

Machine Learning

Introduction

What is machine learning

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.
- Self-customizing programs
 - E.g., Amazon, Netflix product recommendations
- Understanding human learning (brain, real AI).



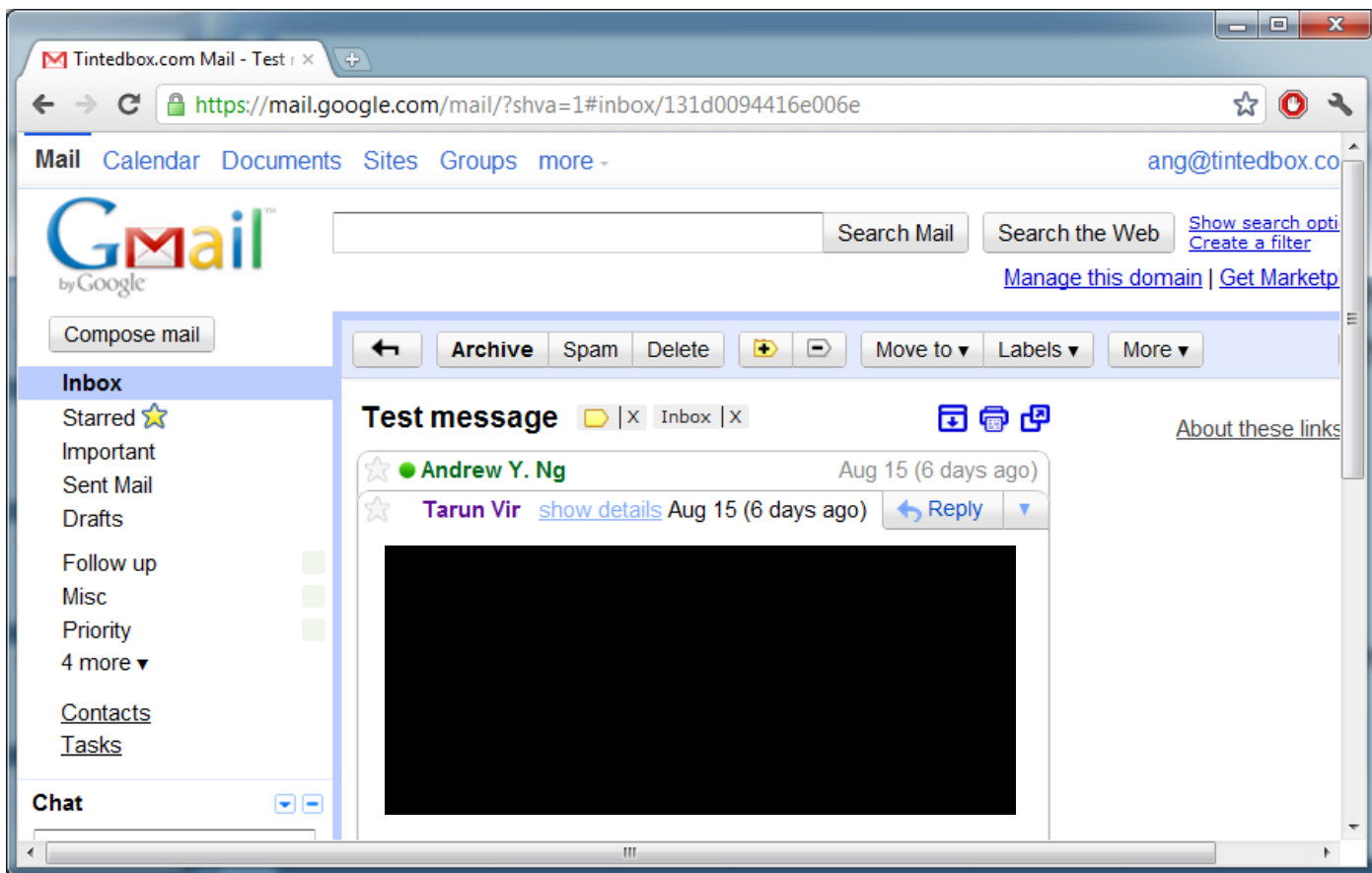
Machine Learning definition

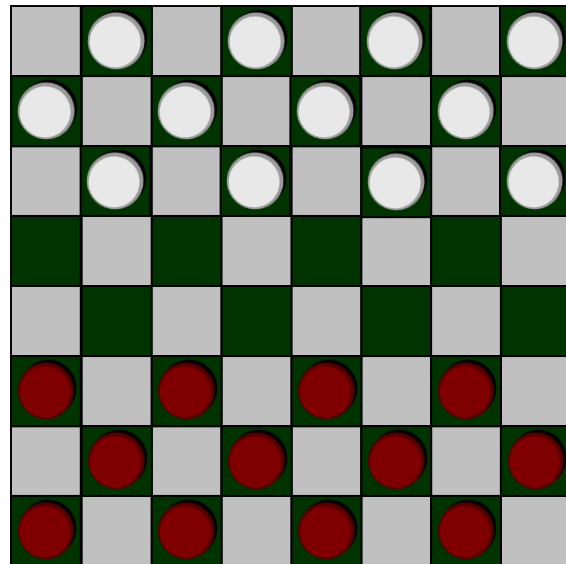
- Arthur Samuel (1959). Machine Learning: Field of study that gives computers the ability to learn without being explicitly programmed.
