

Machine Learning 101

Poo Kuan Hoong

21st April 2018, ACAT, Penang

Agenda

- Introduction to Machine Learning
- Supervised Learning vs Unsupervised Learning
 - Regression
 - Classification
- Unsupervised Learning
 - Clustering
- Reinforcement Learning
- Artificial Intelligence
 - Neural Network
 - Deep Learning
- Take Away

Self Introduction



Poo Kuan Hoong, <http://www.linkedin.com/in/kuanhoong>



- Principal Data Scientist



- Senior Data Scientist



- Senior Manager Data Science



- Senior Lecturer
- Chairperson Data Science Institute



- Founder R User Group & TensorFlow User Group
- Speaker/Trainer

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Cognitics offers Machine Learning / AI solutions
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CONSULTANCY

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Kuala Lumpur,
Malaysia

Founded Jun 5, 2016

[About us...](#)

Welcome to Malaysia R User Group (myRUG)

+ Schedule a new Meetup

[Upcoming](#) Past Calendar

There are no upcoming
Meetups

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Oct 20, 2016 · 7:00 PM

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What's new



<https://www.meetup.com/MY-RUserGroup/>



R User Group Malaysia

@rusergroupmalaysia

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Learn More



224 likes

0 this week
Andy Low and 18 other friends

226 follows

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309 post reach this week

The R User Group Malaysia is a diverse group that come together to discuss anything related to the R programming language.



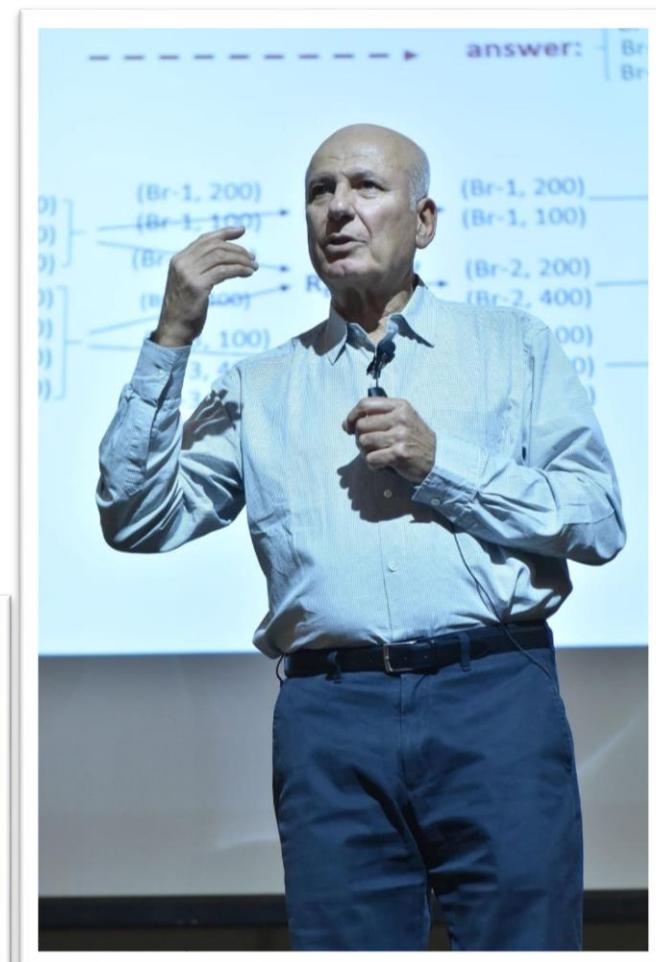
224 Likes

Andy Low and 18 other friends like this

<https://www.facebook.com/rusergroupmalaysia/>

3rd Meet-up & Malaysia Digital Economy Corp (MDEC)

- 24th Nov 2016, 230 participants, 5 speakers



TensorFlow & Deep Learning Malaysia

Public group

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The logo features a large, stylized TensorFlow icon composed of orange and yellow 3D blocks. To the right of the icon is a portion of the Malaysian flag, showing the red and white stripes and the yellow crescent and star.

TENSORFLOW & DEEP LEARNING MALAYSIA

Joined Notifications Share ...

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Write something...



Photo/Video



Feeling/Activity



PINNED POST



Kuan Hoong created a poll.

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MEMBERS

256 members (77 new)











SUGGESTED MEMBERS



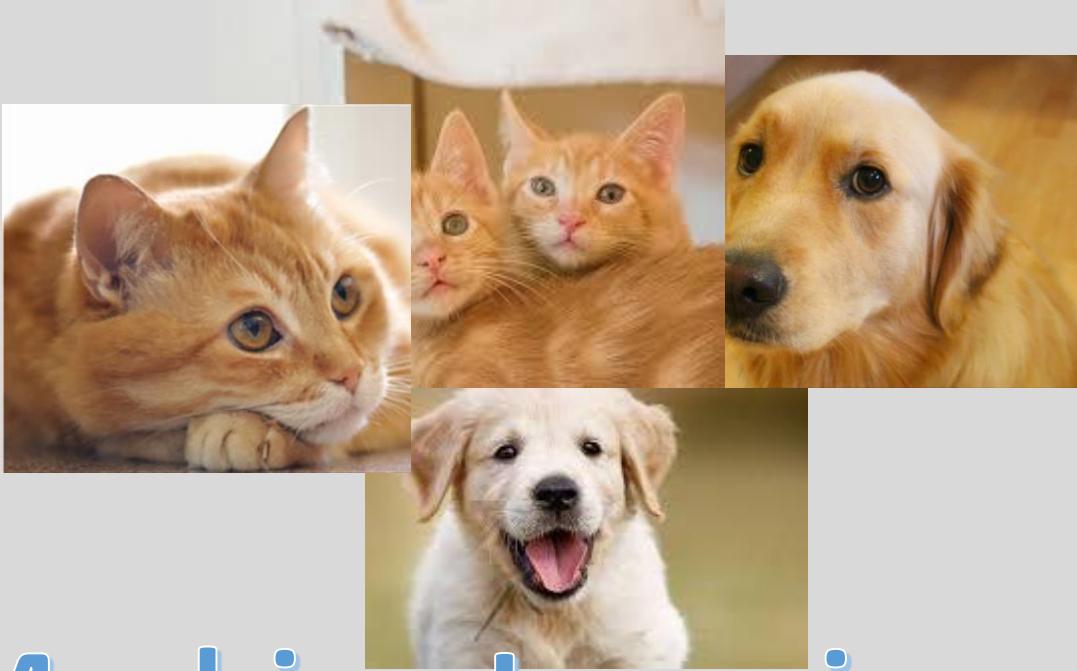
Kurt Orion G

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...

<https://www.facebook.com/groups/TensorFlowMY/>



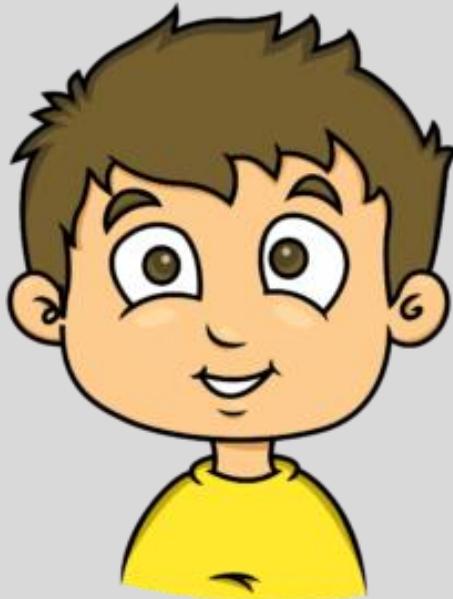
Machine Learning



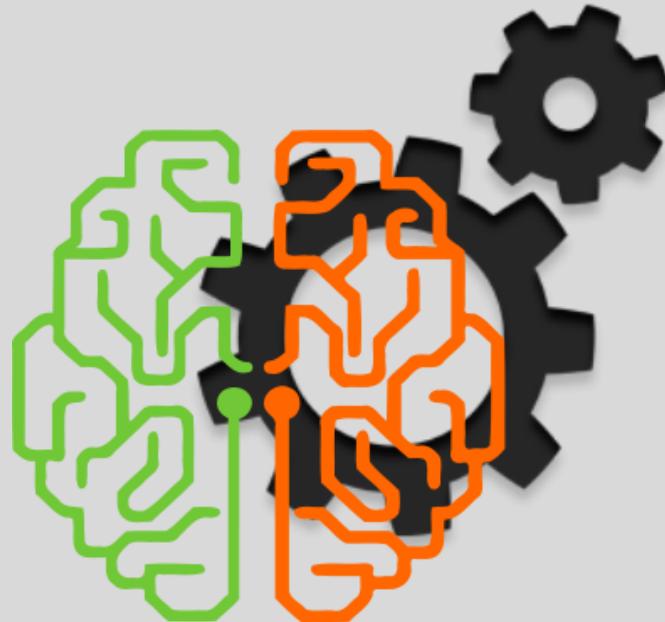
What is Machine Learning?

What is Machine Learning?

Machine Learning



Learn from experience



Learn from ? **DATA**



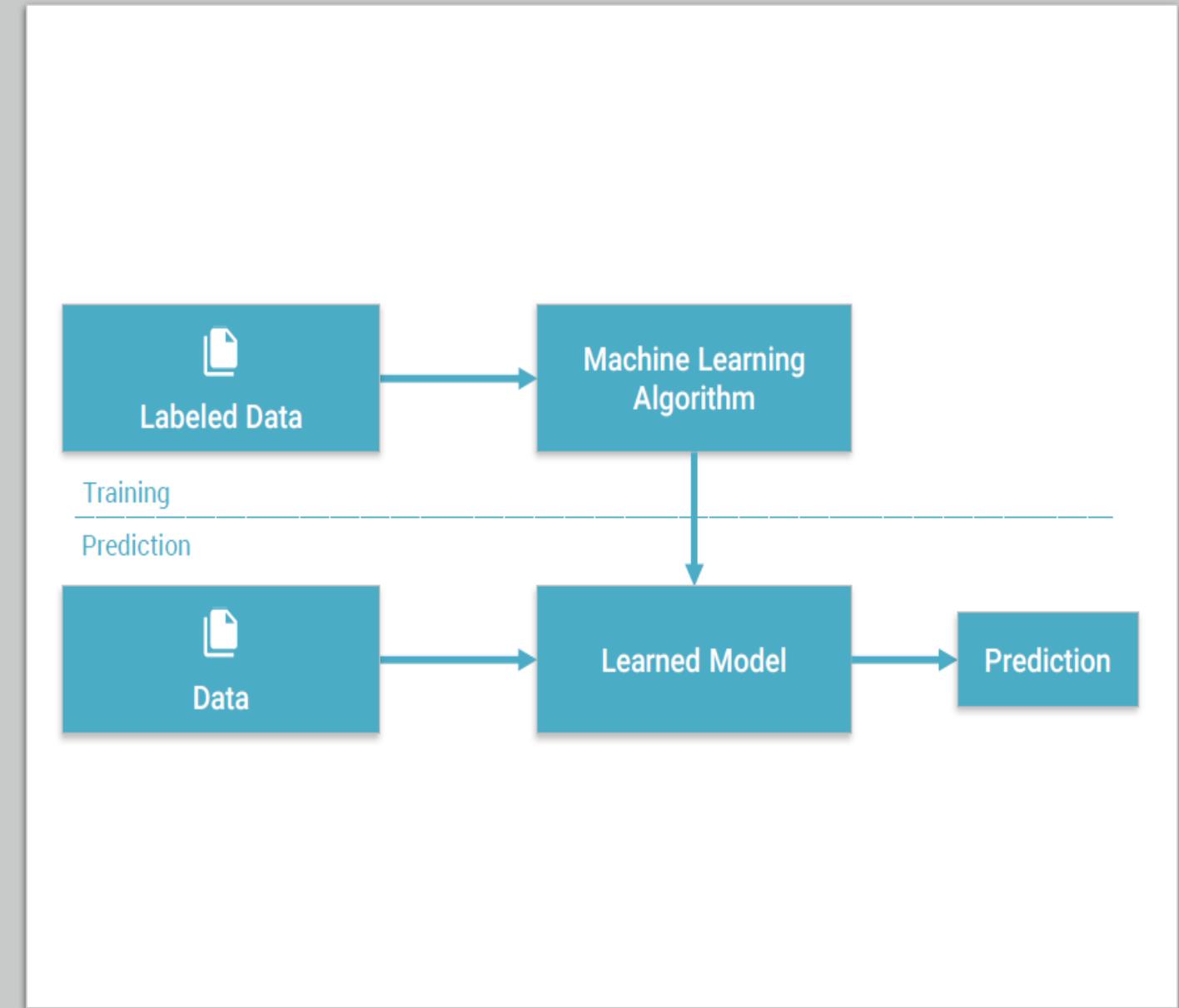
Follow instructions

Supervised Learning vs Unsupervised Learning

Supervised Learning	Unsupervised Learning
<ul style="list-style-type: none">• Data is labelled with class or value	<ul style="list-style-type: none">• Data is unlabeled or value un-known
<ul style="list-style-type: none">• Goal : predict class or value label	<ul style="list-style-type: none">• Goal : Determine data patterns/groupings
<ul style="list-style-type: none">• Knowledge of output – learning with the presence of “expert” / teacher	<ul style="list-style-type: none">• No knowledge of output class or value
<ul style="list-style-type: none">• Regression & classification	<ul style="list-style-type: none">• Clustering

Machine Learning

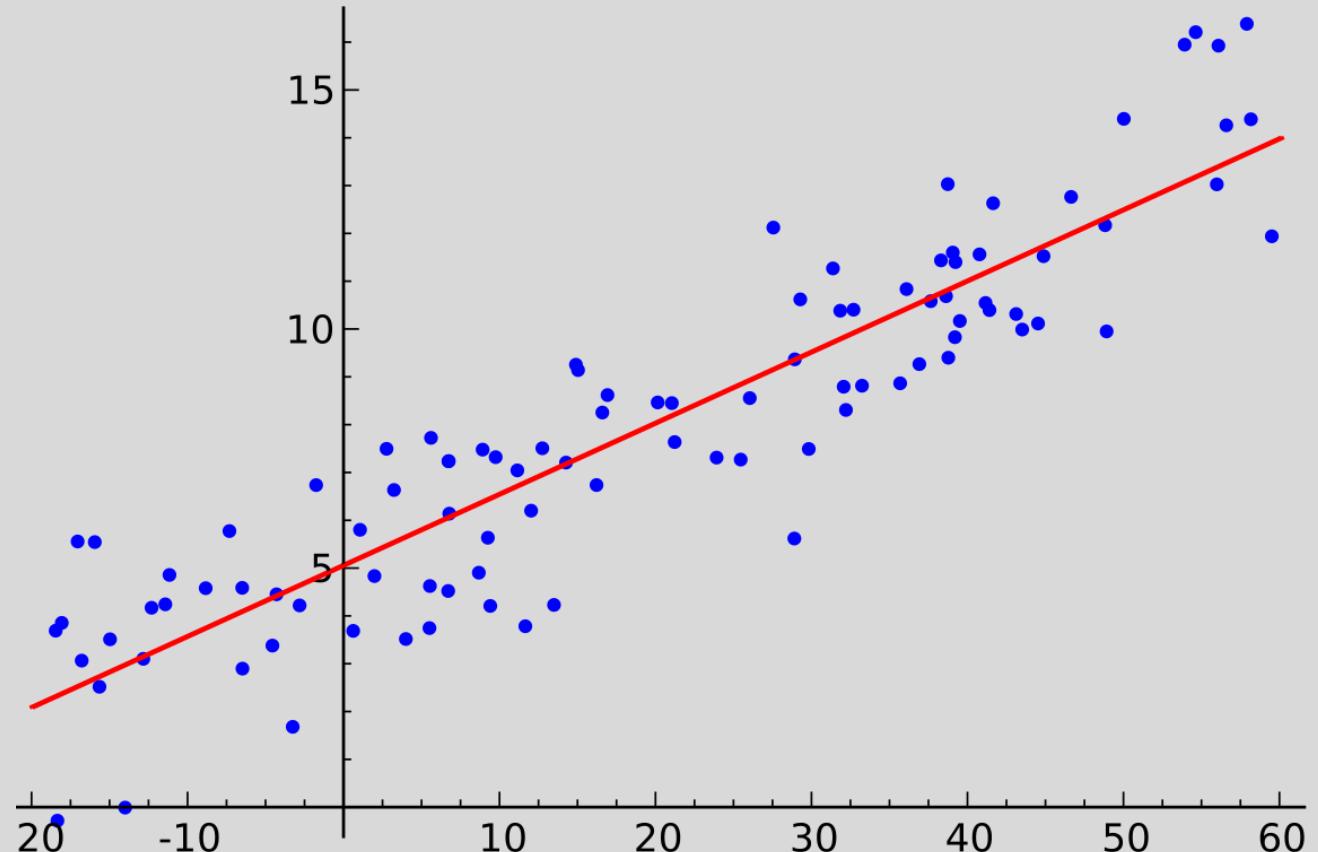
- A type of Artificial Intelligence that provides computers with the ability to learn without being explicitly programmed



Regression

Regression

- Regression analysis is a set of statistical processes for estimating the relationships among variables.



