# Introduction to **Machine Learning**

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Saneem Ahmed

# Why Machine Learning?

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**Scholarly articles for machine learning**
... in search, optimization, and **machine learning** - Goldberg - Cited by 50557
Q-**learning** - Watkins - Cited by 6525
An introduction to MCMC for **machine learning** - Andrieu - Cited by 691

**Machine learning - Wikipedia, the free encyclopedia**
en.wikipedia.org/wiki/**Machine_learning**
**Machine learning**, a branch of artificial intelligence, is a scientific discipline concerned with the design and development of algorithms that allow computers to ...
↳ List of machine learning ... - Category:Machine learning - Weka - Transduction

**Machine Learning | Coursera**
www.coursera.org/course/ml
25 May 2012 – **Machine learning** is the science of getting computers to act without being explicitly programmed. In the past decade, **machine learning** has ...

**Machine Learning textbook**
www.cs.cmu.edu/~tom/mlbook.html
**Machine Learning**, Tom Mitchell, McGraw Hill, 1997. cover; **Machine Learning** is the study of computer algorithms that improve automatically through experience ...

**Machine Learning**
www.springer.com › ... › Computer Science › Artificial Intelligence
**Machine Learning** is an international forum for research on computational approaches to learning. The journal publishes articles reporting substantive results on ...

**Introduction to Machine Learning**
robotics.stanford.edu/~nilsson/mlbook.html
From this page you can download a draft of notes I used for a Stanford course on **Machine Learning**. Although I have tried to eliminate errors, some undoubtedly ...

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These recommendations are based on items you own and more.

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1.

**Nikon ML-L3 Wireless Remote Control**
by Nikon (June 17, 2003)
Average Customer Review: ★★★★½ (1,215)
In Stock

**List Price:** ~~$20.50~~
**Price:** $14.95
30 used & new from $10.00

Add to Cart | Add to Wish List

I own it | Not interested | ☆☆☆☆☆ Rate this item
Recommended because you added **Nikon BM-10 LCD Cover for D90** to your Shopping Cart and more (Fix this)

2.

**Peltor 97010 Ultimate-10 Hearing Protector**
by Peltor (January 12, 2005)
Average Customer Review: ★★★★½ (165)
In Stock

**List Price:** ~~$25.99~~
**Price:** $20.63
45 used & new from $18.77

Add to Cart | Add to Wish List

I own it | Not interested | ☆☆☆☆☆ Rate this item
Recommended because you purchased **Peltor 97079 Combat Arms Earplugs** and more (Fix this)

3.

**Nikon DK-21 Rubber Eyecup Nikon Digital SLR Cameras**
by Nikon (June 17, 2003)
Average Customer Review: ★★★★½ (28)
In Stock

**Price:** $8.94
7 used & new from $4.25

Add to Cart | Add to Wish List

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Recommended because you added **Nikon BM-10 LCD Cover for D90** to your Shopping Cart and more (Fix this)

Control Panel ▸ Speech Recognition Options
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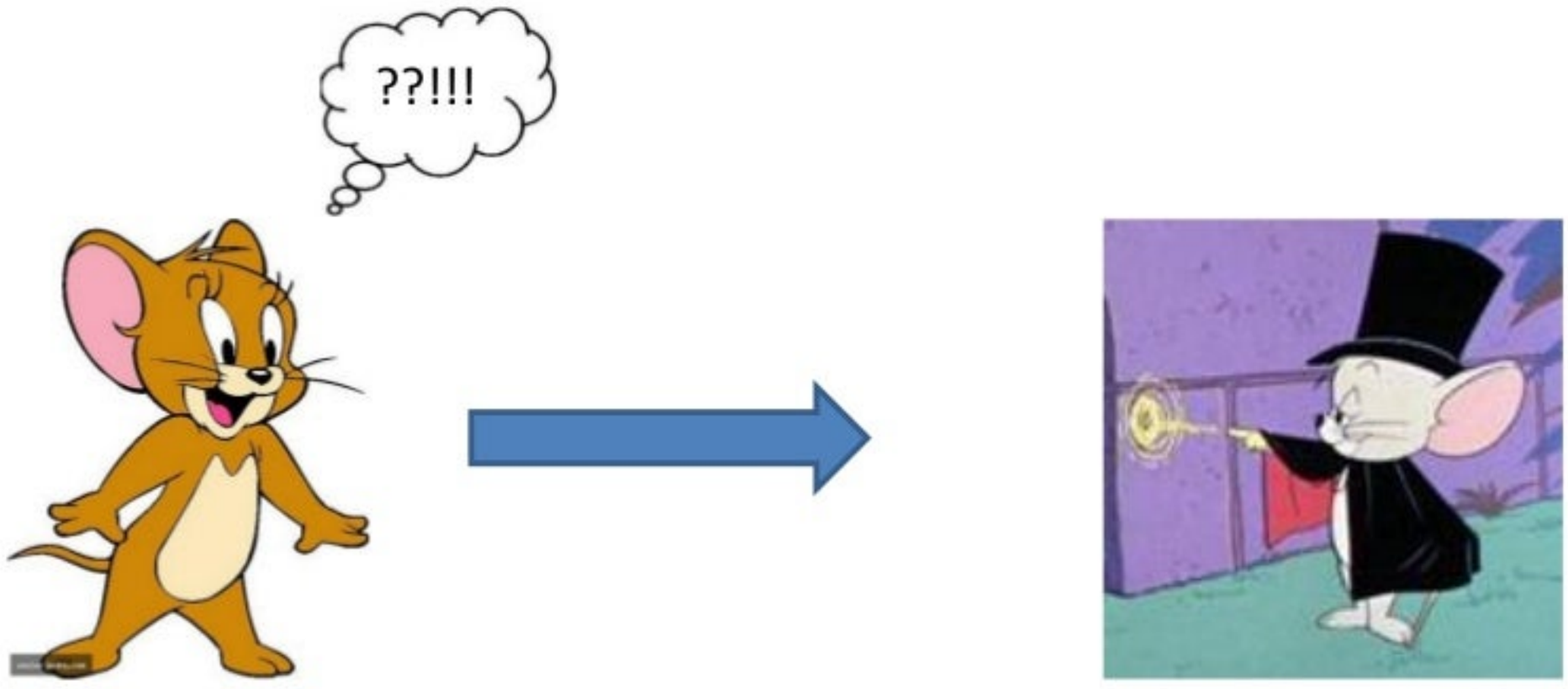
Advanced speech options
Text to Speech
Configure your Speech Recognition experience
Start Speech Recognition
Start using your voice to control your computer.
Set up microphone
Set up your computer to work properly with Speech Recognition.
Take Speech Tutorial
Learn to use your computer with speech. Learn basic commands and dictation.
Train your computer to better understand you
Read text to your computer to improve your computer's ability to understand your voice. Doing this isn't necessary, but can help improve dictation accuracy.
Open the Speech Reference Card
View and print a list of common commands to keep with you so you always know what to say.
If you would like to learn more about speech related tools and support from Microsoft, please visit the Microsoft Speech Online Community.
Listening
See also
Ease of Access
Audio Devices

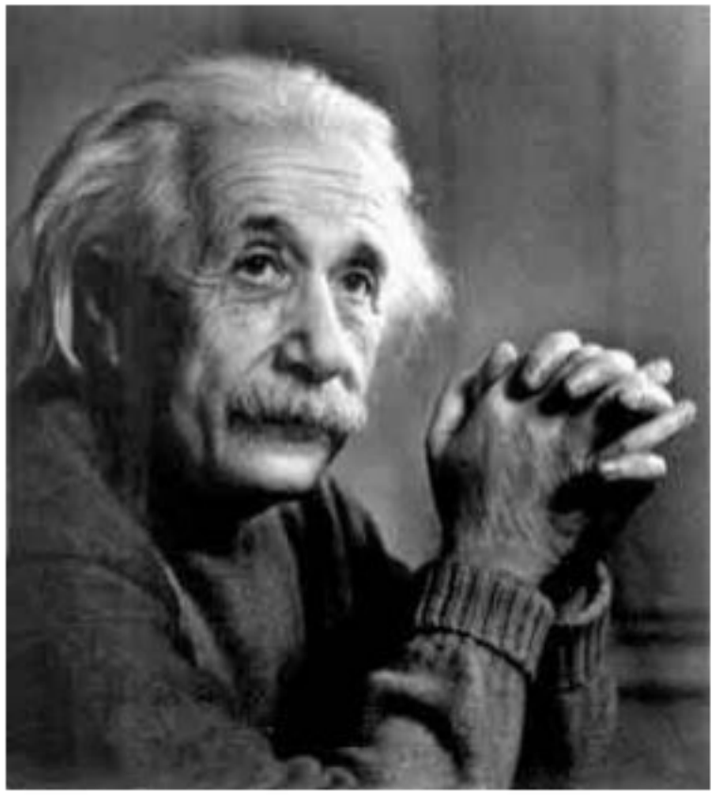
# Above all of this …
# Machine Learning is **AWESOME** !!

