

# Introduction to **Machine Learning**

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Saneem Ahmed

# Why Machine Learning?

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1.



#### [Nikon ML-L3 Wireless Remote Control](#)

by Nikon (June 17, 2003)

Average Customer Review: (1,215)

In Stock

**List Price:** \$20.50

**Price:** \$14.95

[30 used & new](#) from \$10.00

Add to Cart

Add to Wish List

2.



#### [Peltor 97010 Ultimate-10 Hearing Protector](#)

by Peltor (January 12, 2005)

Average Customer Review: (165)

In Stock

**List Price:** \$26.99

**Price:** \$20.63

[45 used & new](#) from \$18.77

Add to Cart

Add to Wish List

3.



#### [Nikon DK-21 Rubber Eyecup Nikon Digital SLR Cameras](#)

by Nikon (June 17, 2003)

Average Customer Review: (28)

In Stock

**Price:** \$8.94

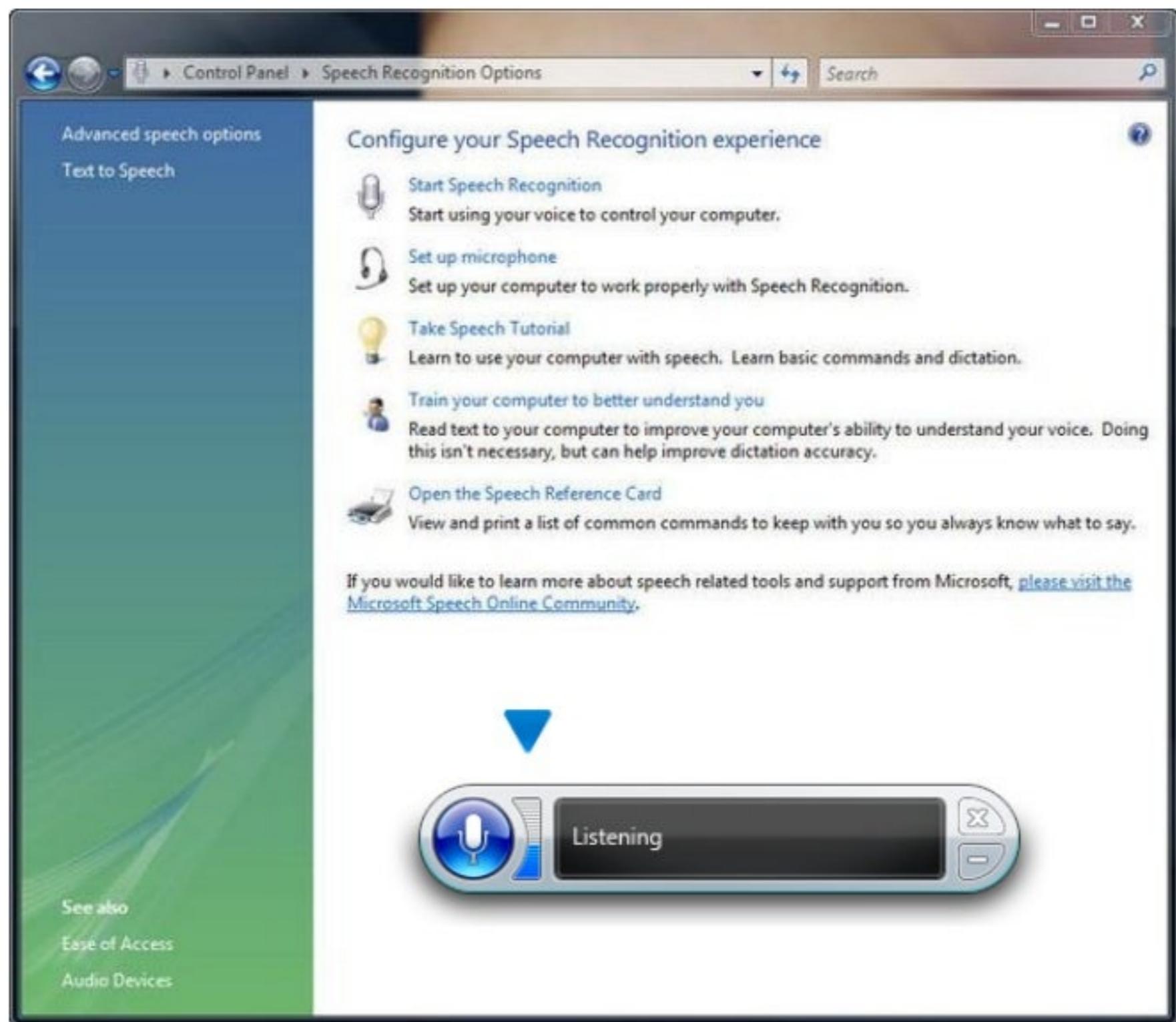
[7 used & new](#) from \$4.25

Add to Cart

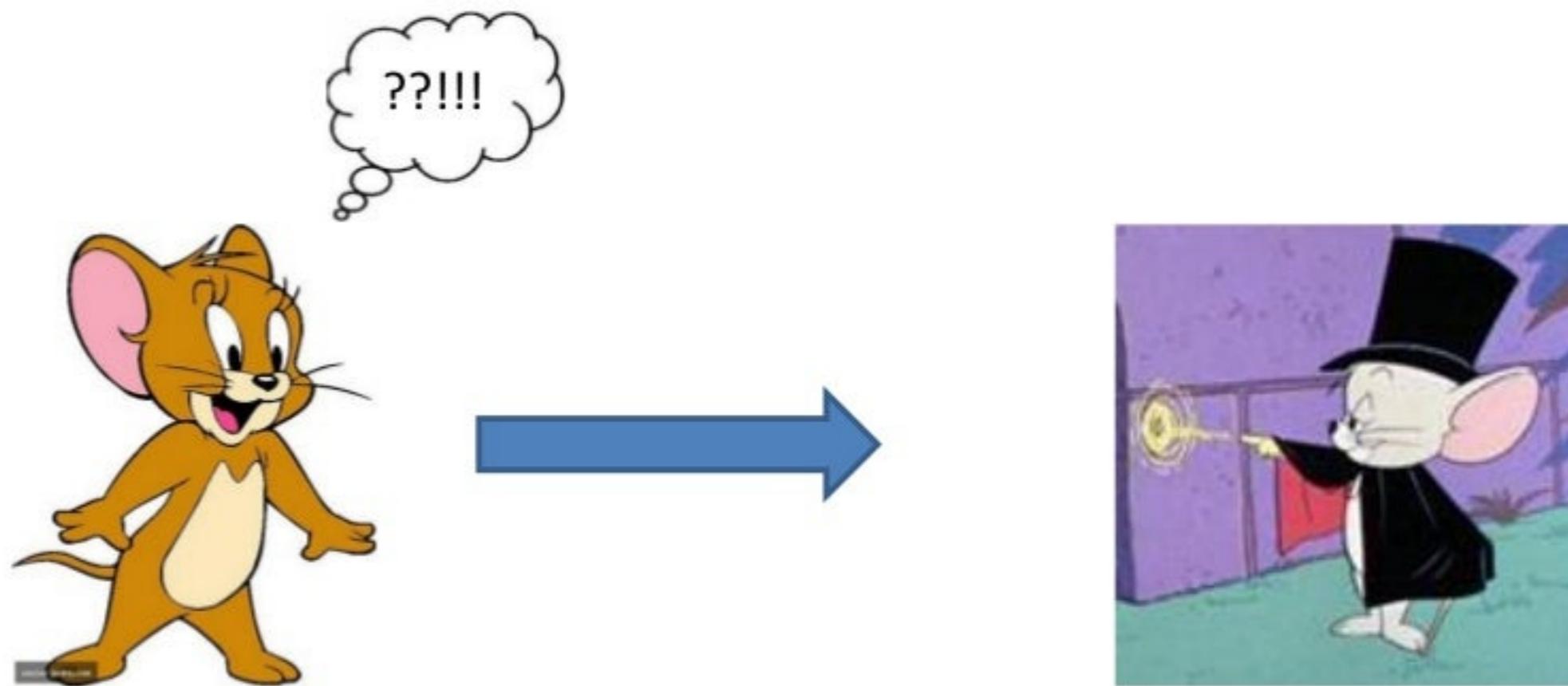
Add to Wish List

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)



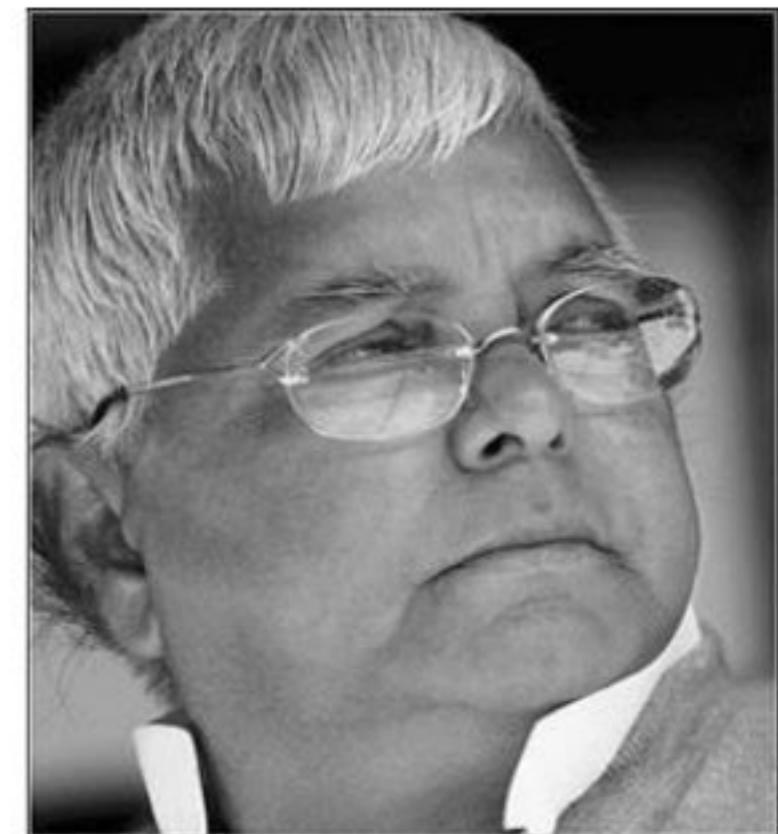
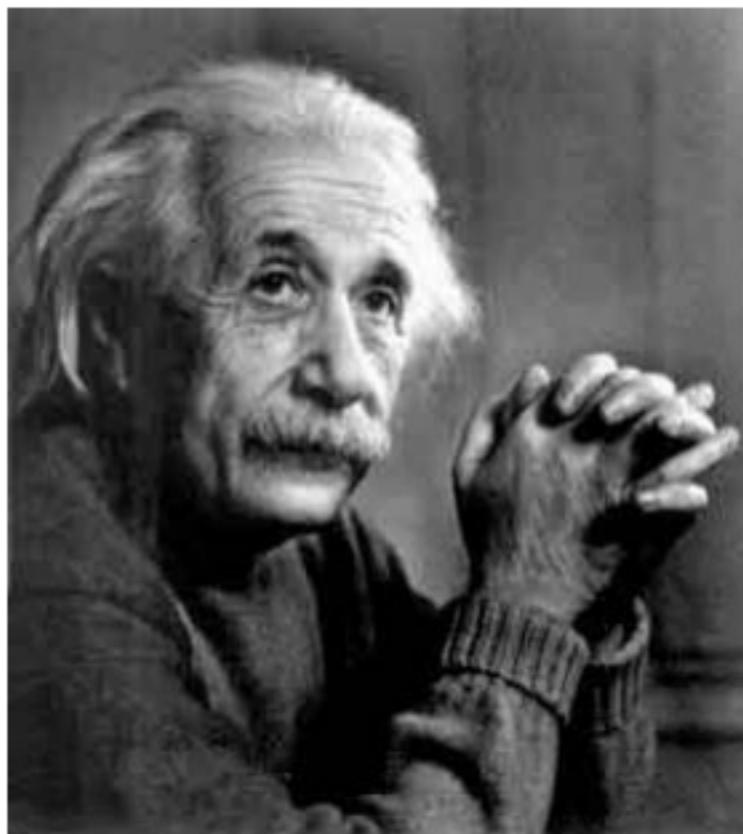
Above all of this ...  
Machine Learning is **AWESOME !!**



What if you know the trick behind  
the magic ...

# What is Machine Learning?

# Who among these is Albert Einstein?





63	67	59	77	74	78	92	101	85	71	51	67	74	101	125	99	85	110	112	82	52	97	65	63	120	167	198	198	203	180	151	98	57	66	139	221	254	251	253	250	248	196	124
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# Can You Teach Your Computer To Recognize Einstein?