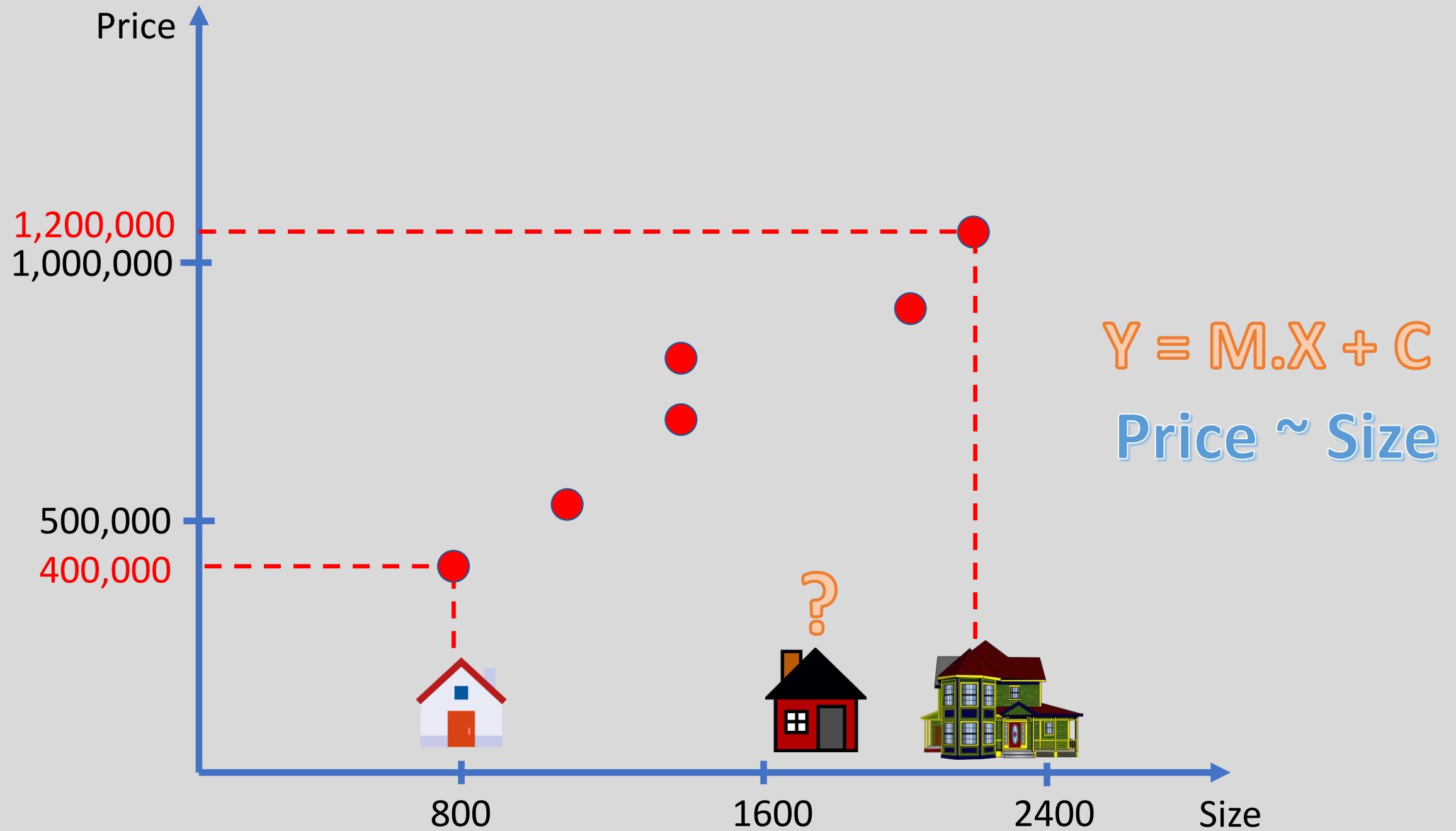
Regression

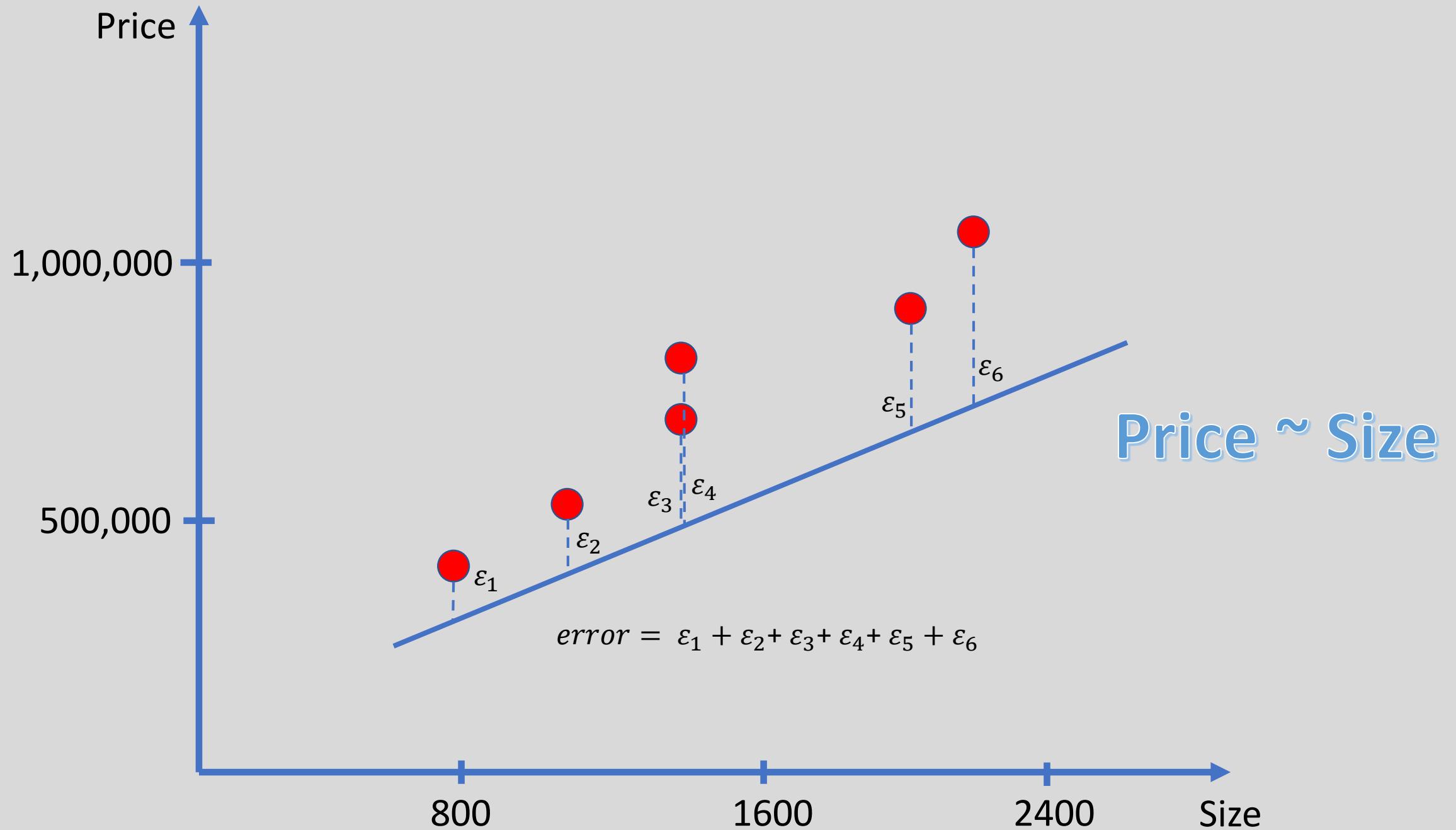
- Predict House price

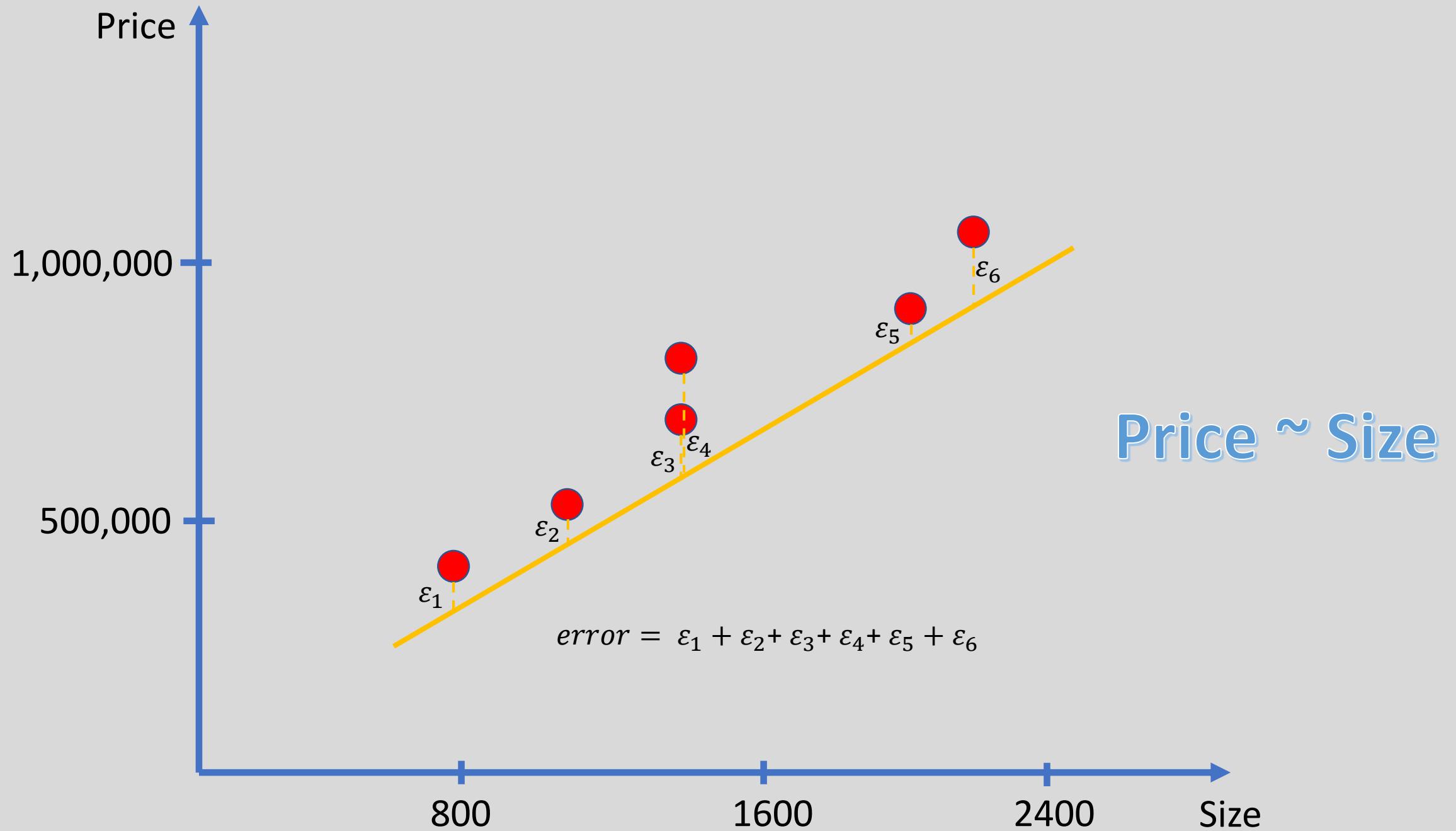


The word "label" is written in orange above the highlighted column.