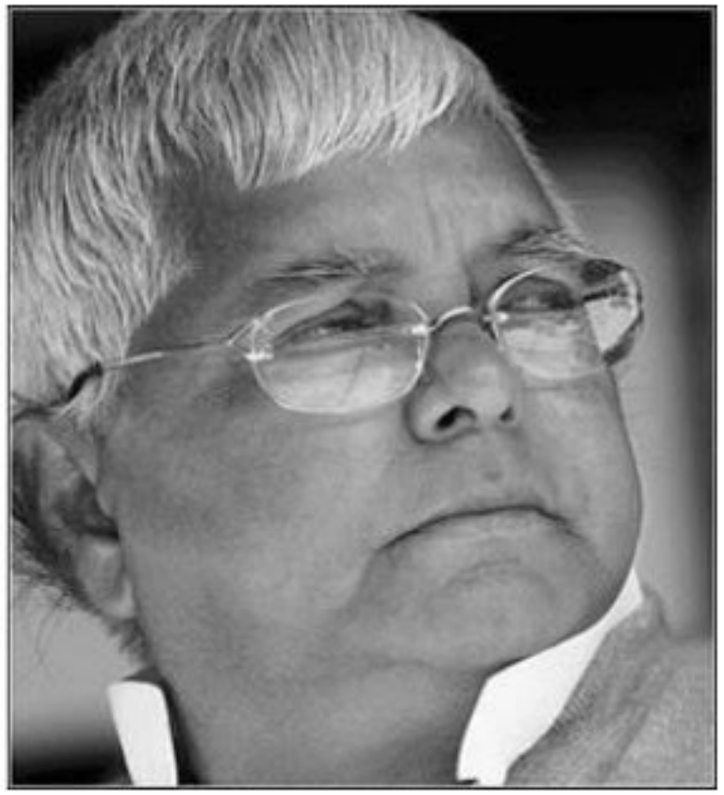


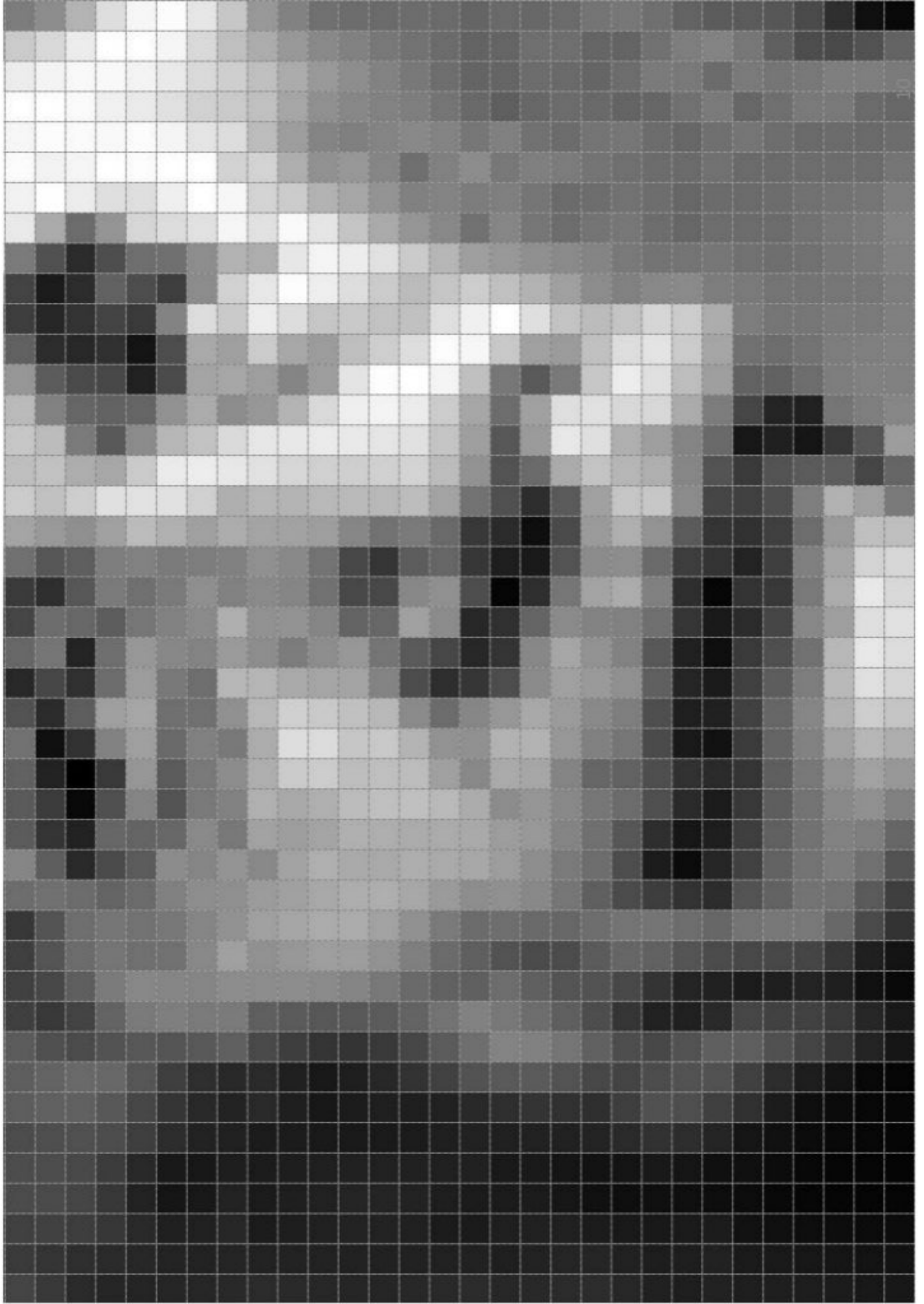

# What if you know the trick behind the magic …

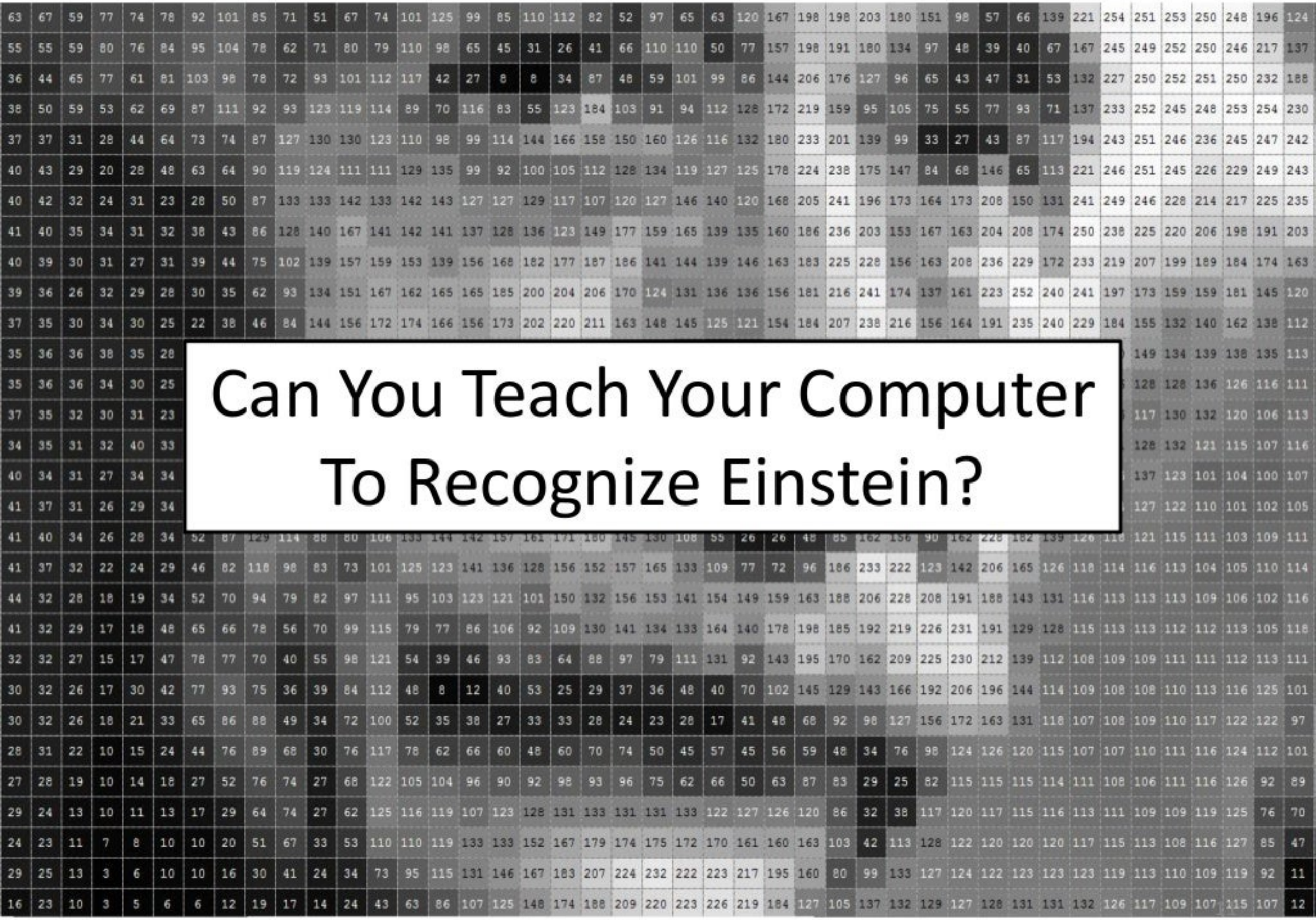
# What is Machine Learning?

# Who among these is Albert Einstein?









# Can You Teach Your Computer To Recognize Einstein?

# Brief Outline

- What is Machine Learning?
- Feature Engineering
- Types of Learning
  - Supervised Learning
  - Unsupervised Learning
  - Reinforcement Learning
- Some Interesting Applications

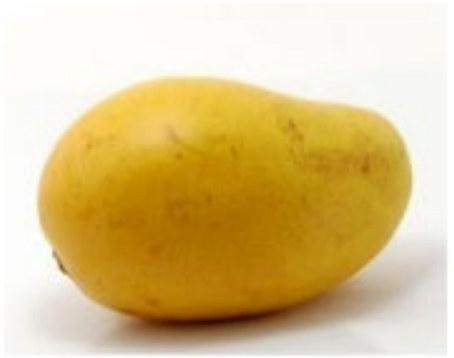
# Machine Learning

*"Field of study that gives computers the ability to learn without being explicitly programmed."*