- Tom Mitchell (1998) Well-posed Learning Problem: A computer program is said to *learn* from experience E with respect to some task T and some performance measure P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



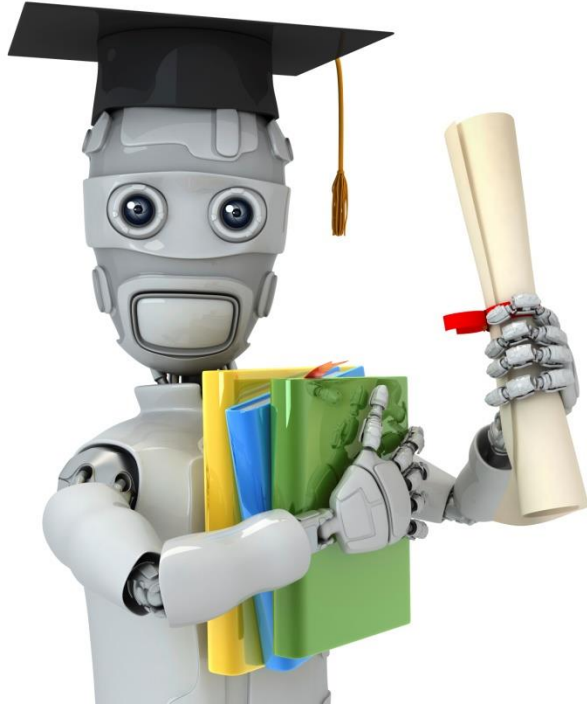


Machine learning algorithms:

- Supervised learning
- Unsupervised learning

Others: Reinforcement learning, recommender systems.

Also talk about: Practical advice for applying learning algorithms.

