



# Neural Network Workshop

Khayyam Salehi, Ph.D.  
Assistant Professor of Computer Science  
Shahrekord University





## Workshop background

- Review of Machine Learning (ML)
- Introduction to Neural Network (NN)
- Implementation of NN
- Learning, evaluating and improving models
- Optimization algorithms
- The concept of Deep Neural Networks (DNN)
- Convolutional Neural Networks (CNN)
- Sequential processing models (RNN, LSTM)
- PyTorch



## Me !

- Computer Science (B.Sc., M.Sc., Ph.D.)
- Assistant Professor of Computer Science
  - Department of Computer Science, Shahrekord University.
- Research Interest
  - Machine Learning
  - Formal Methods
- Previous workshop:
  - Python for Data Mining and Machine Learning (IRC-2021)



*Instructor: Khayyam Salehi, Ph.D.*



## Me !

- Awards:
  - 1<sup>st</sup> rank in B.Sc.
  - 2<sup>nd</sup> rank in M.Sc.
  - 1<sup>st</sup> rank in Ph.D.
  - Entrepreneur section winner of Tabriz's Harekat Festival (2017)
  - Best lecturer of University of Tabriz in the first semester of 2016-7
  - Appreciation from the Consulate General of Iran in Erzurum, Türkiye in 2017
  - Best paper of the international conference (2021 SECURWARE)



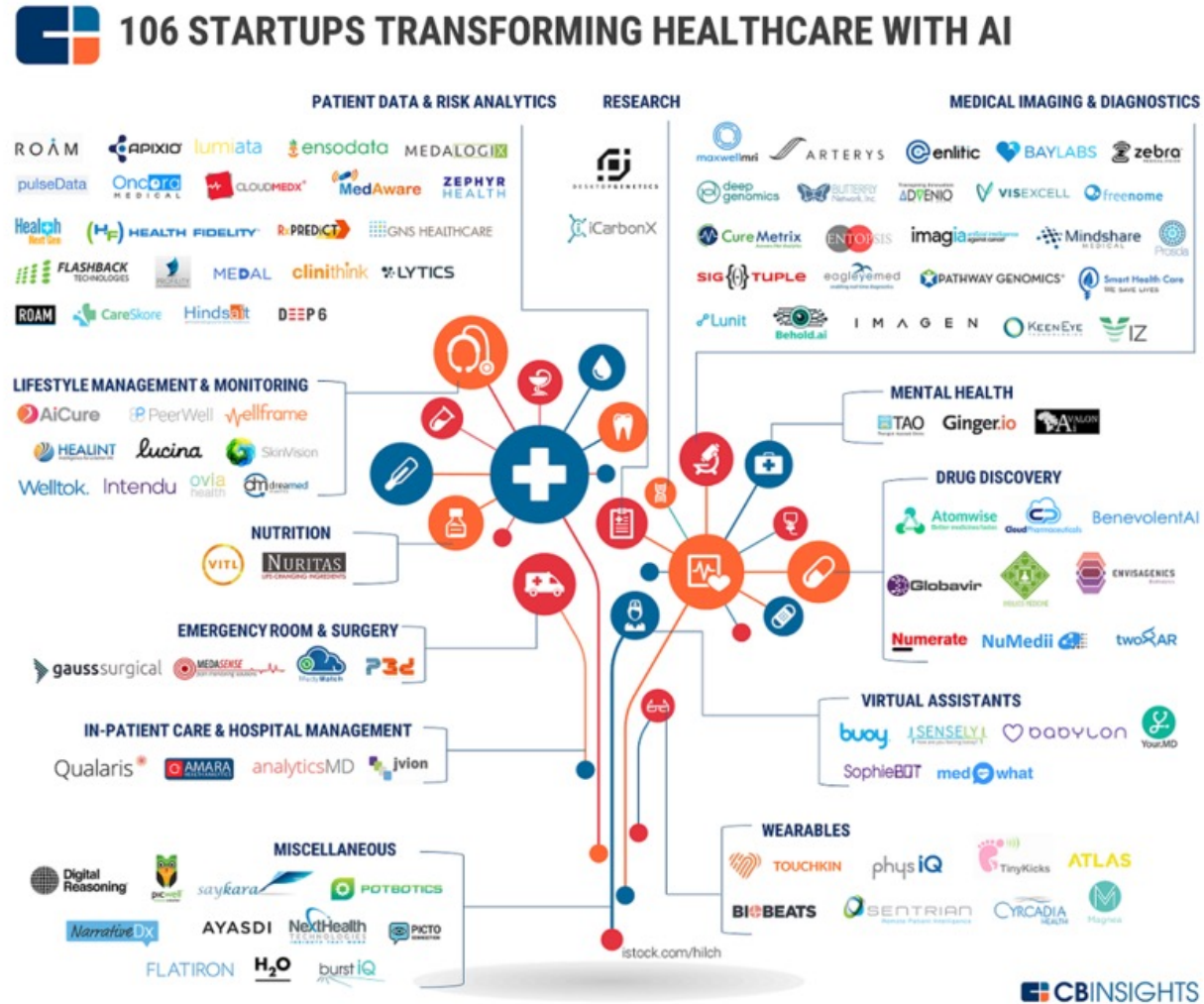
# Fruit of the Slide



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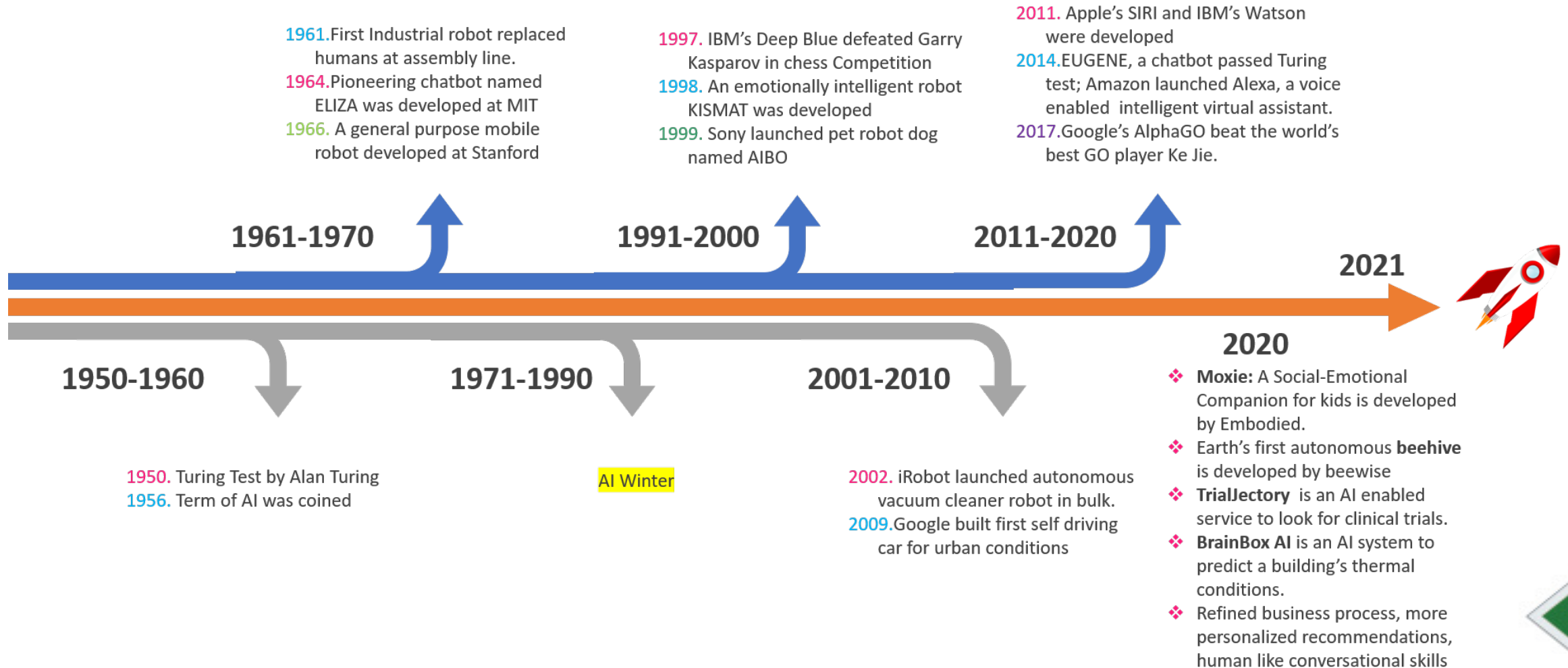


