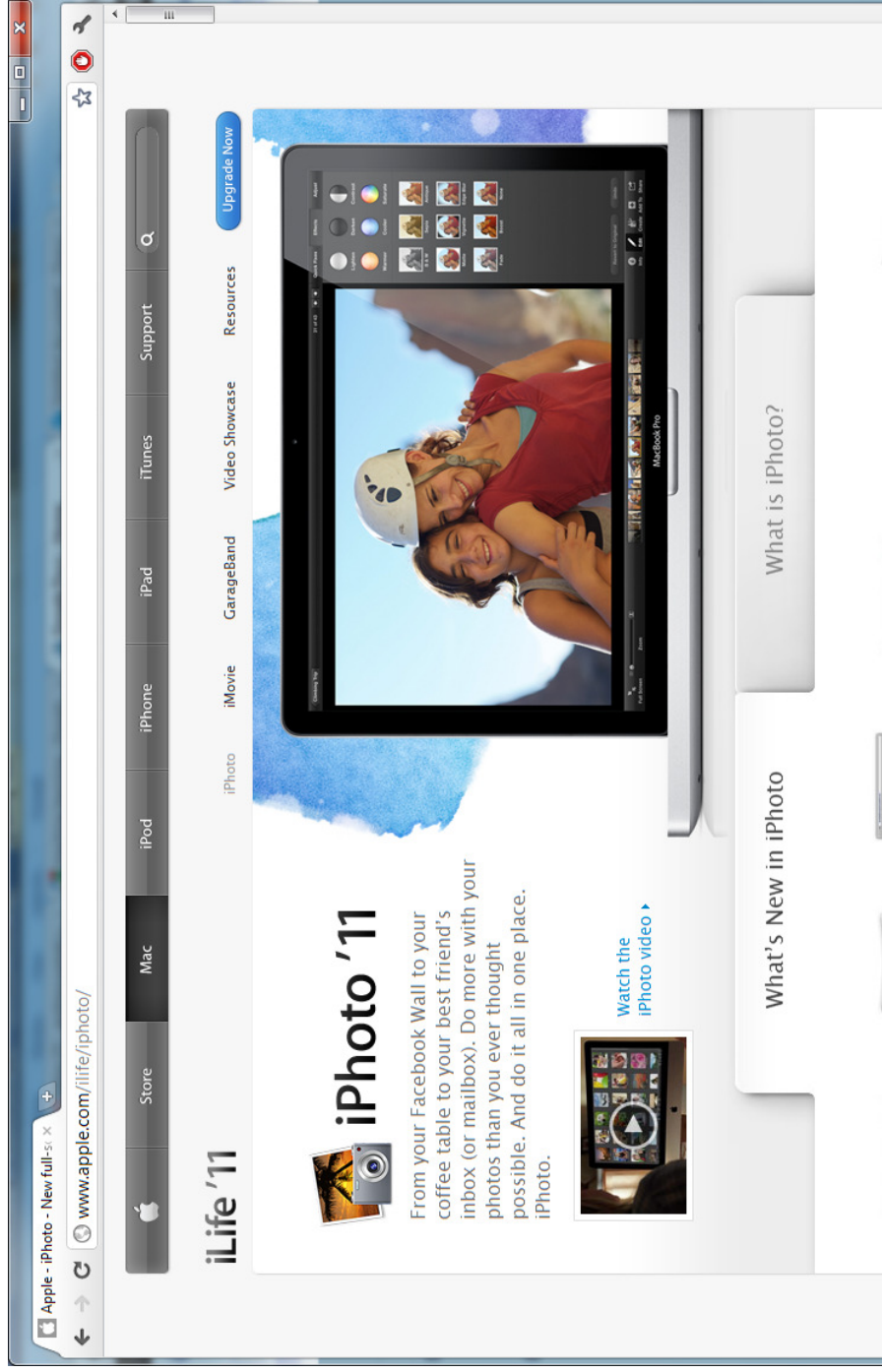


Machine Learning

Introduction

Welcome





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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- |

Exam

- |

- /



lg

lost of

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E.g., Amazon, Netflix product recommendations

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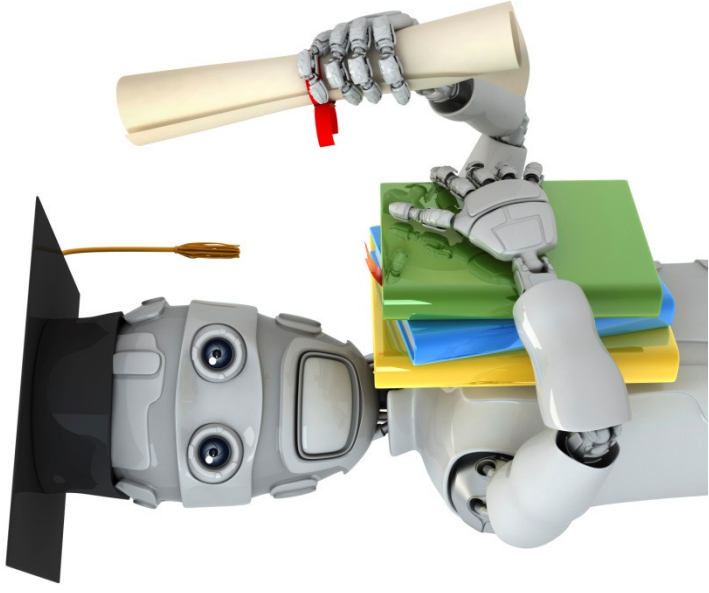
- Applications can't program by hand.

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

- Self-customizing programs

E.g., Amazon, Netflix product recommendations

- Understanding human learning (brain, real AI).