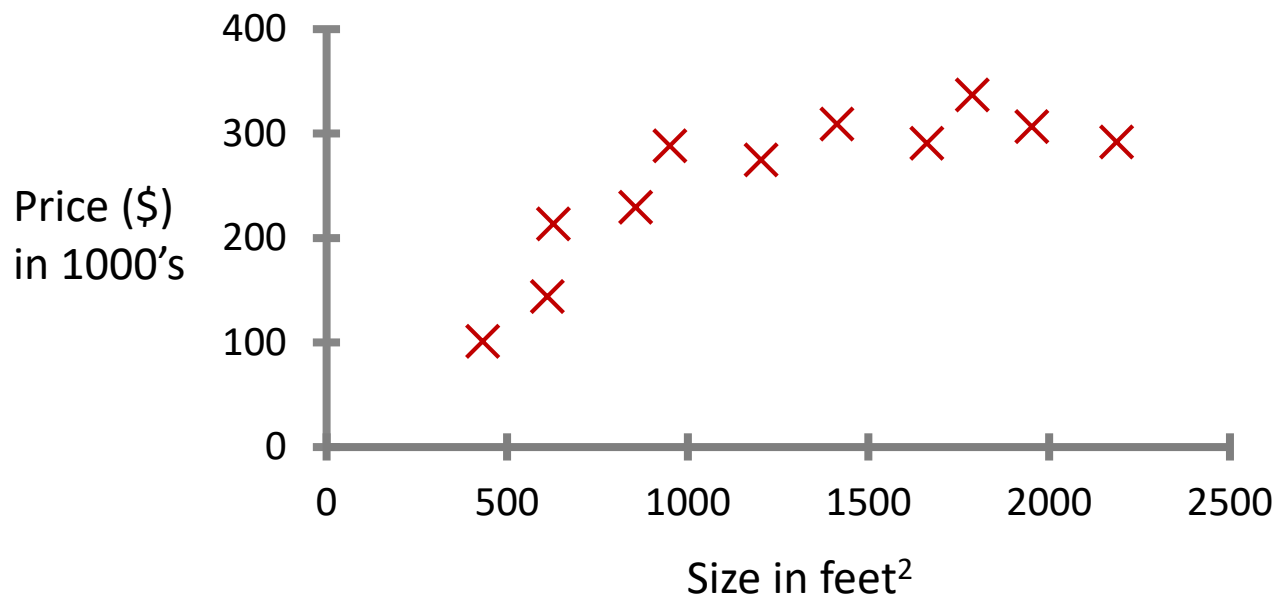


Machine Learning

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Supervised Learning

Housing price prediction.

