FACE RECOGNITION USING DEEP LEARNING WORKSHOP

What is Machine Learning?

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

or in layman terms

“Making machines intelligent”

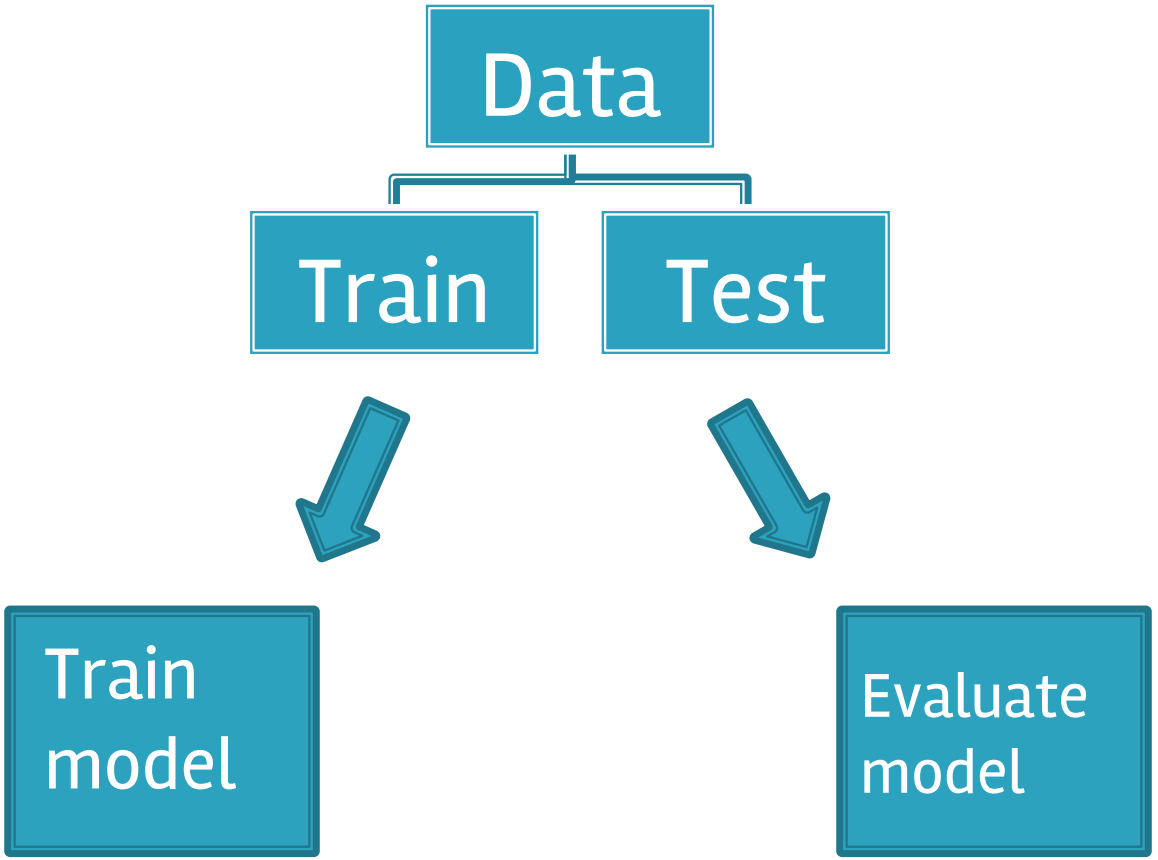
MILESTONES IN MACHINE LEARNING

- **ALPHA GO:**
  - Go is an ancient Chinese game which originated more than 2500 years ago
  - There are more possible positions in Go than there are atoms in the universe!!!
  - Go is played primarily through intuition unlike chess which is played by logic

ML ML EVERYWHERE!!!

- Google, Facebook and Microsoft and many other tech giants are researching on ML
- ML have a widespread applications
  - **Medical applications** such as Classification of EMG signals, Detecting malignant tumours,...
  - **Signal Processing applications** such as speech recognition, machine translation, Face Recognition
  - **Robotic applications**
  - **Data Analytics**
  - and many more ...