# Healthcare with AI





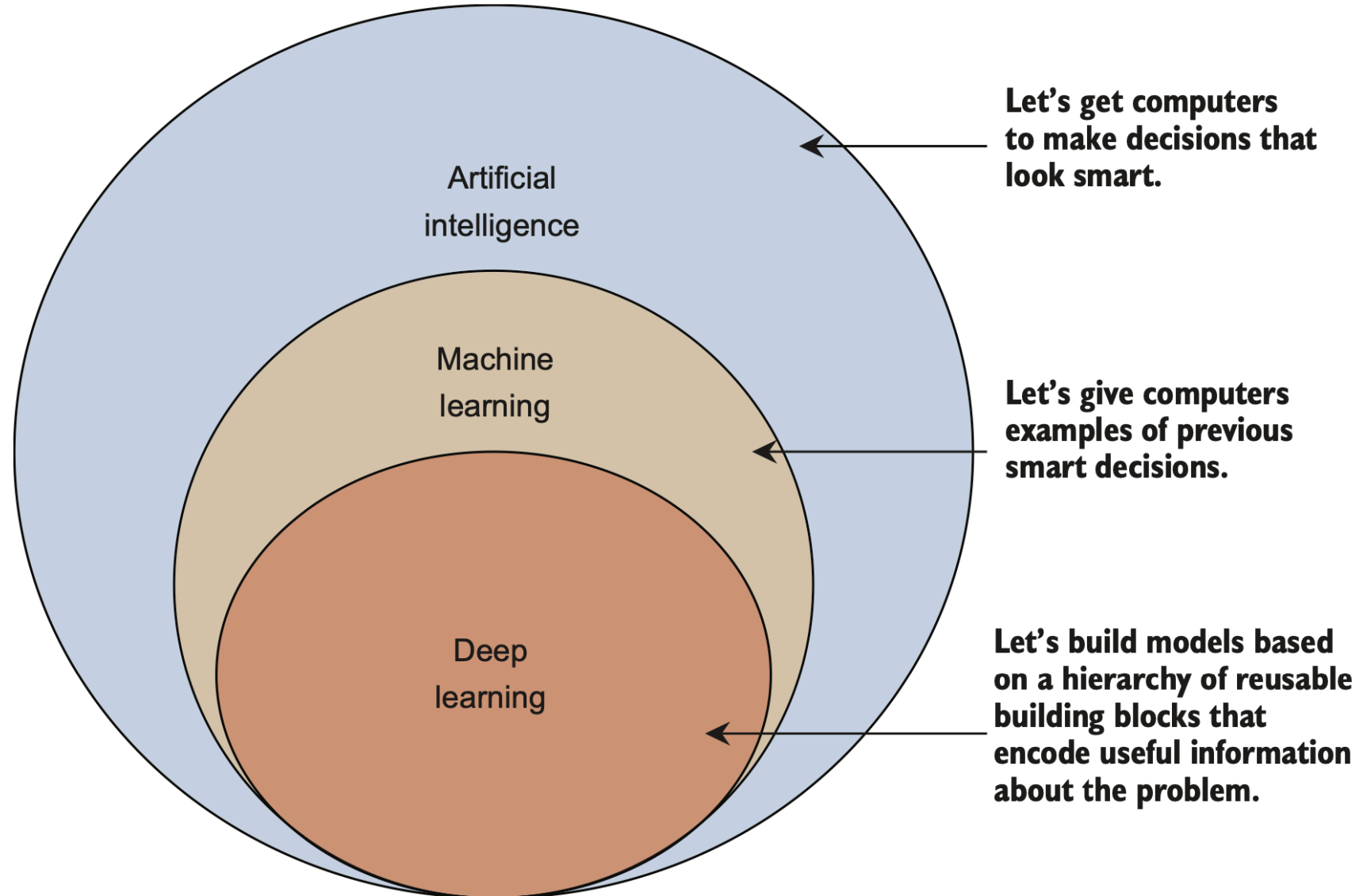
# AI Timeline





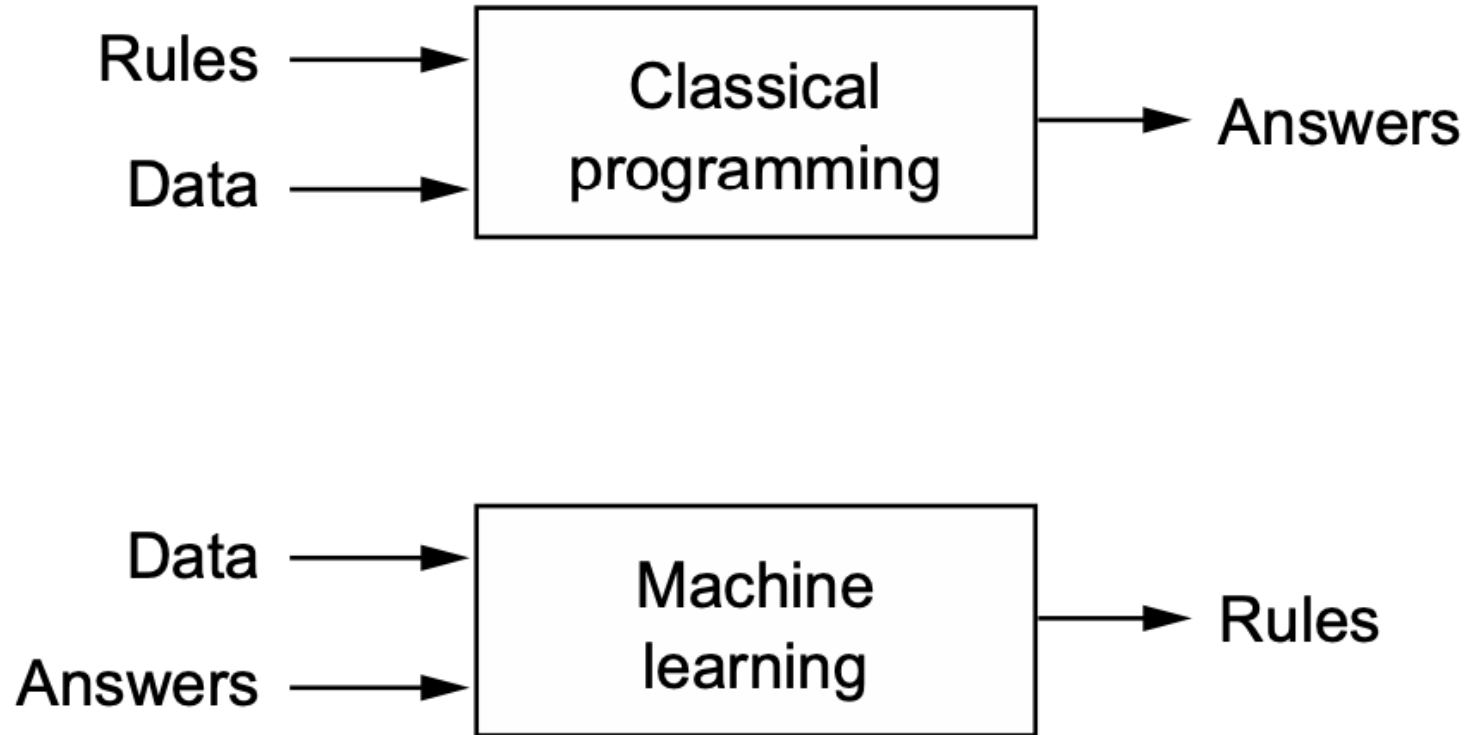


# AI, Machine Learning, Deep Learning





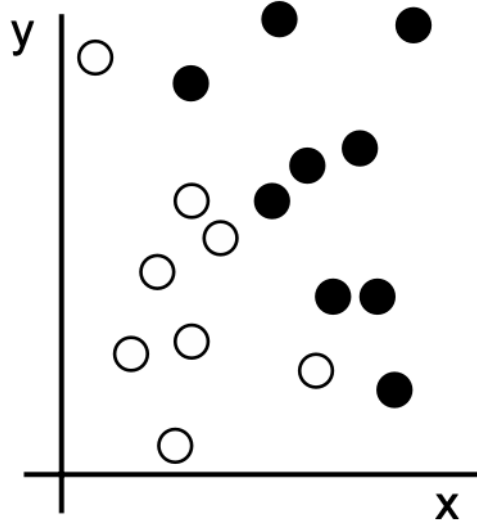
# ML: a new programming paradigm



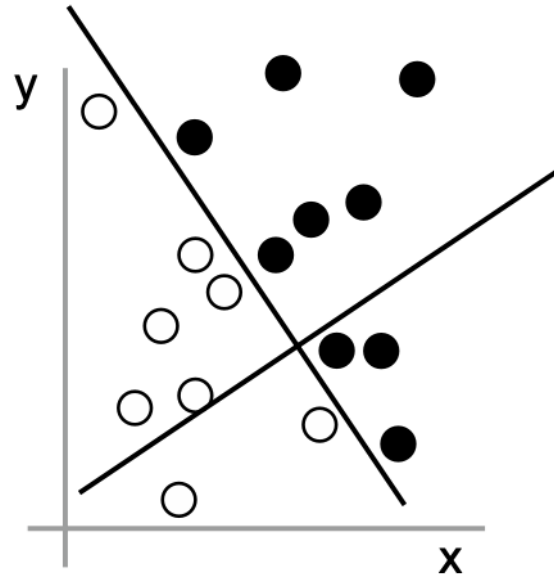


# Coordinate changing

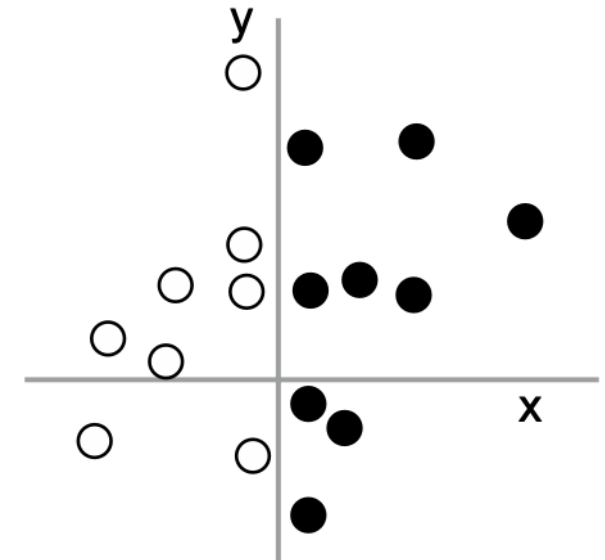
1: Raw data



2: Coordinate change



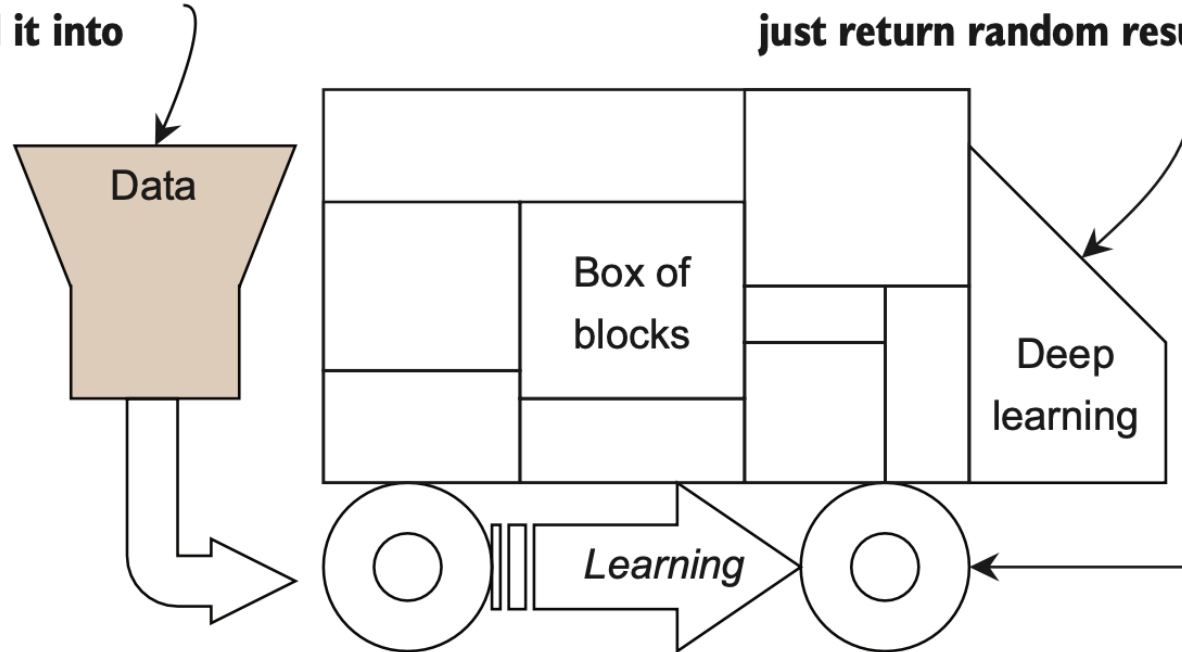
3: Better representation





