Machine Learning, Coursera

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- **Week 1**

Machine Learning

- The science of getting computers to learn, without being explicitly programmed.
- To let the computer learn by experience
- The best way to do that is to try to mimic the human brain using what is called neural networks

- **Examples**

1- Google or Bing search engine which use machine learning for web crawler to rank the pages.

2- Apple or Facebook photo recognizing system is also using machine learning.

3- Spam filter in your email is also done by machine learning.

- **Applications**

- It have many many applications such as : medicine - finance - engineering ---etc

- Database mining

E.g., webclick data → used to improve the user experience
, medical records → used to understand disease better
, biology → help to understand and know more about genome

- Applications we can't program by hand:

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

- Self-Customizing programs

  Amazon, Netflix product recommendations

- Definitions

* Arthur Samuel:

  The machine learning is the field of study that gives computers the ability to learn without being explicitly programmed

  - In 1950: Samuel made a program for the computer to learn checkers playing by experience from playing 10's of 1000's games against itself. Finally the program became a good player and was better than Samuel, the programmer himself.

* Tom Mitchel, 1998:

  A Computer program is said to learn from experience (E), w.r.t some task (T) and some performance measure (P), if its performance (P) improves with experience (E) as measured by (P)

  - For the checkers example

    E: the experience of playing 10's of 1000's games
    T: the task of playing checkers
    P: the probability of winning games

Input (X)	output (Y)	Application
email	spam? (0/1)	spam filtering
audio	text transcripts	speech Recognition
English	Spanish	Machine Translation
ad, user info	click? (0/1)	online Ads
image, radar info	position of other cars	self driving cars
image of phone	defect? (0/1)	visual inspection

- Machine Learning Algorithms

① Supervised Learning [Common Type]
   ▷ to teach the computer how to do something.

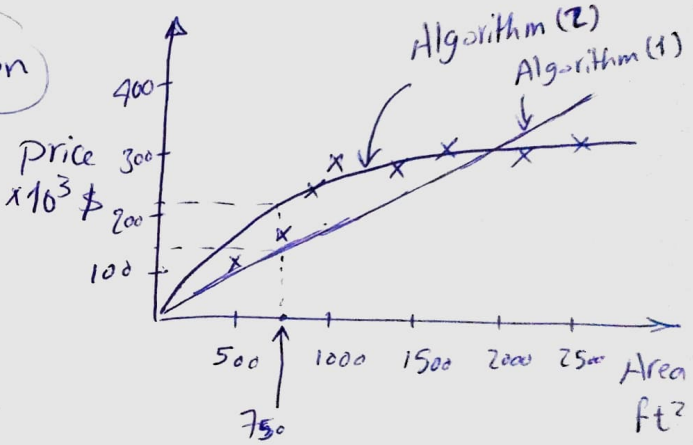
(X → Y) Mapping

② Unsupervised Learning
   ▷ to let the computer learn by itself.

- Other types: Reinforcement Learning, Recommender Systems

- Supervised Learning

Example — House pricing prediction



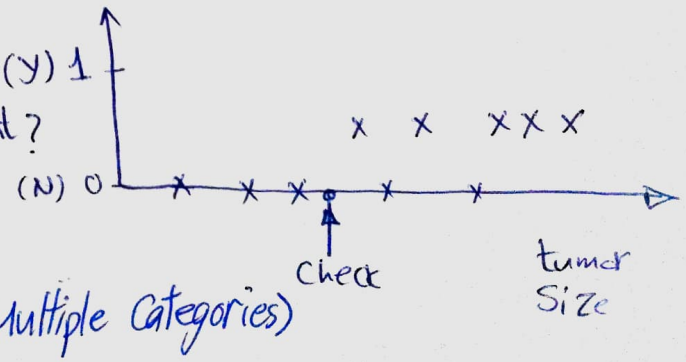
▷ We give the algorithm a data set, which is "right answers"

▷ The toss of the algorithm is just to produce more of these right answers

▷ This is called Regression problem
   ↳ predict Continuous valued output
   (predict a number)

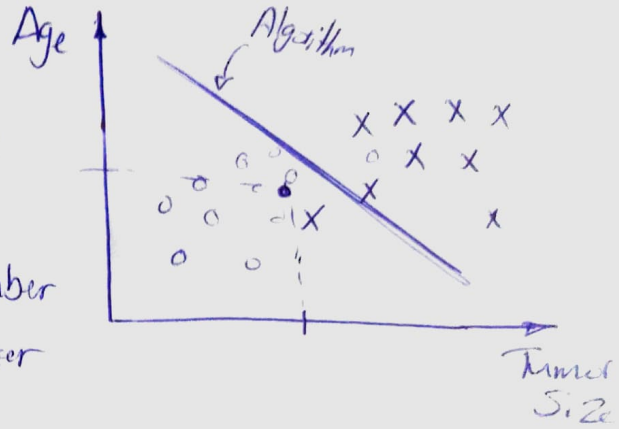
Example — Breast Cancer (malignant, beign)

▷ This is called Classification
   ↳ Discrete valued output
   (zero or one)
   (may be more than two outputs) (Multiple Categories)



↳ predict a category

- In the previous example (Breast Cancer), we used one attribute (tumor size) to predict whether the tumor is bengin or malignant.
- In other machine learning problems, we use more than one feature (attribute)
- Some problems may use an infinite number of features, and the point here how to deal with very big number of attributes without your computer memory is running out ?



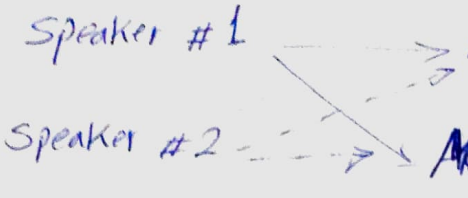
• Unsupervised Learning

- Unlike supervised learning, where we give the algorithm some right answers or labeled examples, unsupervided learning depends on unlabeled examples [same label or no labels]
- An unsupervised learning algorithm may decide that the data lives in two different clusters. This is called Clustering

Examples:

- Grouping new stories in Google news by Automatic Clustering
- Applying clustering algorithm on DNA microarray data to groups individuals according to the degree of having a certain gene

* Cocktail Party problem (Non-Clustering unsupervised Learning)

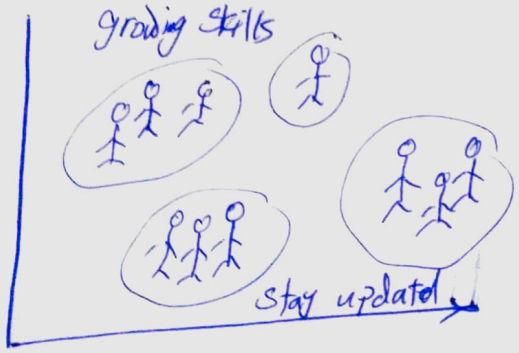


▷ Every microphone records the audios of the two speakers with different levels according to their distance.

▷ An algorithm using unsupervised learning can distinguish the two audios (Cocktail) and outputs two different outputs.

→ This doesn't need tons of code lines, it may be done with one code line using the right environment.

* Grouping Customers (Individuals join ML Courses)



unsupervised learning
[find structure in data]

Clustering
↓
group similar data points together

Anomaly Detection
↓
find unusual data points

Dimensionality Reduction
↓
Compress data using fewer numbers