- Arthur Samuel

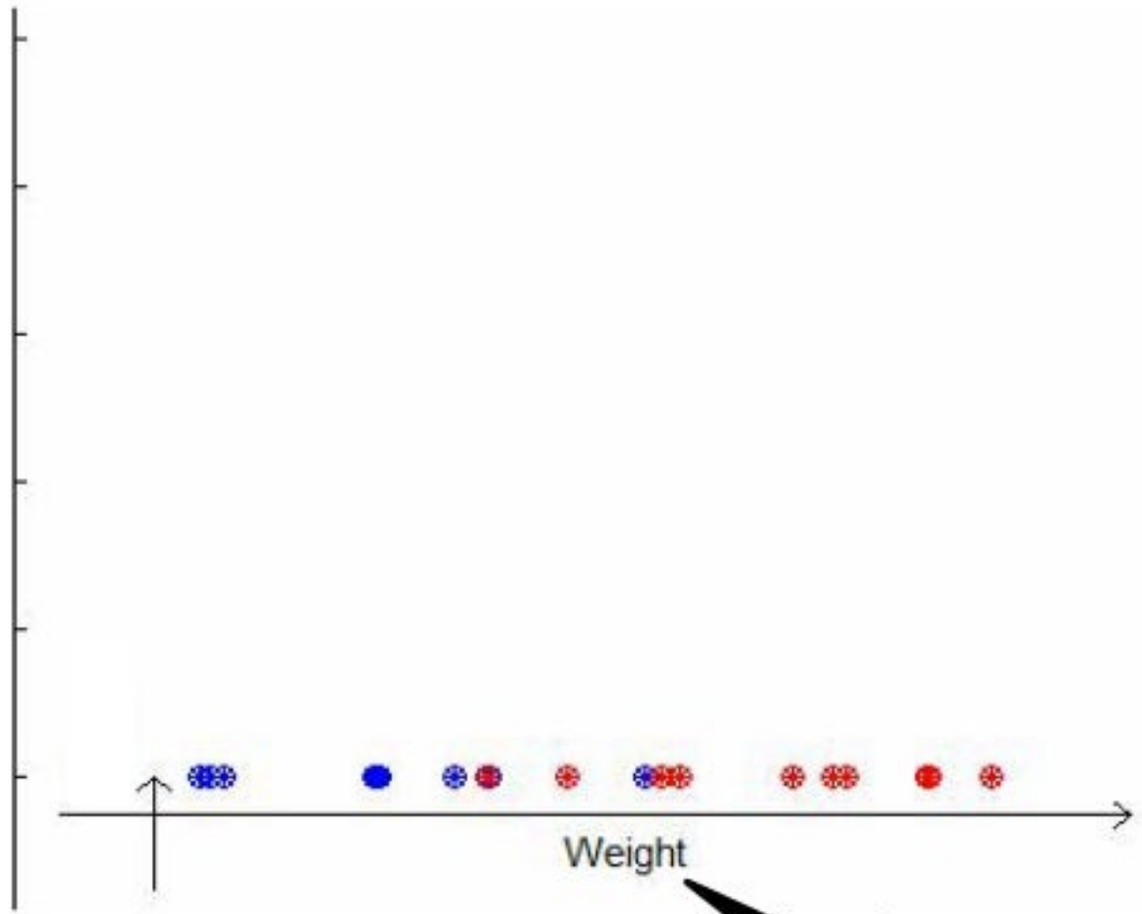
Checkers

# Raw Mango Vs. Ripen Mango



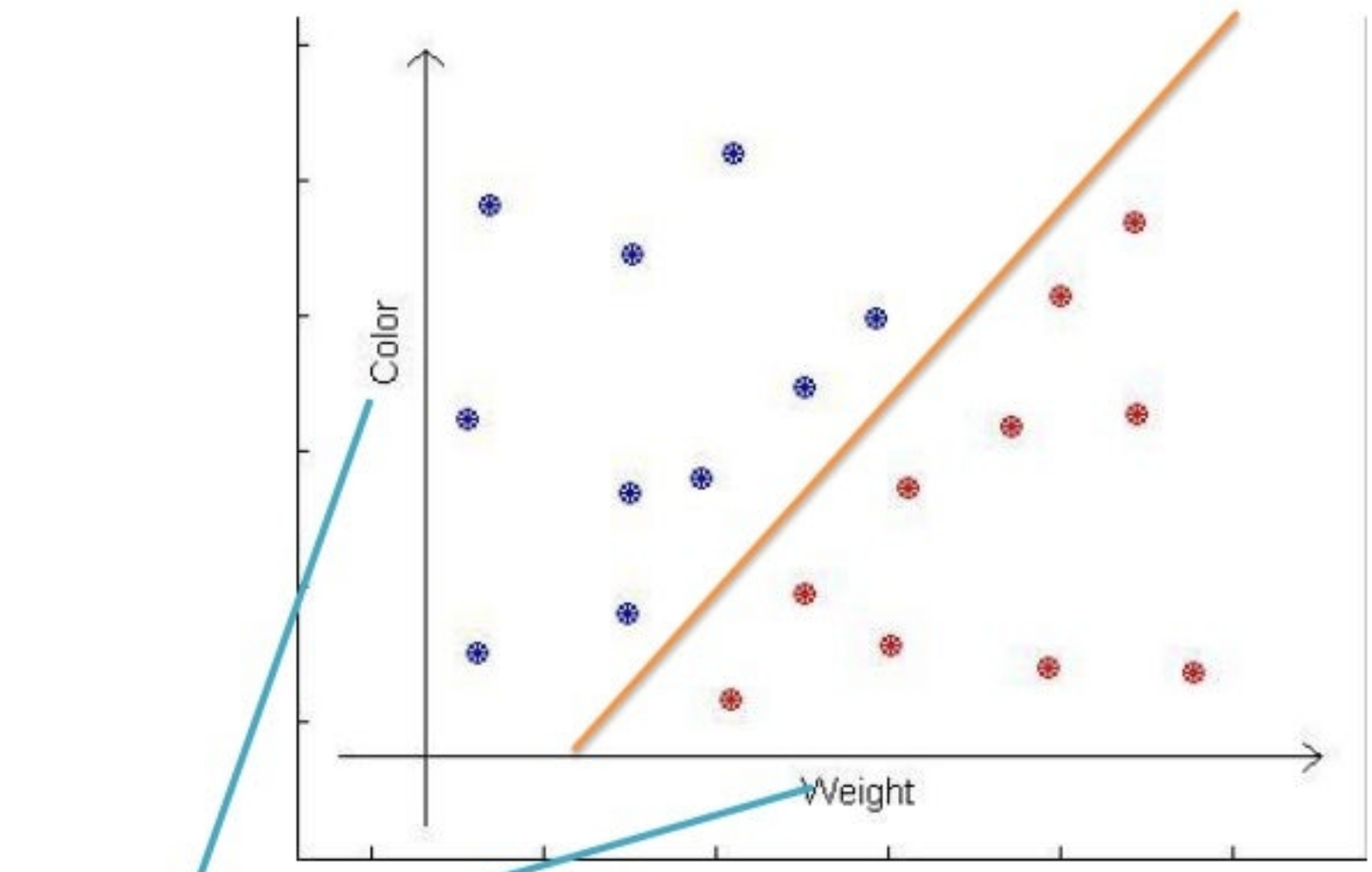
How do you input a mango to a computer?

# Raw Mango Vs. Ripen Mango




Differentiate a raw mango from a ripen mango using their weights?

# Raw Mango Vs. Ripen Mango



# Feature Extraction

# Spam Filter

From Allen and Violet Large  Spam x

**saavedra** saavedra@filo.uba.ar
to undisclosed recipients

May 9

**Be careful with this message.** Similar messages were used to steal people's personal information. Unless you trust the sender, don't click links or reply with personal information. Learn more

–

Dear Sir/Madam,

This is my fifth times of writting you this email since last year till date but no response from you. Hope you get this one, as this is a personal email directed to you.
My wife and I won a Jackpot Lottery of $11.3 million in July and have voluntarily decided to donate the sum of $500,000.00 USD to you as part of our own charity project to improve the lot of 10 lucky individuals all over the world. If you have received this email then you are one of the lucky recipients and all you have to do is get back with us so that we can send your details to the payout bank. Please note that you have to contact my private email for more informations (allenvioletlarge2@ozledim.net)

You can verify this by visiting the web pages below

http://www.dailymail.co.uk/news/article-1326473/Can...e-11-2m-lottery-win.html

http://www.cbc.ca/news/canada/nova-scotia/story/2010/11/04/ns-allen-violet-large-lottery-winning.html

Look for key words

Goodluck,
Allen and Violet Large
Email: allenvioletlarge2@ozledim.net

# Spam Filter

Dictionary Words

| | |
|---|---|
| aardwolf | ✗ |
| abacus | ✗ |
| abandon | ✗ |
| abbreviate | ✗ |
| abdicate | ✗ |
| . | |
| . | |
| dollar | ✓ |
| . | |
| . | |
| jackpot | ✓ |
| . | |
| . | |
| lottery | ✓ |
| . | |
| . | |
| zygotic | ✗ |
| zymurgy | ✗ |



0 0 0 0 . . . 1 . . 1 . . 1 . . 0 . . 0

Binary Features

# Exercise

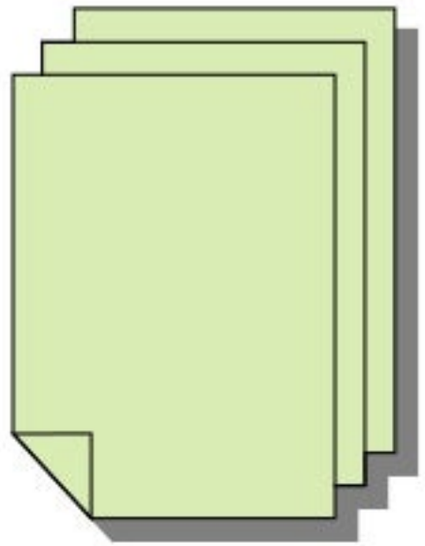
Can you guess the Features for the given Applications?

# Guess the Features?

- Medical Diagnosis
  - Predict whether a patient will survive
- Features?
  - Heart rate
  - Systolic blood pressure
  - White blood cell count
  - Age
  - ….

# Guess the Features?

- Document Categorization
  - Sports, Politics, Entertainment, …
- Features?
  - Part of speech tags (noun, verb, etc)
  - Word Counts



| abacus | abandon | abbreviate | ..... | zebra | zygotic |
|---|---|---|---|---|---|
| 12 | 0 | 1 | ..... | 5 | 0 |