Machine Learning

Introduction

What is machine learning

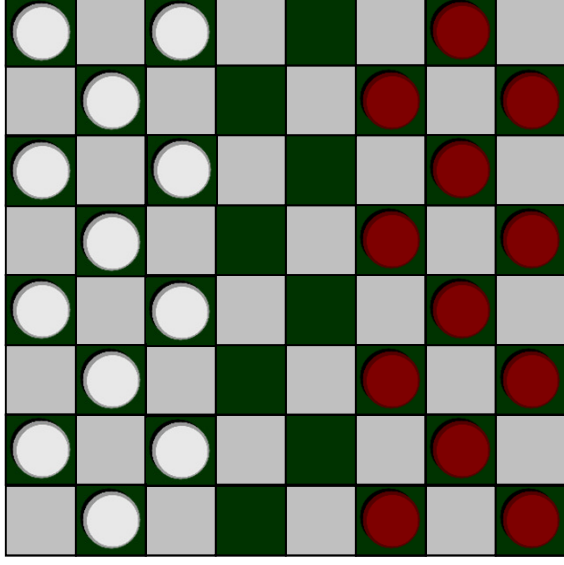
Machine Learning definition

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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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- 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?

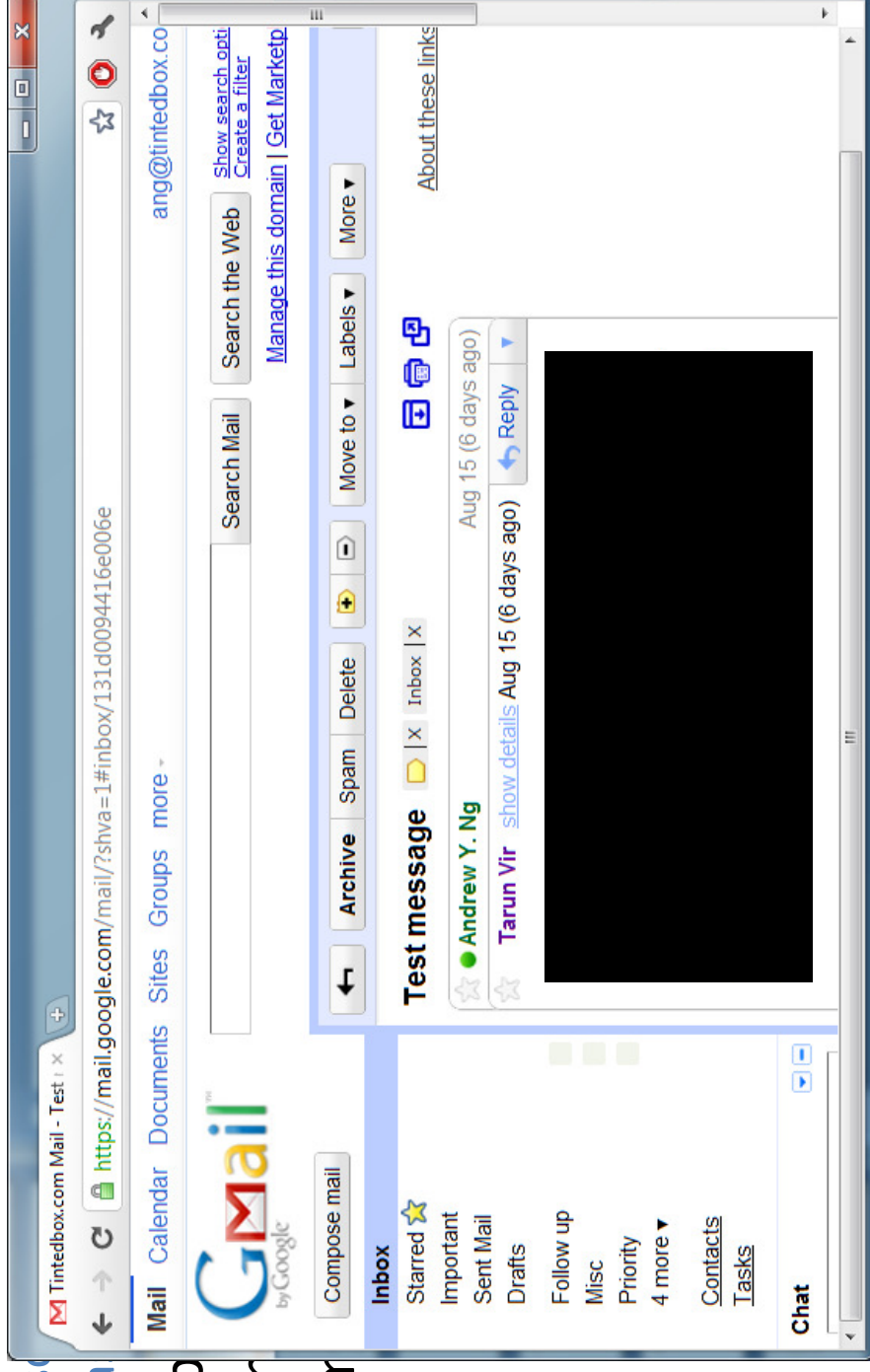
- ☐ Classifying emails as spam or not spam. T ←
- ☐ Watching you label emails as spam or not spam. E ←
- ☐ The number (or fraction) of emails correctly classified as spam/not spam.
- ☐ None of the above—this is not a machine learning problem. P ←