41	40	34	26	28	34	52	87	129	114	88	80	106	133	144	142	157	161	171	180	145	130	108	55	26	26	45	85	162	156	90	162	228	182	139	126	116	121	115	111	103	109	111
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# 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.”*

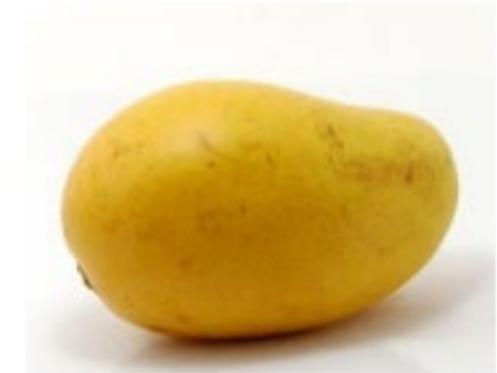
- Arthur Samuel



Checkers

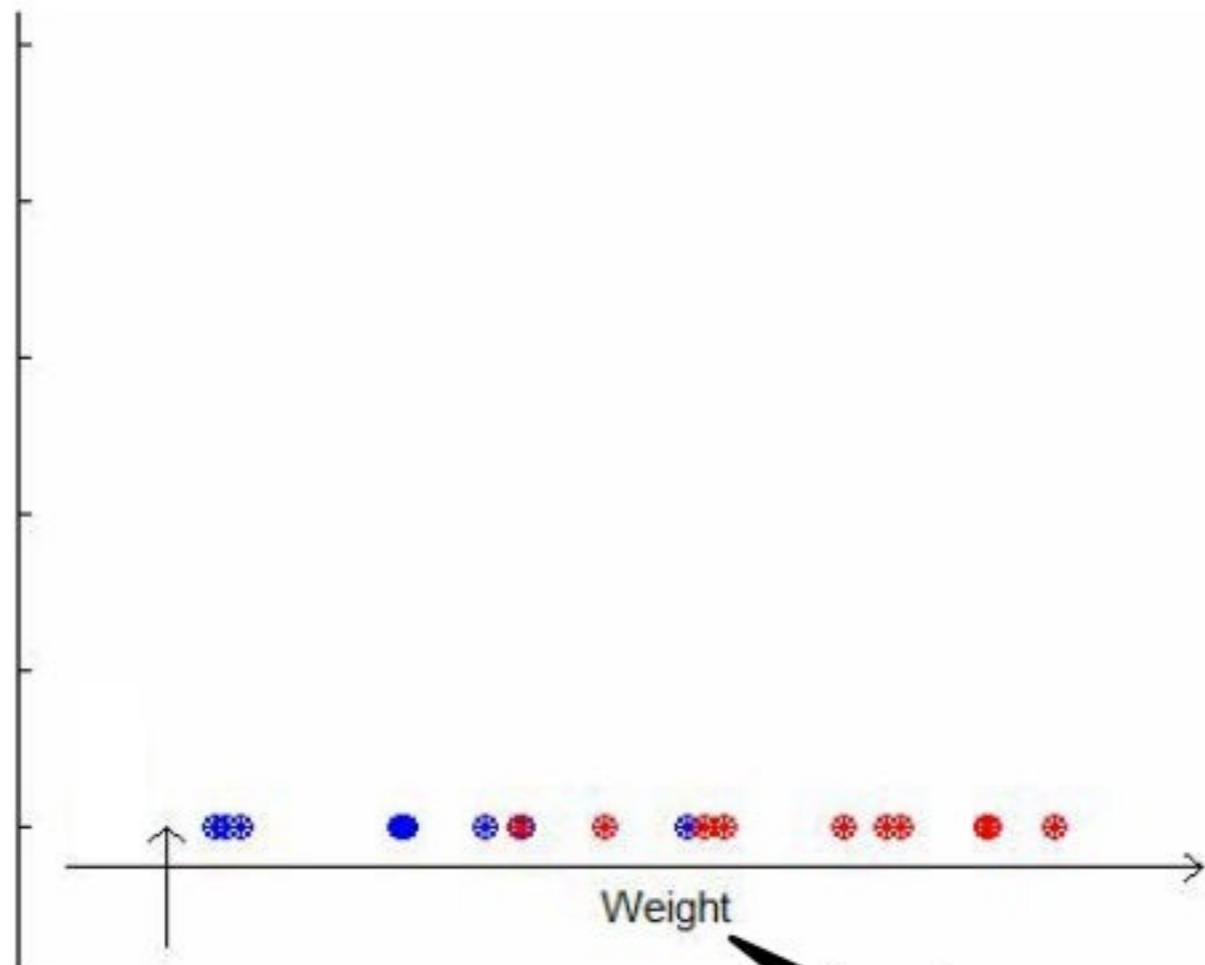


# Raw Mango Vs. Ripen Mango



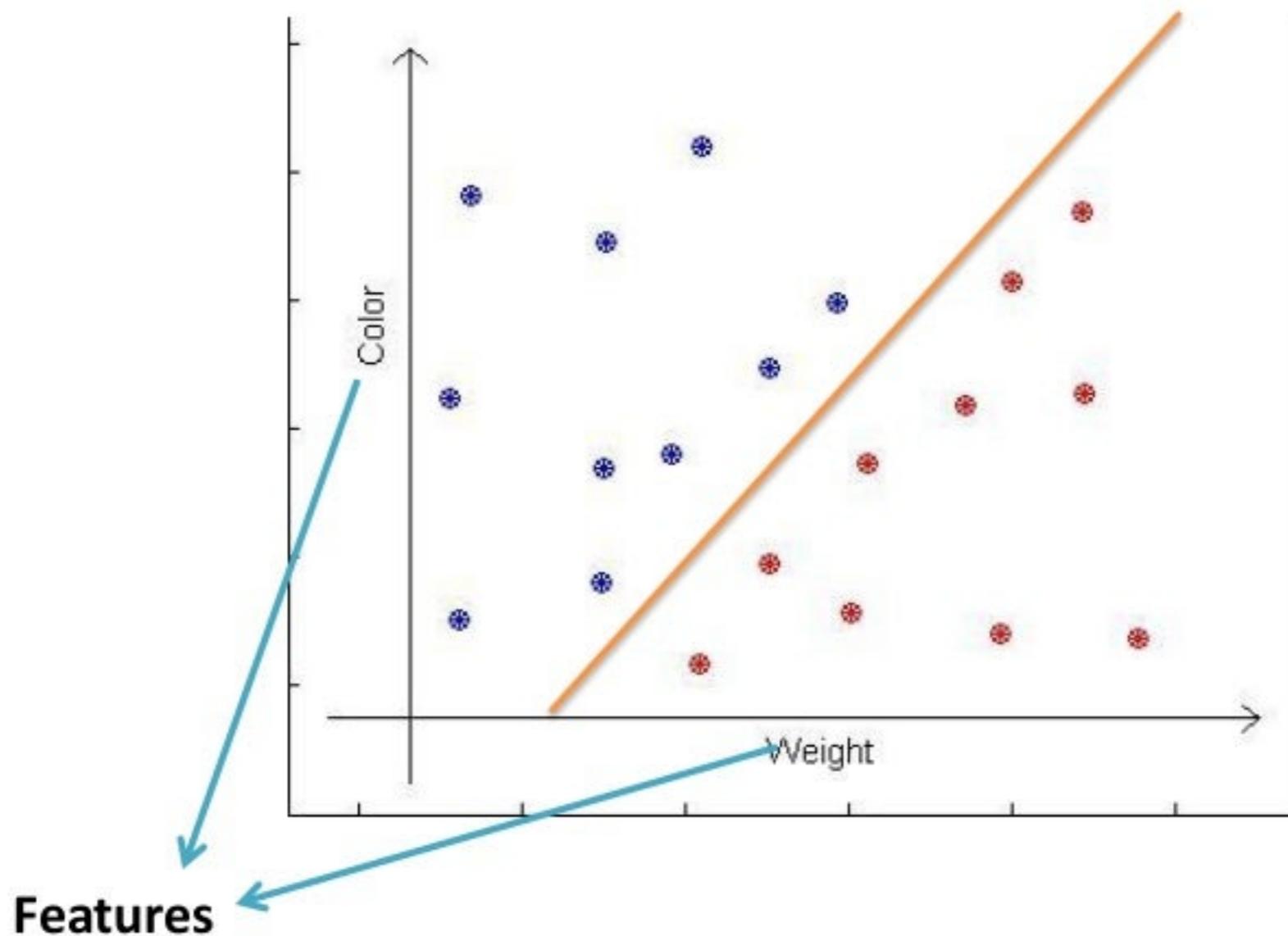
How do you input a  
mango to a computer?