# Guess the Features?

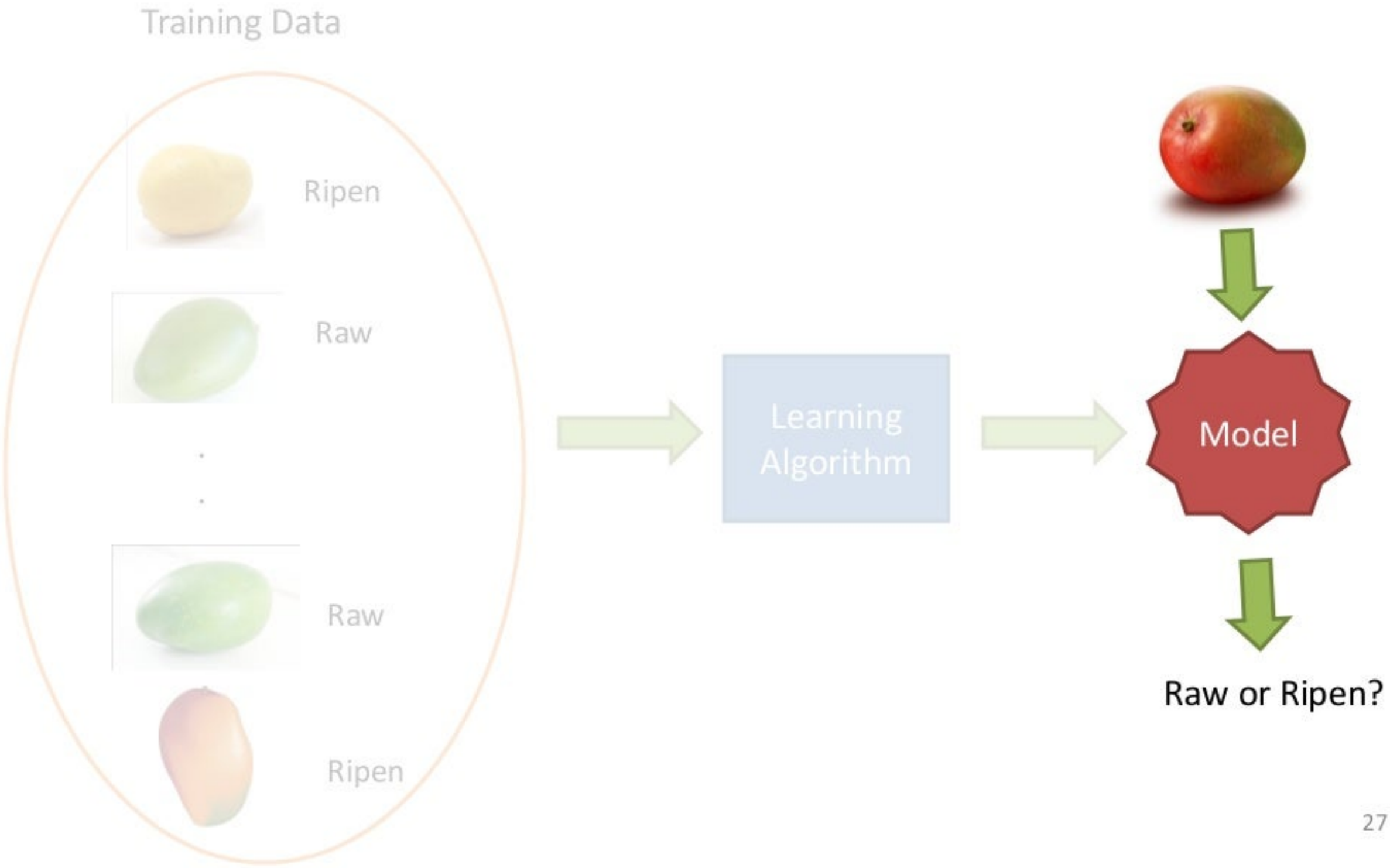
- Image Annotation
  - Car or Not a car
- Features?
  - RGB pixels.
  - Circle detection
  - Edge detection
  - Corner detection
  - …

# Types of Learning

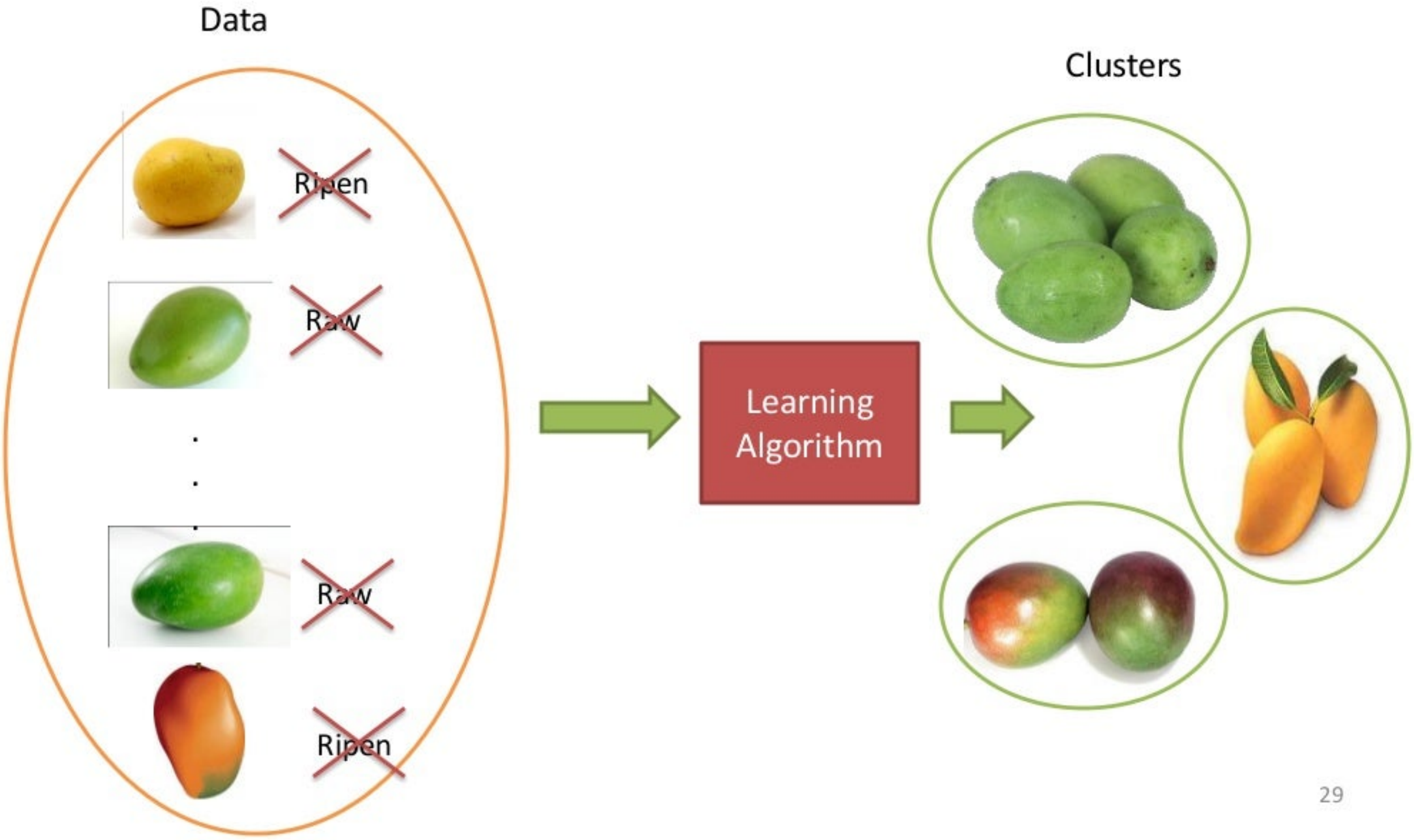
# Types of Learning

- Supervised Learning
- Unsupervised Learning
- Reinforcement Learning

# Supervised Learning



# Unsupervised Learning



# Example
# Image Segmentation

# Exercise

# Can you guess the Type of Learning in the given Applications?

# Guess the Type of Learning?

- Given a bank customer's profile, should I sanction him/her a loan?
  - Supervised Learning
- Given an audio track, separate the singer's voice from the background music.
  - Unsupervised Learning
- Automatically group your personal collection of photographs in Picasa into categories.
  - Unsupervised Learning
- Given a patient's X-ray image, diagnose if he has cancer.
  - Supervised Learning