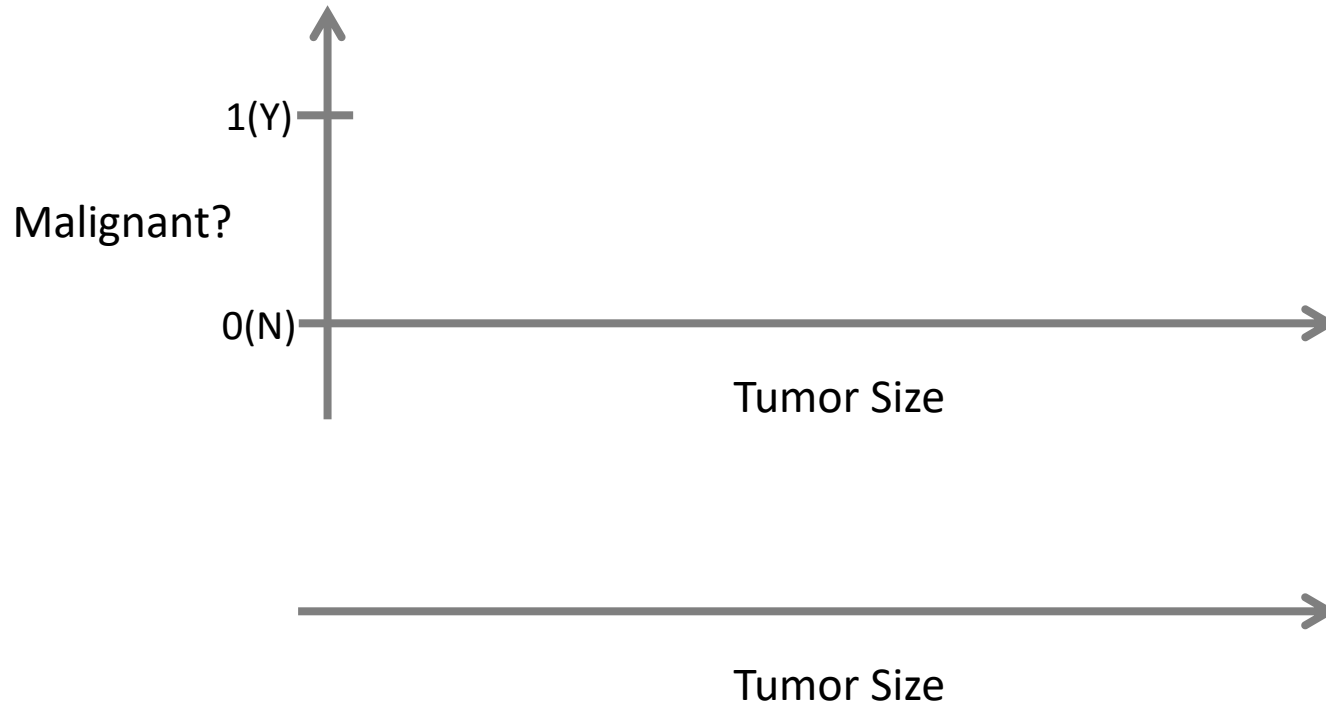


Supervised Learning

“right answers” given

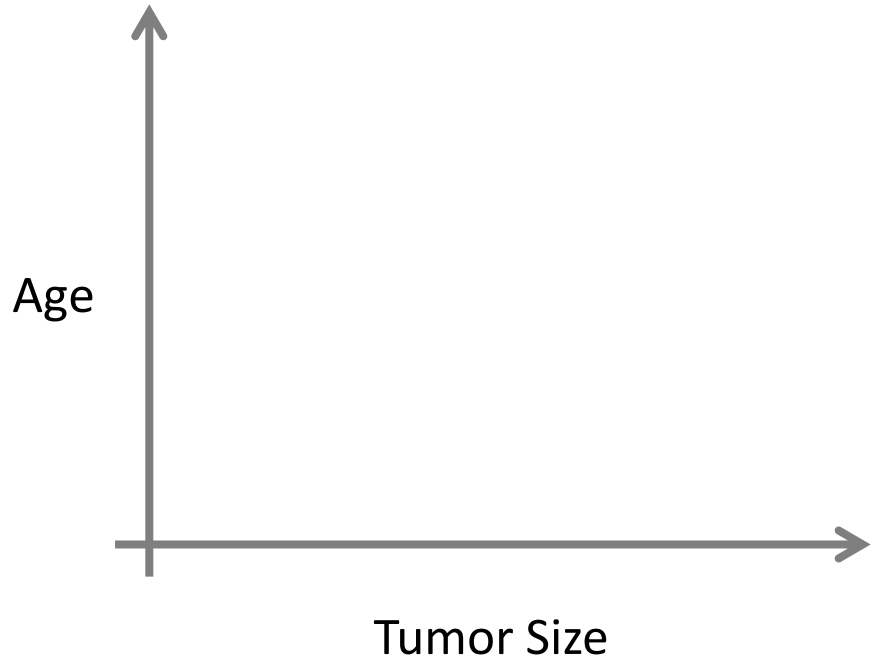
Regression: Predict continuous
valued output (price)

Breast cancer (malignant, benign)



Classification

Discrete valued
output (0 or 1)