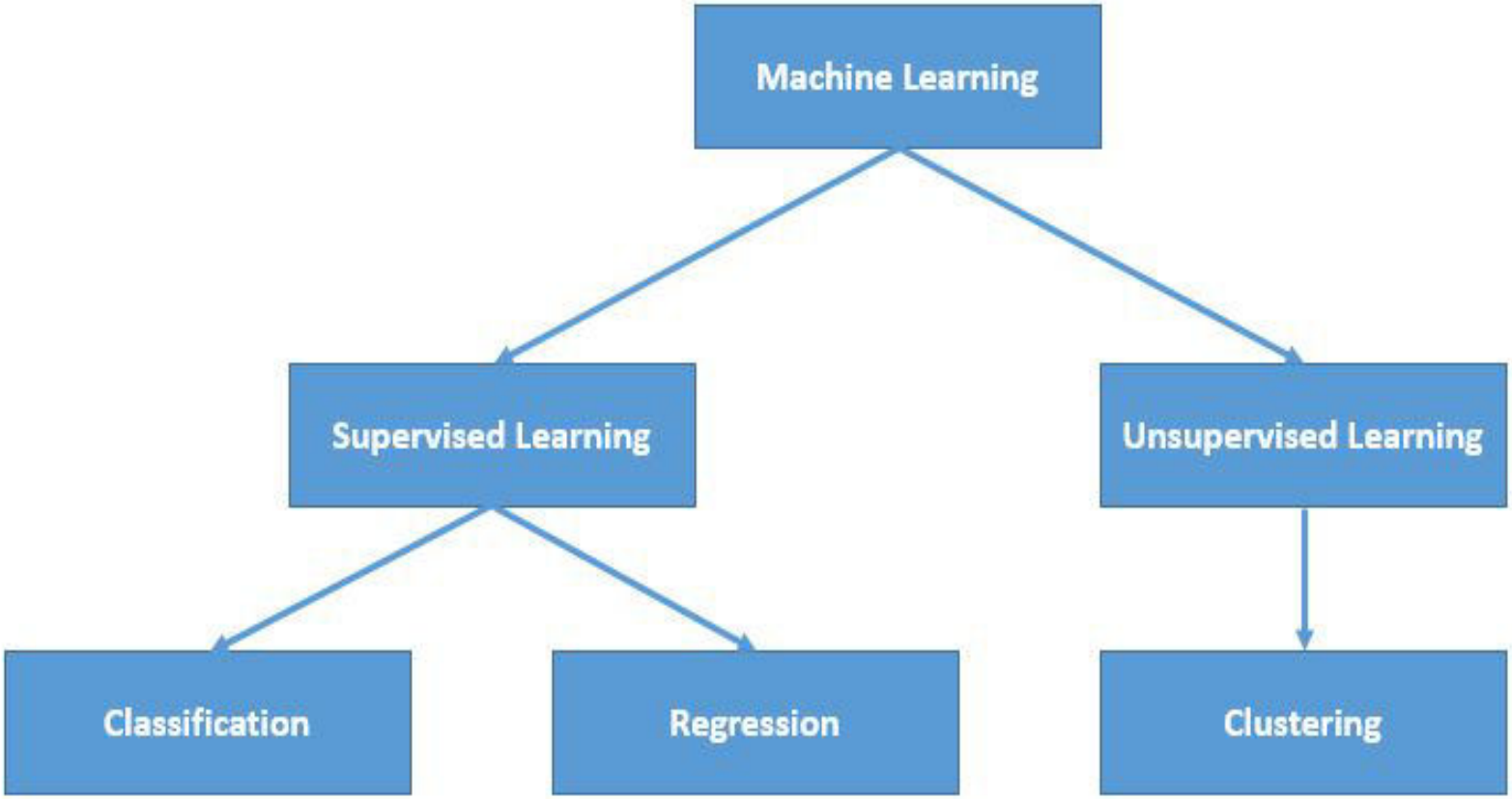
The ML Process



The hard part of ML

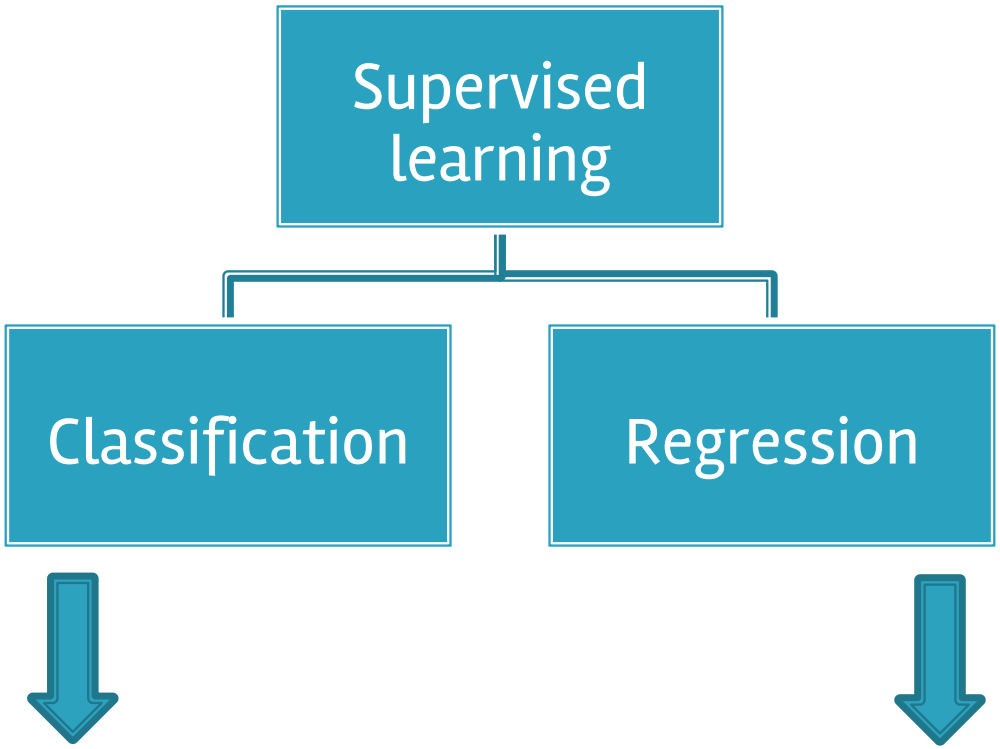
Establishing model accuracy

TYPES OF ML


Machine Learning
Supervised Learning
Unsupervised Learning
Classification
Regression
Clustering