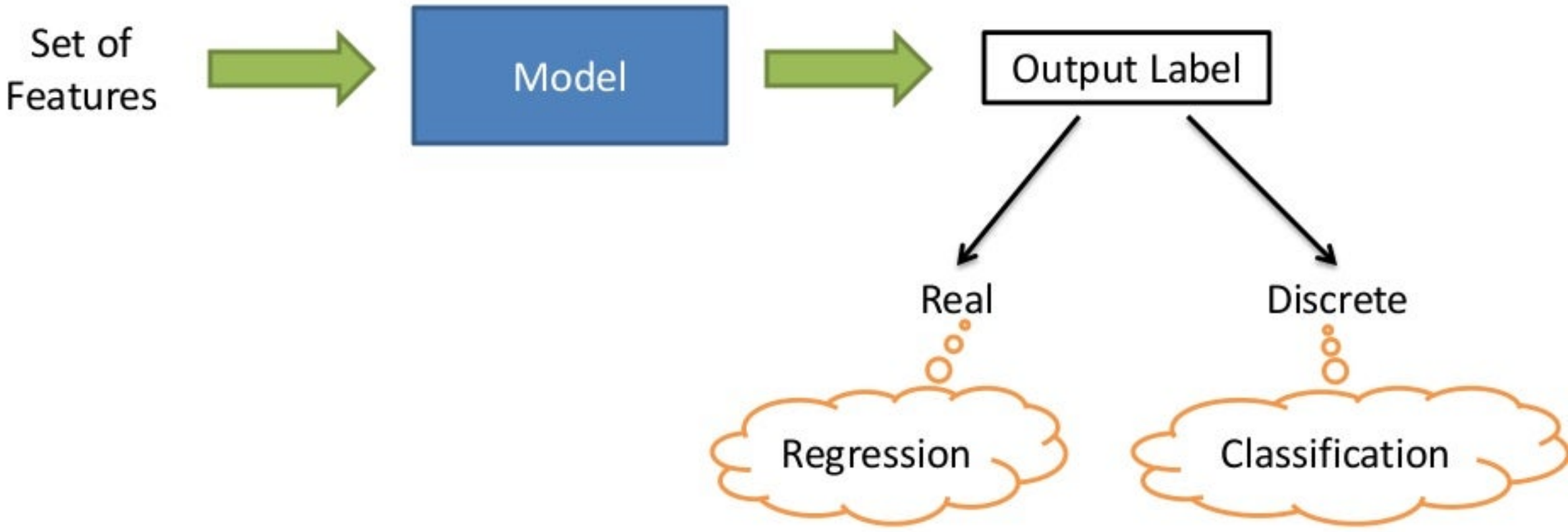
# Recap

- Introduction
  - Why Machine Learning?
  - What is Machine Learning?
- Feature Engineering
- Types of Learning
  - Supervised Learning
  - Unsupervised Learning

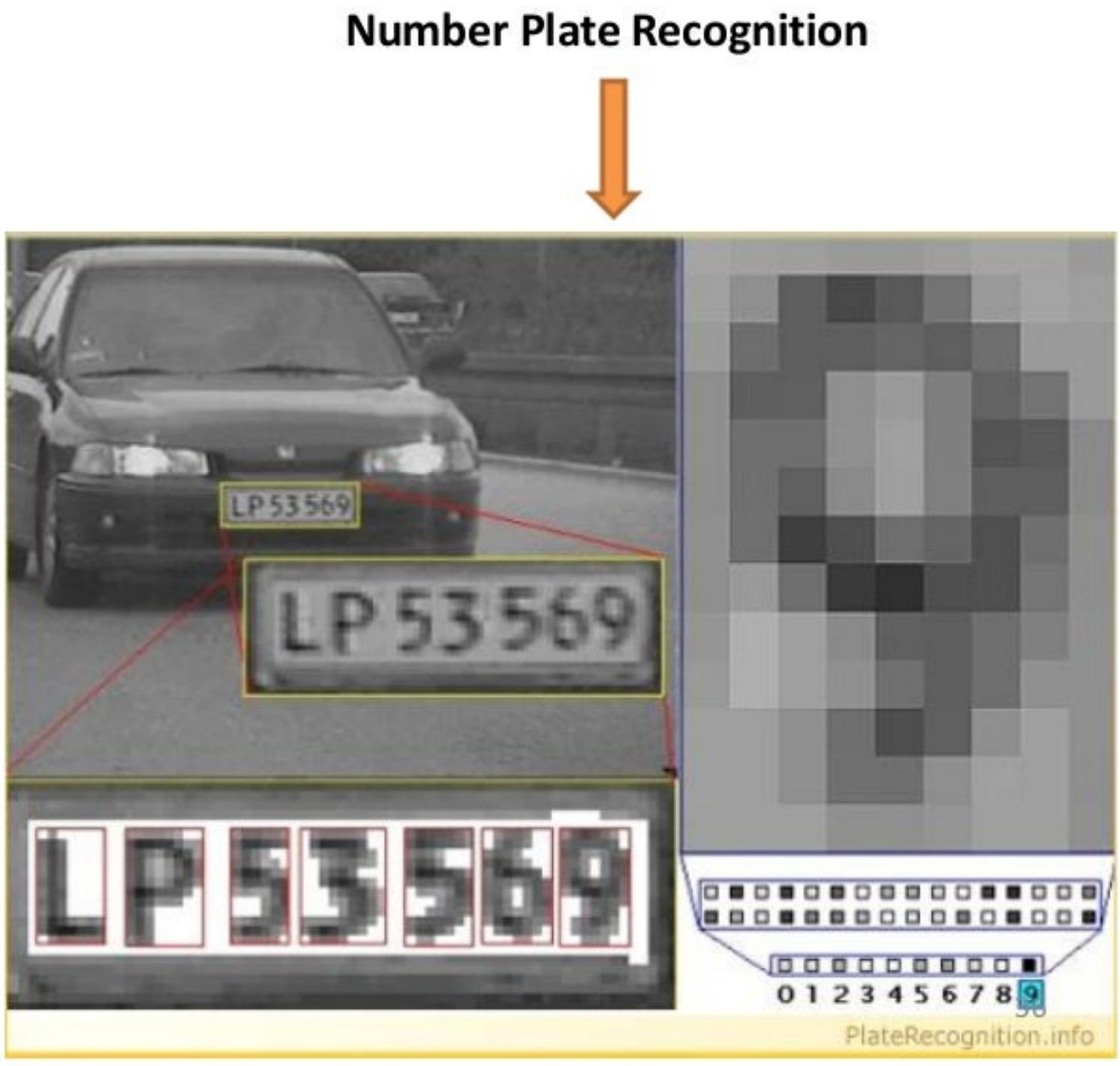