# The car of Deep Learning

Data is the “fuel” that drives our model’s learning. We need a way to load it into PyTorch.

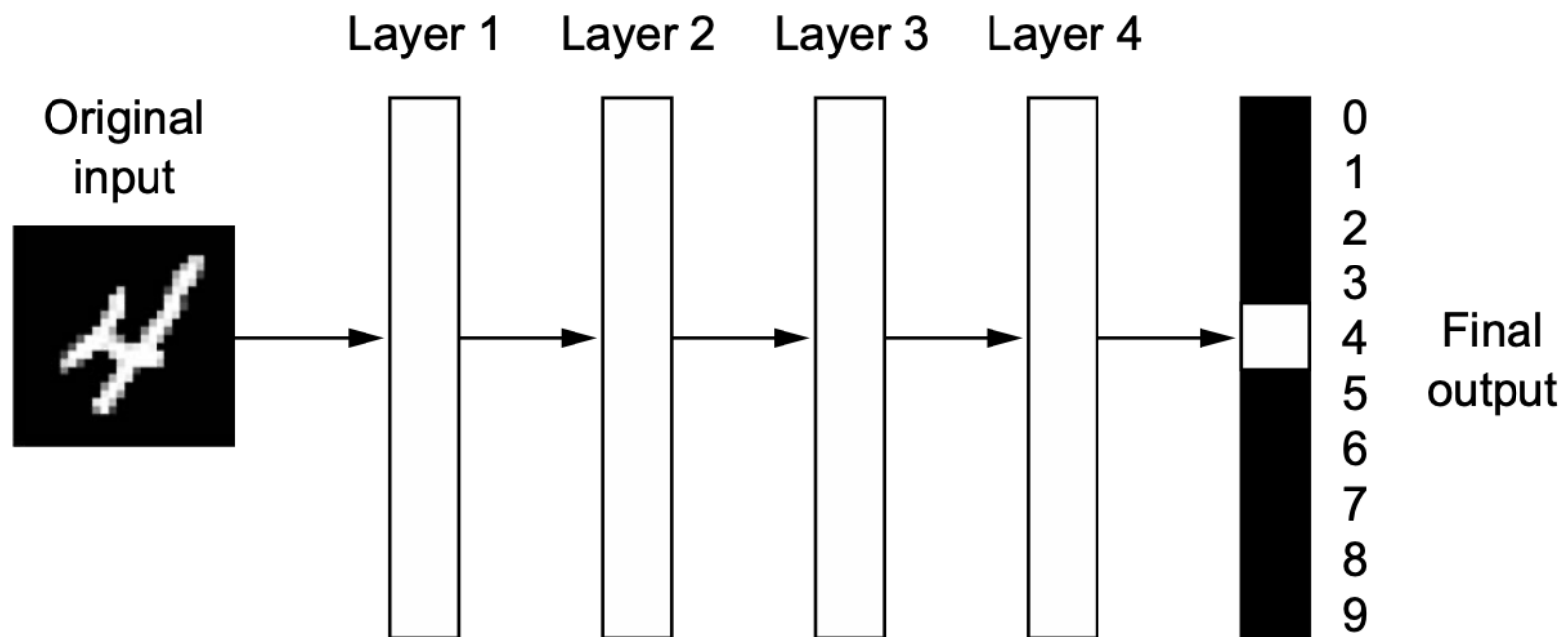


Our neural network is the car we want to make move based on our goals. It’s composed of building blocks, each containing “weights” or “parameters” that need to be set correctly; otherwise, it will just return random results.

“Learning” is the process of adjusting all the parameters of our neural network to make it perform the task we care about.