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not n
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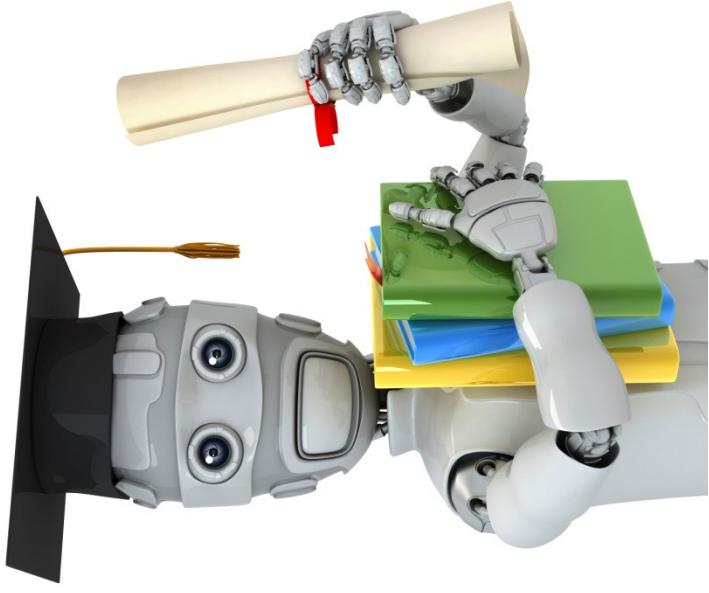
← P

Machine learning algorithms:

- Supervised learning
 - Unsupervised learning
- 

Others: Reinforcement learning, recommender systems.

Also talk about: Practical advice for applying learning algorithms. 

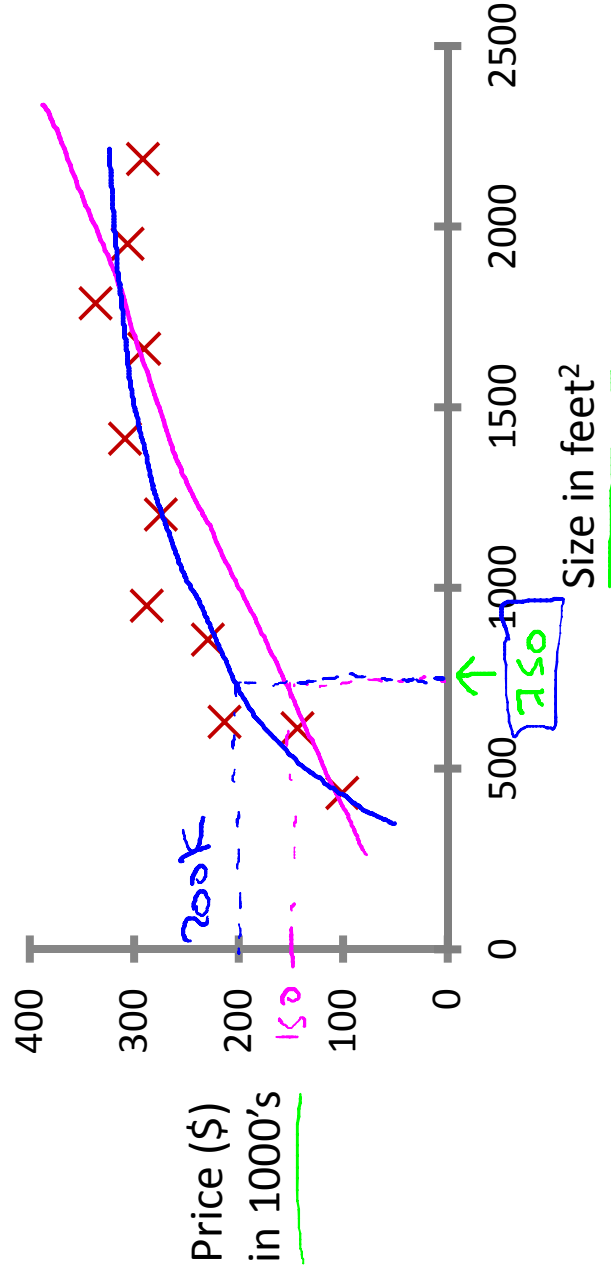


Machine Learning

Introduction

Supervised Learning

Housing price prediction.