# Supervised Learning

# Supervised Learning

- Learn a **model** from labeled data.



# Classification: Example
## Character Recognition



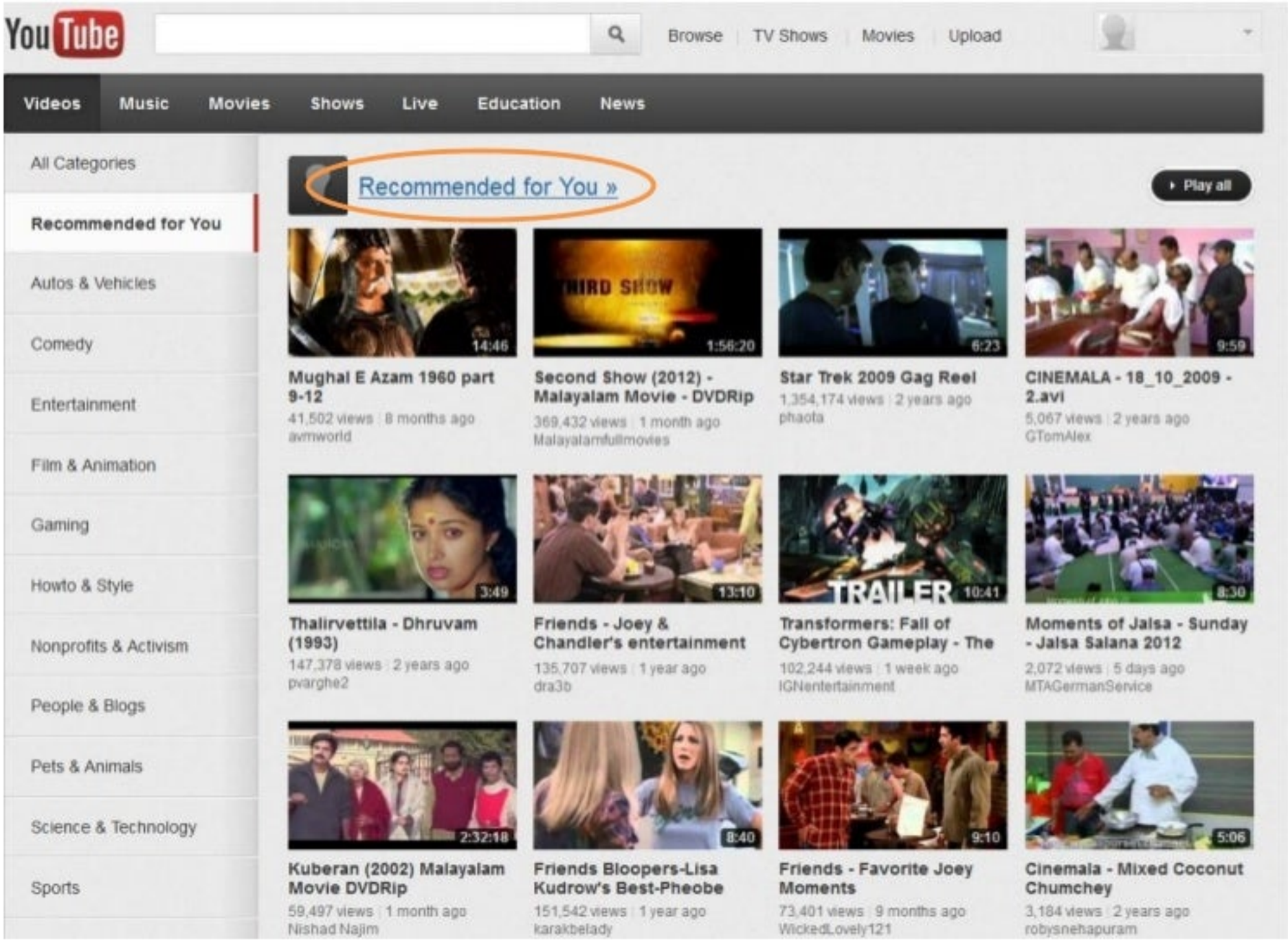
# Demo
# Classification
# Character Recognition