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

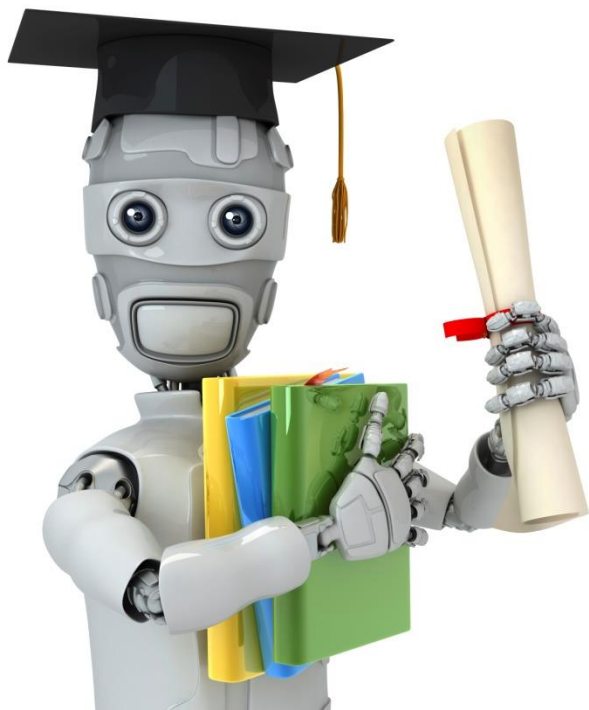
You're running a company, and you want to develop learning algorithms to address each of two problems.

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.

