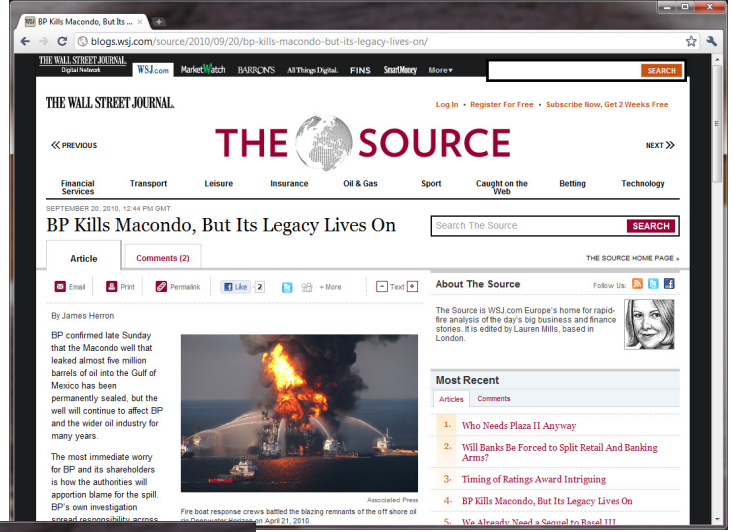
White House official denies Tea Party-focused ad campaign
US Stocks Climb After Recession Called Over, Homebuilders Gain
BP Oil Well, Site of National Catastrophe, Dies at One
Spotlight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THE WALL STREET JOURNAL.
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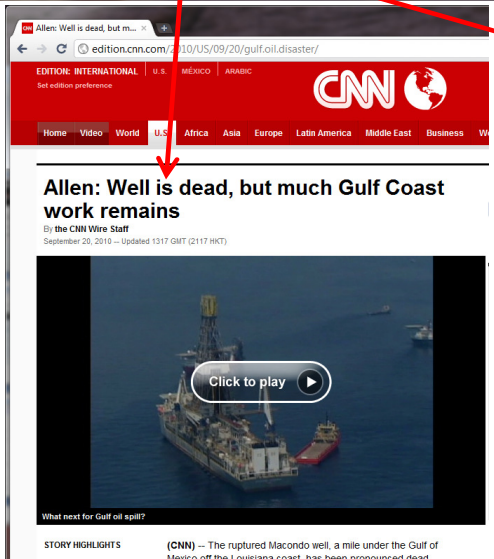
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Allen: Well is dead, but much Gulf Coast work remains
By the CNN Wire Staff
September 20, 2010 -- Updated 1317 GMT (2117 HKT)
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What next for Gulf oil spill?
STORY HIGHLIGHTS
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Business : BP
BP oil spill cost hits nearly $10bn
BP has set up a $20bn compensation fund after the Deepwater Horizon disaster, which has so far paid out 19,000 claims totalling more than $240m
Julia Kollewe
guardian.co.uk, Monday 20 September 2010 08.33 BST
Article history
BP's costs for the Deepwater Horizon disaster have hit $10bn. Photograph: Hoi/Reuters