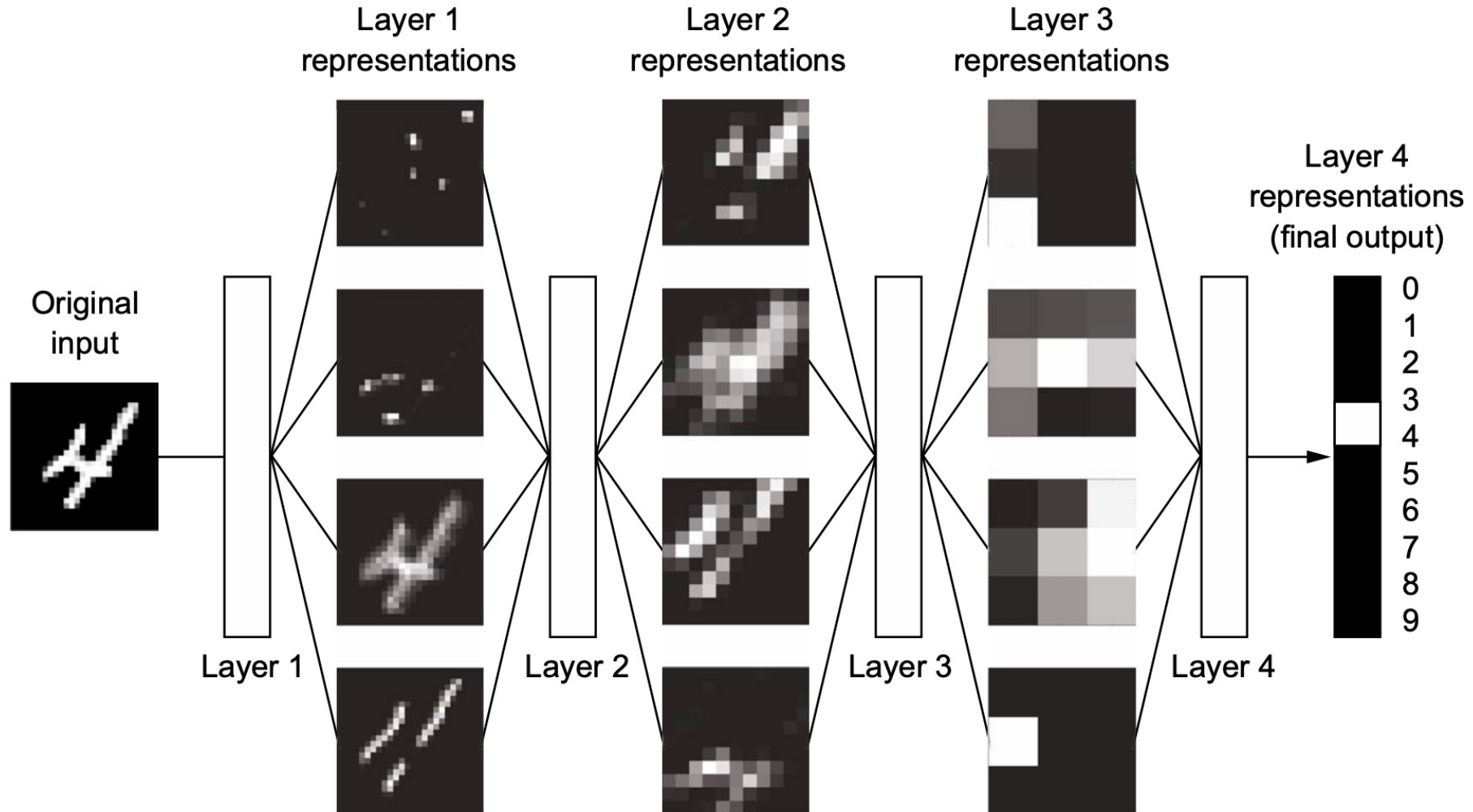


# DNN for digit classification



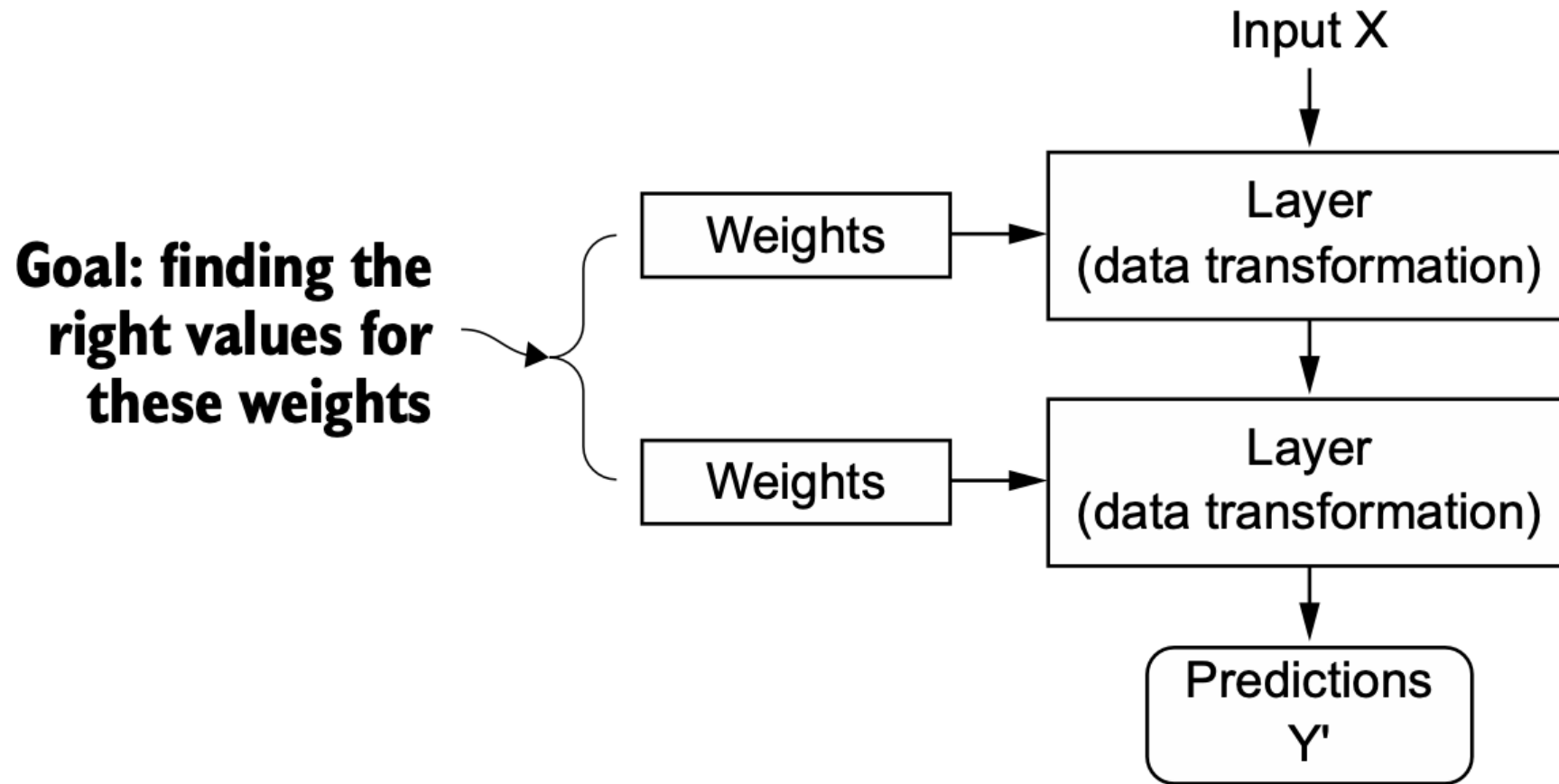


# DNN for digit classification



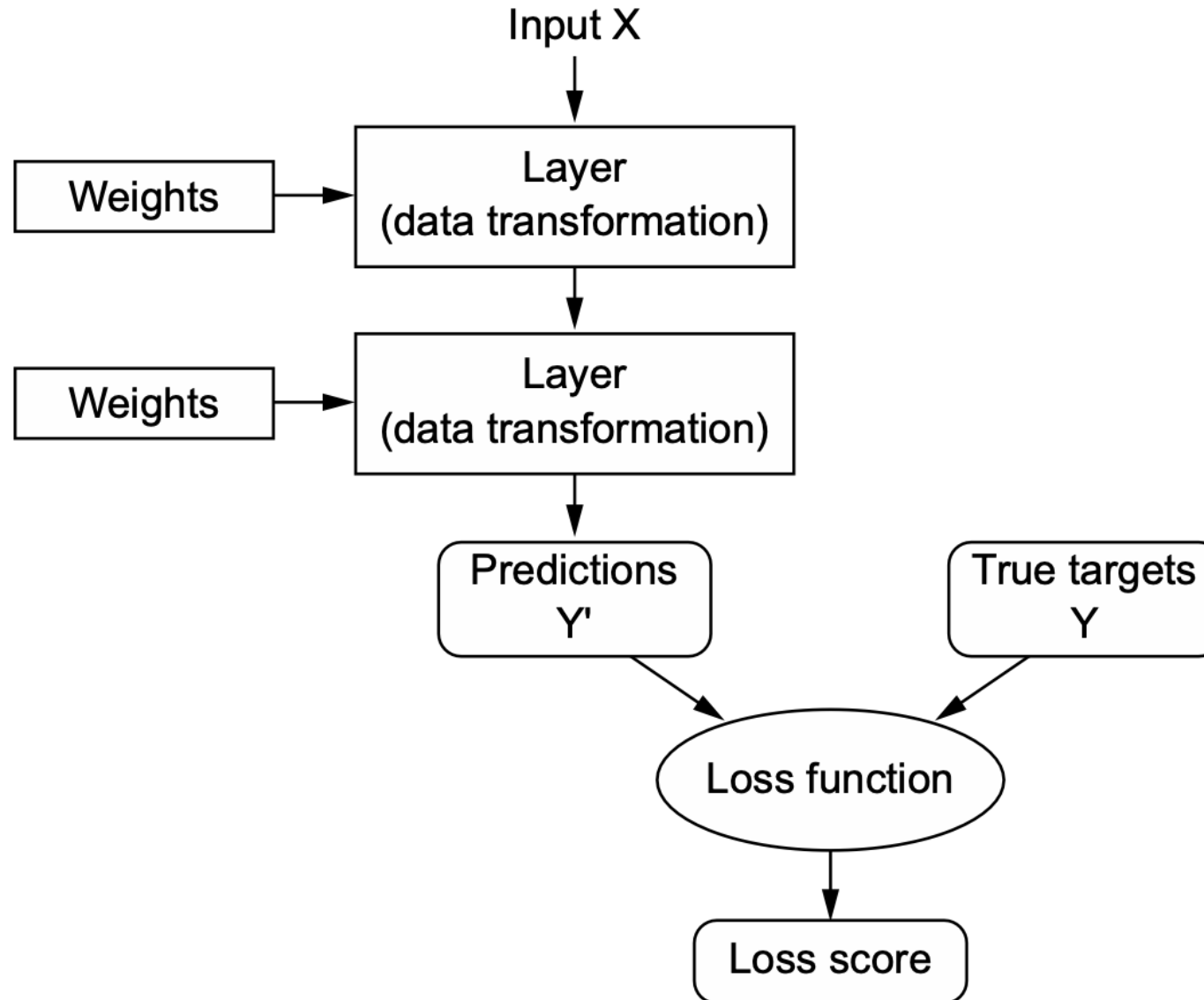


# A Neural Network





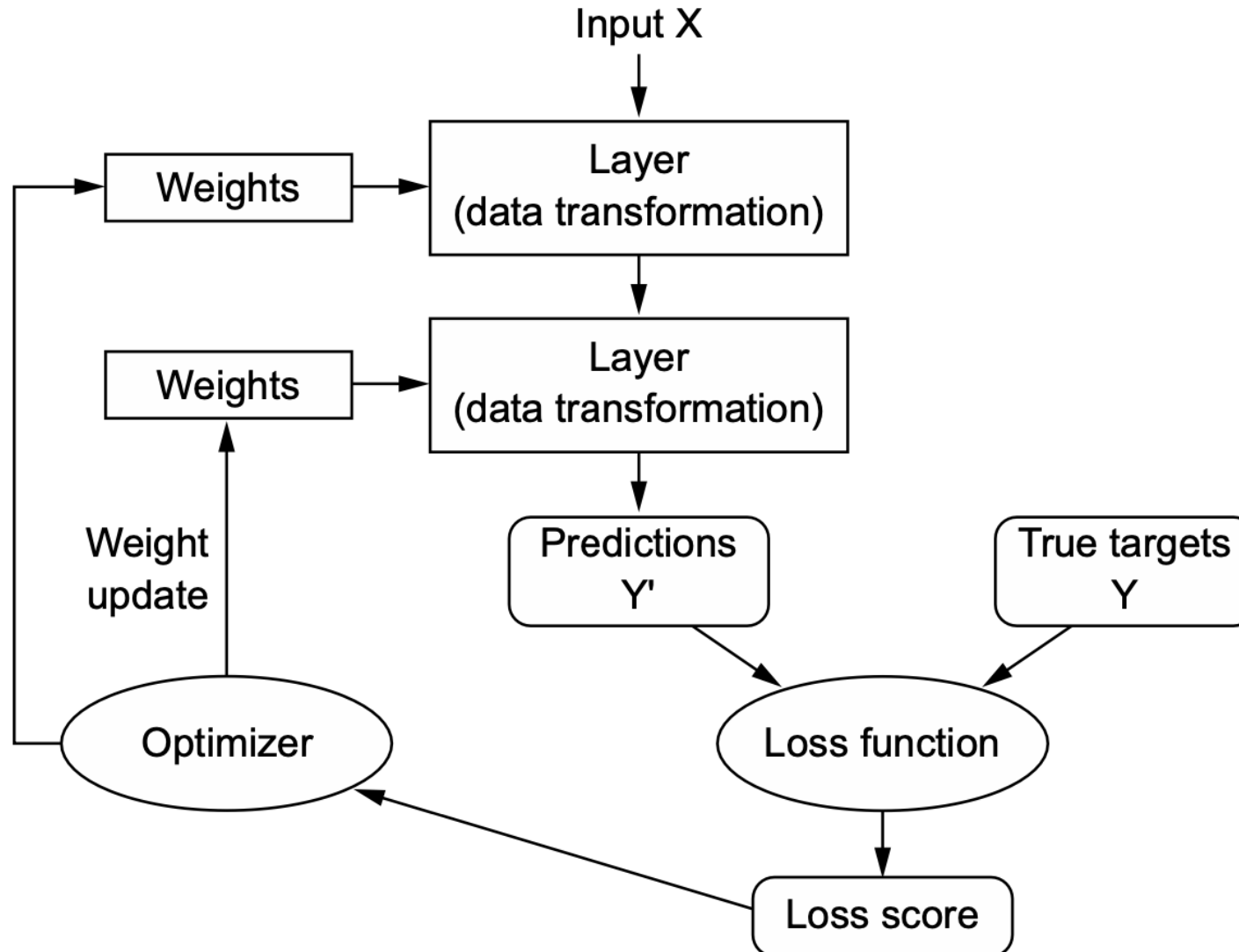
# A Neural Network





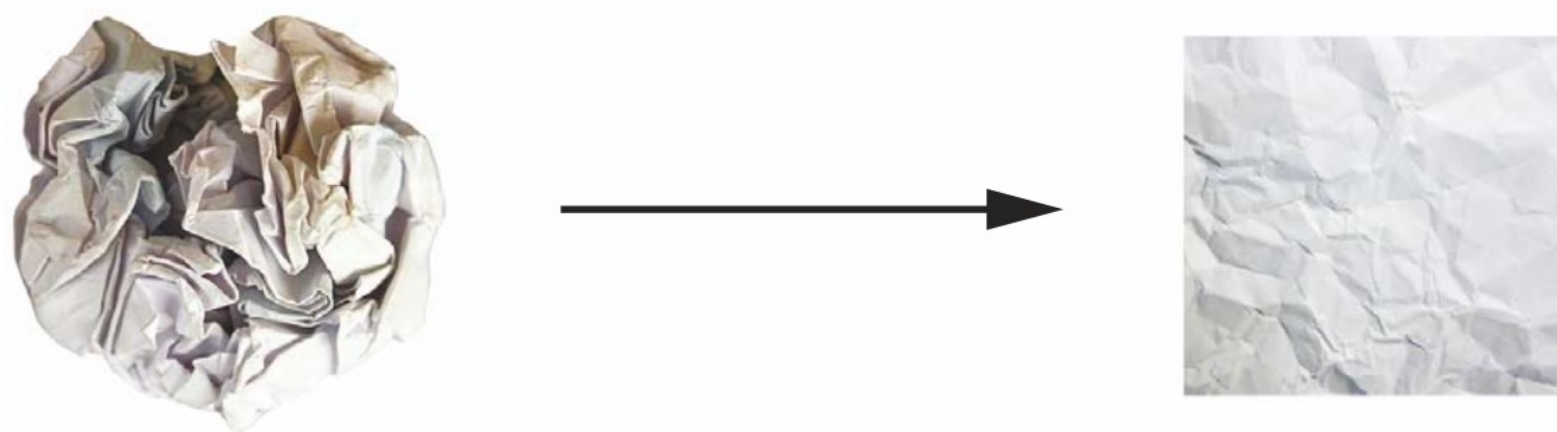


# A Neural Network





# A Deep Neural Network





# Neural Network breakthroughs

- Near-human-level image classification
- Near-human-level speech transcription
- Near-human-level handwriting transcription
- Dramatically improved machine translation
- Dramatically improved text-to-speech conversion
- Digital assistants such as Google Assistant and Amazon Alexa
- Near-human-level autonomous driving
- Improved ad targeting, as used by Google, Baidu, or Bing
- Improved search results on the web
- Ability to answer natural language questions
- Superhuman Go playing