Rooms	Size	Price
3	1400	750,000
2	1000	550,000
2	800	400,000
3	2000	900,000
4	2100	1,200,000
3	1400	810,000

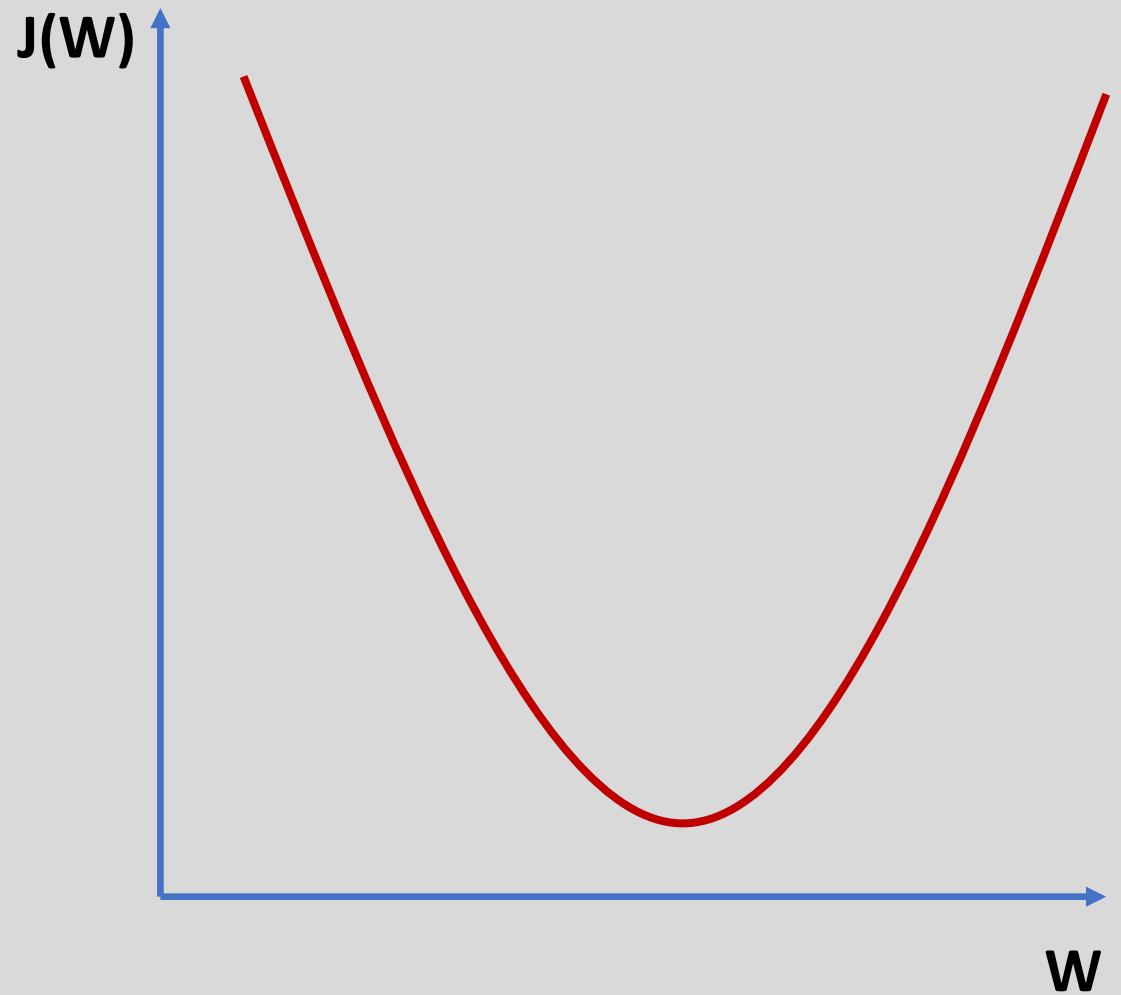




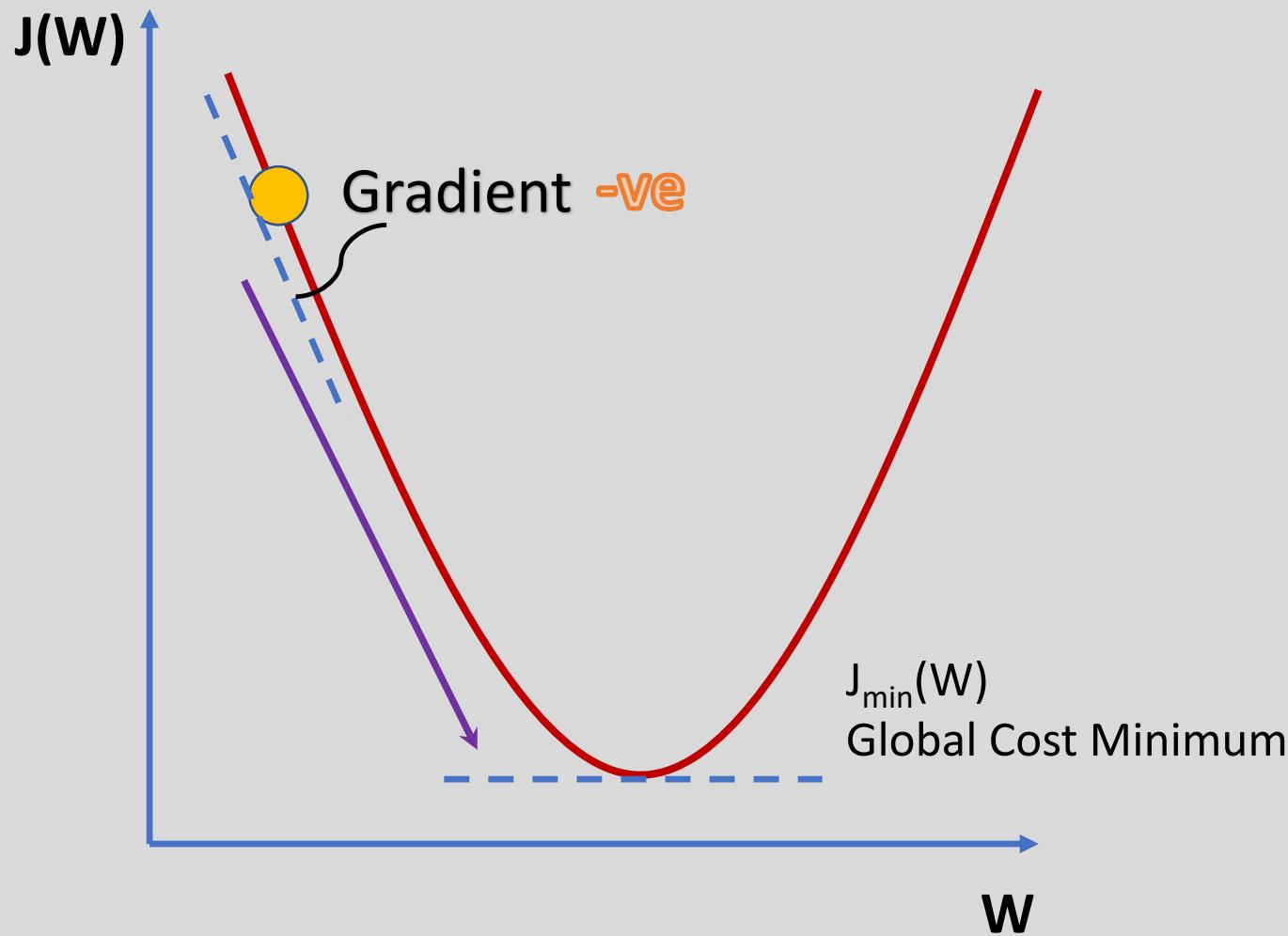


Loss/Cost Function – Minimize errors

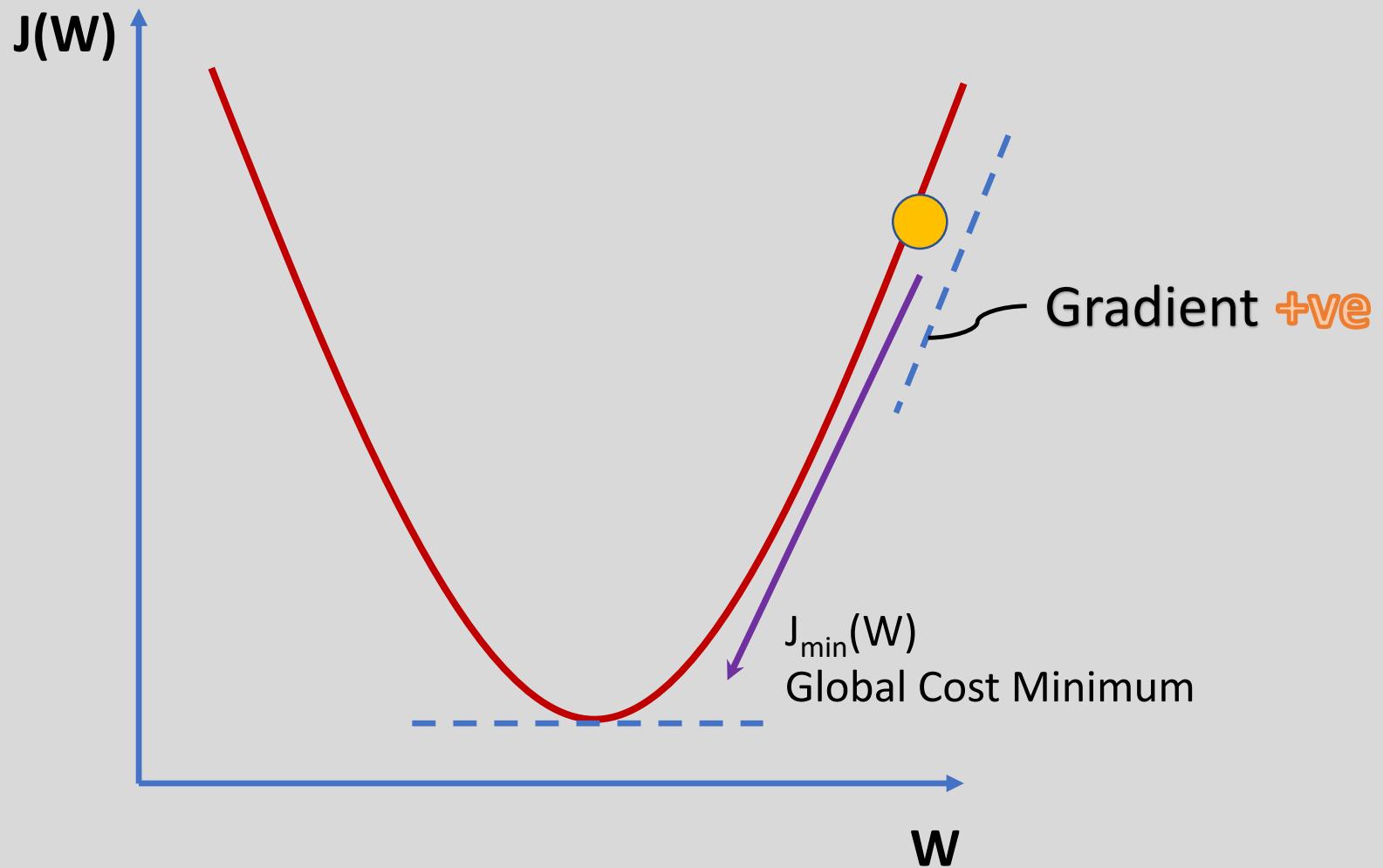
- A Loss function or Cost function is a function that maps an event or values of one or more variables onto a real number intuitively representing some "cost" associated with the event.
- An **optimization** problem seeks to **minimize a loss** function.