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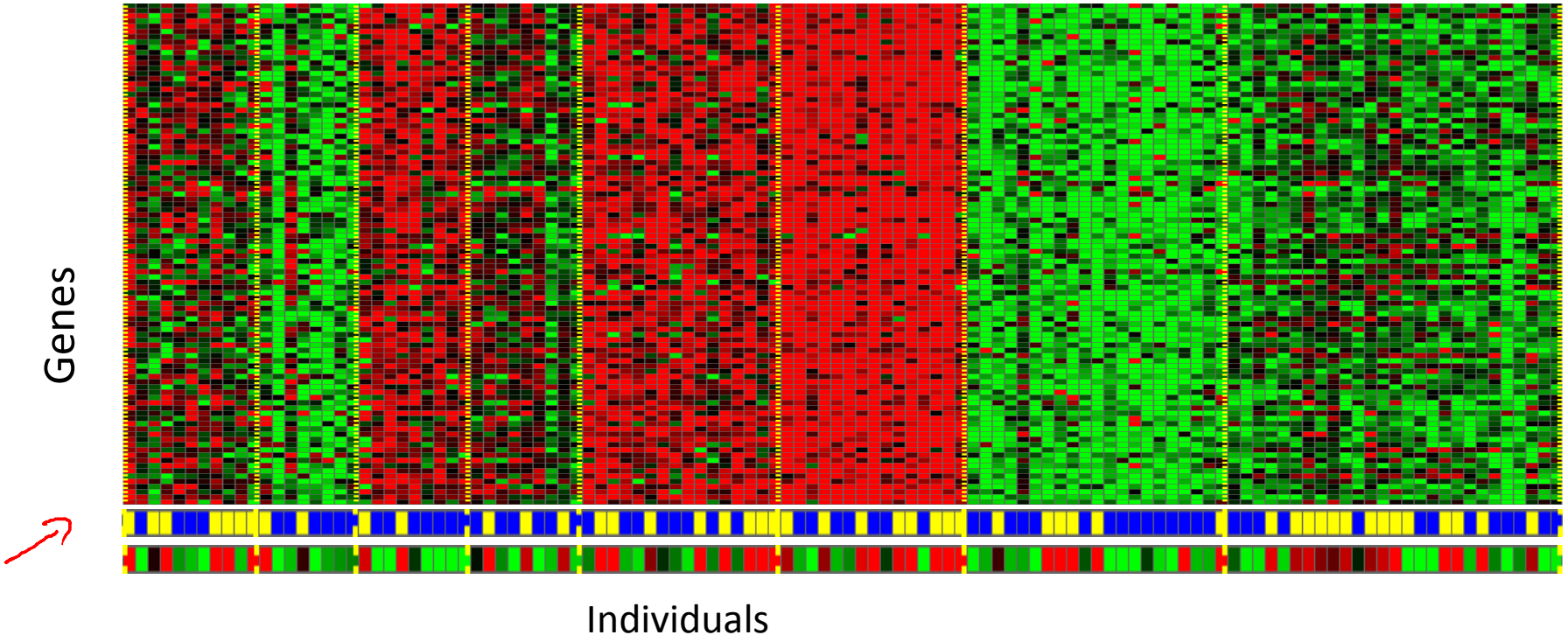
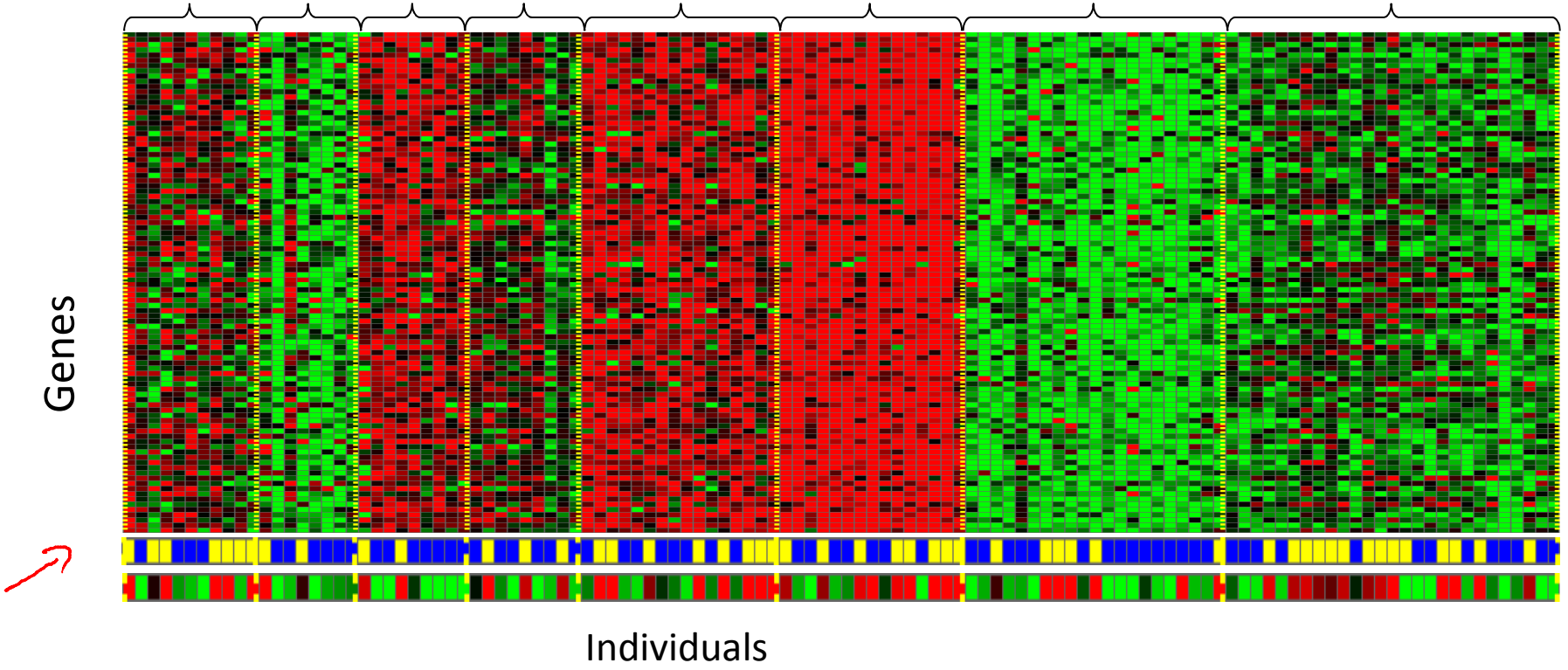