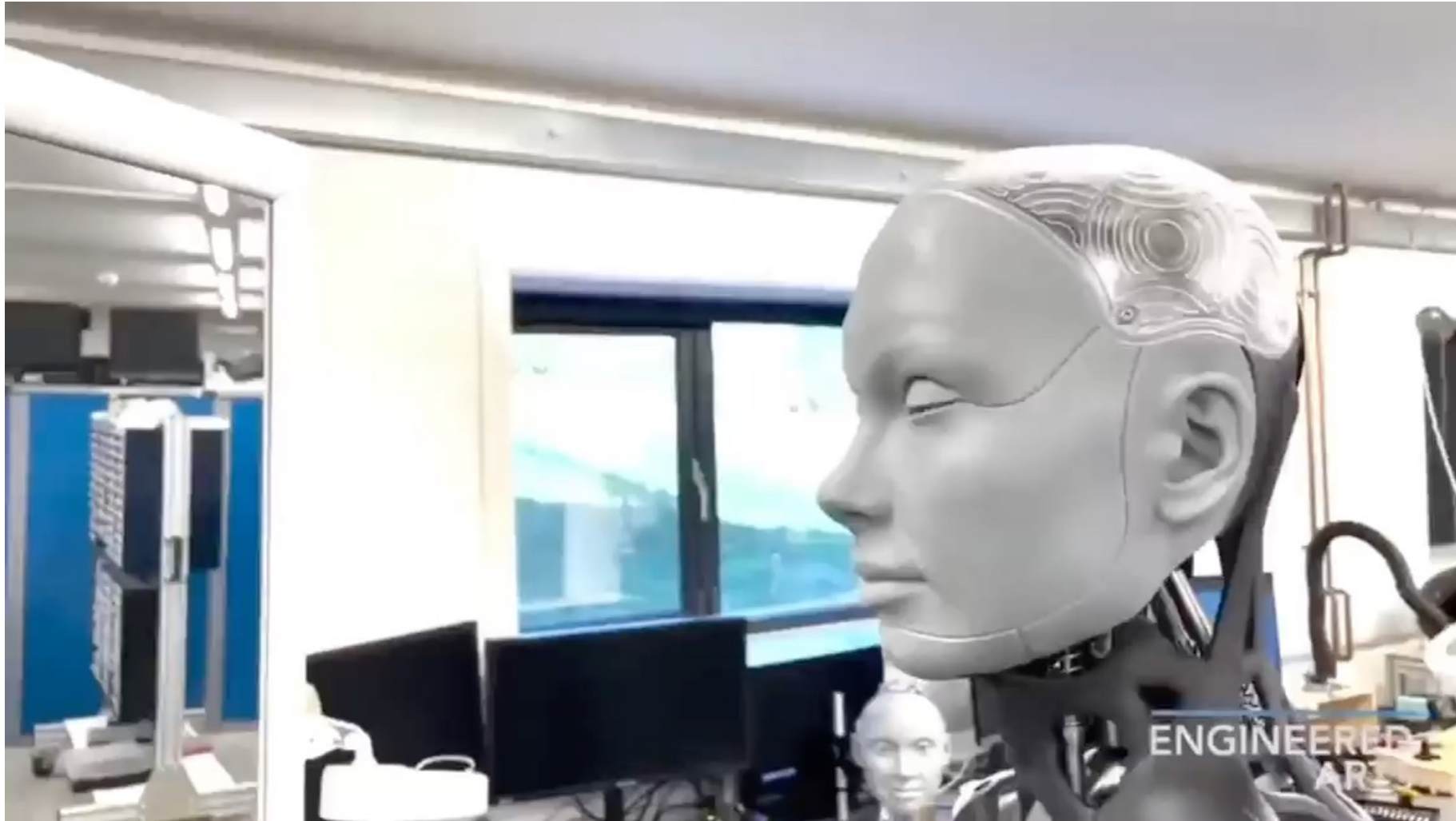
# ChatGPT



*Instructor: Khayyam Salehi, Ph.D.*



# Ameca Robot



*Instructor: Khayyam Salehi, Ph.D.*



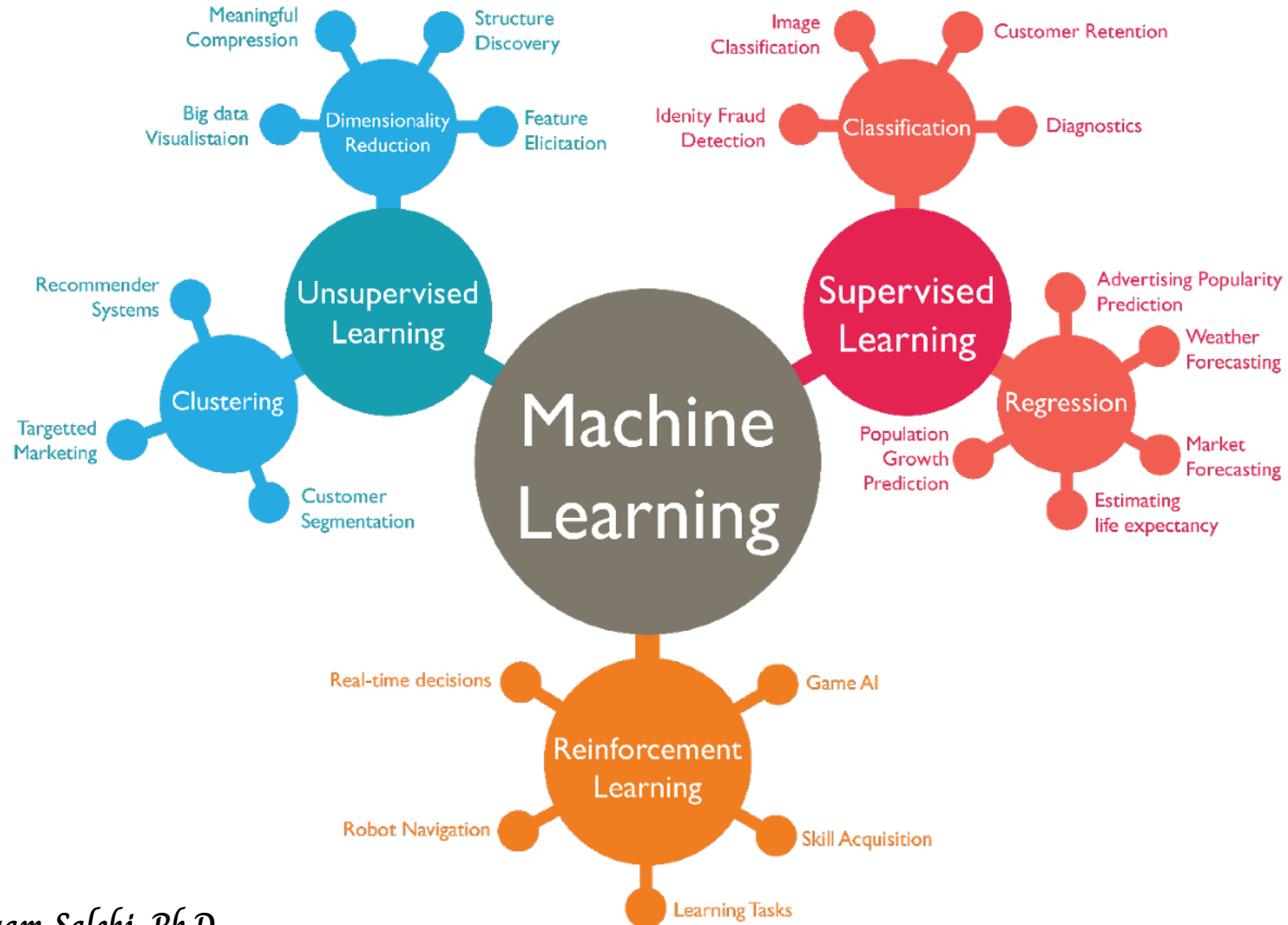
Wait, Wait, Please Wait!