SUPERVISED LEARNING

Types of Supervised learning

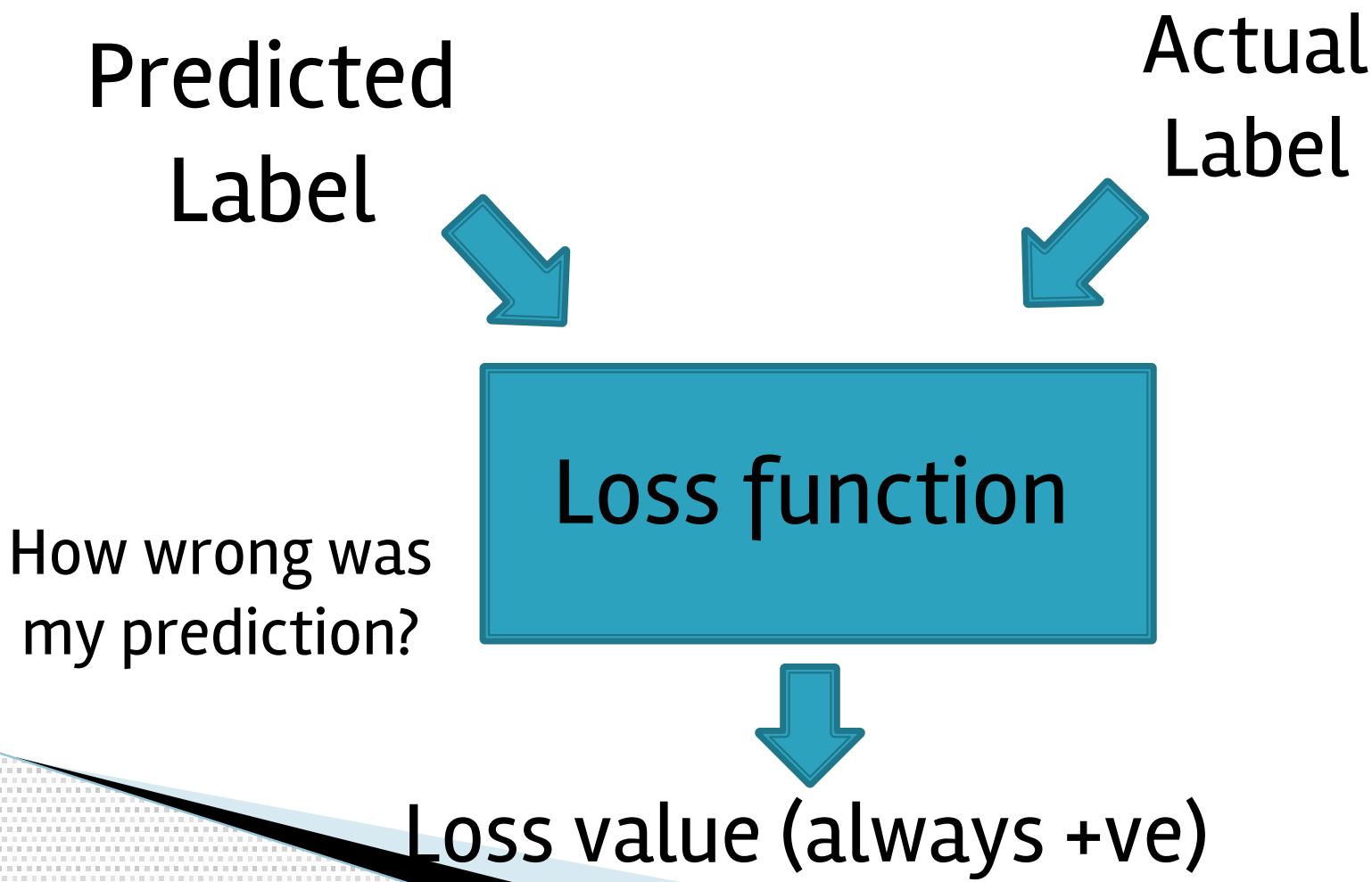


"Categorical labels"
Eg: 'cat', 'dog',..

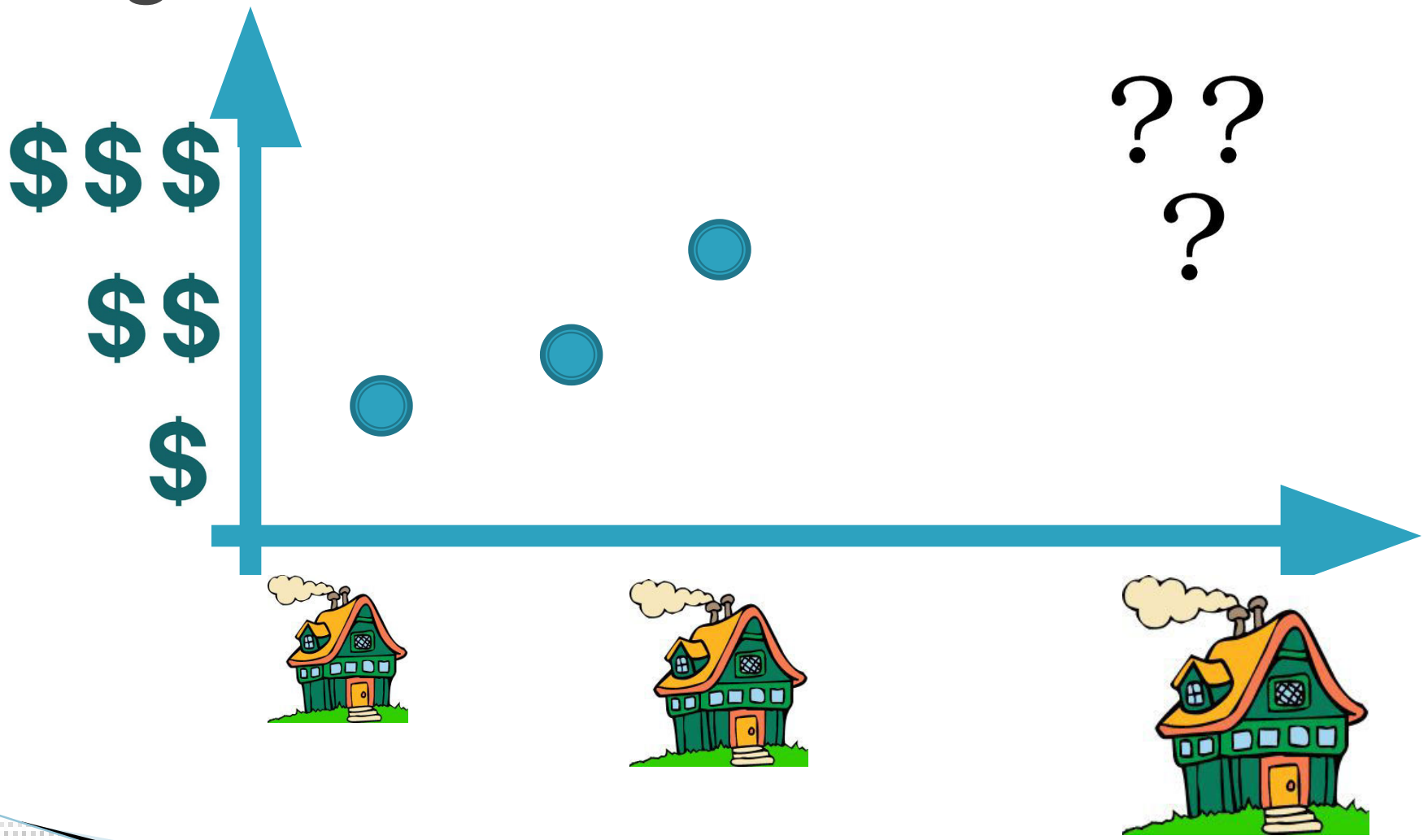
"Continuous labels"
Eg: 0.5, –1.7, ...