[Source: Daphne Koller]



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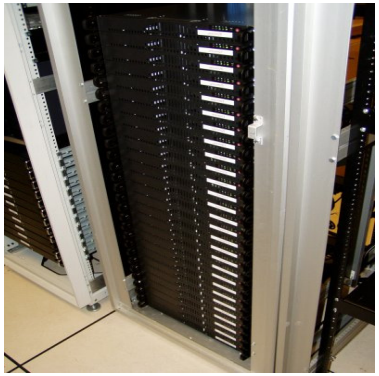
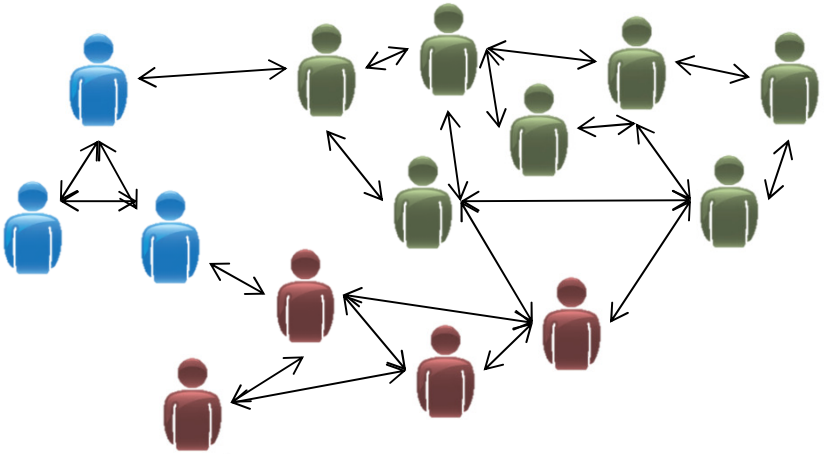
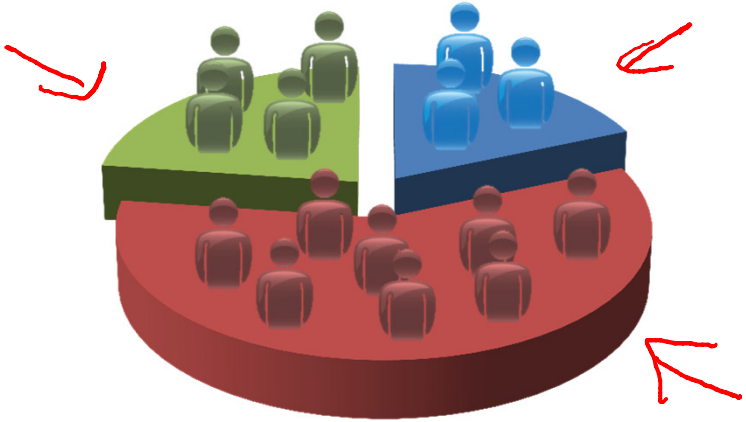