# 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 Print Close

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 in touch 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 ([allenvioletpurple2@ozledim.net](mailto:allenvioletpurple2@ozledim.net))

You can verify this by visiting the web pages below

[http://www.dailymail.co.uk/news/article-1326473/Canada-wins-11-million-lottery.html](http://www.dailymail.co.uk/news/article-1326473/Canada-woman-wins-11-million-lottery.html)

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

Goodluck,  
Allen and Violet Large  
Email: [allenvioletpurple2@ozledim.net](mailto:allenvioletpurple2@ozledim.net)

**Look for key words**

# Spam Filter

## Dictionary Words

aardwolf X

abacus X

abandon X

abbreviate X

abdicate X

.

.

dollar ✓

.

.

jackpot ✓

.

.

lottery ✓

.

.

zygotic X

zymurgy X



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

Binary Features

## Exercise

Can you guess the Features for the given Applications?

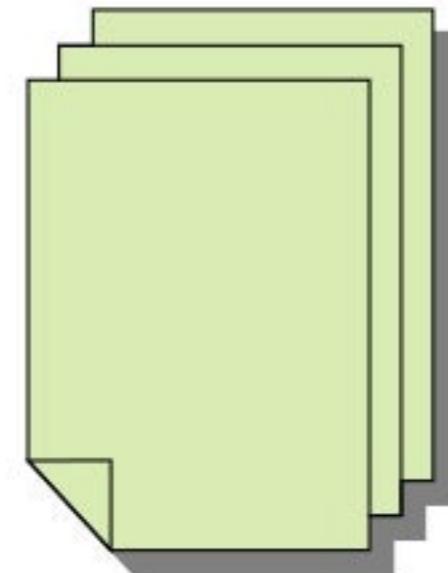
# Guess the Features?

- **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
  - ...