# Regression: Example
## Weather Forecasting

- Predict amount of rainfall
- Features:
  - Temperature
  - Humidity
  - Pressure
  - Wind
  - Atmospheric Stability
  - Seeding Potential
  - .....

# Unsupervised Learning

# Recommendation Systems




Cluster Similar Items (or) Cluster Similar Users

# Social Network Analysis

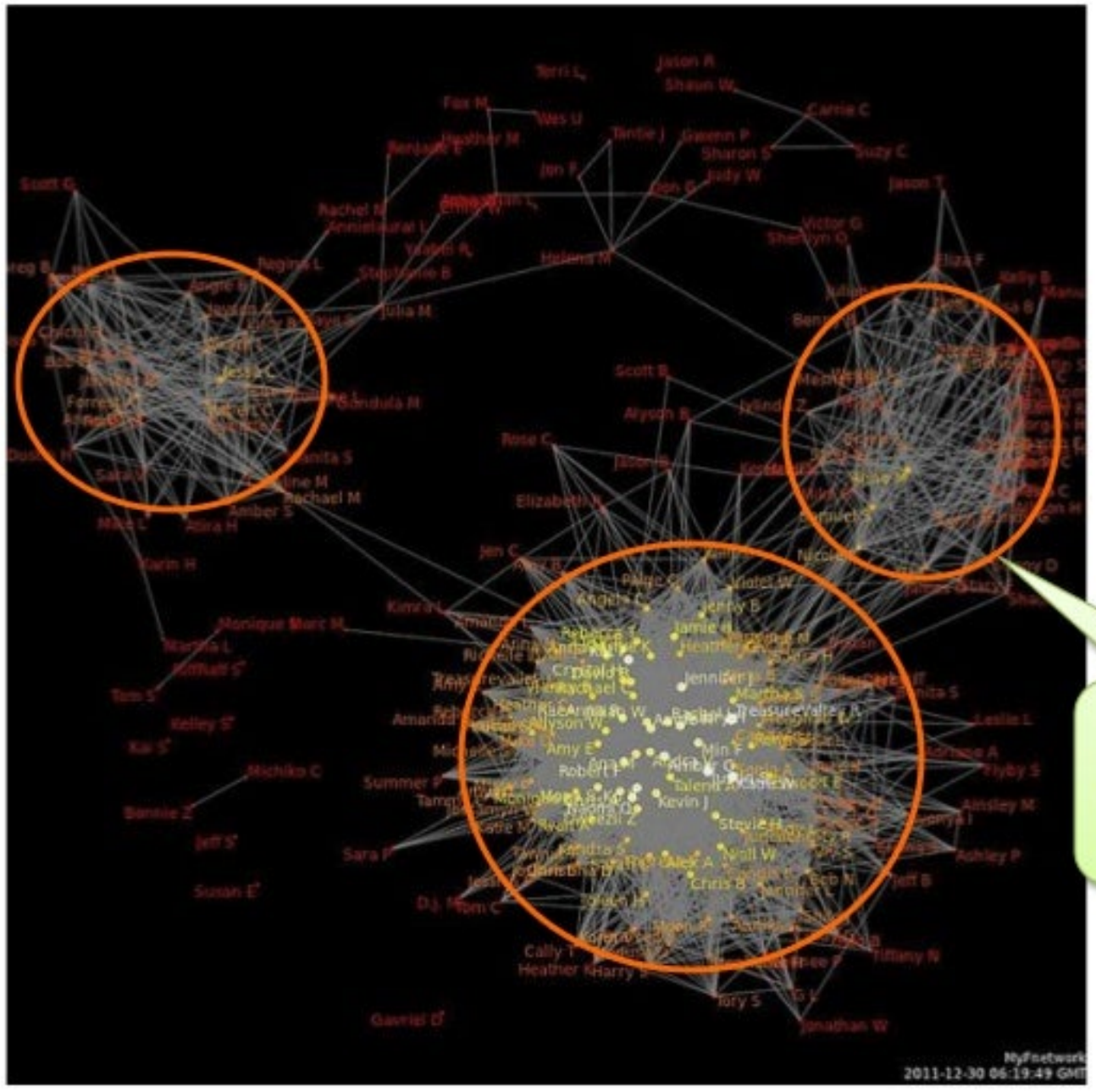
facebook

LinkedIn

Google+

orkut

twitter



# Demo

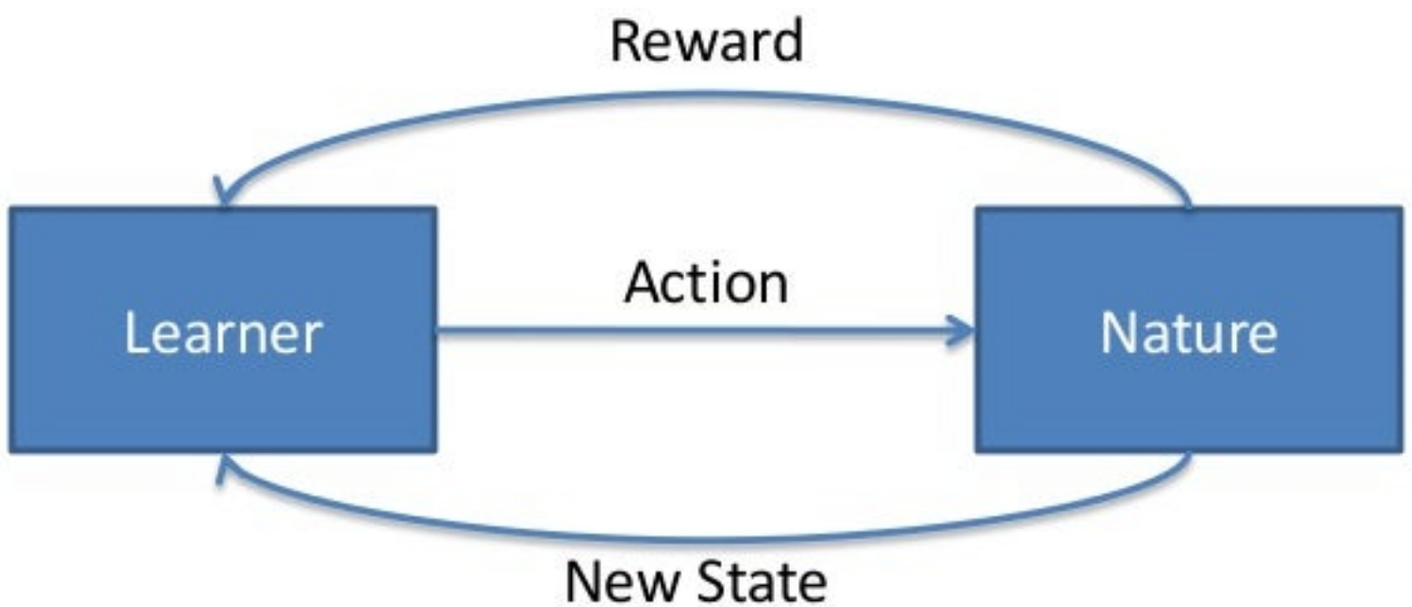
## Unsupervised Learning

## Clustering

# Reinforcement Learning

# Reinforcement Learning

- No explicit training data set.
- Nature provides reward for each of the learners actions.
- At each time,
  - Learner has a state and chooses an action.
  - Nature responds with new state and a reward.
  - Learner learns from reward and makes better decisions.