What do we mean by learning?

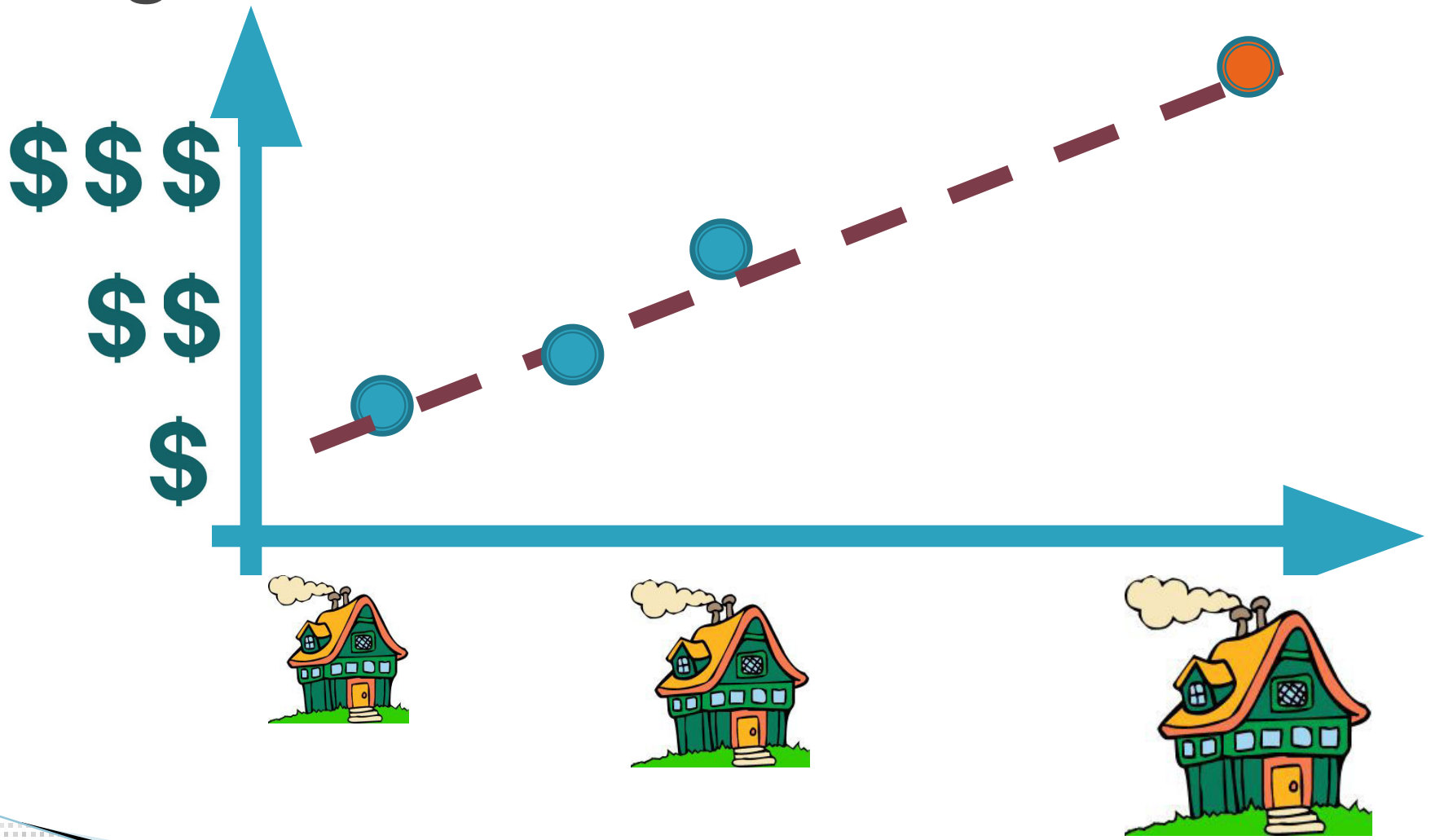
Learning = Minimizing a function



Regression



Regression



Classification

Cat

Dog

Cat

Dog

?

Cat ?

Dog ?

Classification

0

1

0

1

?

0 ?

1 ?

Classification

1

0

?

Classification

1

0

0.91 = Dog!