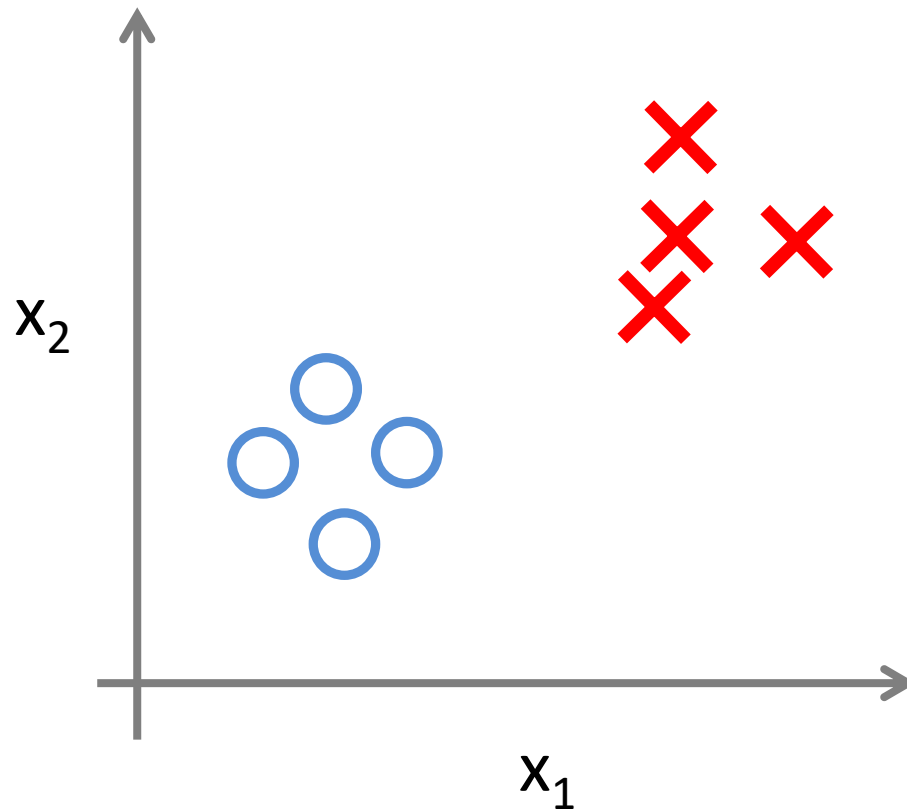


Machine Learning

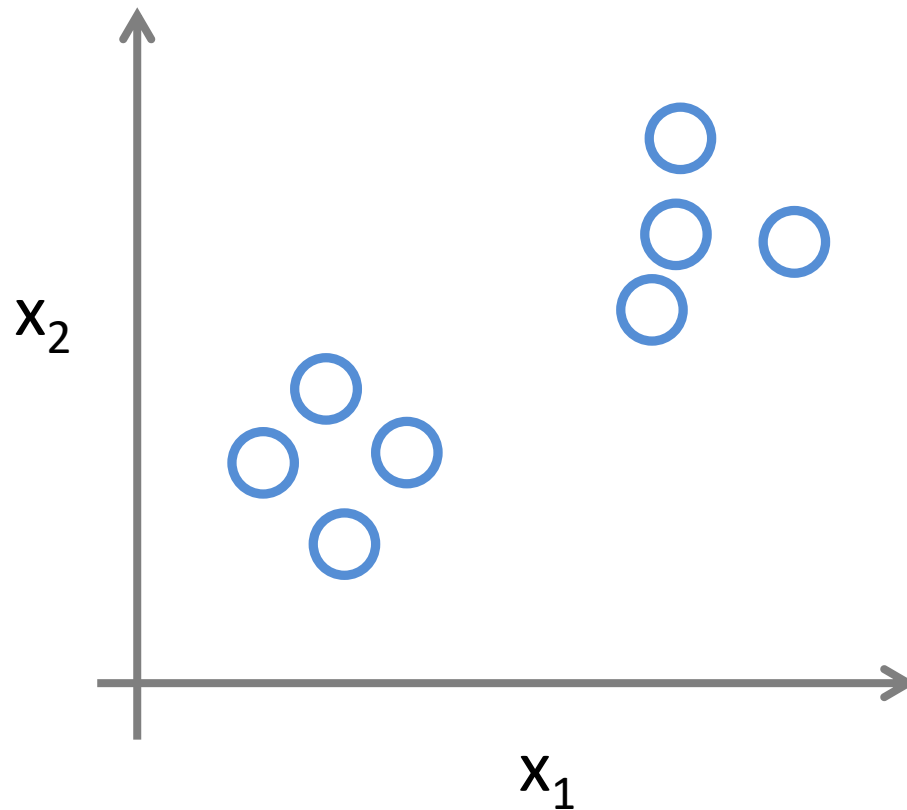
Introduction

Unsupervised Learning

Supervised Learning



Unsupervised Learning



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Weiss Doubts BP Would End Operations in Gulf of Mexico: Video Bloomberg

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Recession

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What next for Gulf oil spill?

STORY HIGHLIGHTS

(CNN) -- The ruptured Macondo well, a mile under the Gulf of Mexico off the Louisiana coast, has been permanently dead.