*Instructor: Khayyam Salehi, Ph.D.*

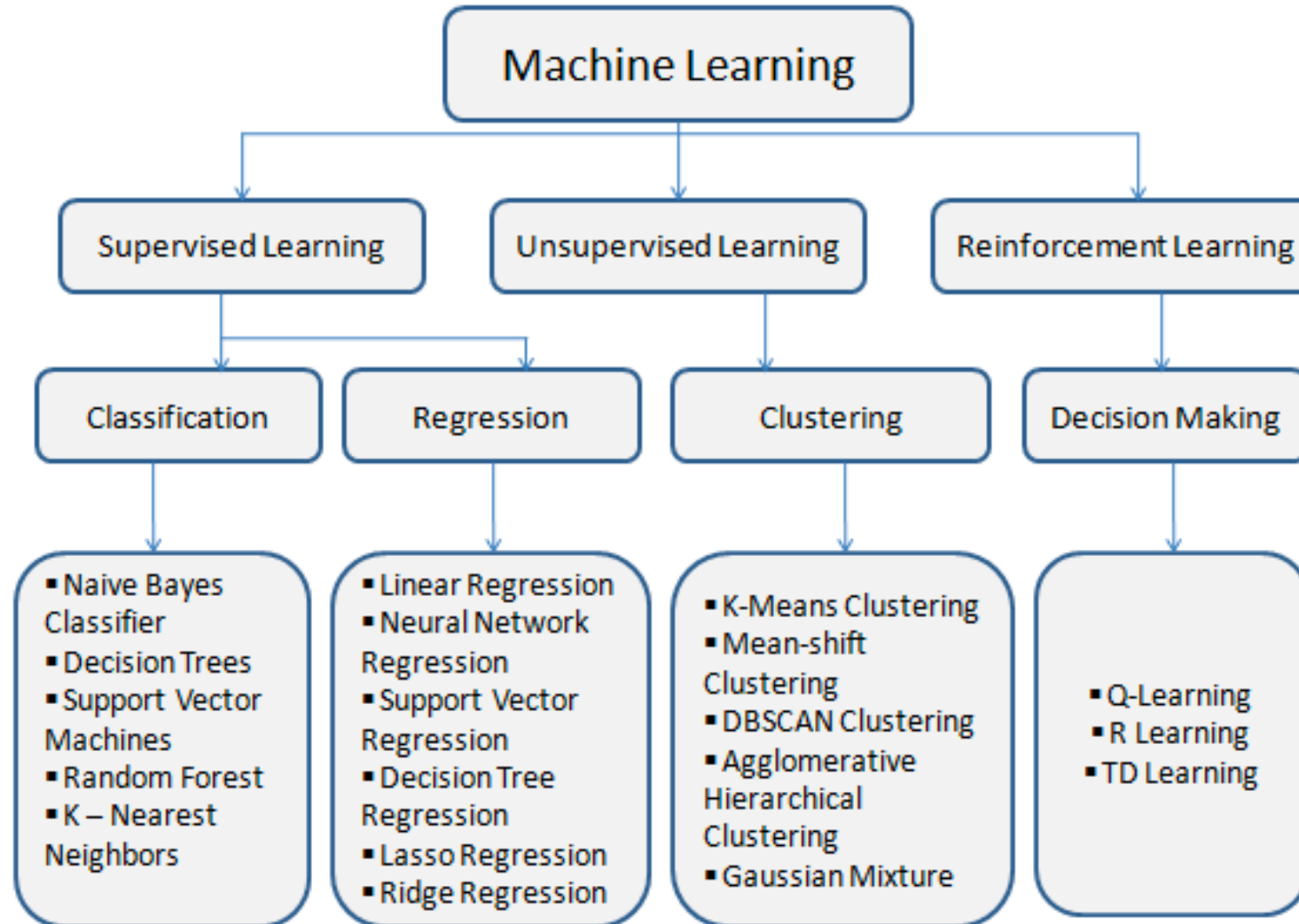


# Machine Learning: review





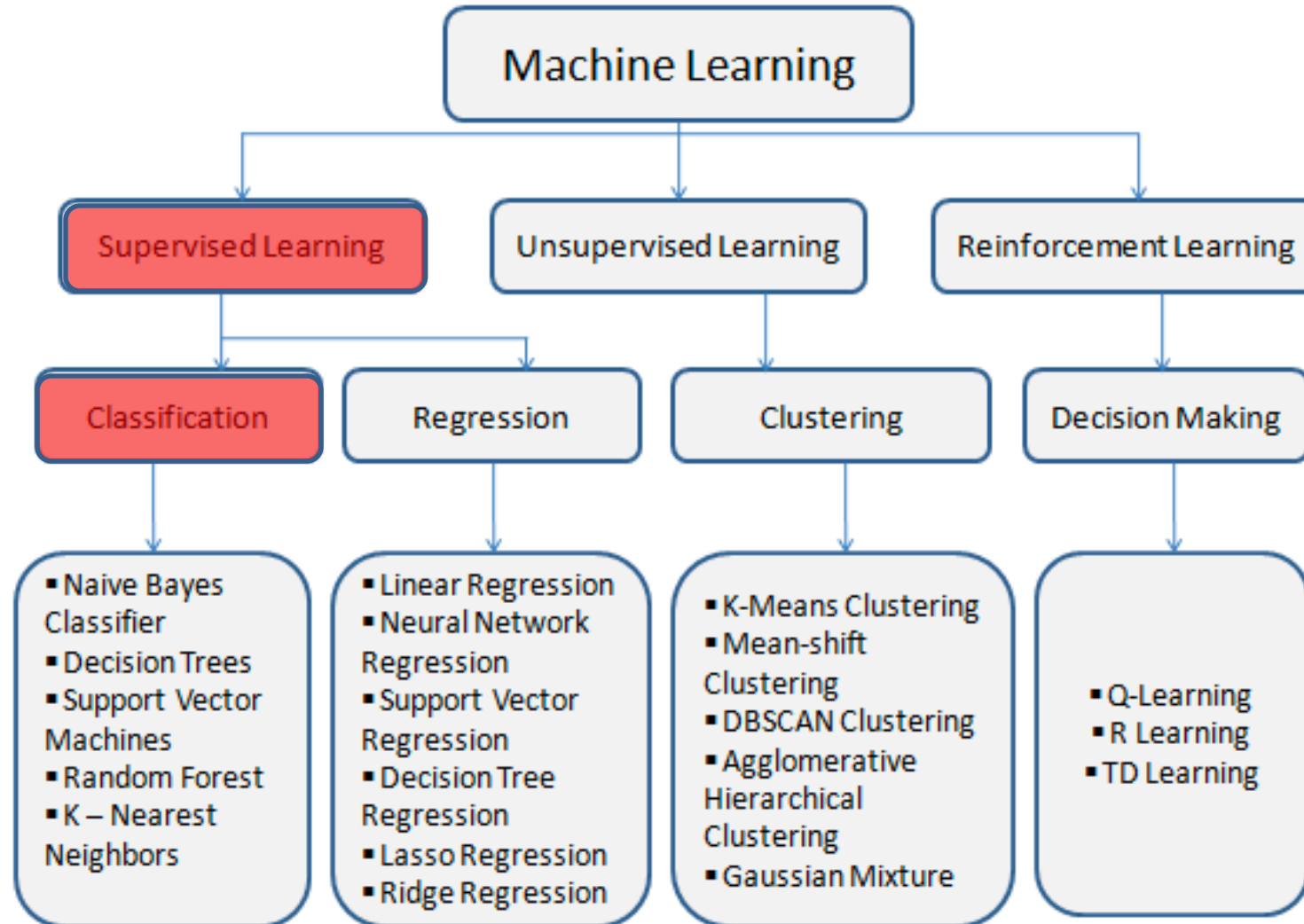
# Machine Learning Algorithms: review







# Classification





# Naive Bayes

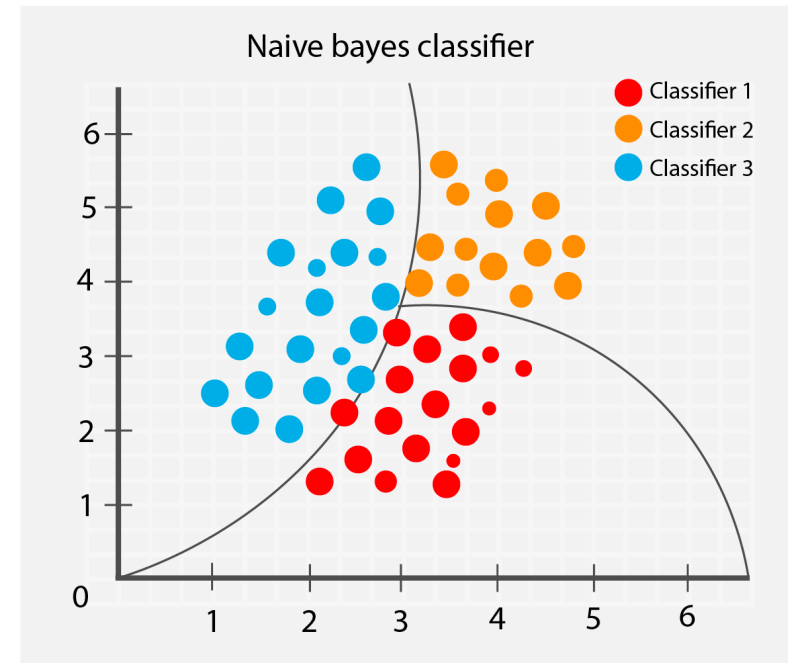


In machine learning, naive Bayes classifiers are a family of simple "probabilistic classifiers" based on applying Bayes' theorem with strong (naive) independence assumptions between the features.

$$P(A|B) = \frac{P(B|A) P(A)}{P(B)}$$

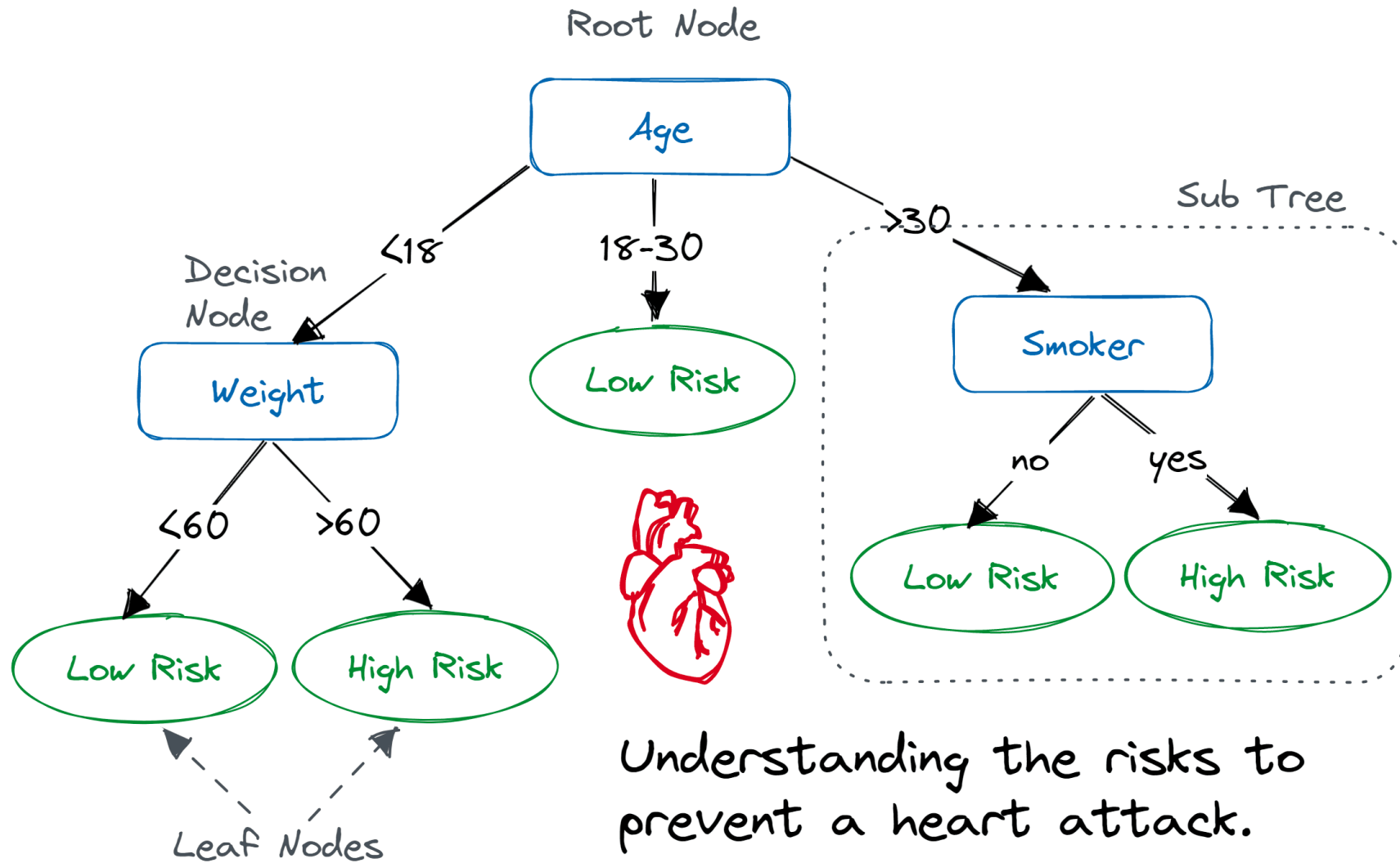
using Bayesian probability terminology, the above equation can be written as