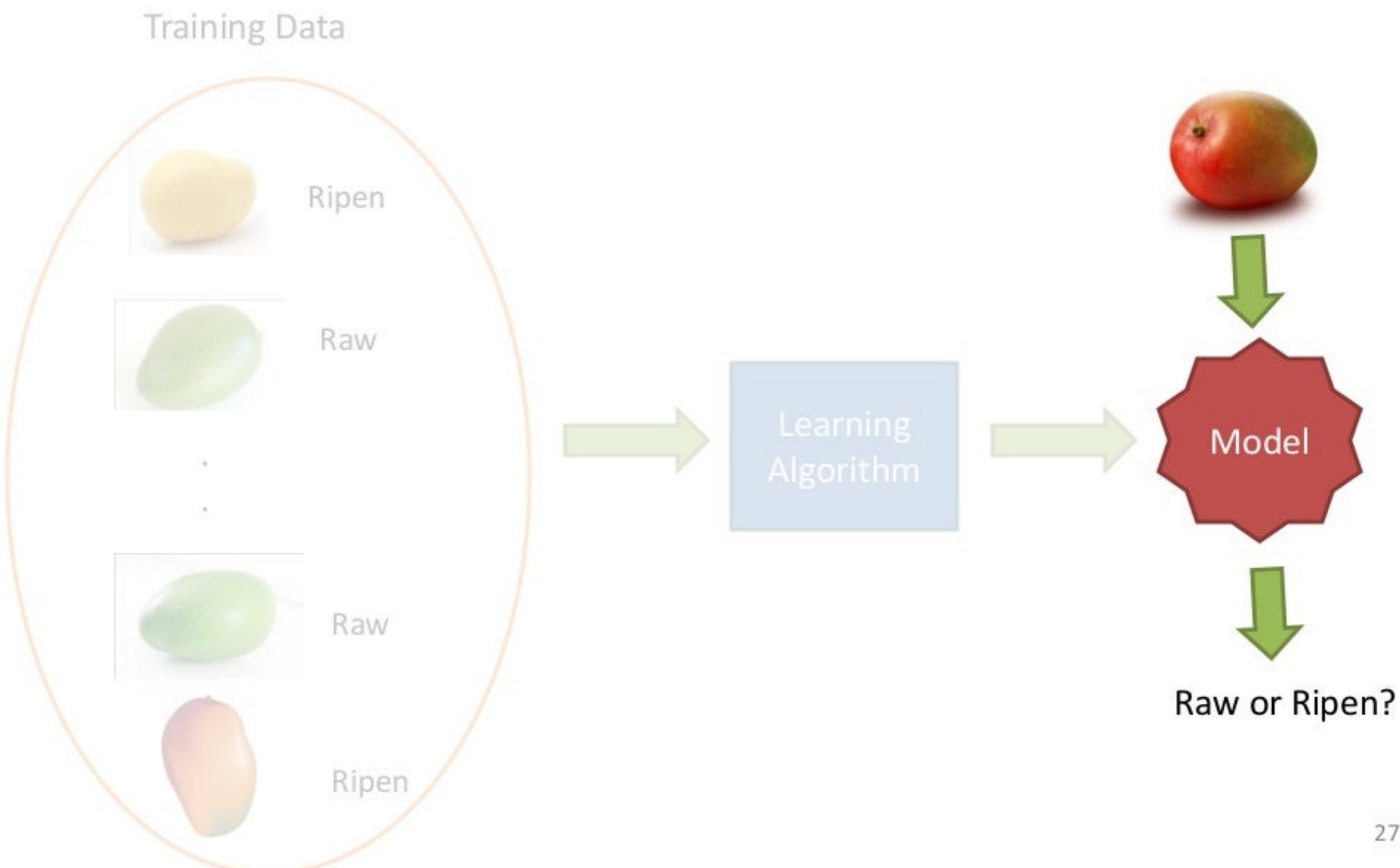


# Types of Learning

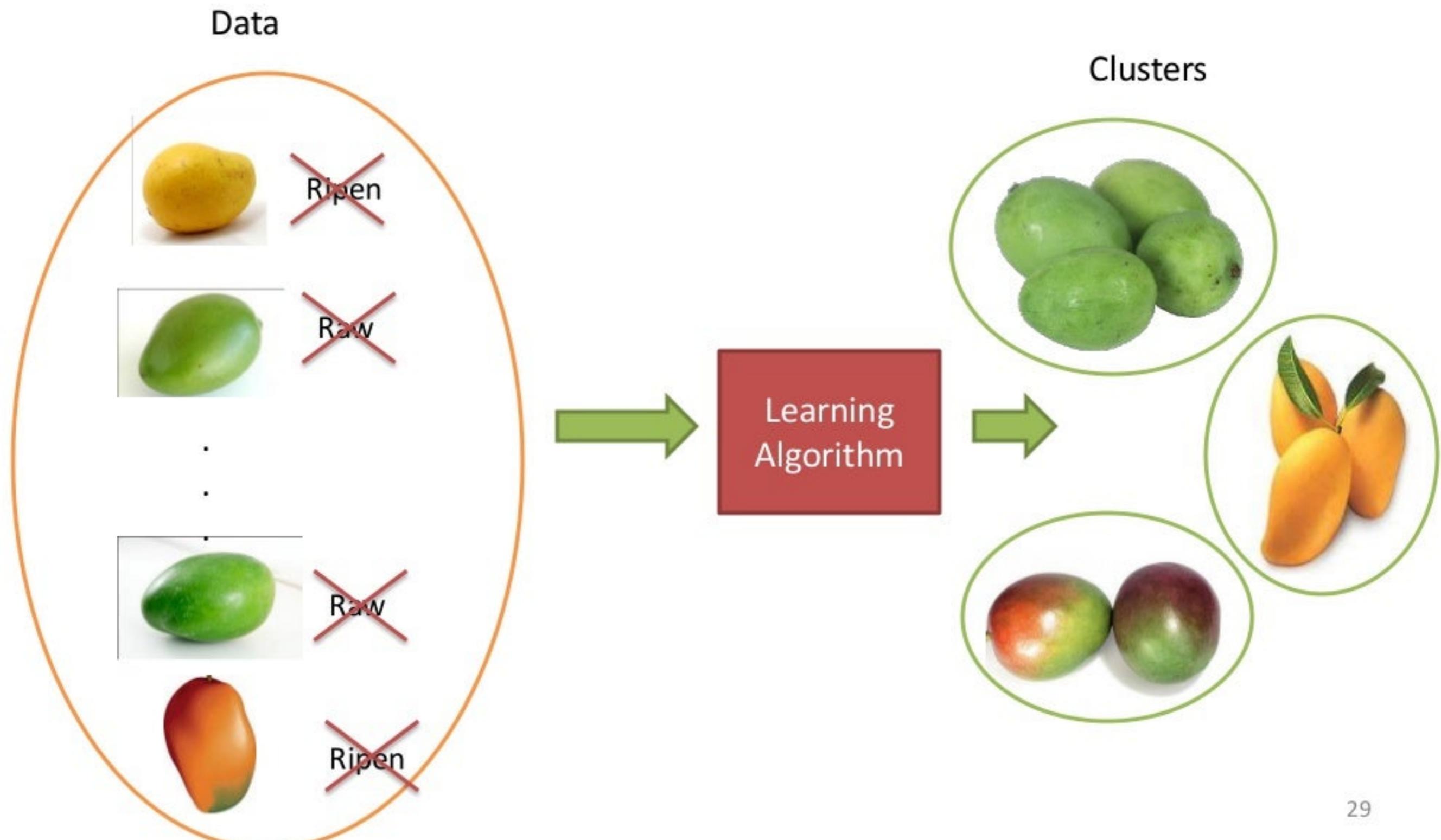
# Types of Learning

- 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

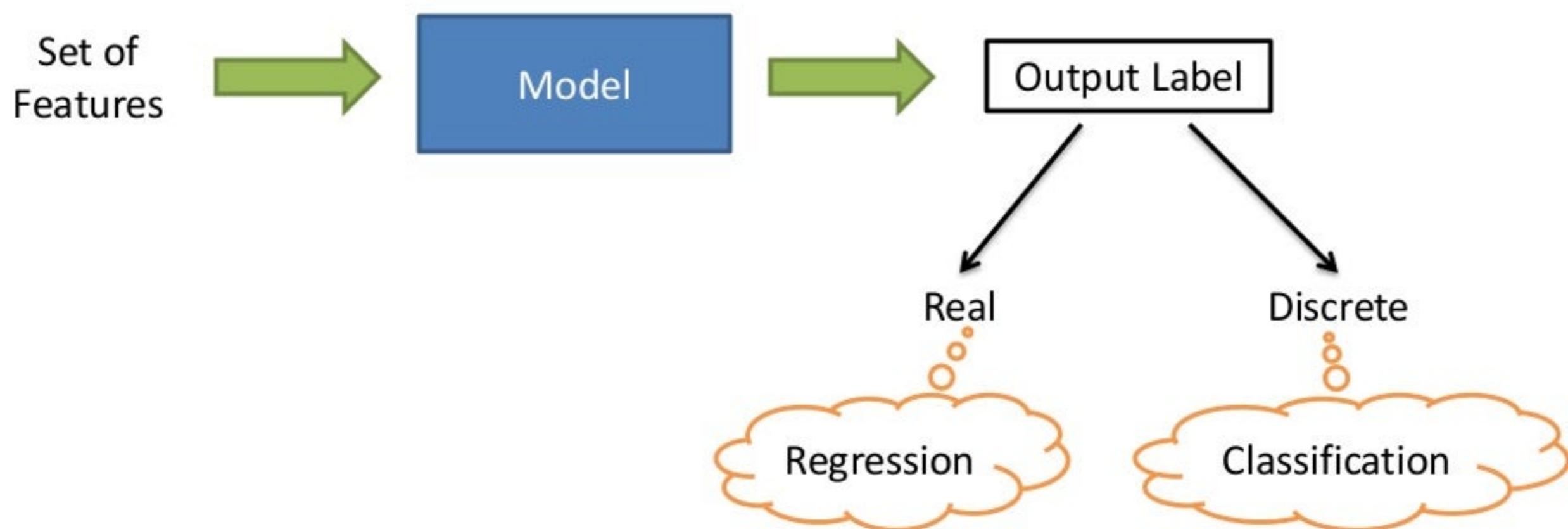
# Recap

- 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

## Training Data

## Number Plate Recognition



# Demo

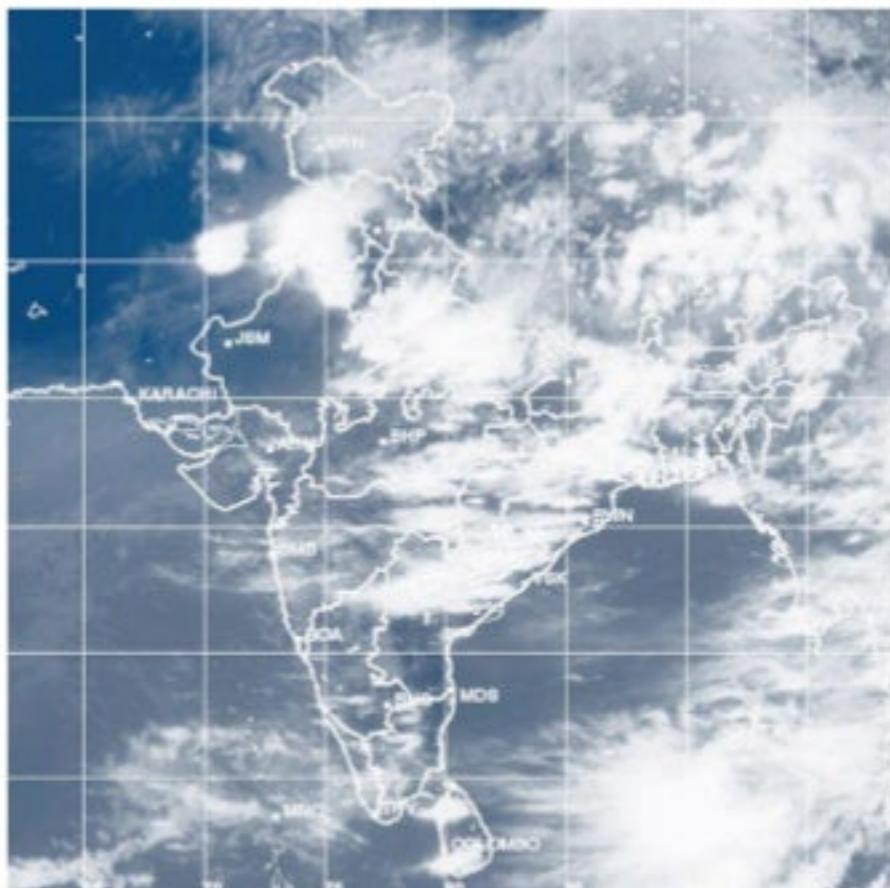
## Classification

### Character Recognition

# Regression: Example

## Weather Forecasting

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



Weather for Bangalore, Karnataka



24°C | °F

Scattered Clouds  