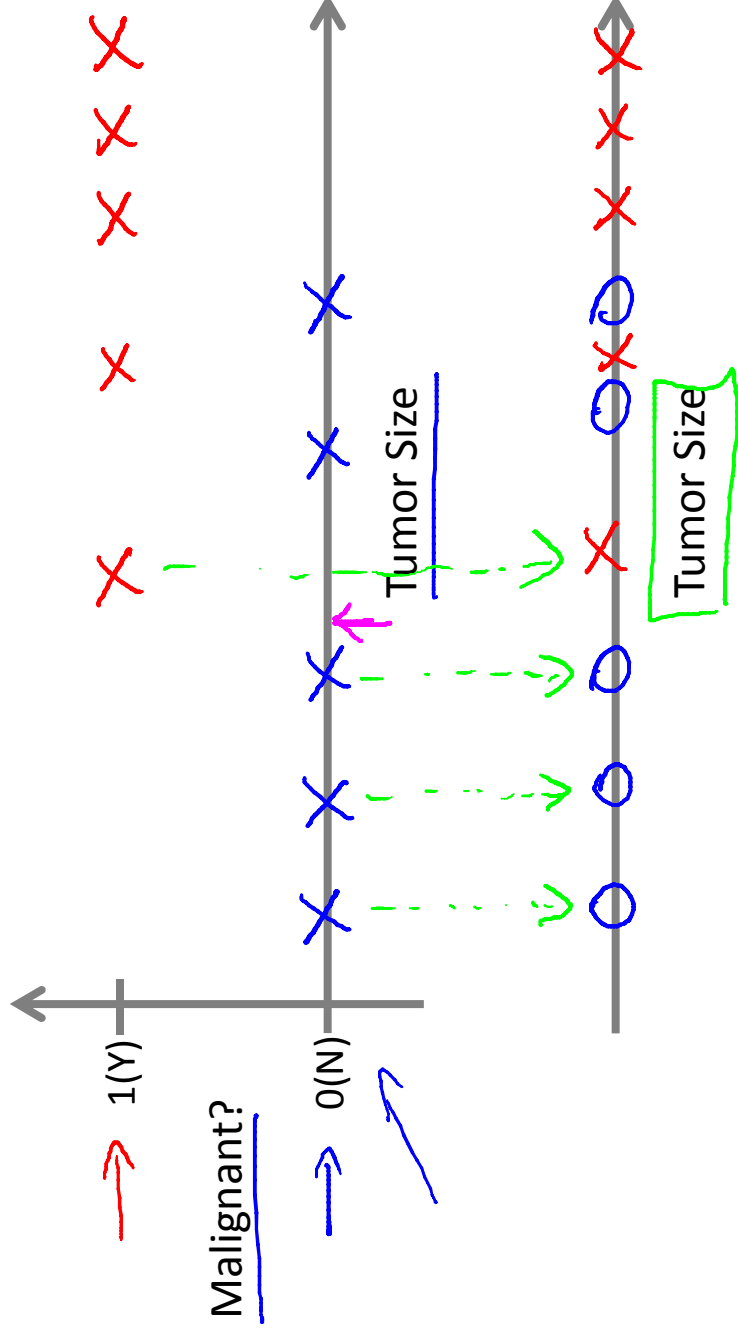


Supervised Learning

"right answers" given

Regression: Predict continuous
valued output (price)

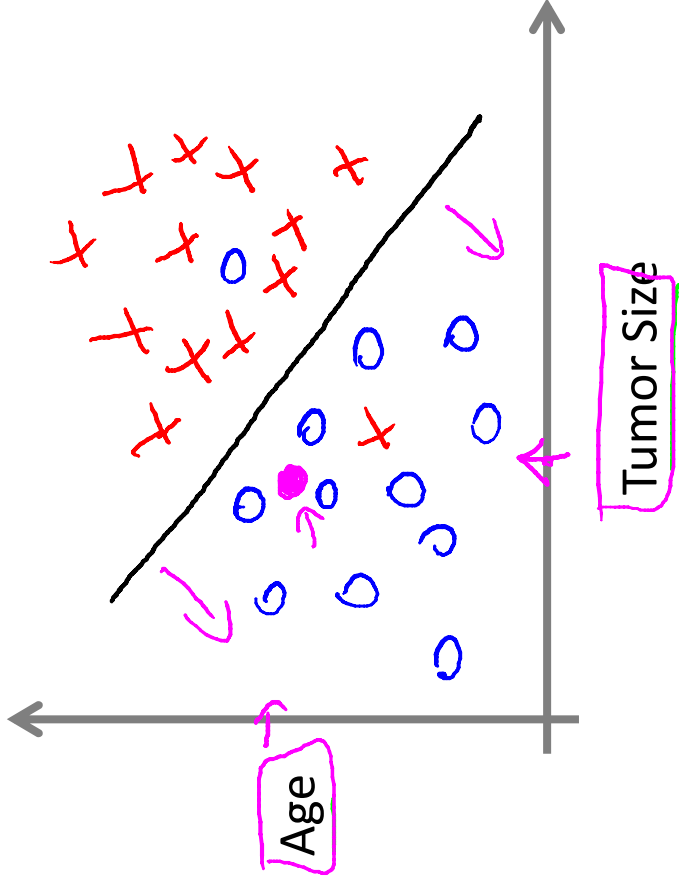
Breast cancer (malignant, benign)



Classification

Discrete valued
output (0 or 1)

0, 1, 2, 3
↓ benign type 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.

1000's

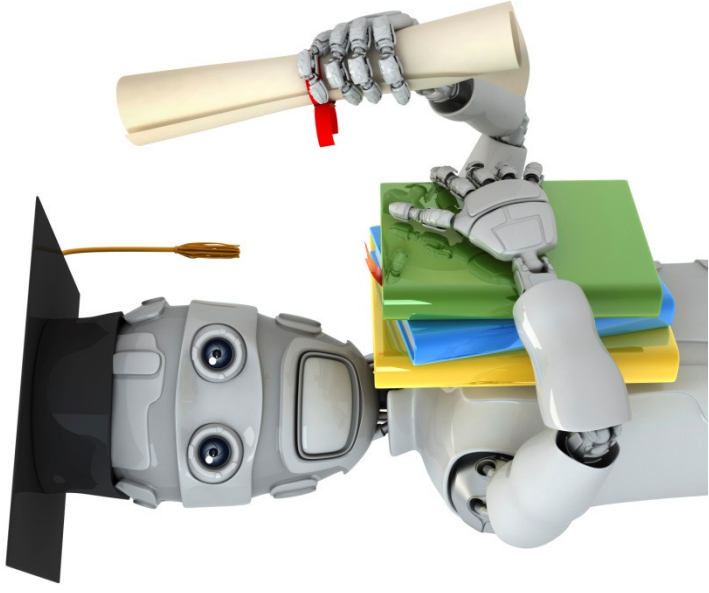
Problem 1: You have a large inventory of identical items. You want to predict how many of these items will sell over the next 3 months.

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

→ 0 - not hacked
→ 1 - hacked

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.