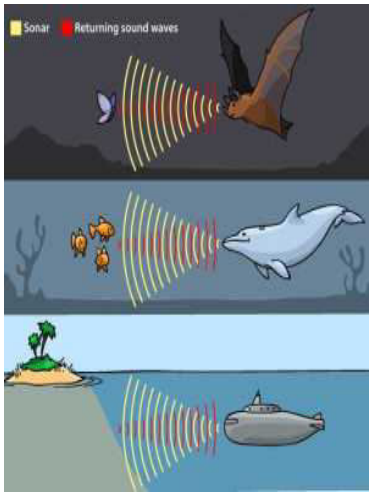
Unsupervised Learning

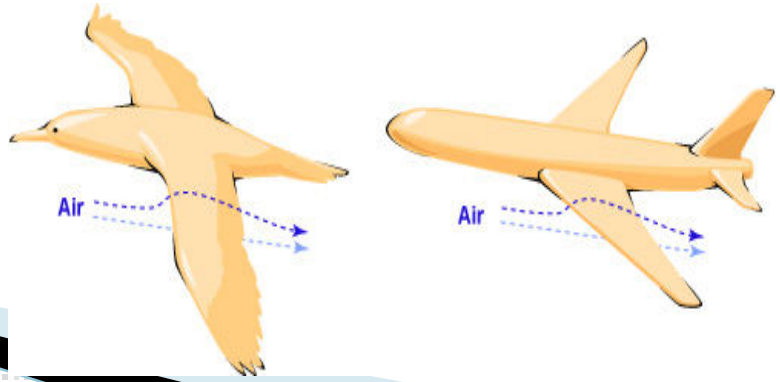
Unsupervised Learning

Unsupervised Learning

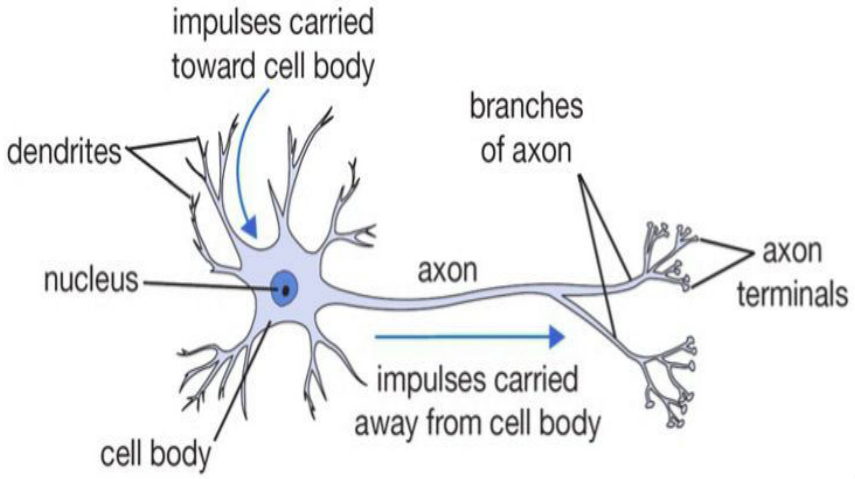
NEURAL NETWORKS(SUPERVISED)

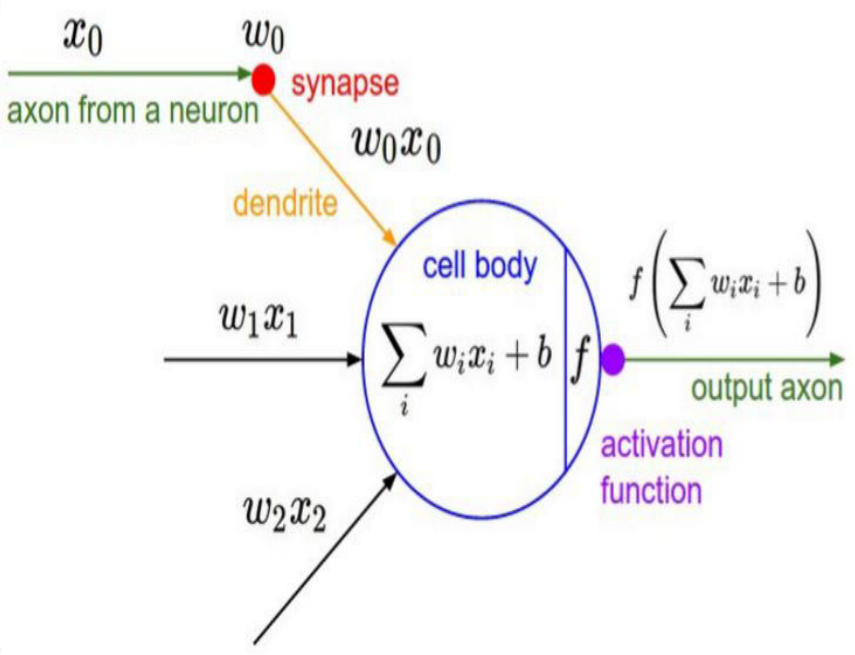
Copying from Nature –– Nothing New, Really !!!