Wind: SW at 10 km/h  
Humidity: 62%

Tue



Wed



Thu



Fri



32° 21°

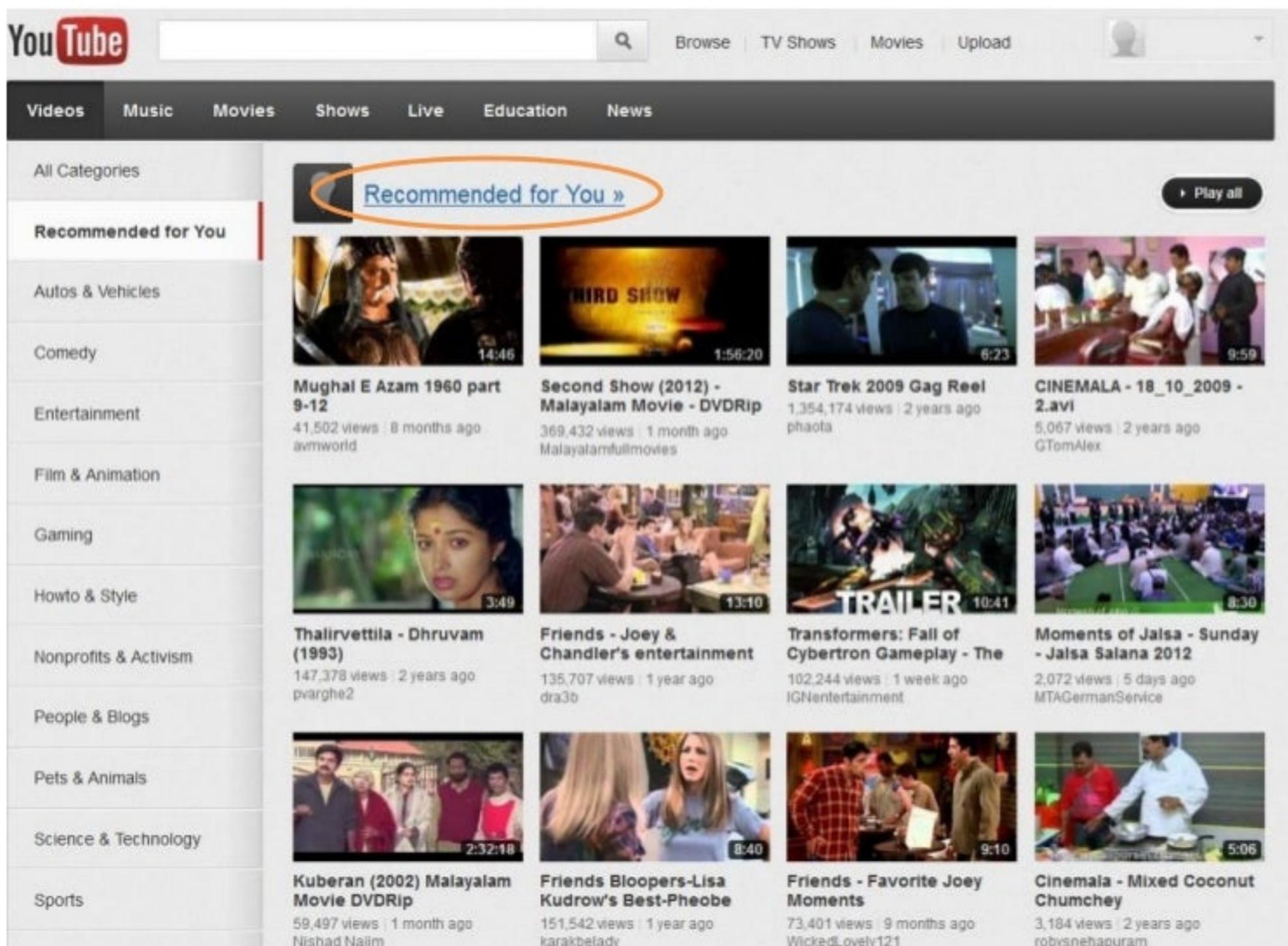
27° 21°

29° 21°

30° 21°

# Unsupervised Learning

# Recommendation Systems



The image shows a screenshot of a YouTube homepage. On the left, there's a sidebar with categories like 'Videos', 'Music', 'Movies', etc. The main area features a 'Recommended for You' section with several video thumbnails. One specific video thumbnail for 'Second Show (2012) - Malayalam Movie - DVDRip' is circled in orange. A 'play all' button is visible at the top right of the recommended section.