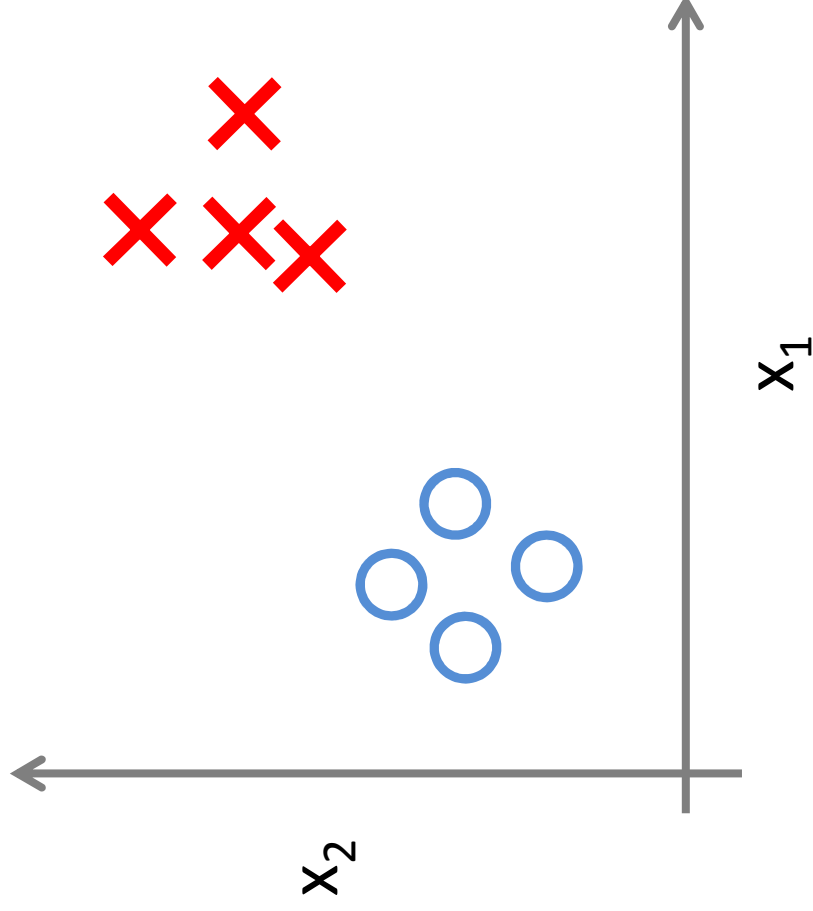


Machine Learning

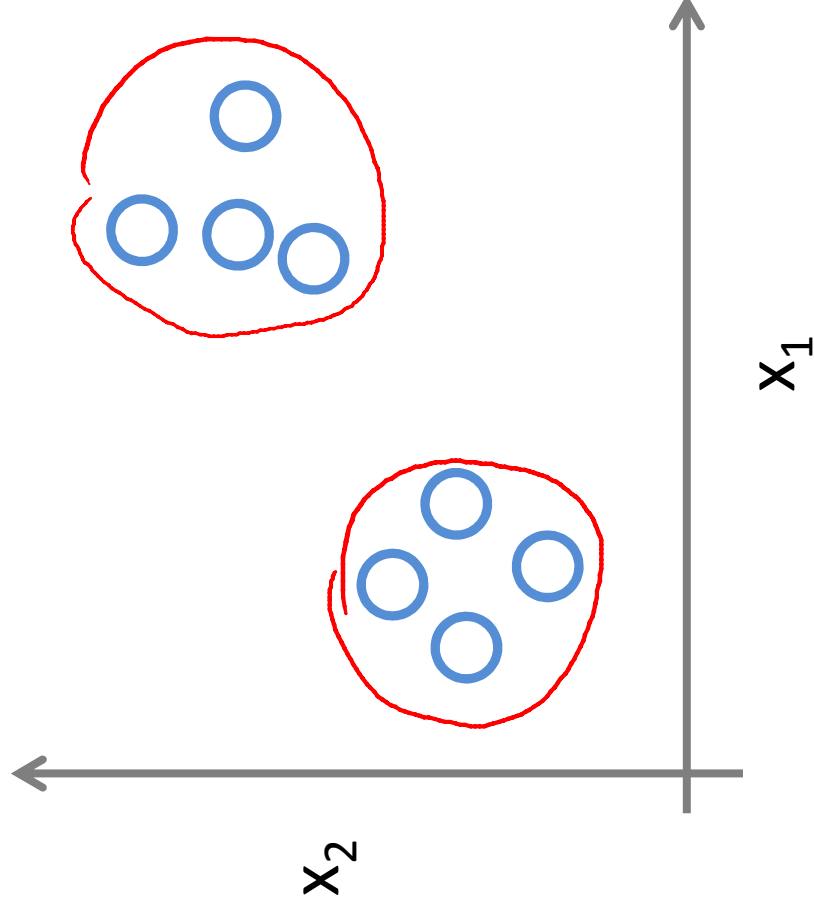
Introduction

Unsupervised Learning

Supervised Learning



Unsupervised Learning



Google News

news.google.com

Web Images Videos Maps News Shopping Gmail more

Google news

andrewyantakng@gmail.com | Web History | Settings | Sign out

Search the Web

Search News

Advanced news search

U.S. edition | Add a section

Top Stories

Deepwater Horizon

Fed meeting

Foreign exchange market

Lindsay Lohan

IBM

Tom Brady

Toronto International Film Festival

Paris Hilton

Iran

Hurricane Igor

Starred

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Christine O'Donnell »

White House official denies Tea Party-focused ad campaign

CNN International - Ed Henry - 1 hour ago

Democratic sources say the White House is not considering an ad campaign tying Republicans to the Tea Party. Washington (CNN) -- A top White House official sharply denied a report that claims President Obama's political advisers are weighing a national ...

Tea Party is misplacing the blame, former President Bill Clinton claims

New York Daily News

GOP tea party backer defends Christine O'Donnell

The Associated Press

Atlanta Journal Constitution - Politics Daily - MyFox Washington DC - Salon

all 726 news articles »

US Stocks Climb After Recession Called Over, Homebuilders Gain

MarketWatch - Kristina Peterson - 16 minutes ago

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.

Longest recession since 1930s ended in June 2009, group says

Los Angeles Times

Downturn Was Longest in Decades, Panel Confirms

New York Times

Wall Street Journal - AFP - CNN - USA Today

all 276 news articles »

BP Oil Well, Site of National Catastrophe, Dies at One

Deepwater Horizon »

Vanity Fair - Juli Weiner - 22 minutes ago

The BP oil well, site of the Deepwater Horizon explosion that led to the worst oil spill in US history, died today at one year old.