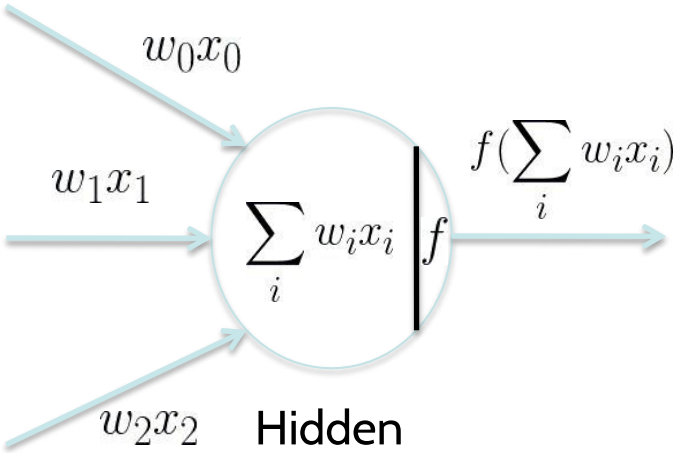


Basic Building block :: A Neuron

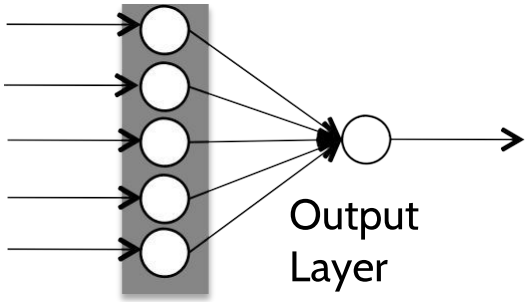




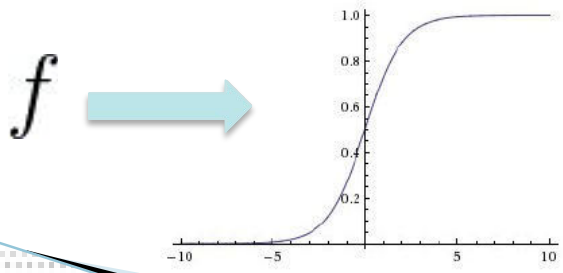
Neuron, Perceptron and MLP



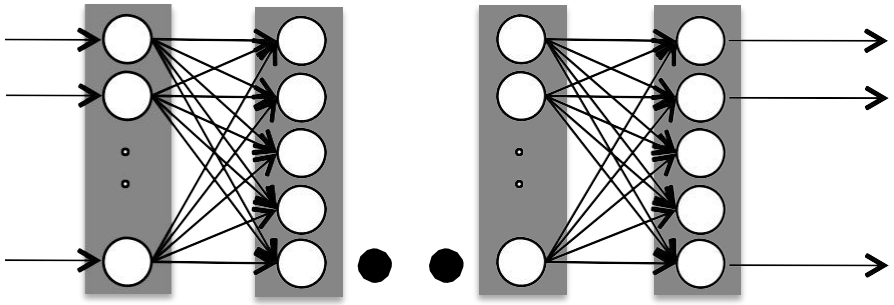
Hidden unit/Neuron



Perceptron



E.g. Sigmoid Activation Function



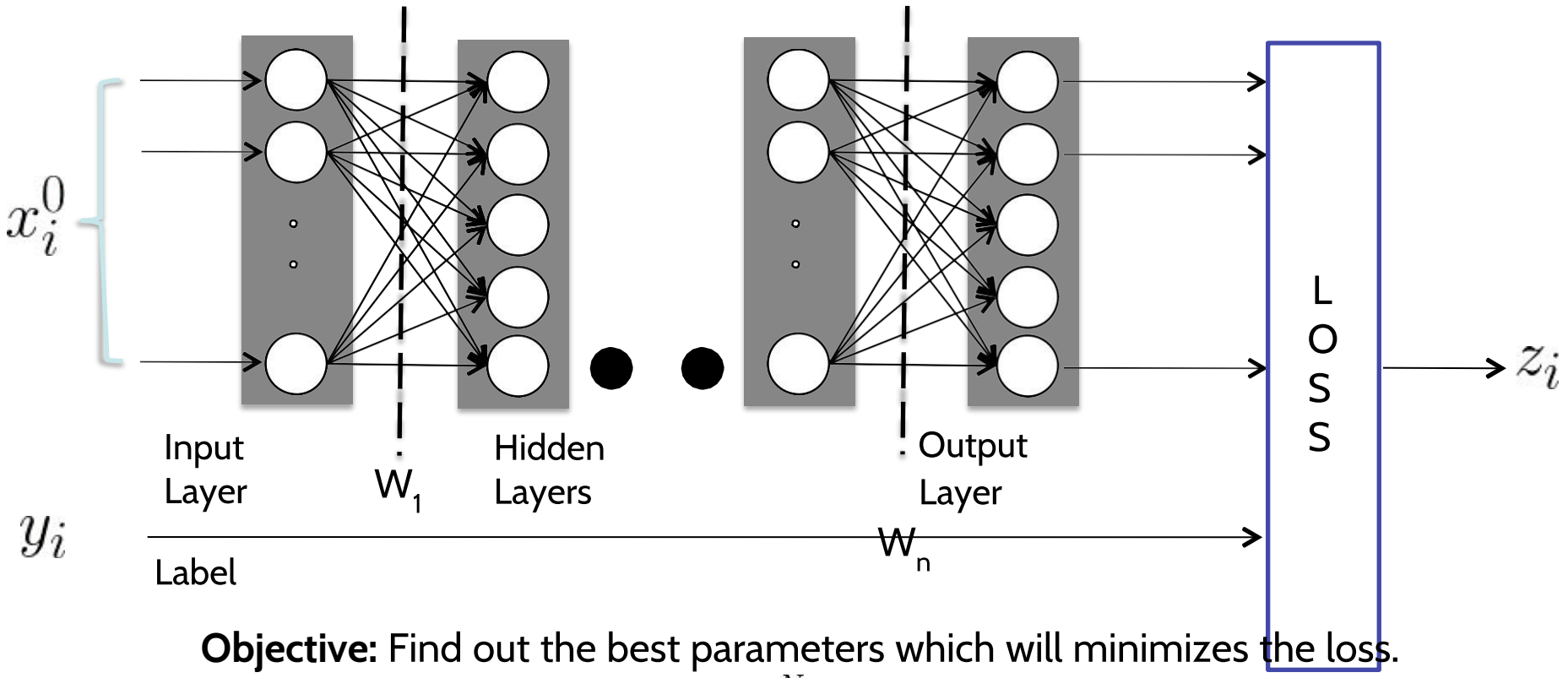
Input Layer Layers

Hidden

Multi Layer Perceptron

Output Layer

Loss or Objective



Objective: Find out the best parameters which will minimizes the loss.

$$W^* = arg\min_W \sum_{i=1}^{N} L(x_i^n, y_i; W)$$

Weight Vector

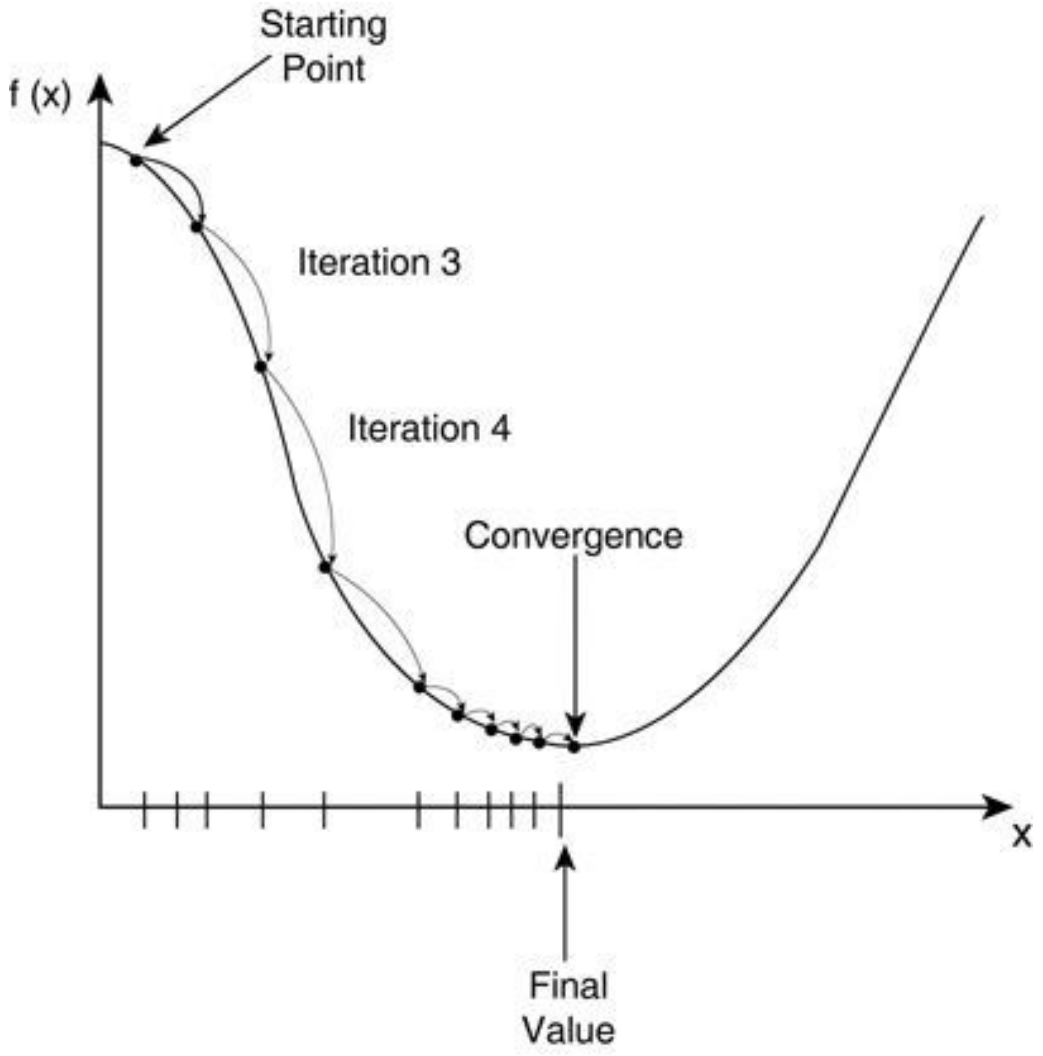
$$z_i = \frac{1}{2} \parallel x_i^n - y_i \parallel_2^2$$