Category	Video Title	Length	Views	Uploader
Recommended for You	Second Show (2012) - Malayalam Movie - DVDRip	1:56:20	369,432	Malayalamfullmovies
Entertainment	Mughal E Azam 1960 part 9-12	14:46	41,502	avmworld
Film & Animation	Star Trek 2009 Gag Reel	6:23	1,354,174	phaota
Gaming	CINEMALA - 18_10_2009 - 2.avi	9:59	5,067	GTomAlex
Howto & Style	Thalirvettilla - Dhruvam (1993)	3:49	147,378	pvarge2
People & Blogs	Friends - Joey & Chandler's entertainment	13:10	135,707	dra3b
Pets & Animals	Transformers: Fall of Cybertron Gameplay - The TRAILER	10:41	102,244	IGNentertainment
Science & Technology	Moments of Jalsa - Sunday - Jalsa Salana 2012	8:30	2,072	MTAGermanService
Sports	Kuberan (2002) Malayalam Movie DVDRip	2:32:18	59,497	Nishad Najim
	Friends Bloopers-Lisa Kudrow's Best-Pheobe	8:40	151,542	karakbelady
	Friends - Favorite Joey Moments	9:10	73,401	WickedLlovely121
	Cinemala - Mixed Coconut Chumchey	5:06	3,184	robysnephapuram