Video: Blown-out BP Well Finally Killed in Gulf

The Associated Press

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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Armor All

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San Jose Mercury News - Bruce Newman - 1 hour ago

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Martinez man still unconscious as police investigate weekend shooting

San Jose Mercury News - Robert Salonga - 48 minutes ago - all 6 articles »

Spotlight

Sarkozy rages at EU 'humiliation'

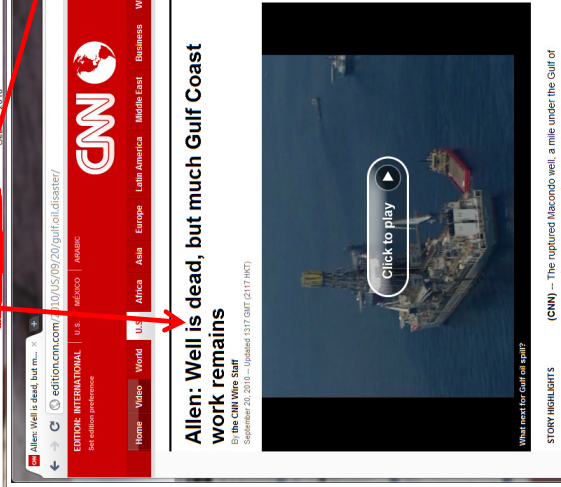
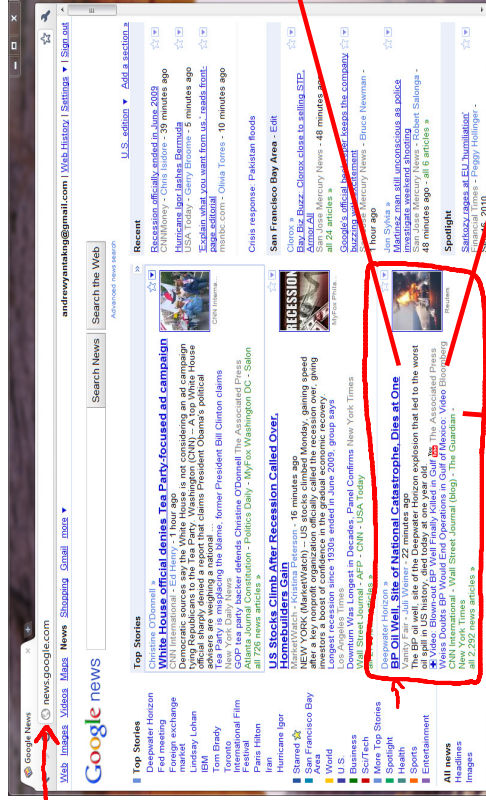
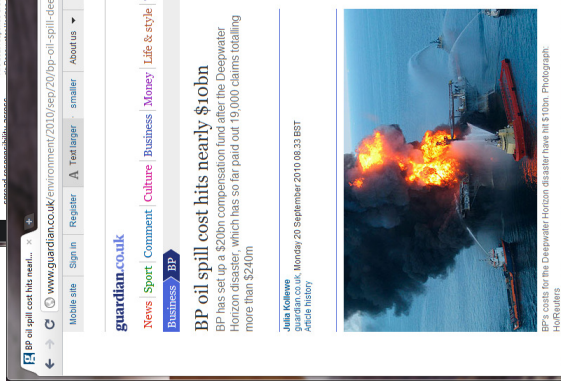
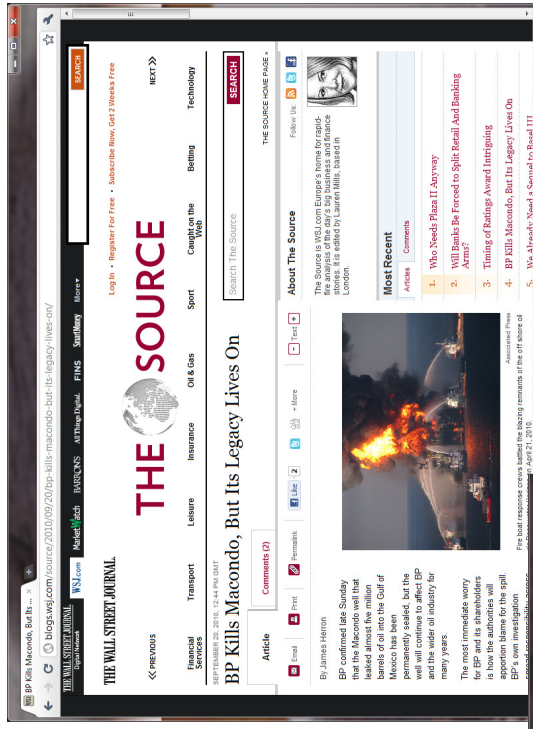
Financial Times - Peggy Hollinger - Sep 16, 2010