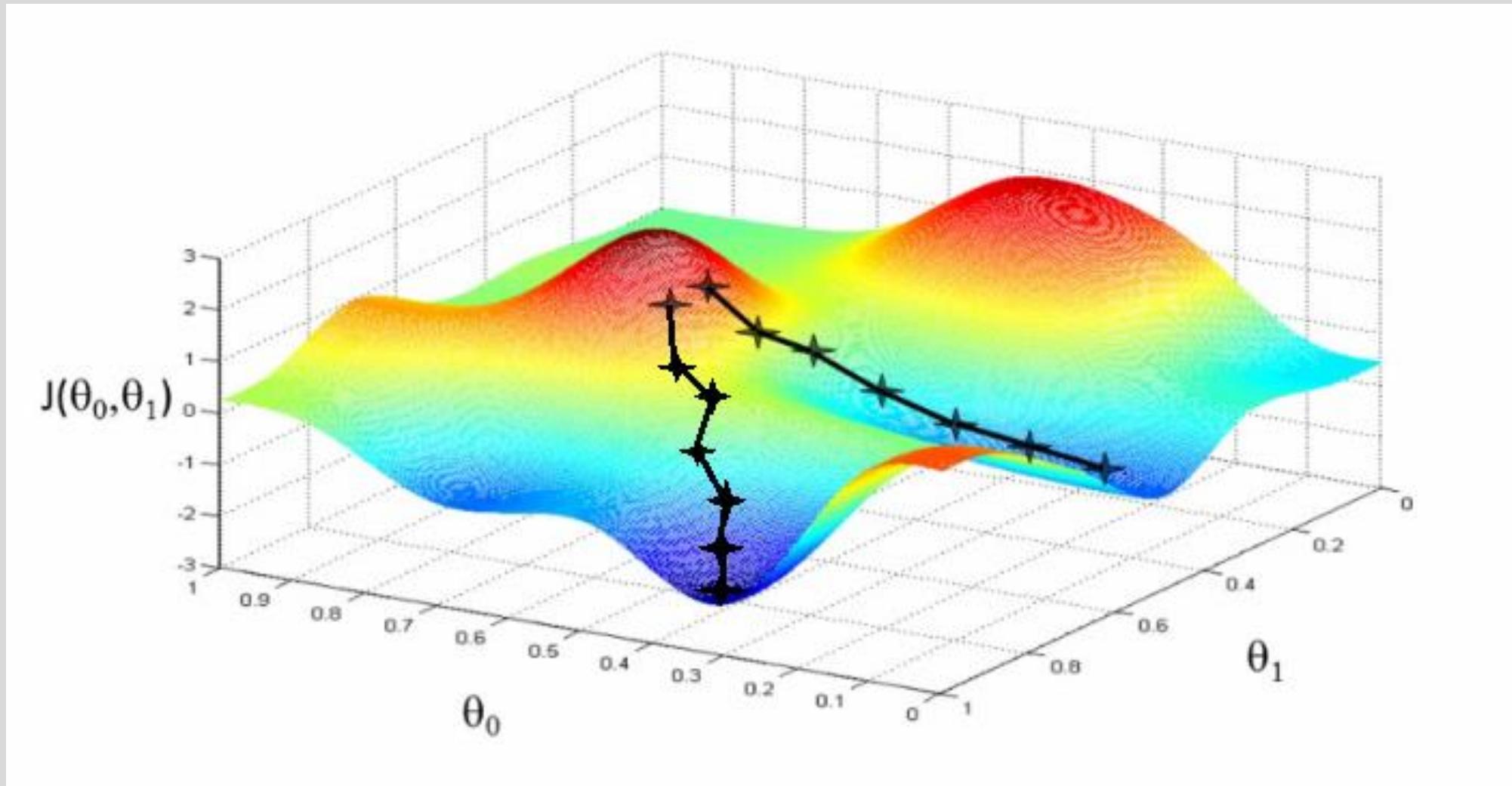
Gradient Descent

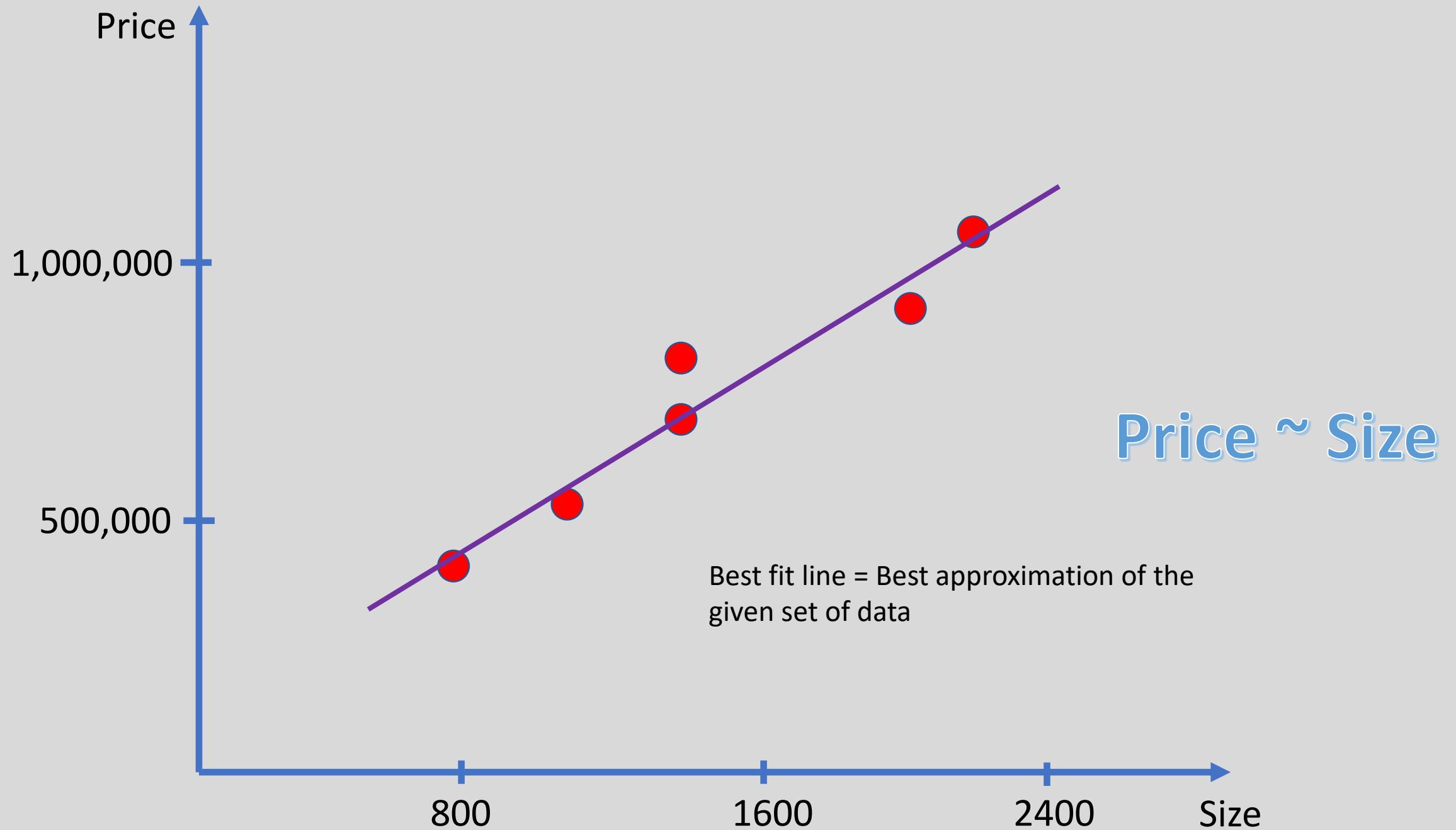


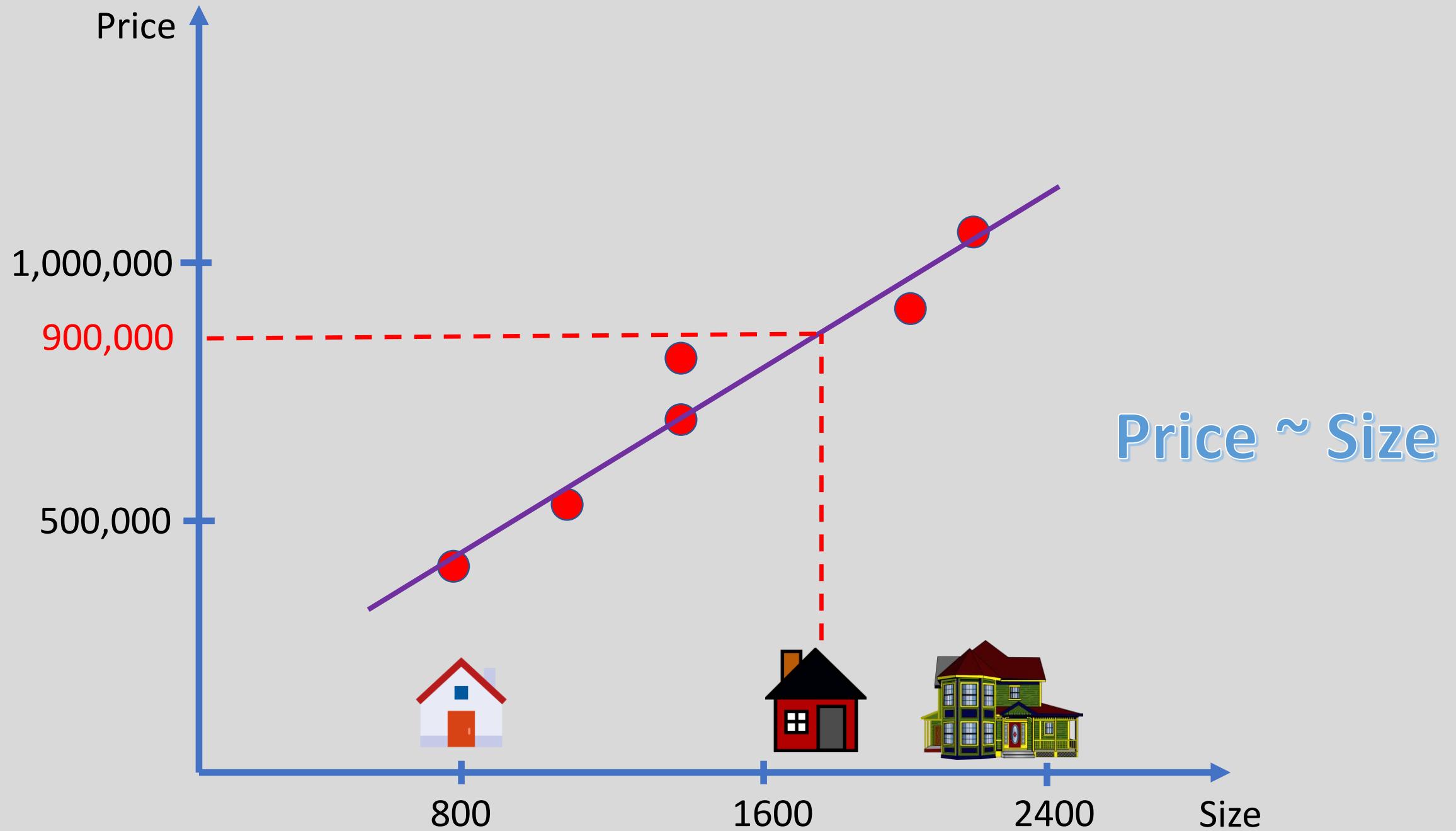
Gradient Descent



Gradient Descent







Classification

Classification

label

Gender	Age	Drinks
F	15	
M	20	
F	21	
F	18	
M	23	
F	22	

Classification

Gender	Age	Drinks
F	15	
M	20	
F	21	
F	18	
M	23	
F	22	

Quiz: Between Gender and Age, which one seems to be more decisive for predicting which drink will the users choose?

- Gender
- Age

Classification

Gender	Age	Drinks
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M	20	
F	21	
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F	22	

Quiz: Between Gender and Age, which one seems to be more decisive for predicting which drink will the users choose?

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Classification

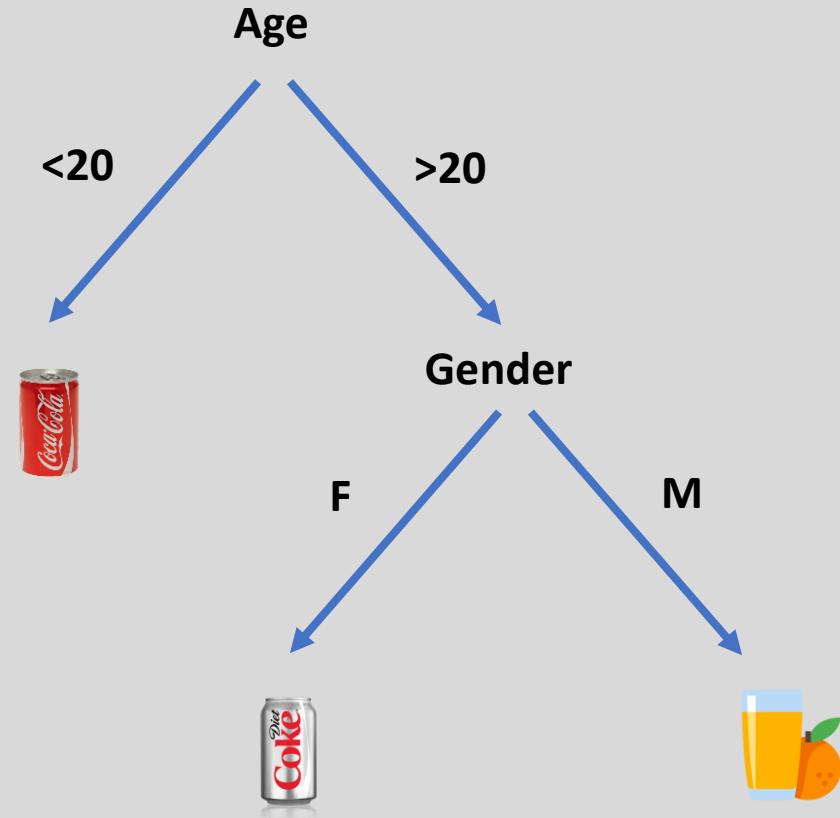
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F	22	

Quiz: Between Gender and Age, which one seems to be more decisive for predicting which drink will the users choose?

- Gender
- Age

Decision Tree

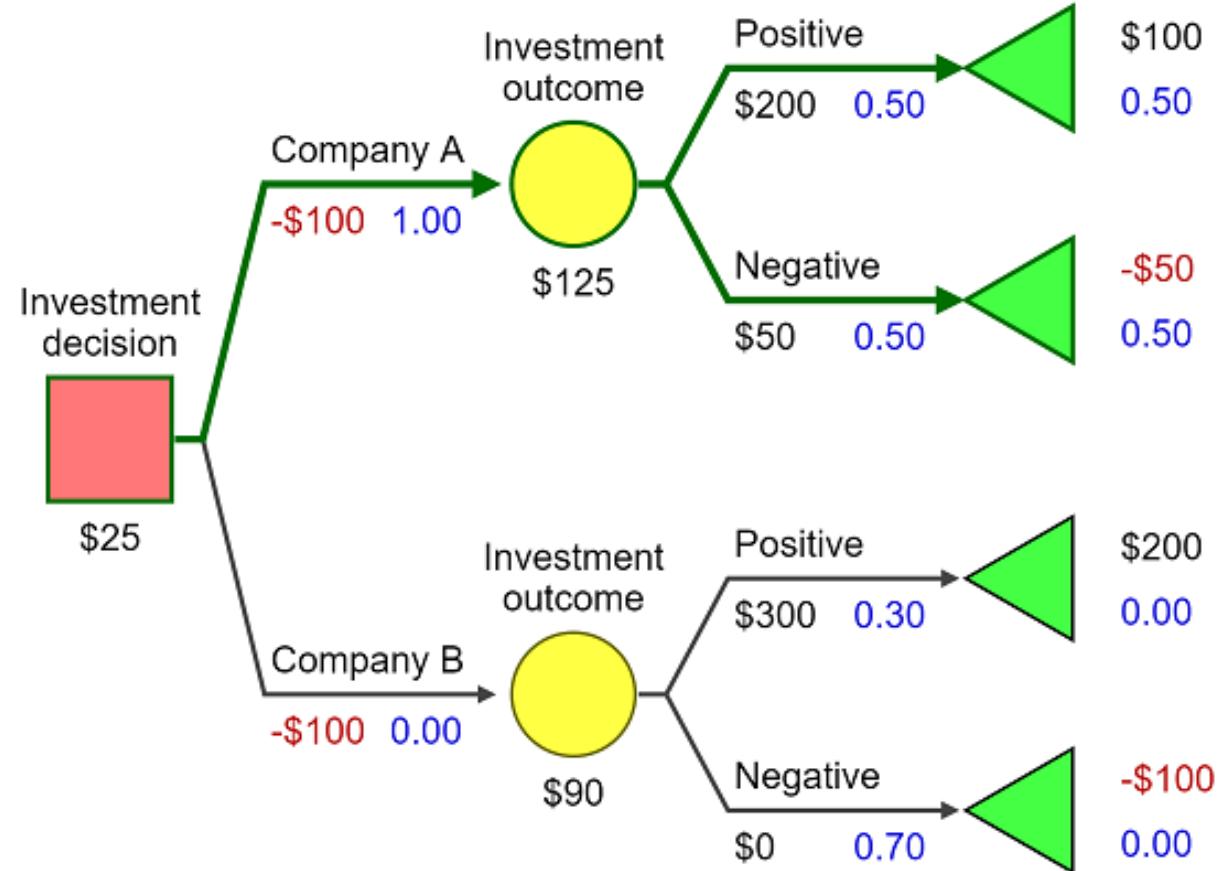
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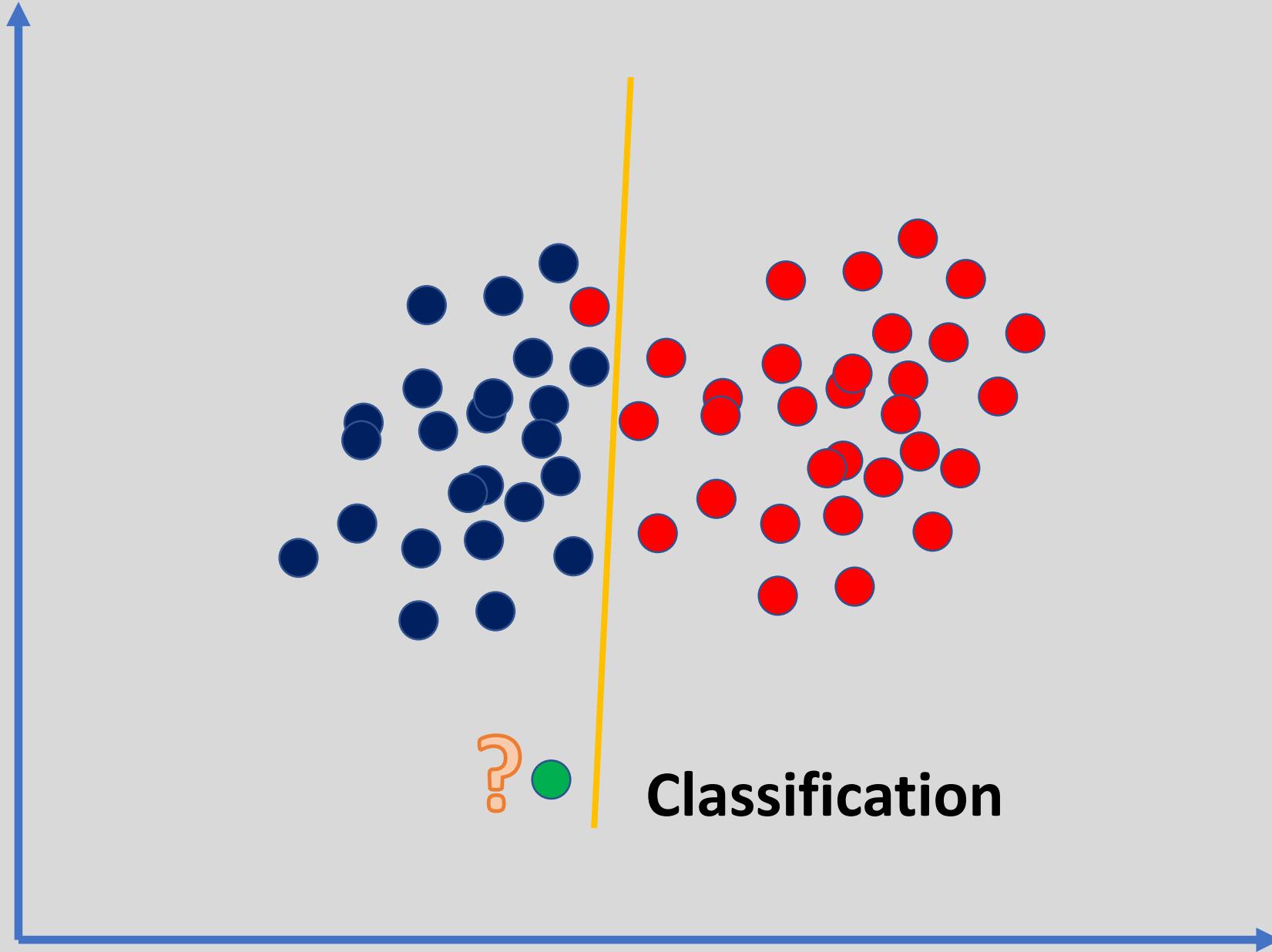