Cluster Similar Items (or) Cluster Similar Users

# Social Network Analysis

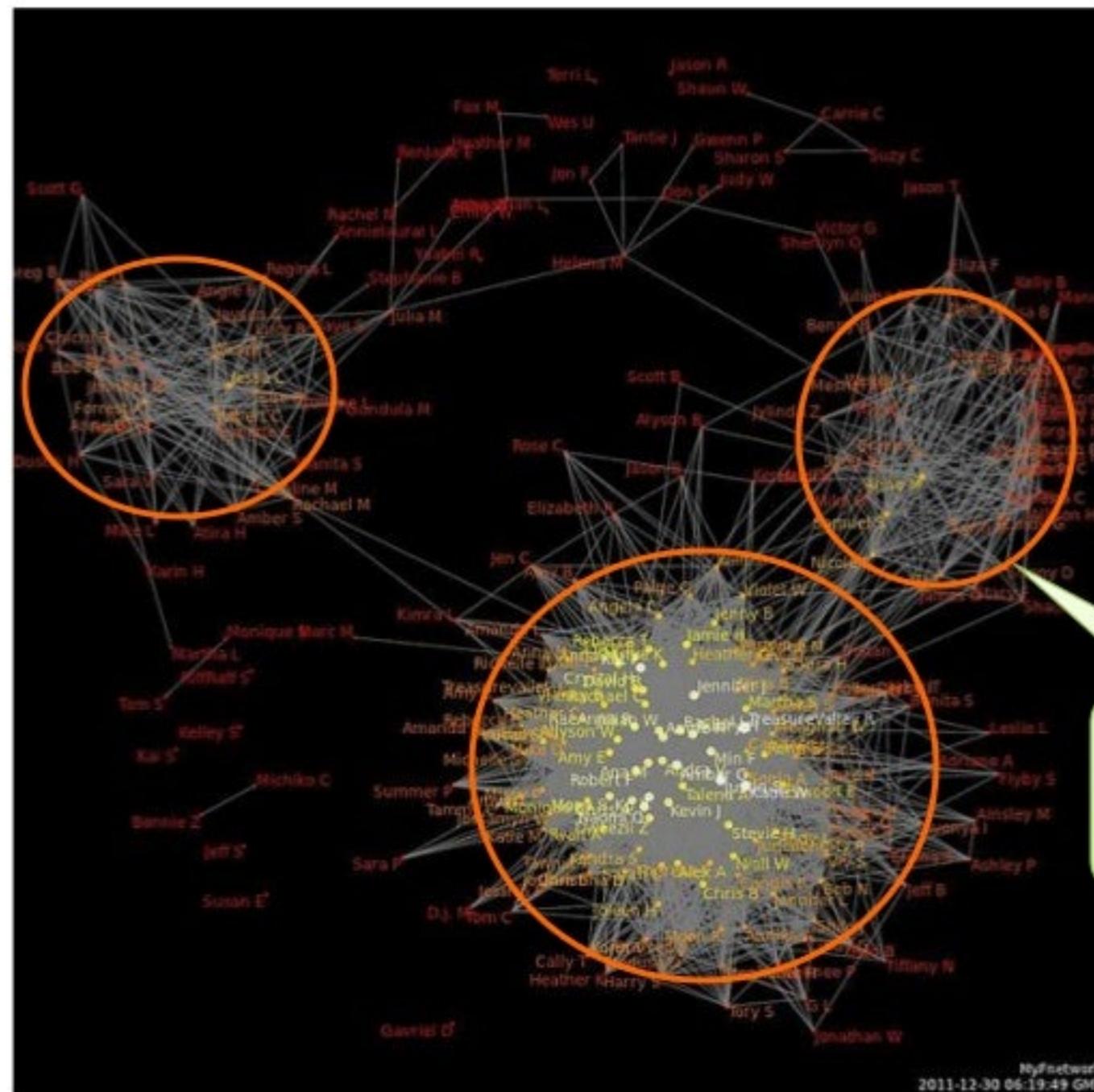
facebook

LinkedIn

Google+

orkut

twitter



Detect  
Communities

# Demo

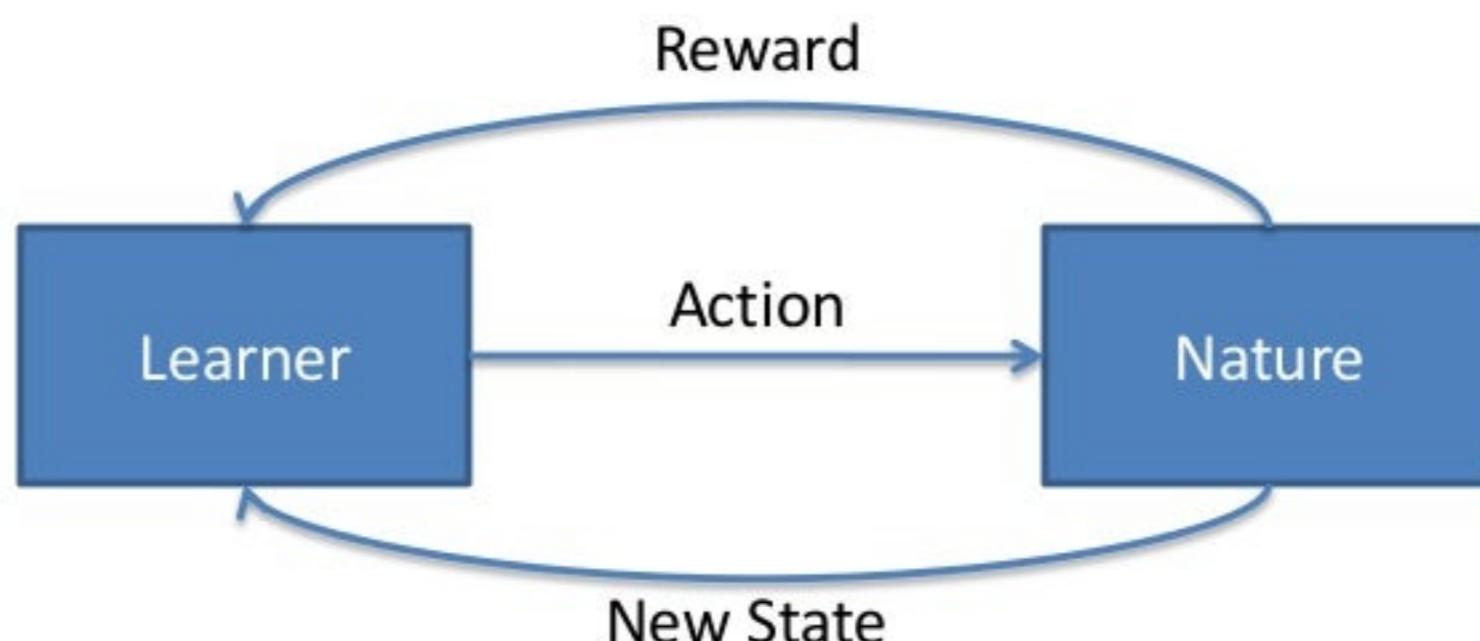
## Unsupervised Learning

### 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

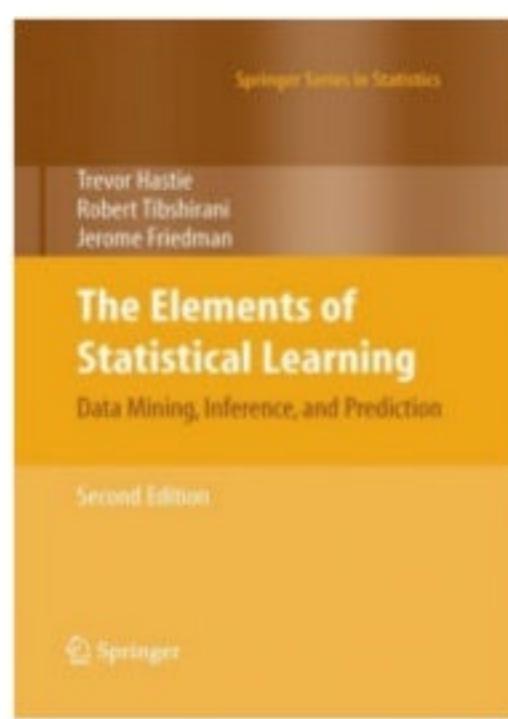
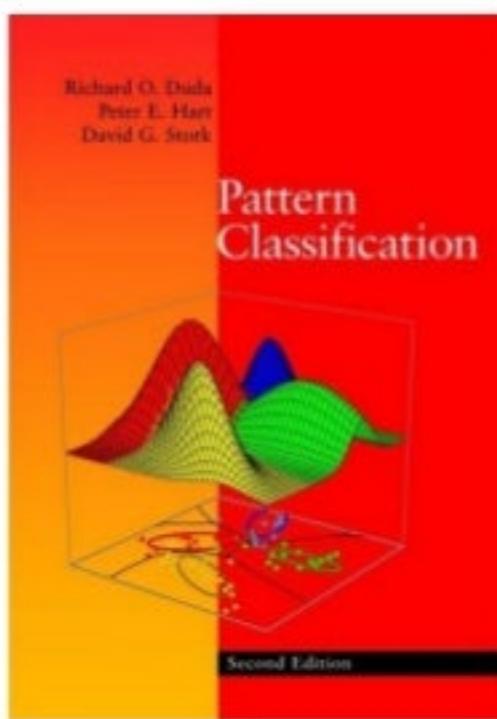
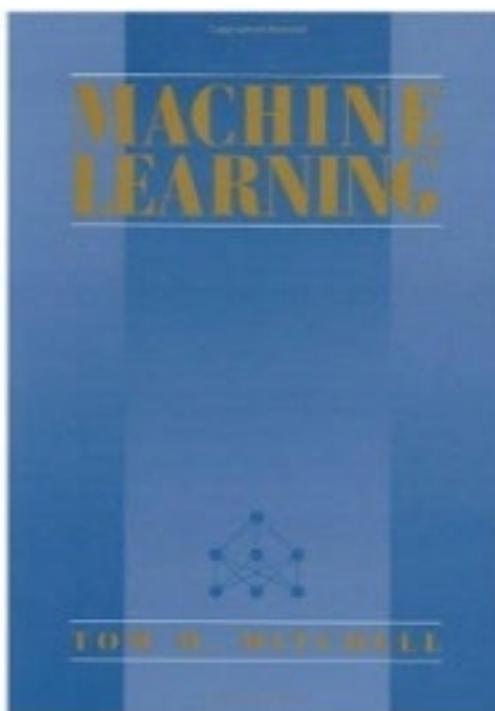
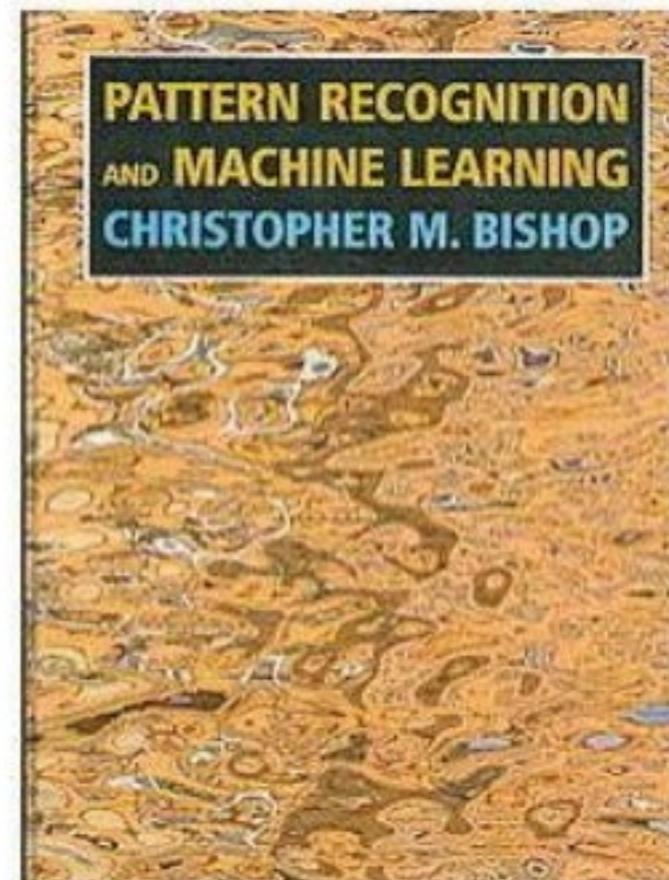
# Resources

- 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/>



# 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?