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

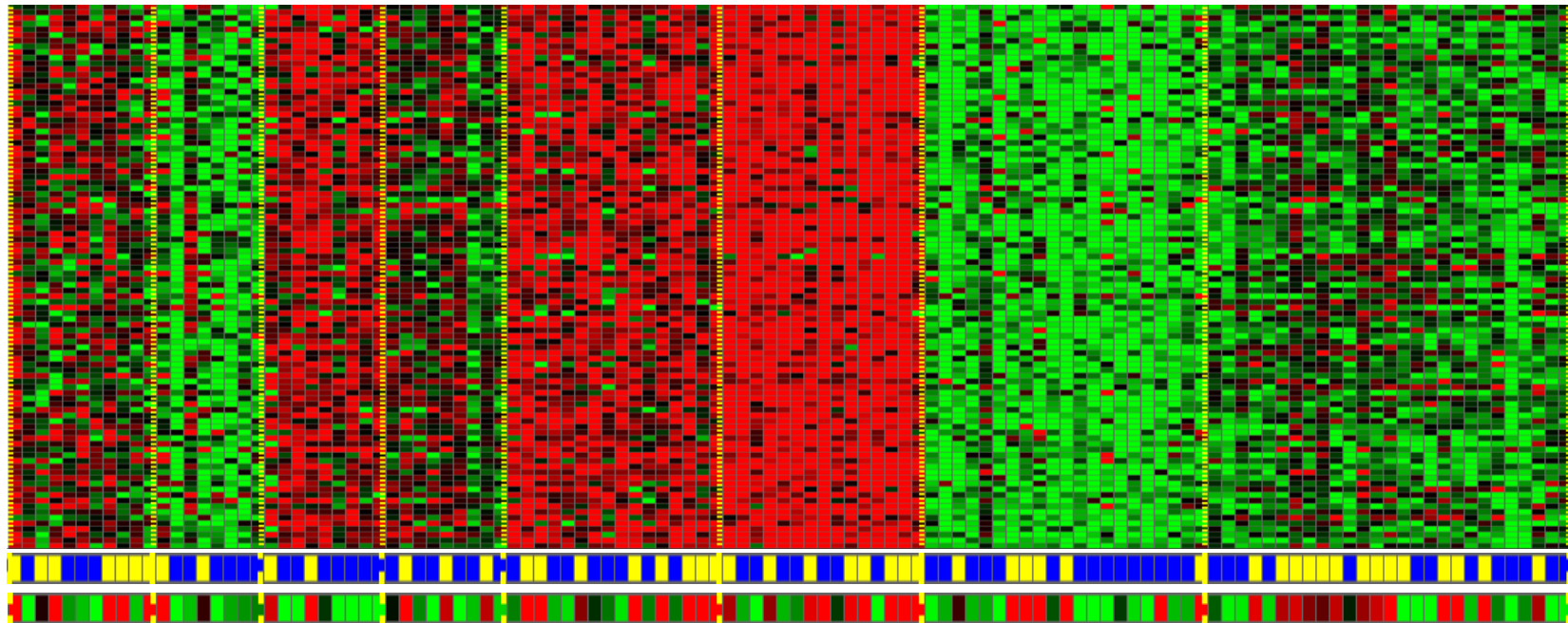
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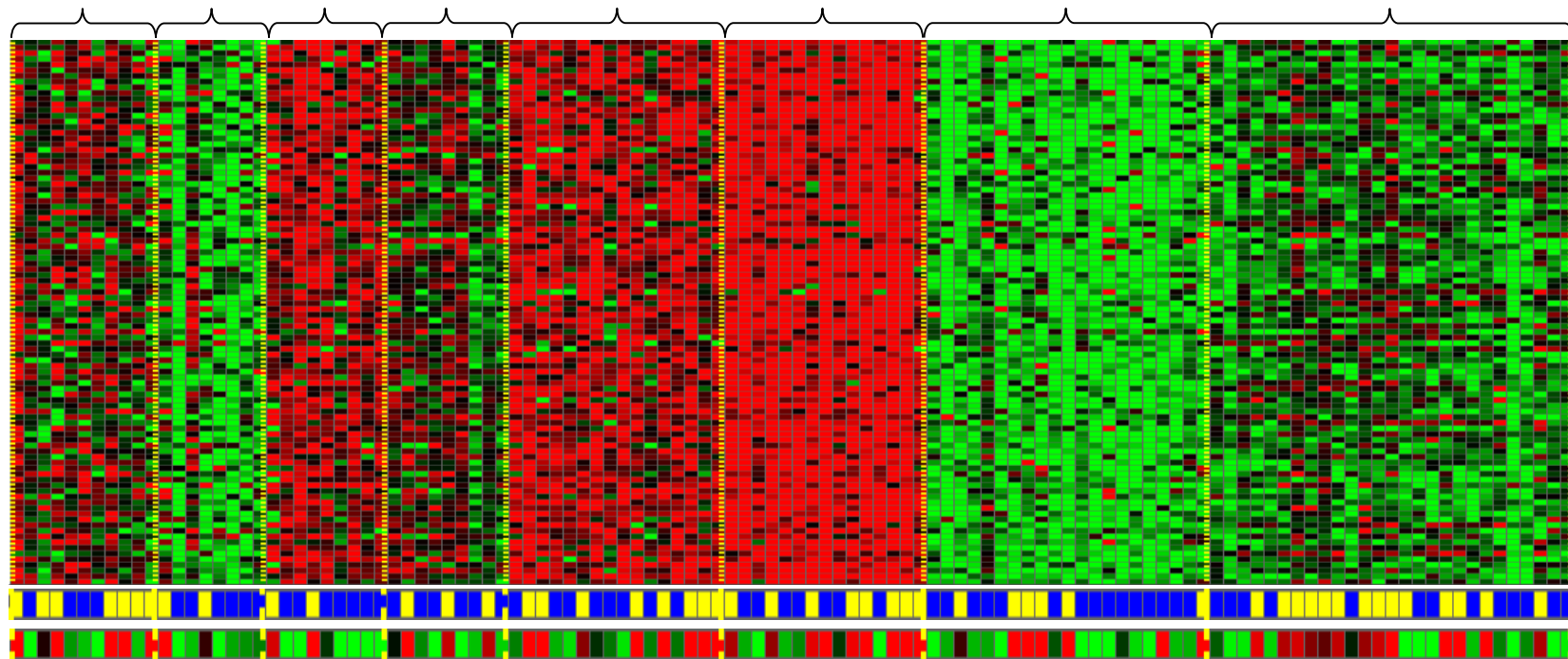
BP's costs for the Deepwater Horizon disaster have hit \$10bn. Photograph: HoReuters