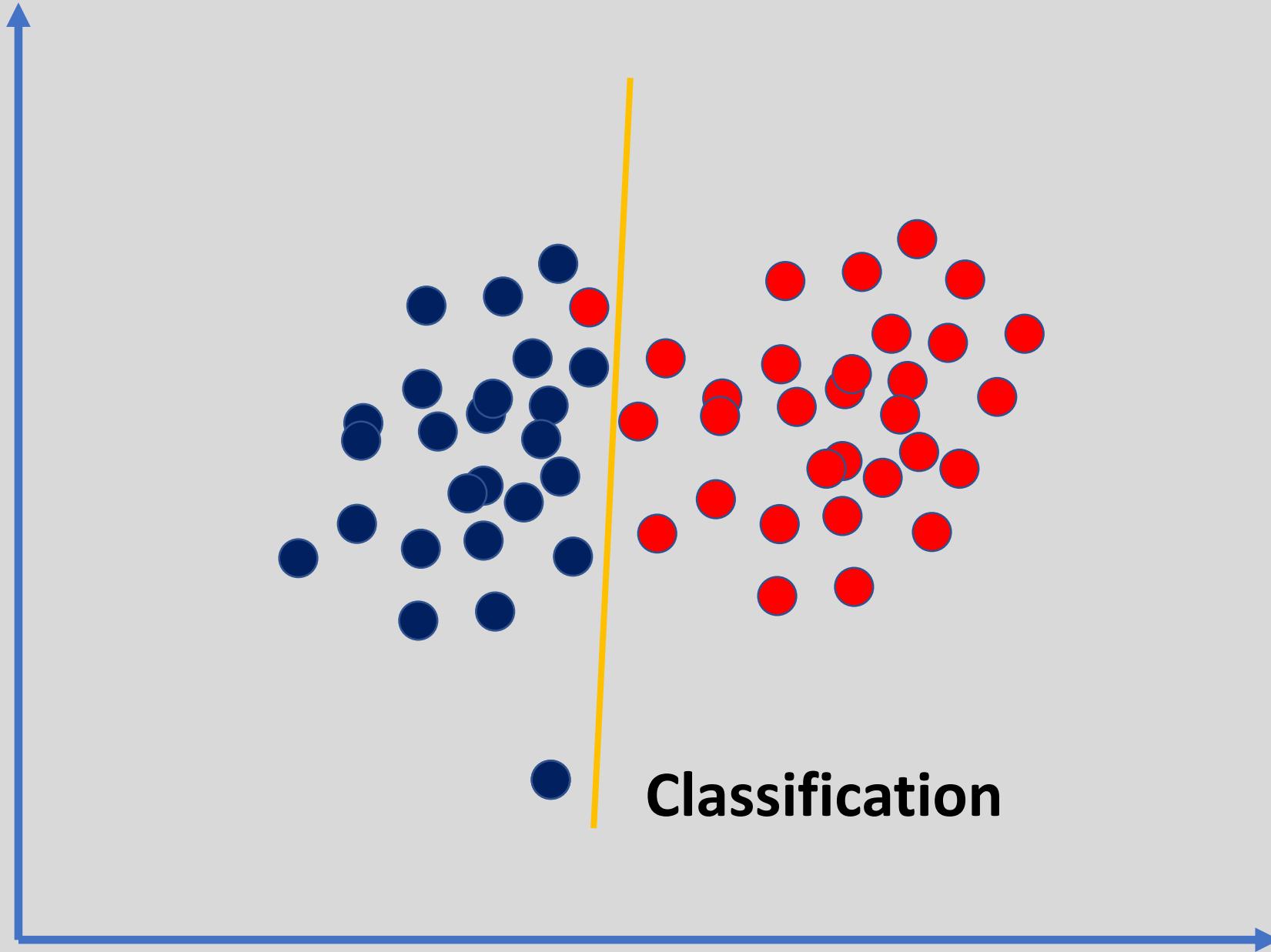
Decision Tree

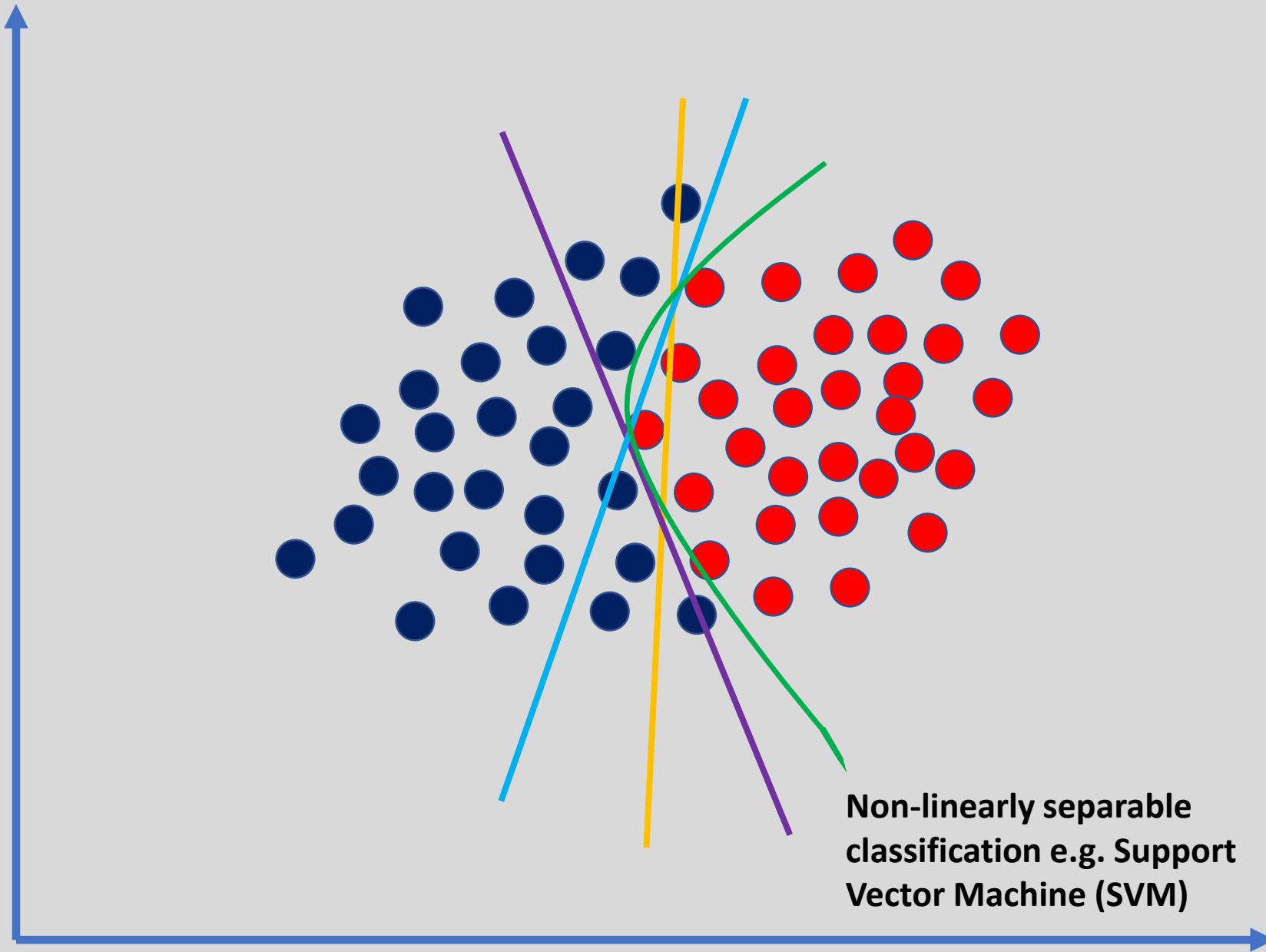
- Decision tree learning uses a decision tree (as a predictive model) to go from observations about an item (represented in the branches) to conclusions about the item's target value (represented in the leaves).

A Simple Investment Decision Model







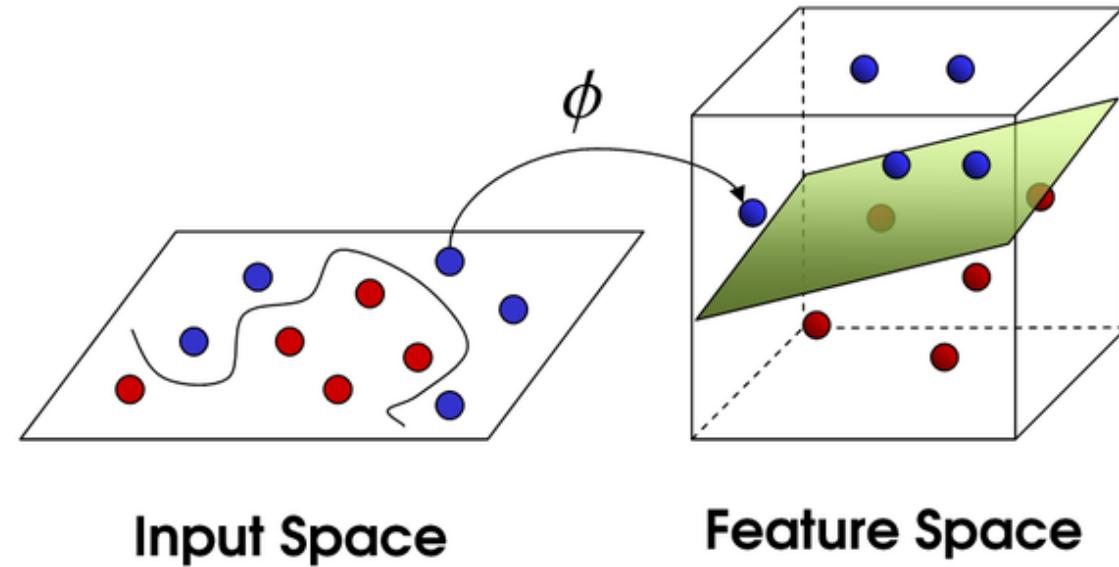


SVM with a polynomial Kernel visualization

Created by:
Udi Aharoni

Support Vector Machine (SVM)

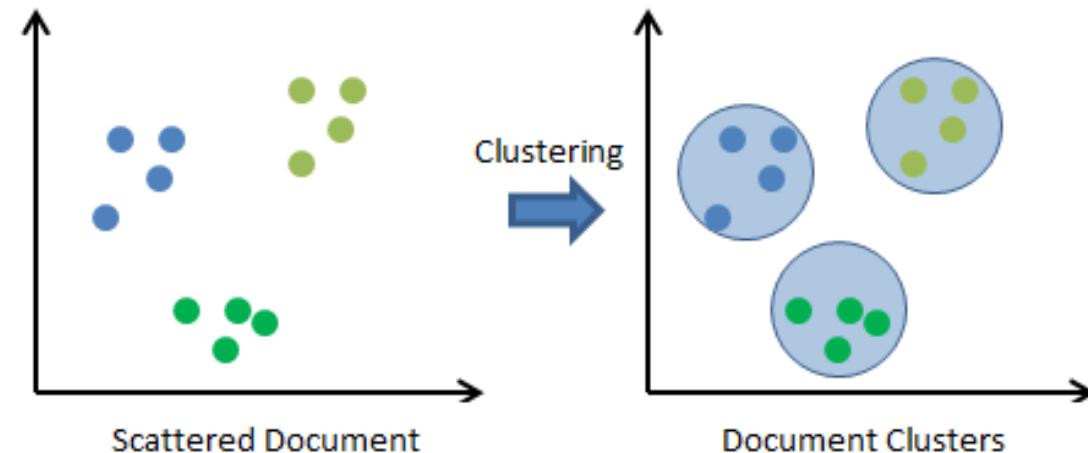
- A **Support Vector Machine (SVM)** is a discriminative classifier formally defined by a separating **hyperplane**. In other words, given labeled training data (supervised learning), the algorithm outputs an optimal hyperplane which categorizes new examples.