Recession

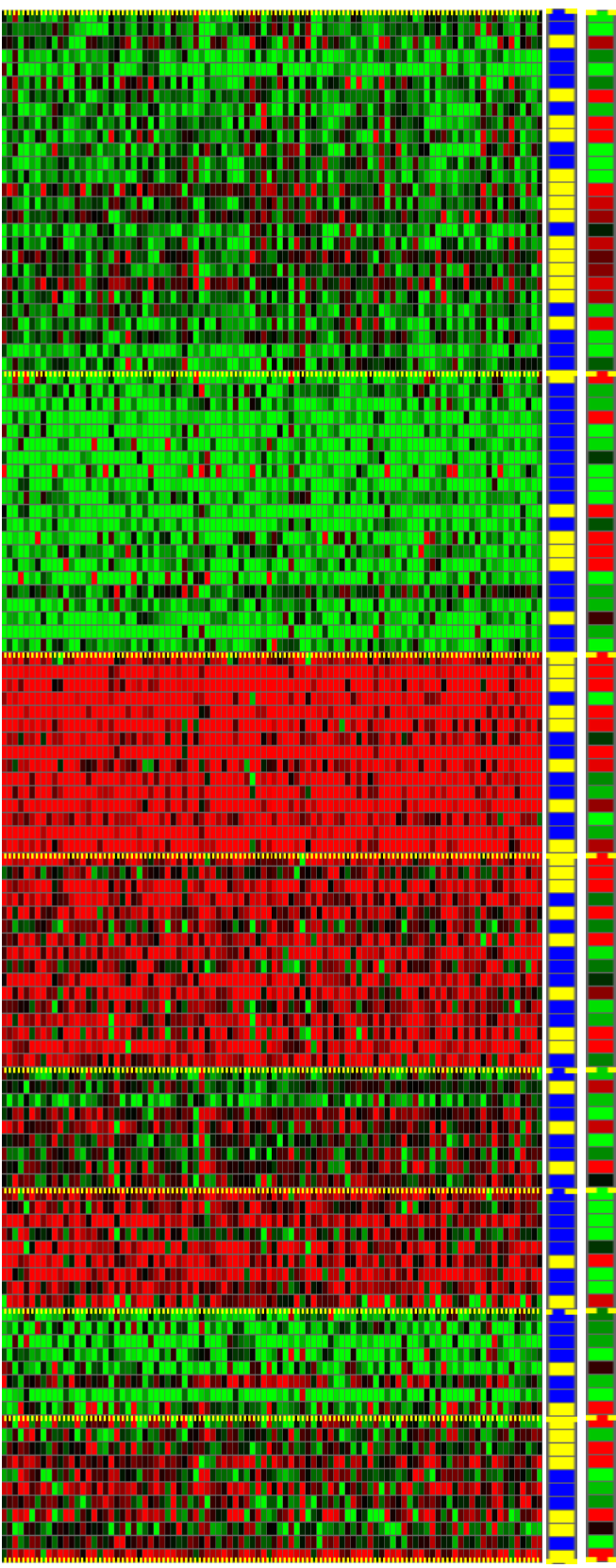
MyFox Phila...

Reuters

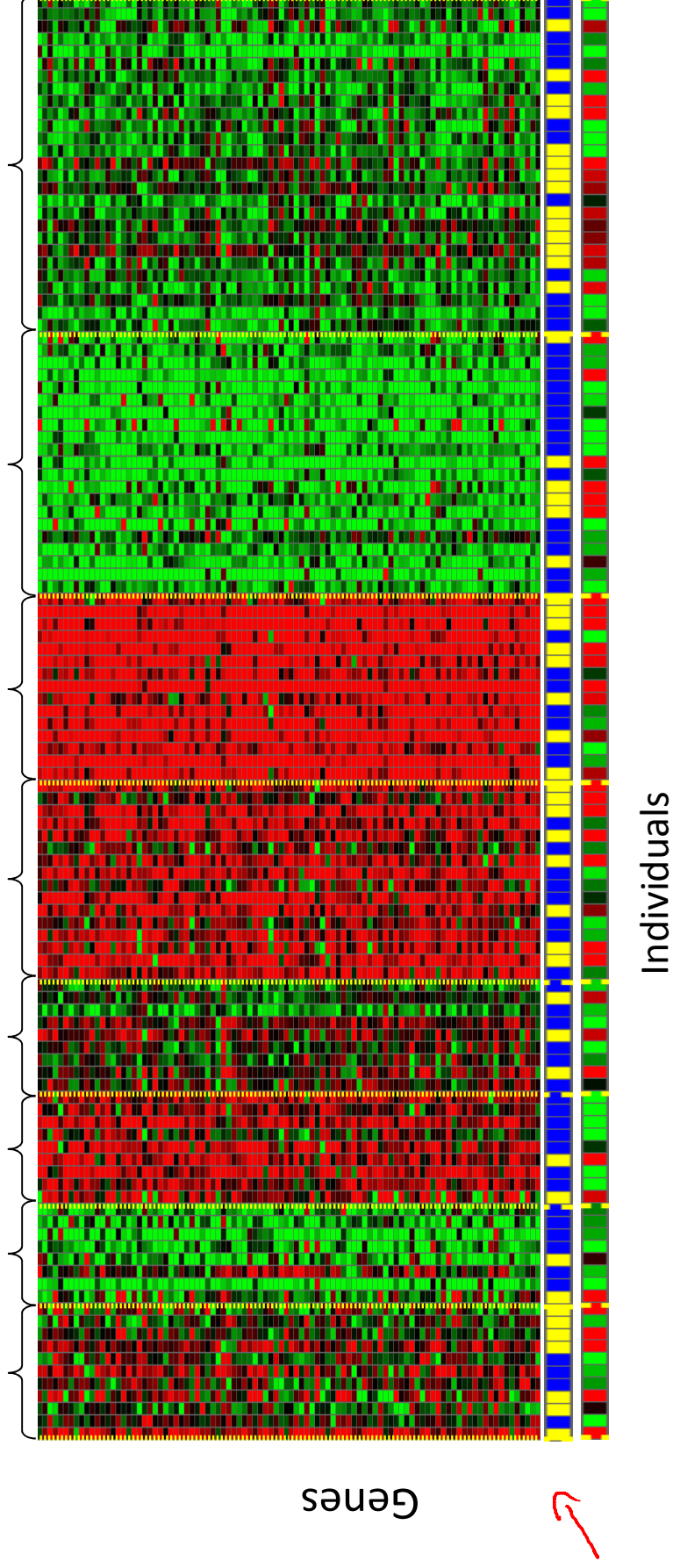
Andrew Ng



Andrew Ng



[Source: Daphne Koller]