Organize computing clusters



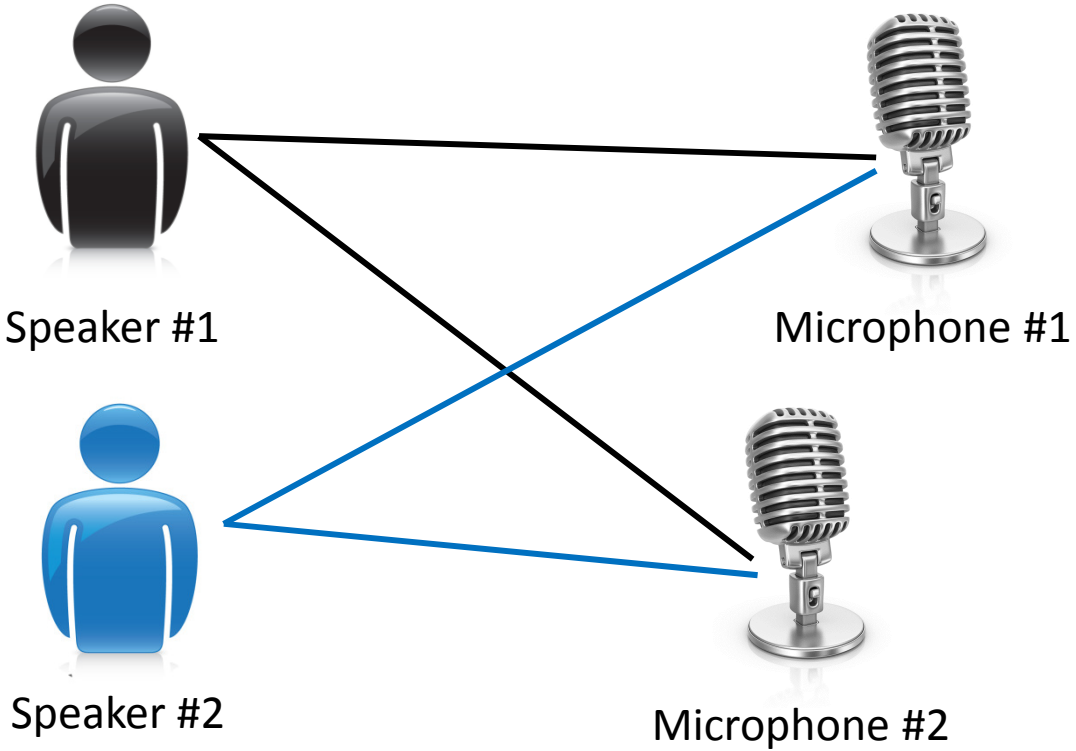
Social network analysis



Market segmentation

Astronomical data analysis

Cocktail party problem



Microphone #1:

Output #1:

Microphone #2:

Output #2:

Microphone #1:

Output #1:

Microphone #2:

Output #2:

[Audio clips courtesy of Te-Won Lee.]

Cocktail party problem algorithm

```
[W,s,v] = svd((repmat(sum(x.*x,1),size(x,1),1).*x)*x');
```

[Source: Sam Roweis, Yair Weiss & Eero Simoncelli]

Of the following examples, which would you address using an unsupervised learning algorithm? (Check all that apply.)

- [ ] Given email labeled as spam/not spam, learn a spam filter.
- [ ] Given a set of news articles found on the web, group them into set of articles about the same story.
- [ ] Given a database of customer data, automatically discover market segments and group customers into different market segments.
- [ ] Given a dataset of patients diagnosed as either having diabetes or not, learn to classify new patients as having diabetes or not.