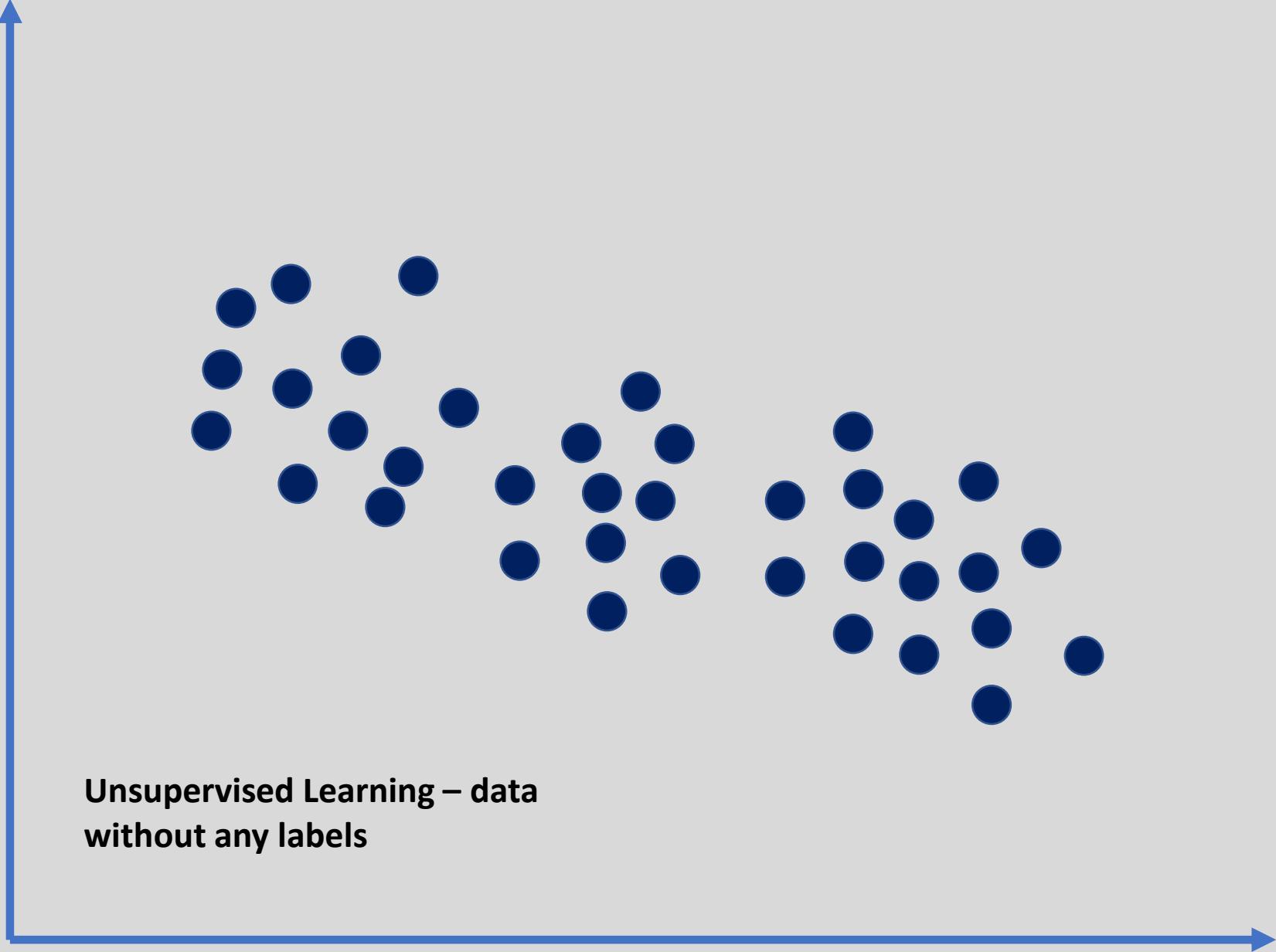


Clustering

Clustering

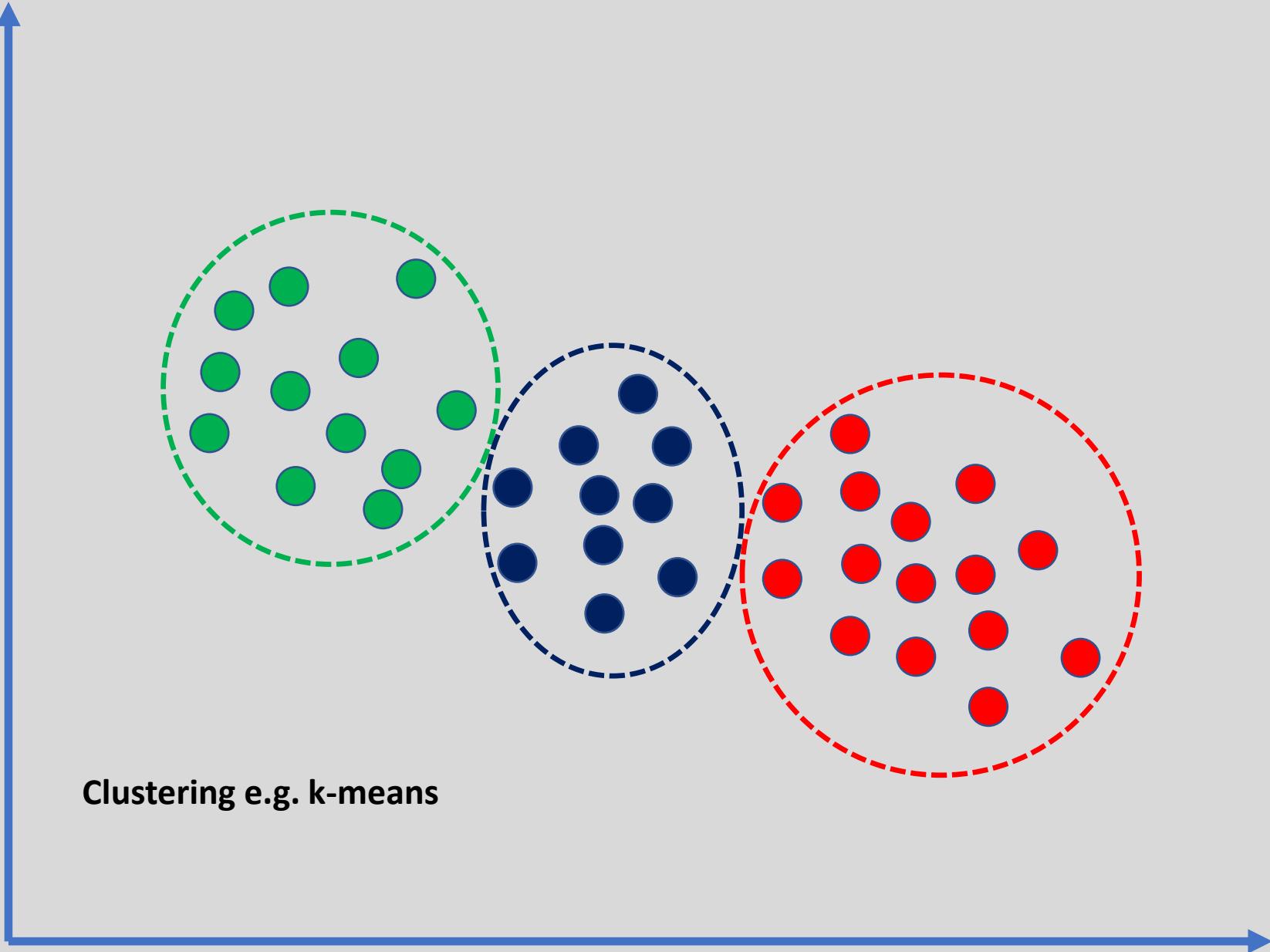
- Cluster analysis or clustering is the task of grouping a set of objects in such a way that objects in the same group (called a cluster) are more similar (in some sense) to each other than to those in other groups (clusters).





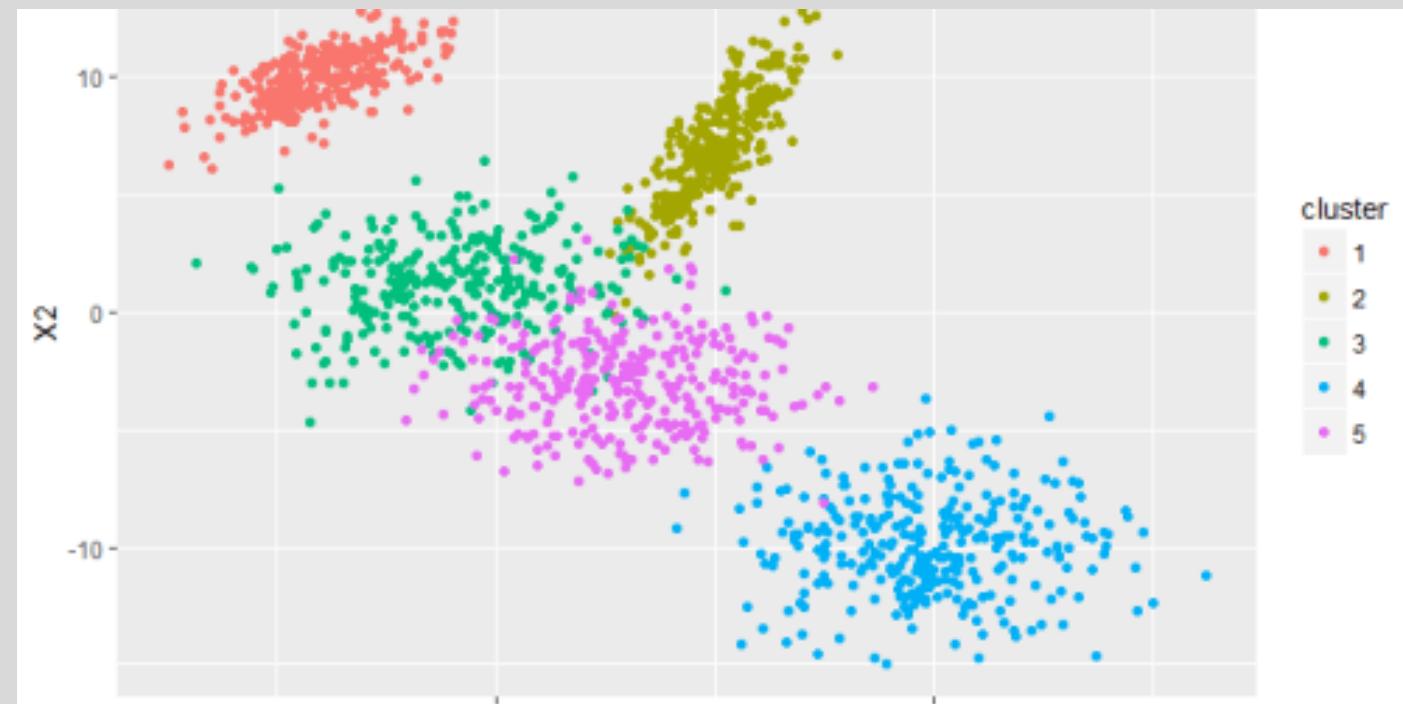
A scatter plot illustrating unsupervised learning. The plot features two axes: a vertical blue arrow pointing upwards on the left, and a horizontal blue arrow pointing to the right at the bottom. Dark blue circular data points are scattered across the plot area, forming several distinct clusters. These clusters are roughly aligned along a diagonal line from the top-left towards the bottom-right, suggesting a linear relationship or trend in the unlabeled data.

**Unsupervised Learning – data
without any labels**



K-means

- k-means clustering aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean, serving as a prototype of the cluster.