E.g. Squared Loss

HOW DO NEURAL NETWORKS LEARN

Gradient Descent

Workhorse for modern Deep Neural Networks!



Gradient descent

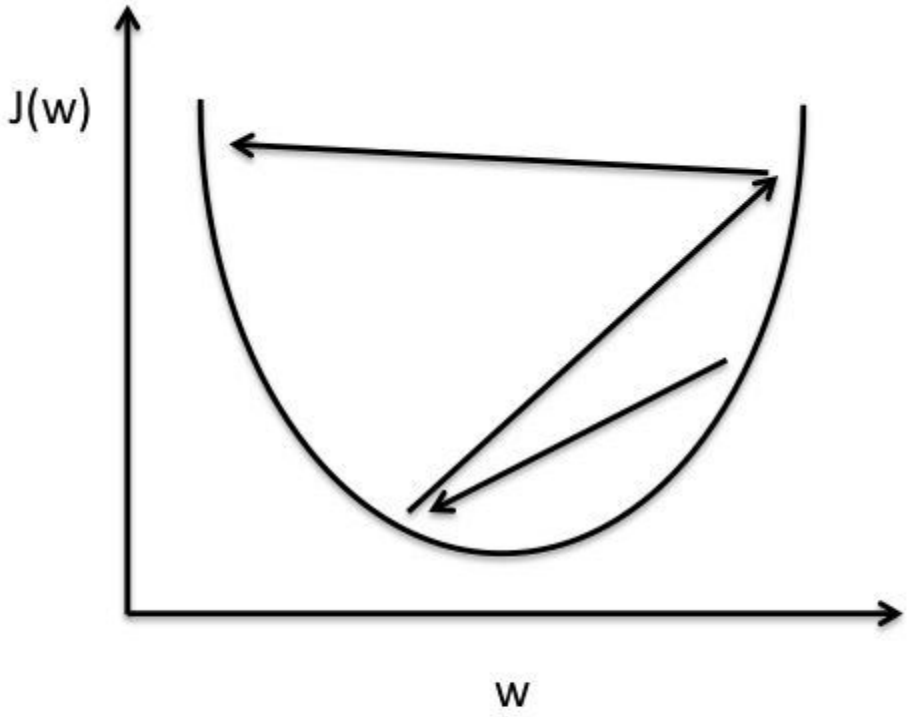
Let θ be the parameters (a,b) and let J(θ) be the cost function.

Repeat until convergence {

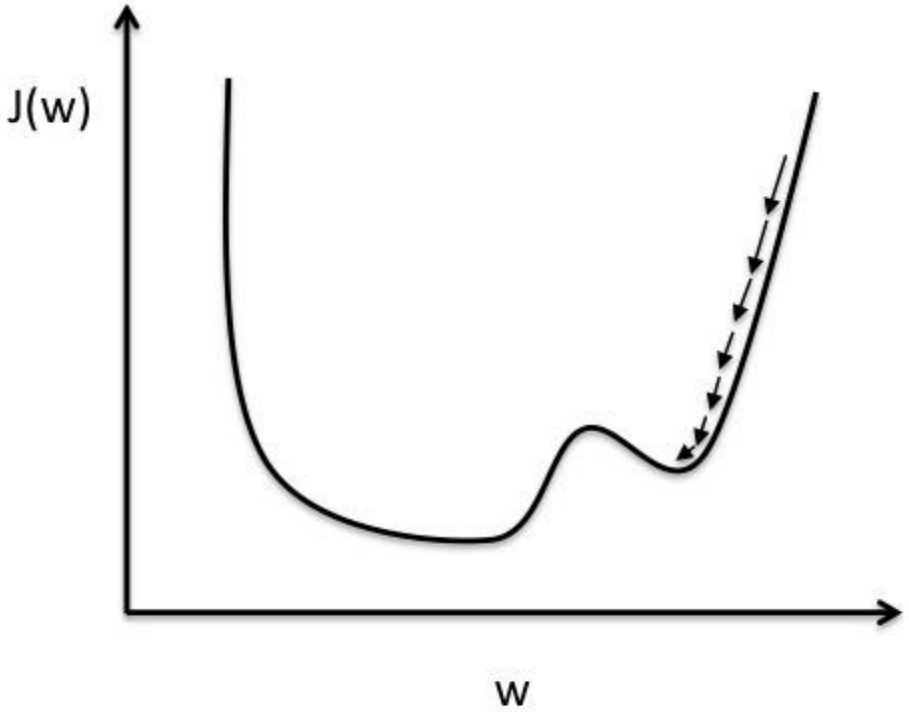
$$\theta_j \leftarrow \theta_j - \alpha \frac{\partial}{\partial \theta_j} J(\theta)$$

}

Learning rate



Large learning rate: Overshooting.