# Example
# Learning to Play Board Games

Checkers

Tic-Tac-Toe

Backgammon

# Machine Learning in Action

# DARPA Grand Challenge

# DARPA Grand Challenge

- International competition for building autonomous ground vehicles.
- Conducted by Defense Advanced Research Projects Agency (DARPA) of United States.
- Challenge was to build a driverless car that can navigate through a difficult track without human intervention.

# DARPA Grand Challenge

- DARPA Grand Challenge 2005 was won by the Stanford Racing Team.
- Supervised learning used to control speed and identify obstacles.
- Unsupervised learning used to find the path.

# What have we learnt?

- What is Machine Learning?
- Feature Engineering
- Types of Learning
  - Supervised Learning
  - Unsupervised Learning
  - Reinforcement Learning
- Supervised Learning
  - Classification
  - Regression
- Interesting Applications

# Resources

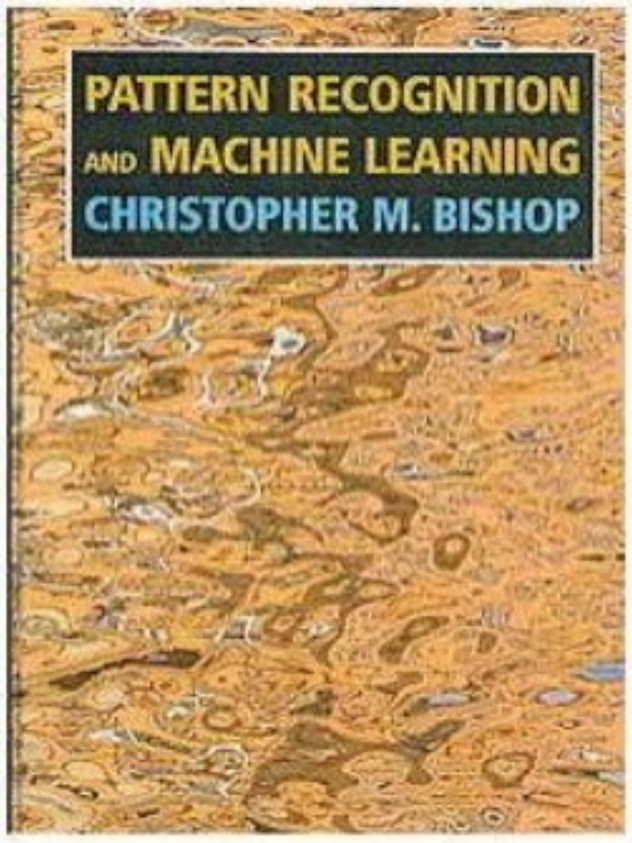
- Free online course by Andrew Ng in coursera.org
  - https://www.coursera.org/#course/ml

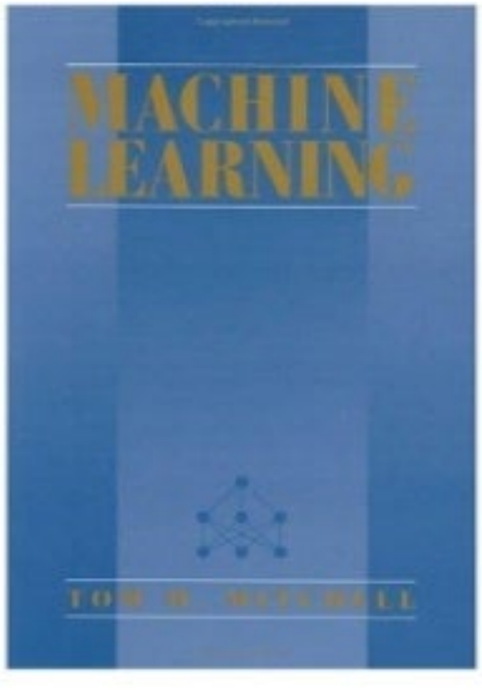
- E-learning course in NPTEL:-
  - V. Susheela Devi and M. Narasimha Murty
  - http://www.nptel.iitm.ac.in/

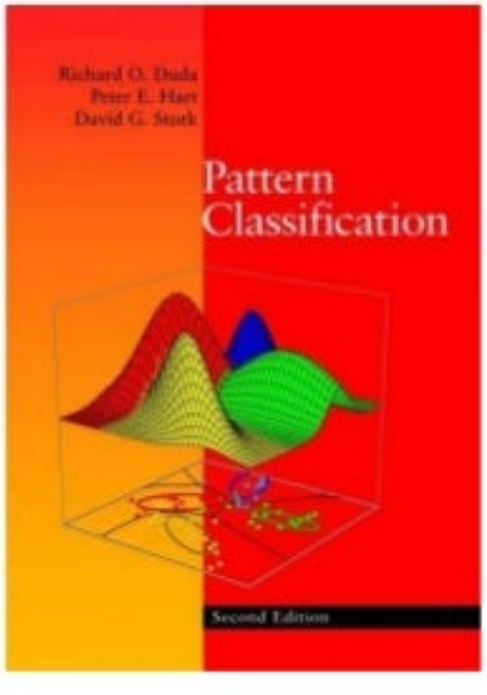
NPTEL

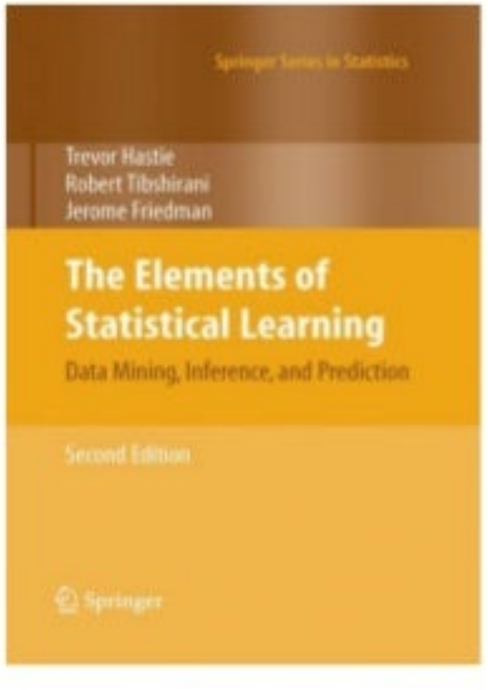
# Resources

- Books on Machine Learning
  - "Pattern Recognition and Machine Learning" by Christopher M Bishop



# What do I need to know to get started with Machine Learning?

- Linear Algebra
  - To exploit structure in data
- Probability and Statistics
  - To account for uncertainty in data
- Optimization
  - To decide from a set of alternatives

# Topics in Summer School

- Natural Language Processing
- Probability & Applications in ML
- Linear Algebra
- Optimization
- Support Vector Machine
- Matrix Factorization
- Computer Vision

# Questions?

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