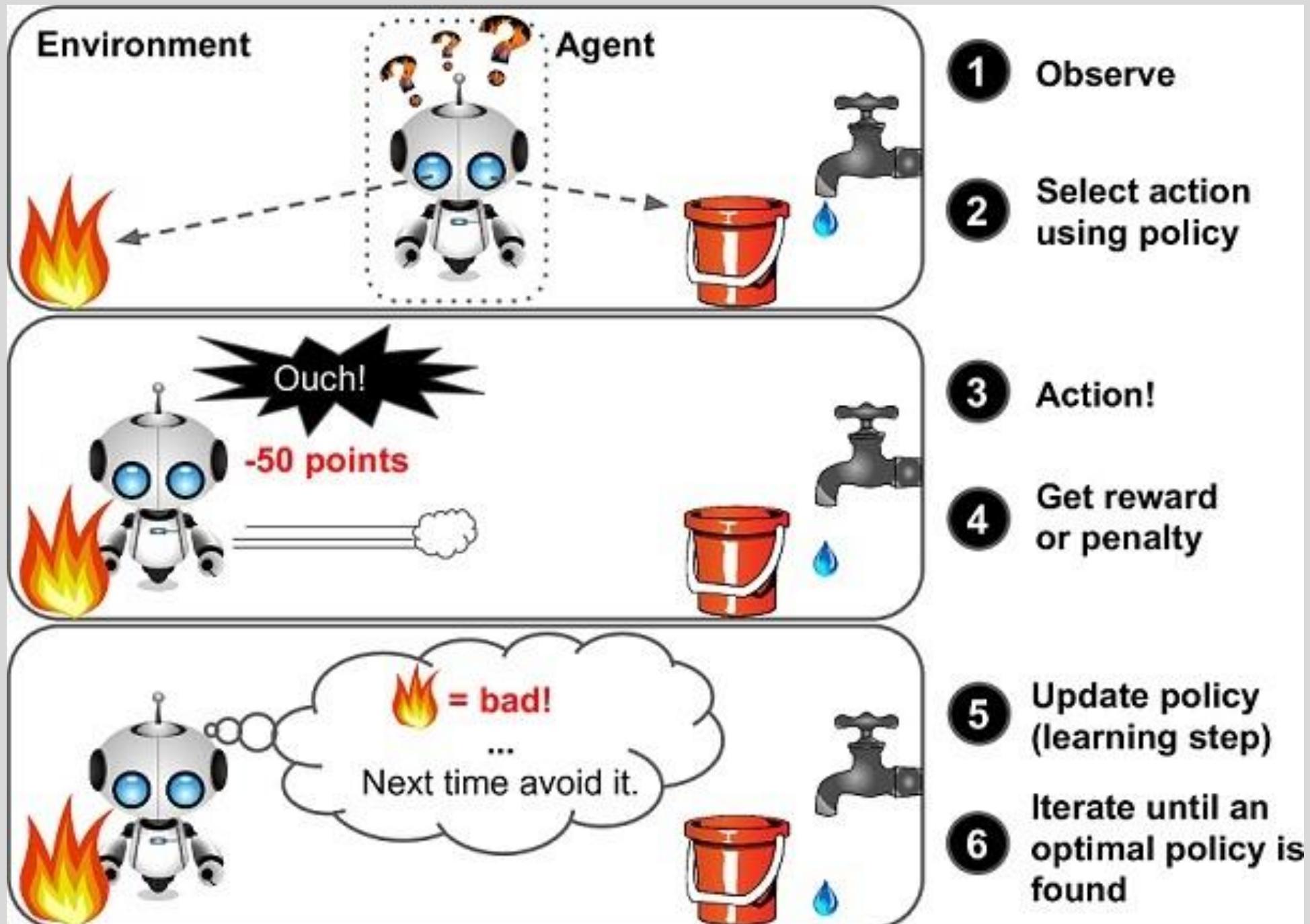
k-means
algorithm

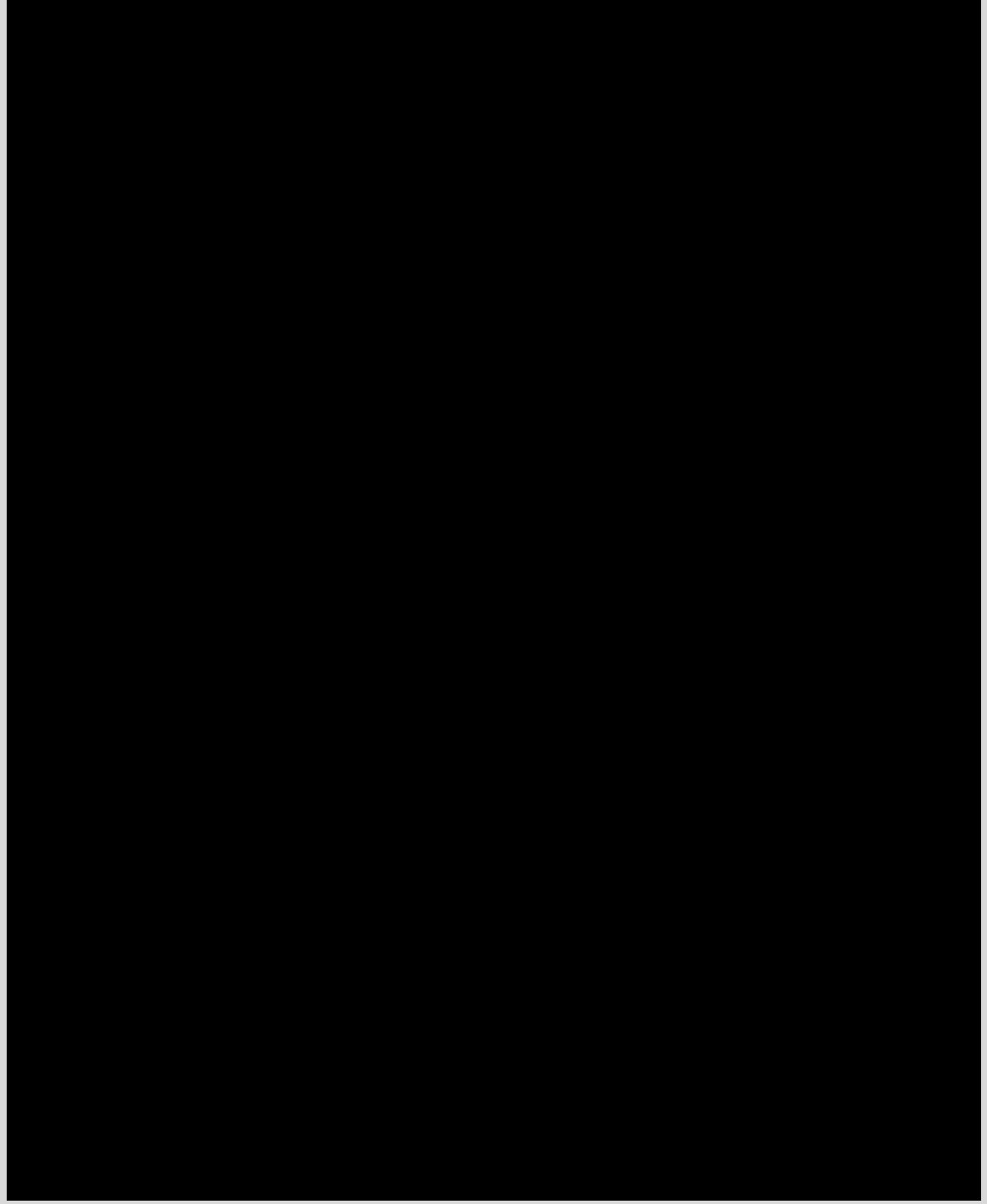
Reinforcement Learning

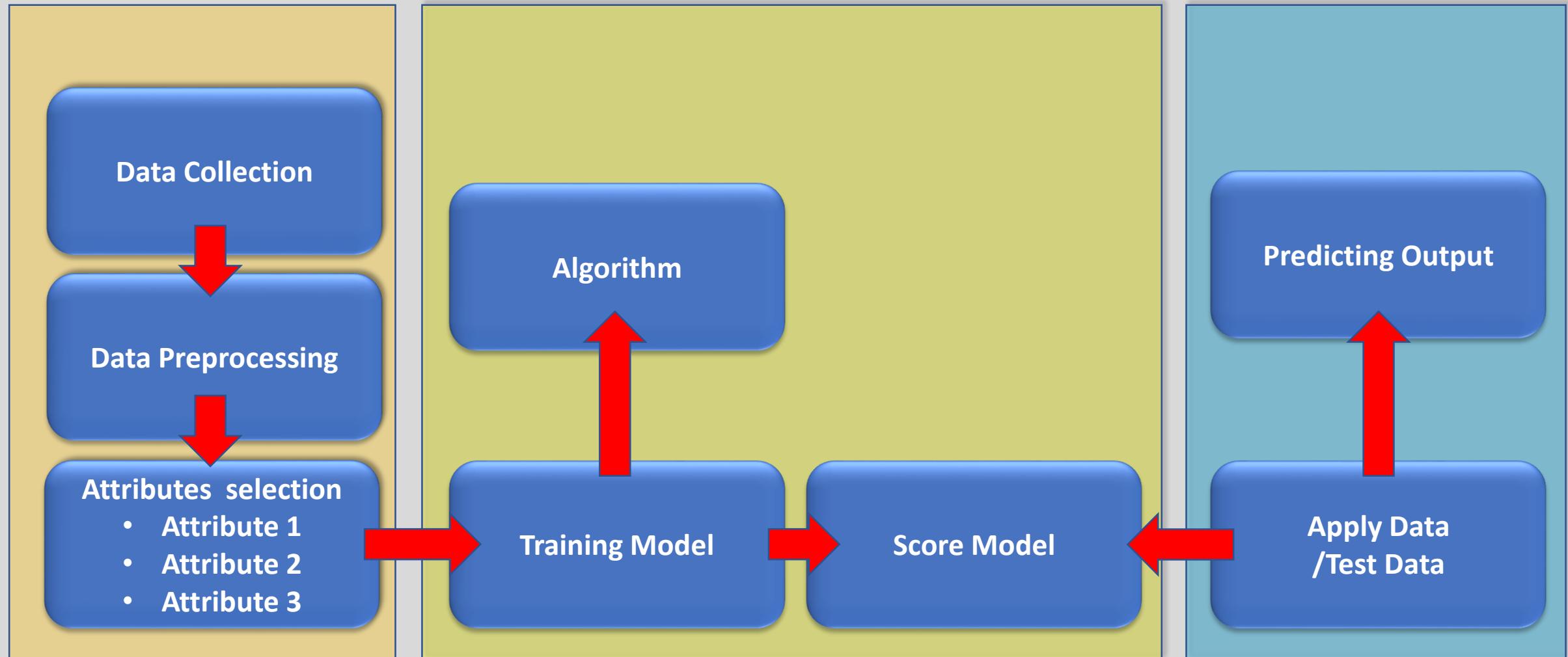
Reinforcement Learning

- Reinforcement learning (RL) is an area of machine learning inspired by behaviourist psychology concerning with how software agents ought to take actions in an environment so as to maximize some notion of cumulative reward.









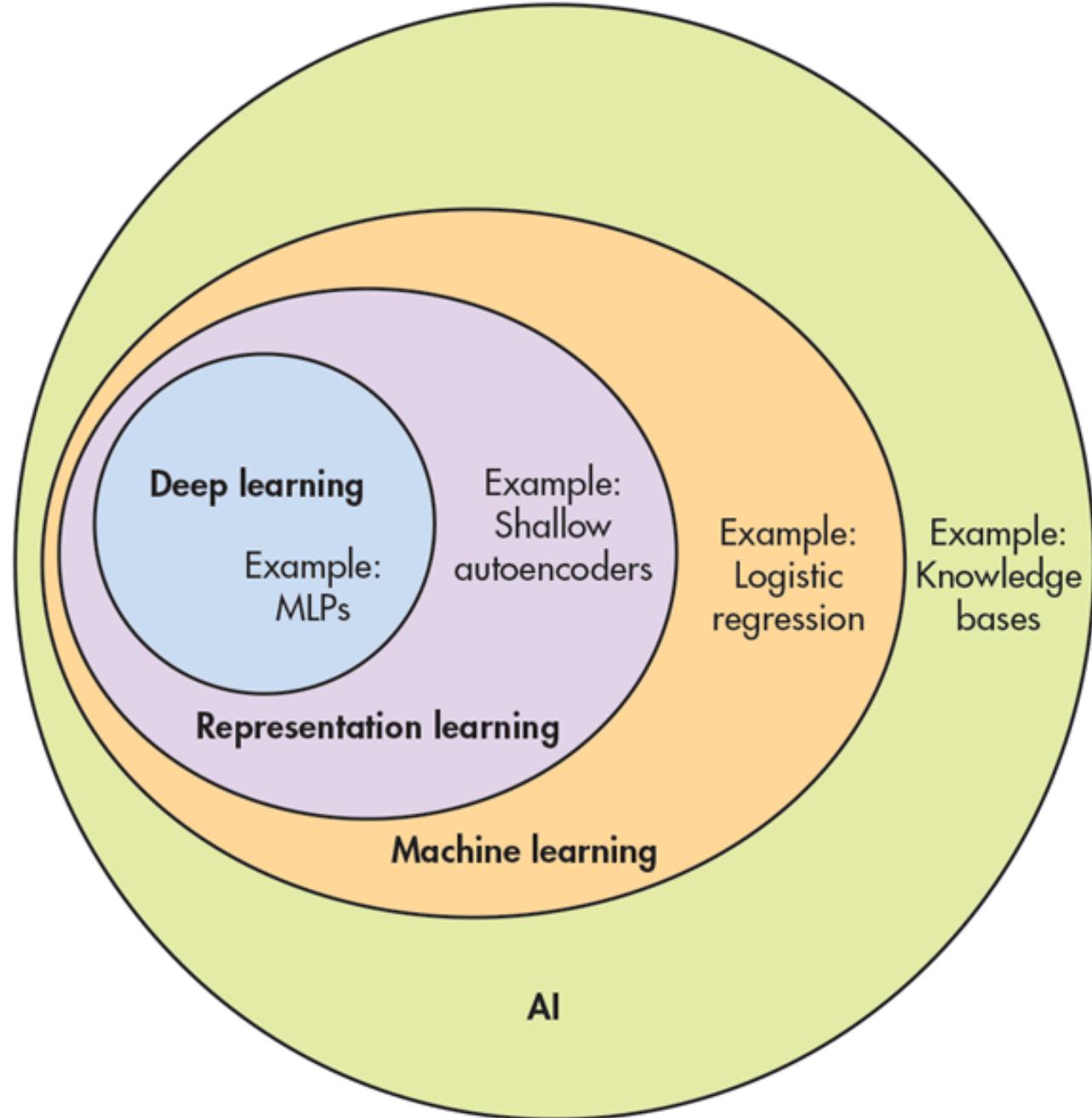
Initialization Step

Learn Step

Apply Step

Machine Learning Framework

Machine Learning vs AI vs Deep Learning



Artificial Intelligence

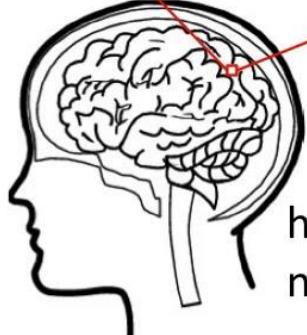
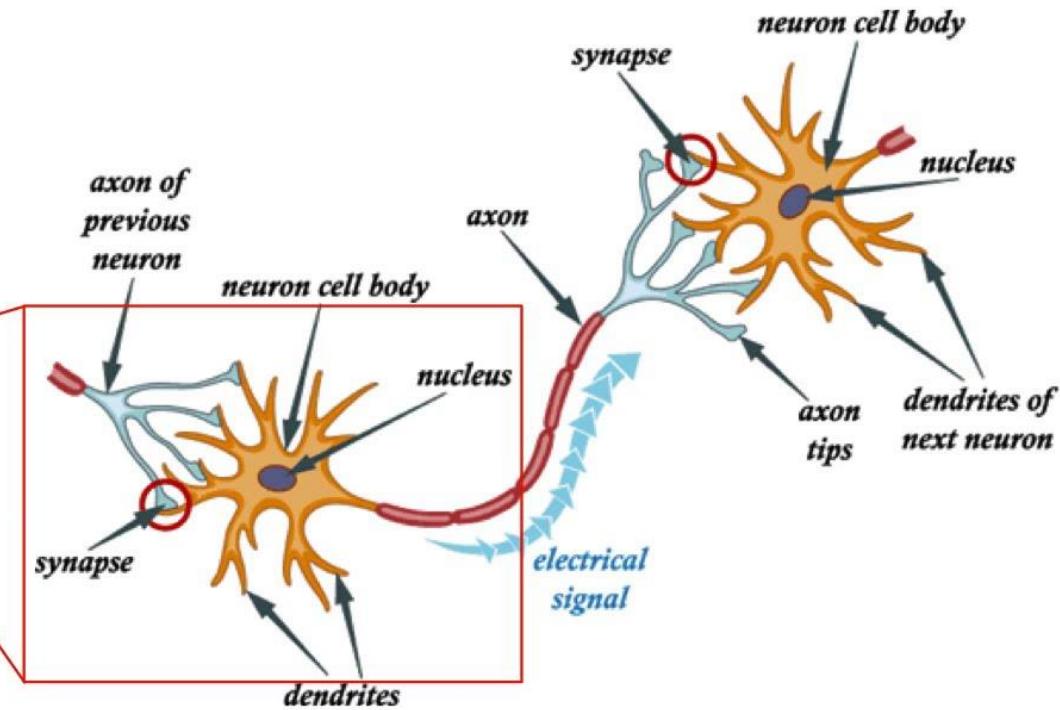
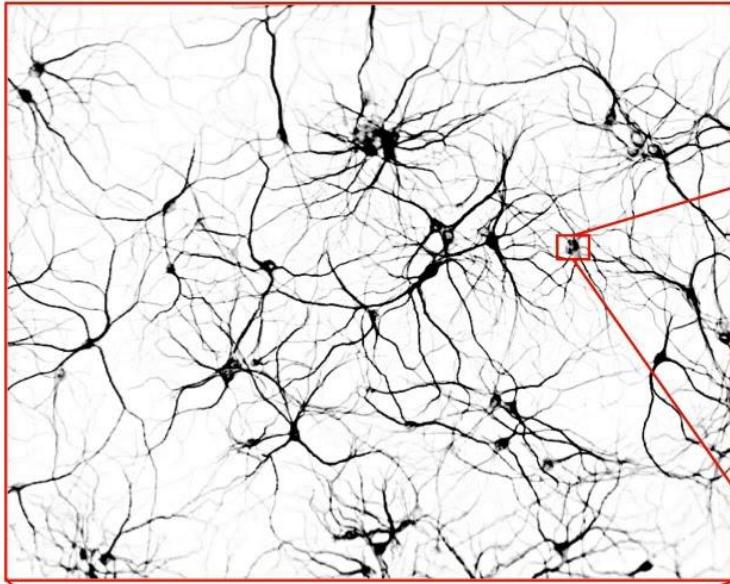
Neural Network

Biological Inspiration

- Animals are able to react adaptively to changes in their external and internal environment, and they use their nervous system to perform these behaviours.
- An appropriate model/simulation of the nervous system should be able to produce similar responses and behaviours in artificial systems.
- The nervous system is build by relatively simple units, the neurons, so copying their behaviour and functionality should be the solution.