Small learning rate: Many iterations until convergence and trapping in local minima.

Gradient descent procedure

- Choose high learning rate and perform GD
- If learning diverges, divide learning rate by 10
- Perform GD

Other methods to select learning rate also exist

LET’S SEE AN EXAMPLE

Image Understanding

Caption: "*Two pizzas sitting on top of a stove top oven*"

Caption:

"*A group of people shopping at an outdoor market.*"

Image Understanding

DAQUAR

Q: What is the object close to the wall?

A: whiteboard

Q: What is the object in front of the sofa?

A: table

DAQUAR

Q: What is the largest object?

A: sofa

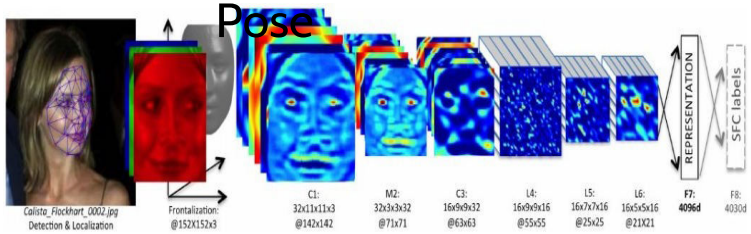
Q: How many windows are there?

A: 2

Impact in many vision tasks ..

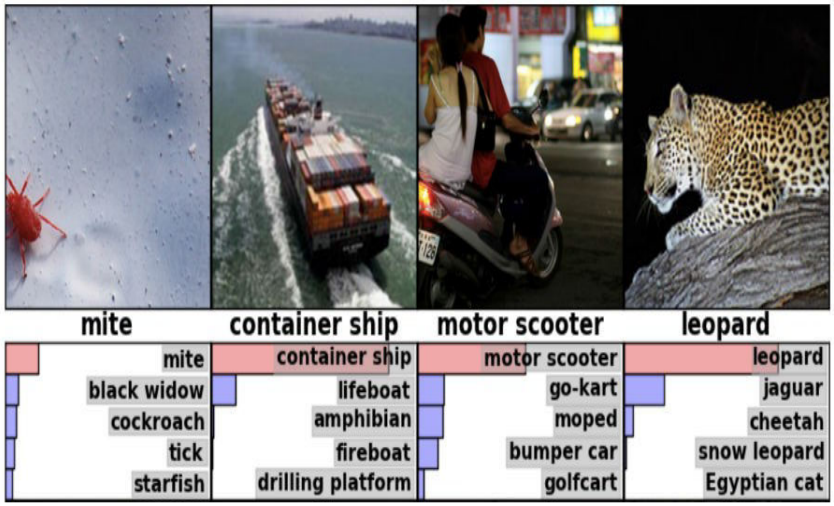
Semantic

Human Pose



Face Recognition

Deep Dream,



Classification:Alex Net

Basic Approach

Example Images

Annotated Data Set (Training Data)

Feature Extraction
Ex: PHOW, PHOG, GIST, CNN

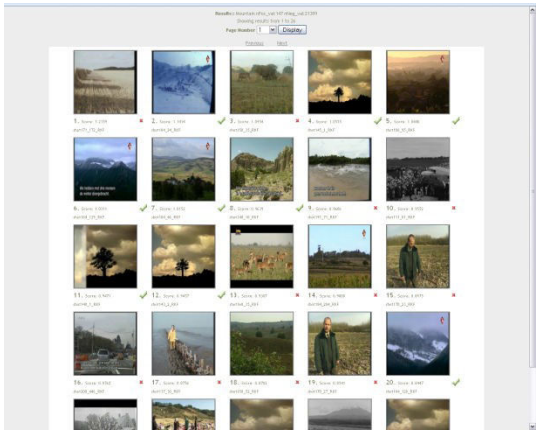
Training

offline

Feature Extraction

Testing

Classifier
Ex: SVM, Random Forests, FC

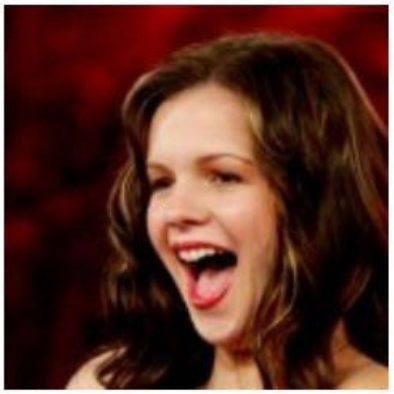


Unseen Image(s)

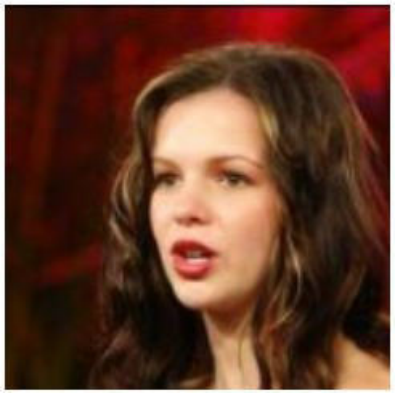
Ranked List

Face Verification

X_1



X_2



Same person?

YES

$C = l$

$$l \in L = \{l_1 = \text{"YES"}, l_2 = \text{"NO"}\}$$

Goal: To predict if the two input images X_1 & X_2 are of same person or not.

Challenge: Variation in Lighting, occlusion, pose, expression, multiple faces. Different people in train and test set.

ADVANCED NEURAL NETWORKS

- CONVOLUTIONAL NEURAL NETWORKS
- RECURRENT NEURAL NETWORKS
- GENERATIVE ADVERSERIAL NETWORKS

ML RESOURCES

- Coursera Machine learning Courses by Andrew ng
- http://neuralnetworksanddeeplearning.com/
  - Online book by Michael Nielsen
- http://cs231n.github.io/
  - Courses by Stanford University