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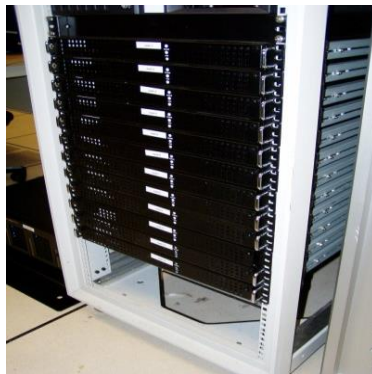
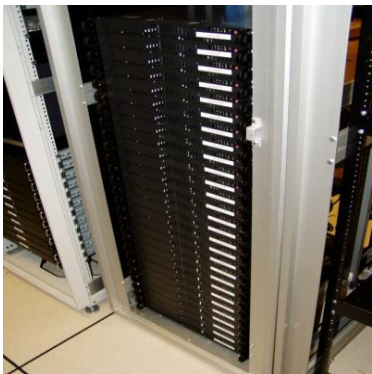


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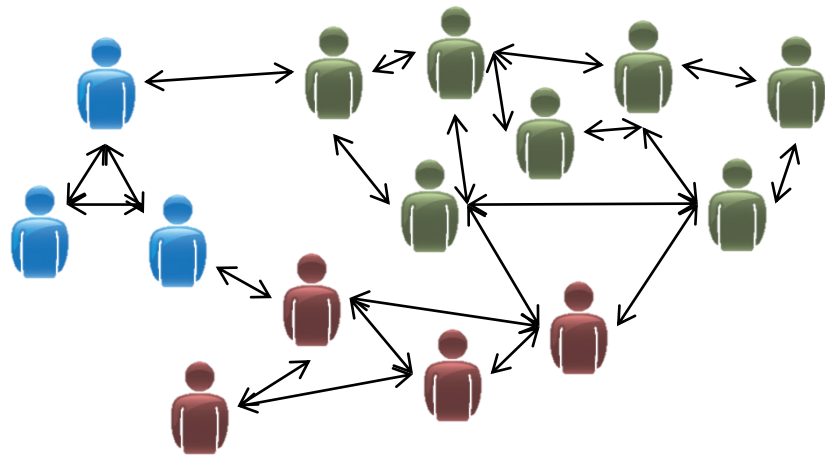
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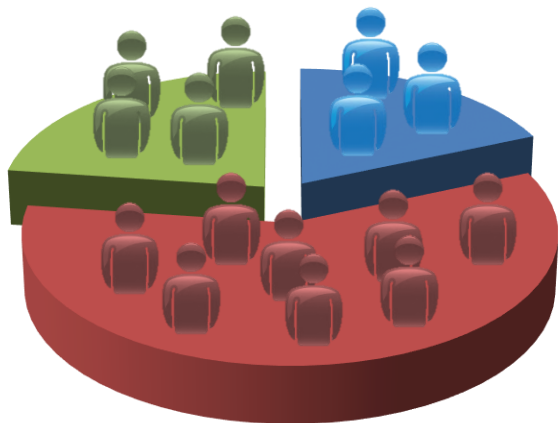
Individuals



Organize computing clusters



Social network analysis

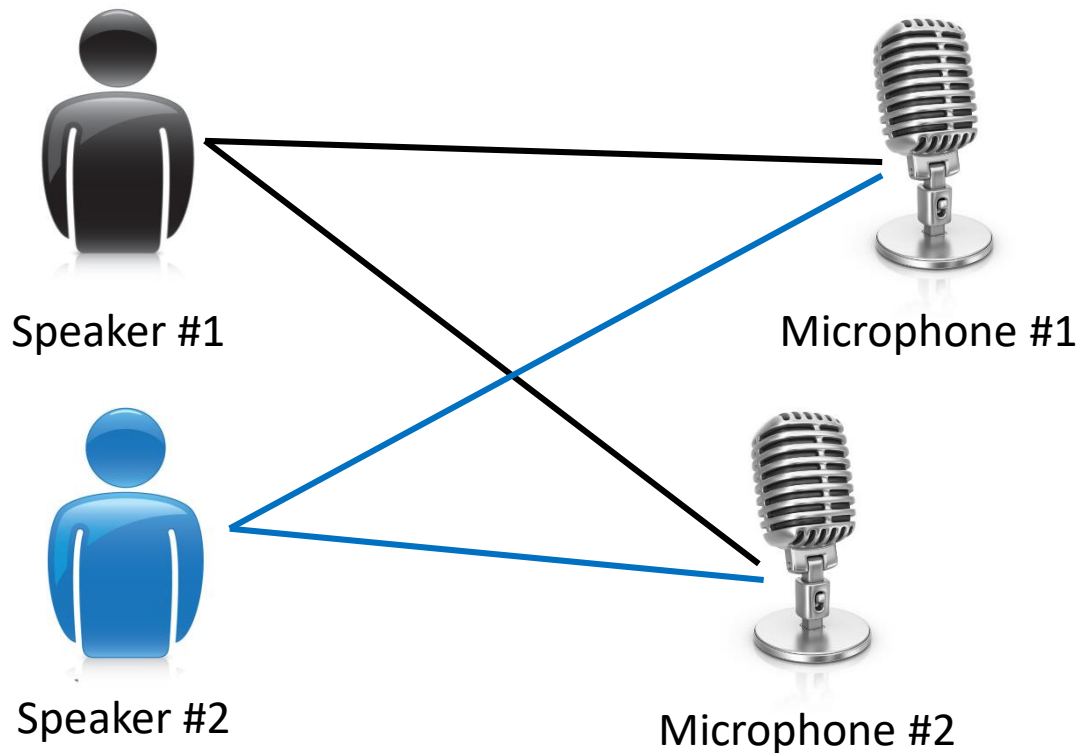


Market segmentation



Astronomical data analysis

Cocktail party problem



Microphone #1: 🗣️

Output #1: 🗣️

Microphone #2: 🗣️

Output #2: 🗣️

Microphone #1: 🗣️

Output #1: 🗣️

Microphone #2: 🗣️

Output #2: 🗣️

Cocktail party problem algorithm

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


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.