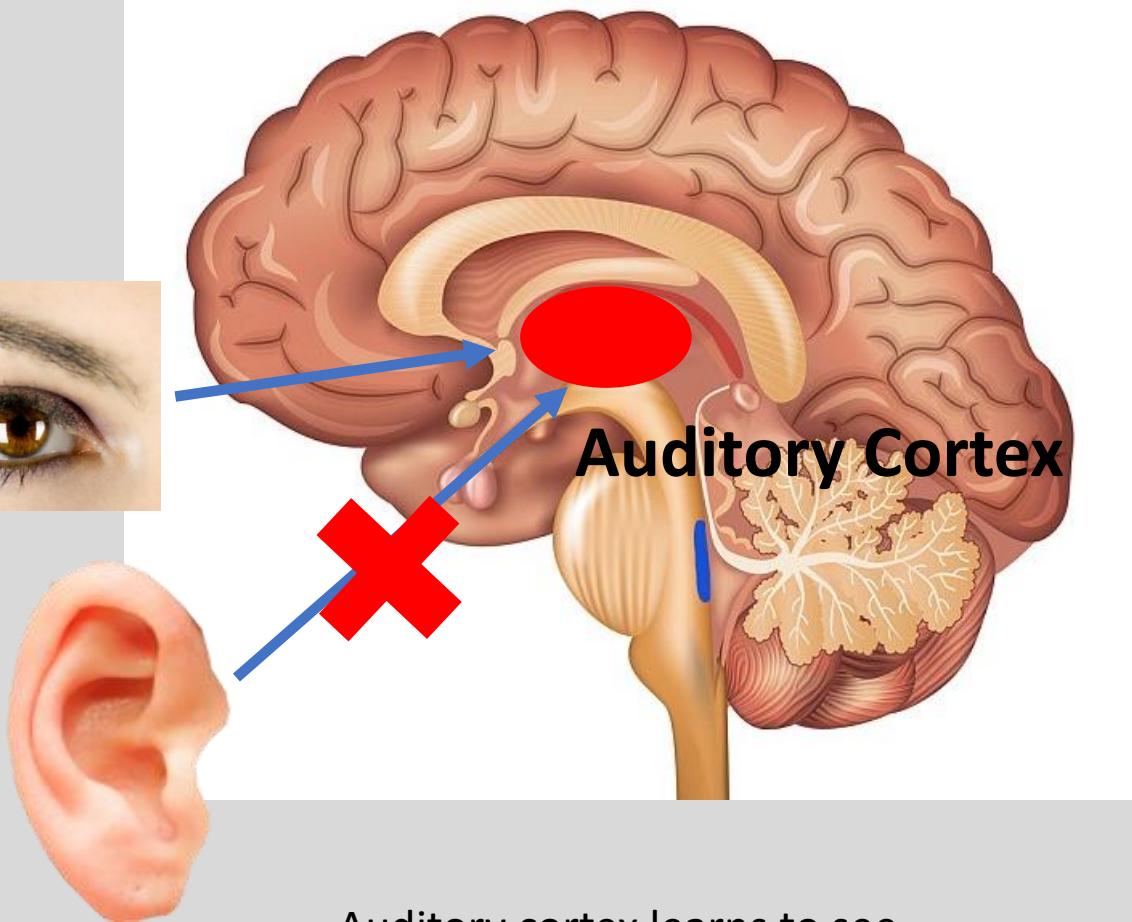


Neurons and the brain

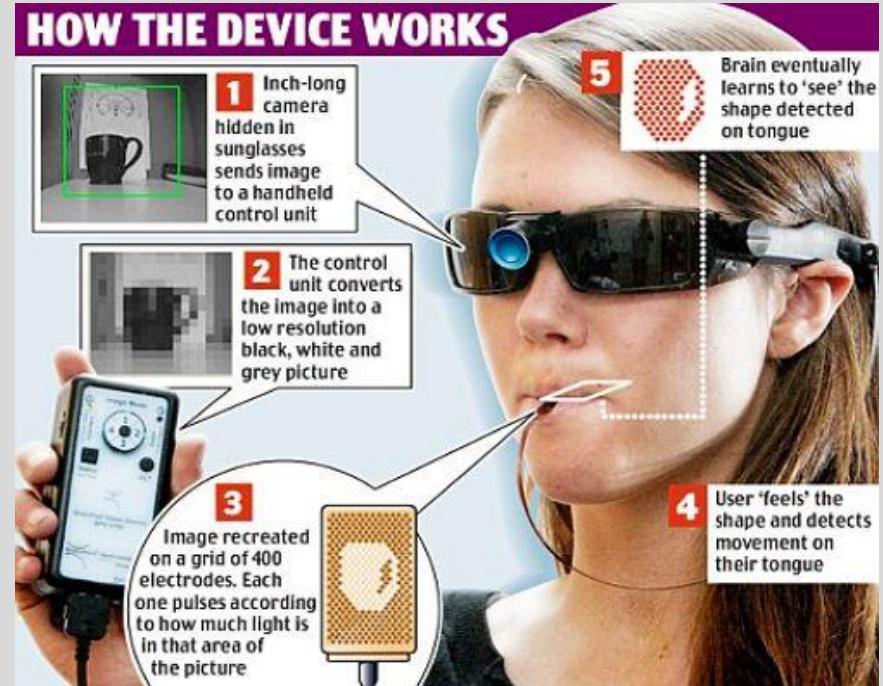


humans don't
need features

Human Brain

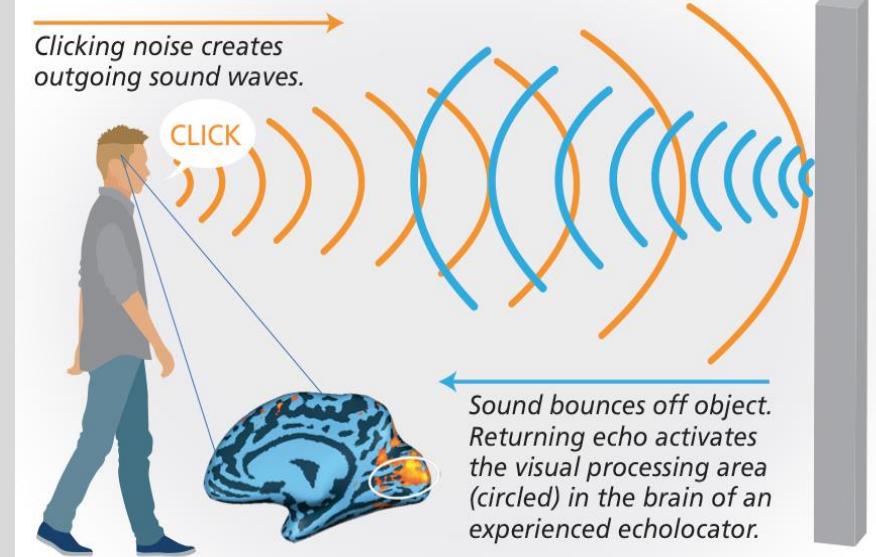


Auditory cortex learns to see.
(Same rewiring process also
works for touch/ somatosensory
cortex.)



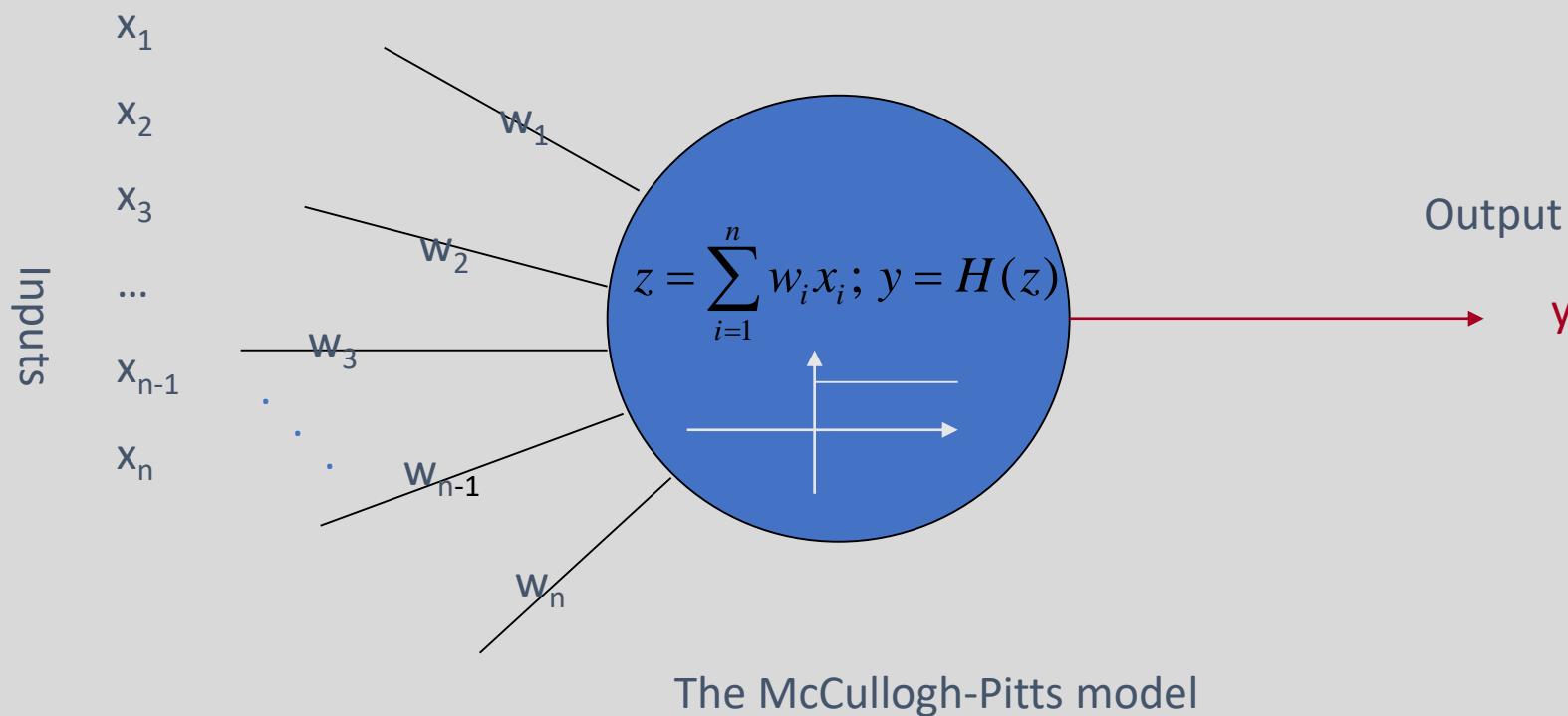
Seeing with tongue

HUMAN ECHolocation: HOW IT WORKS



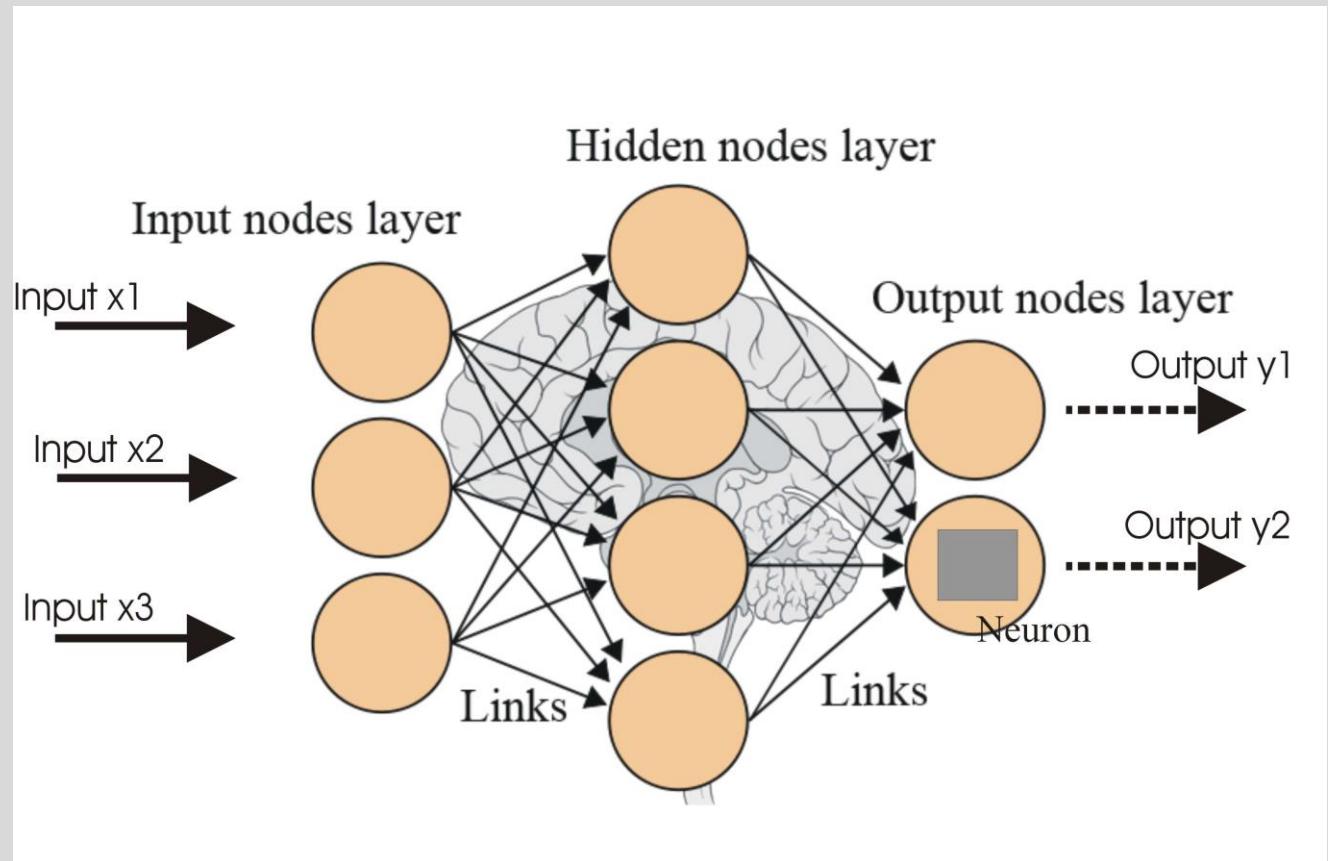
Artificial Neurons

- Neurons work by processing information. They receive and provide information in form of spikes.



Artificial Neural Networks

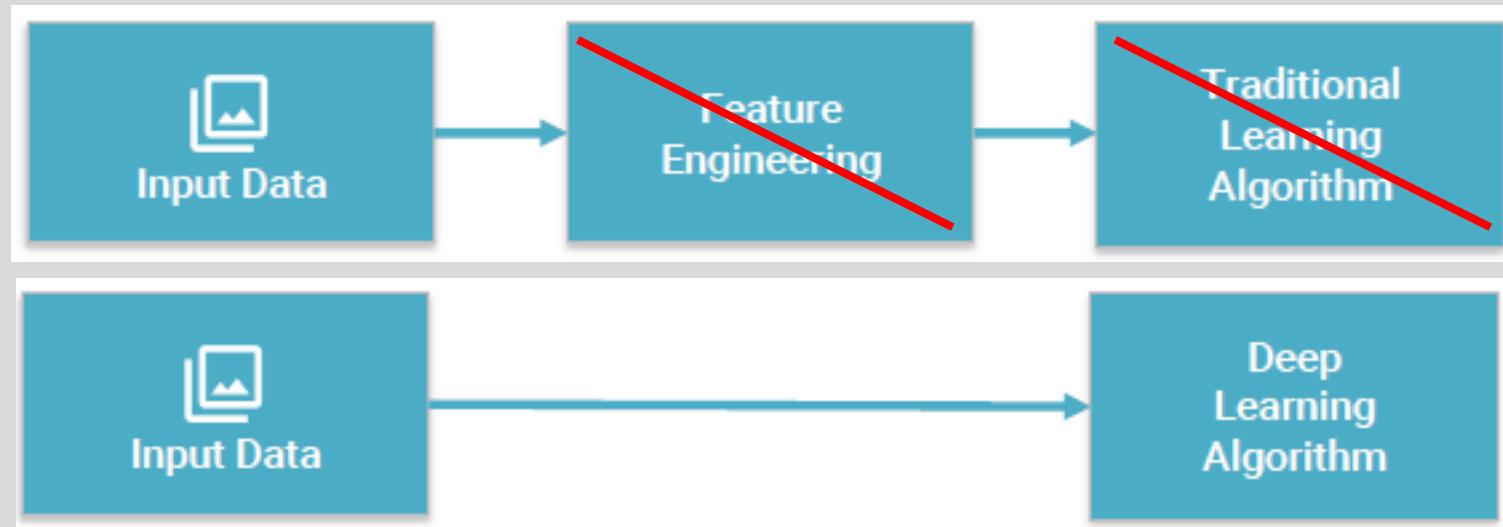
- An artificial neural network is composed of many artificial neurons that are linked together according to a specific network architecture. The objective of the neural network is to transform the inputs into meaningful outputs.



Deep Learning

Deep Learning

- Removes the need to **manually** craft the feature (DL “**finds**” them instead)
- Removes the need to **perform separate learning** (DL “**learns**” them directly)



Deep Learning: Strengths

- Robust
 - Features are automatically learned to be optimal for the task at hand
- Generalizable
 - The same DL approach/architecture can be used for many different applications and data types
- Scalable
 - Performance improves with more data, method is massively parallelizable

Deep Learning: Weaknesses

- **Requires large datasets** (typically), also means long training periods.
- **Not necessarily > traditional ML methods** like SVMs, decision trees
- Learned features are often **difficult to understand or explain**.
 - Many vision features are also not really human-understandable (e.g, concatenations/combinations of different features).
- Requires **a good understanding of how to design new models** for new tasks, or using new forms of data, etc.

Deep
Learning
Tools : Open
Source



theano



torch

Caffe



DL4J Deep Learning for Java



Lasagne

NVIDIA DIGITS

K Keras

dmlc
mxnet

n
neon

Conclusion

Summary

- In a nutshell, machine learning can be divided into 2 main categories:
 - Supervised Learning – Classification & Regression
 - Unsupervised Learning – Clustering
- Other recent advancement to Machine Learning are:
 - Reinforcement Learning
 - Artificial Intelligence
 - Neural Network
 - Deep Learning

Slides and codes

Slides are available from github:

<http://bit.ly/globalazurebootcamp2018>



Thanks!

Questions?



@kuanhooong



<https://www.linkedin.com/in/kuanhooong>



kh@coqnitics.com