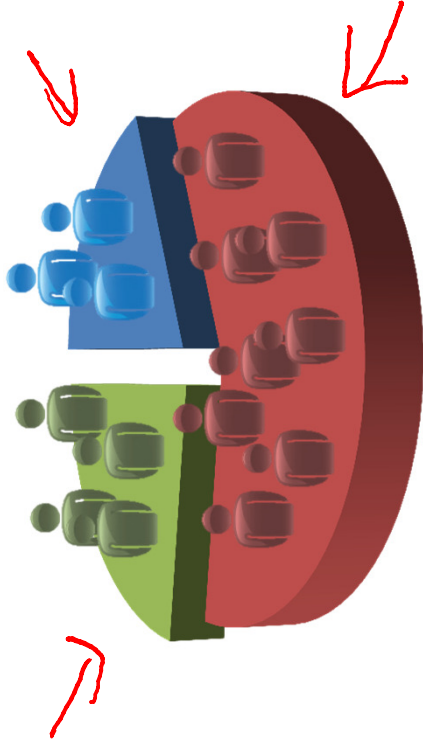


[Source: Daphne Koller]

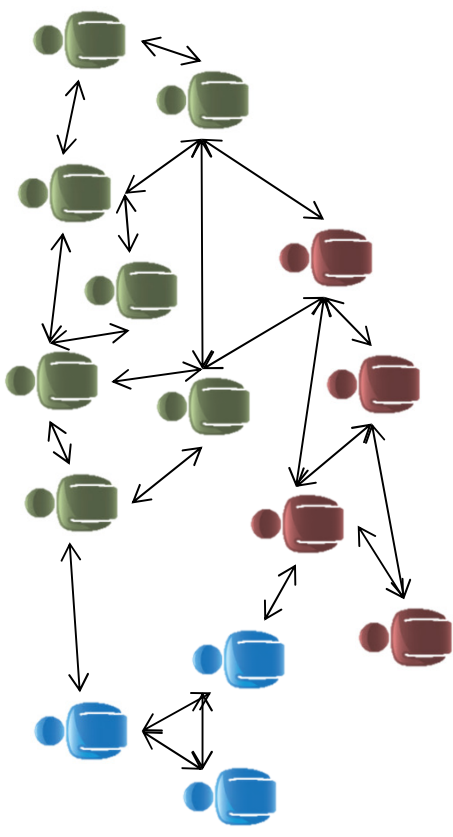
Andrew Ng



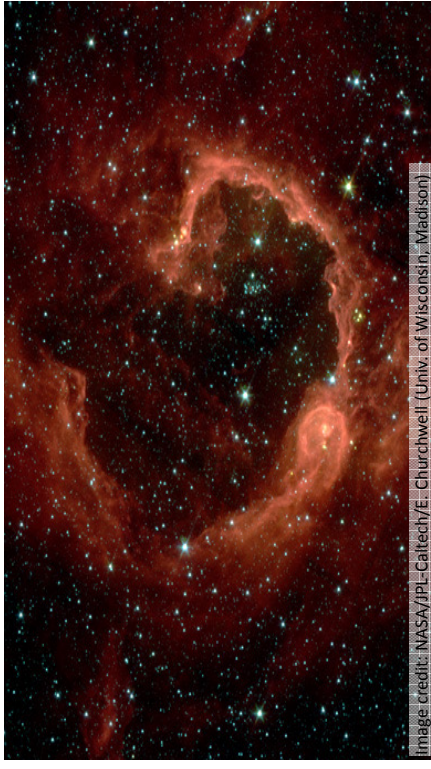
Organize computing clusters



Market segmentation

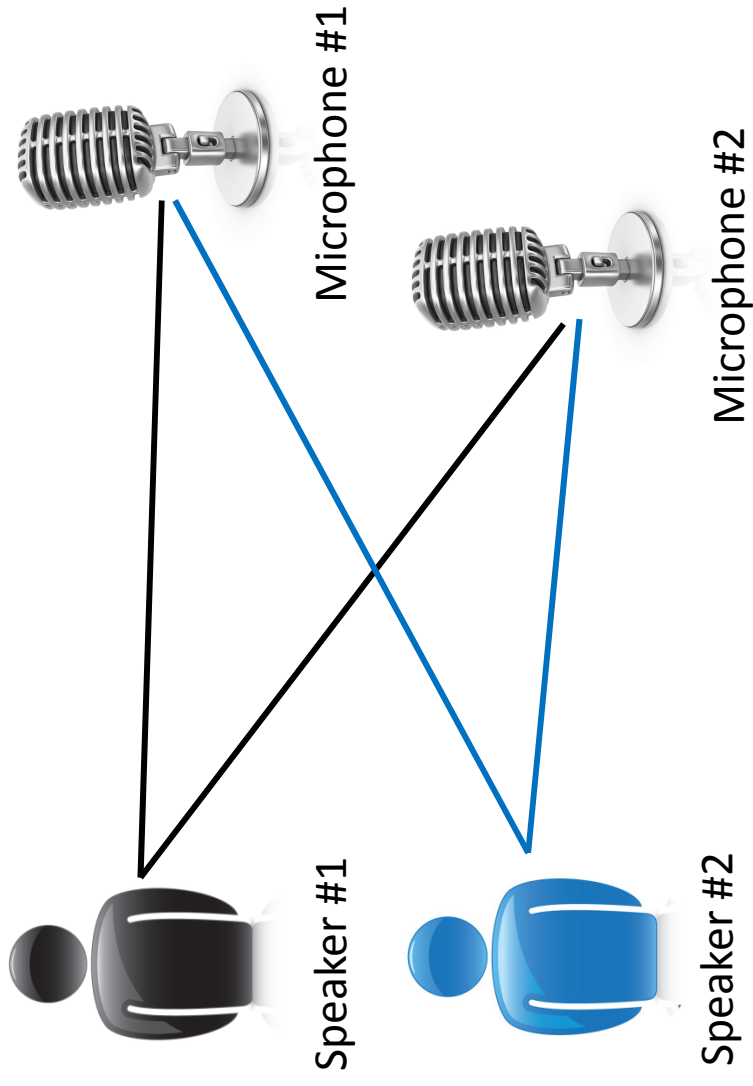


Social network analysis



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.