$$\text{Posterior} = \frac{\text{prior} \times \text{likelihood}}{\text{evidence}}$$





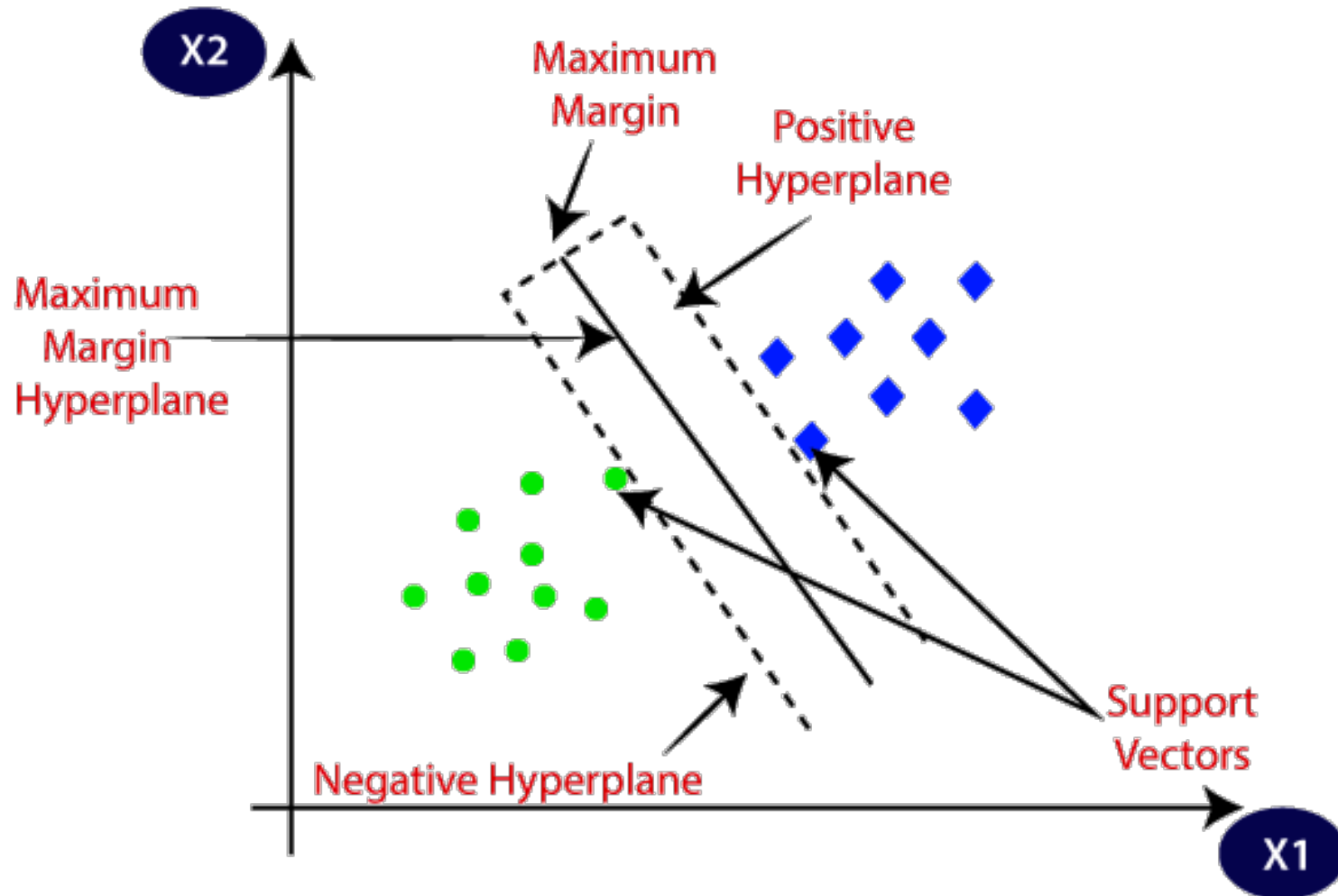
# Decision Tree



Understanding the risks to prevent a heart attack.

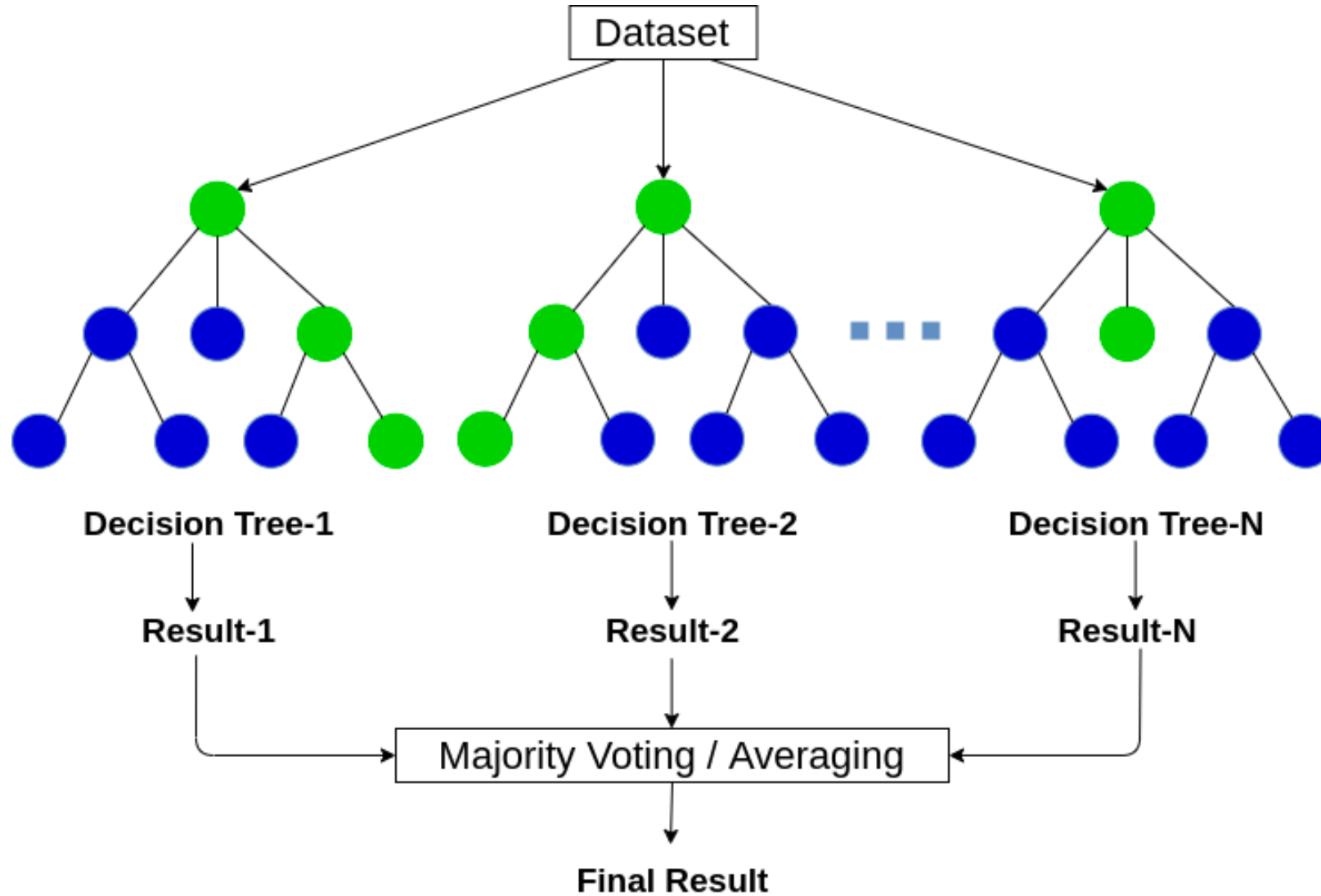


# Support Vector Machine



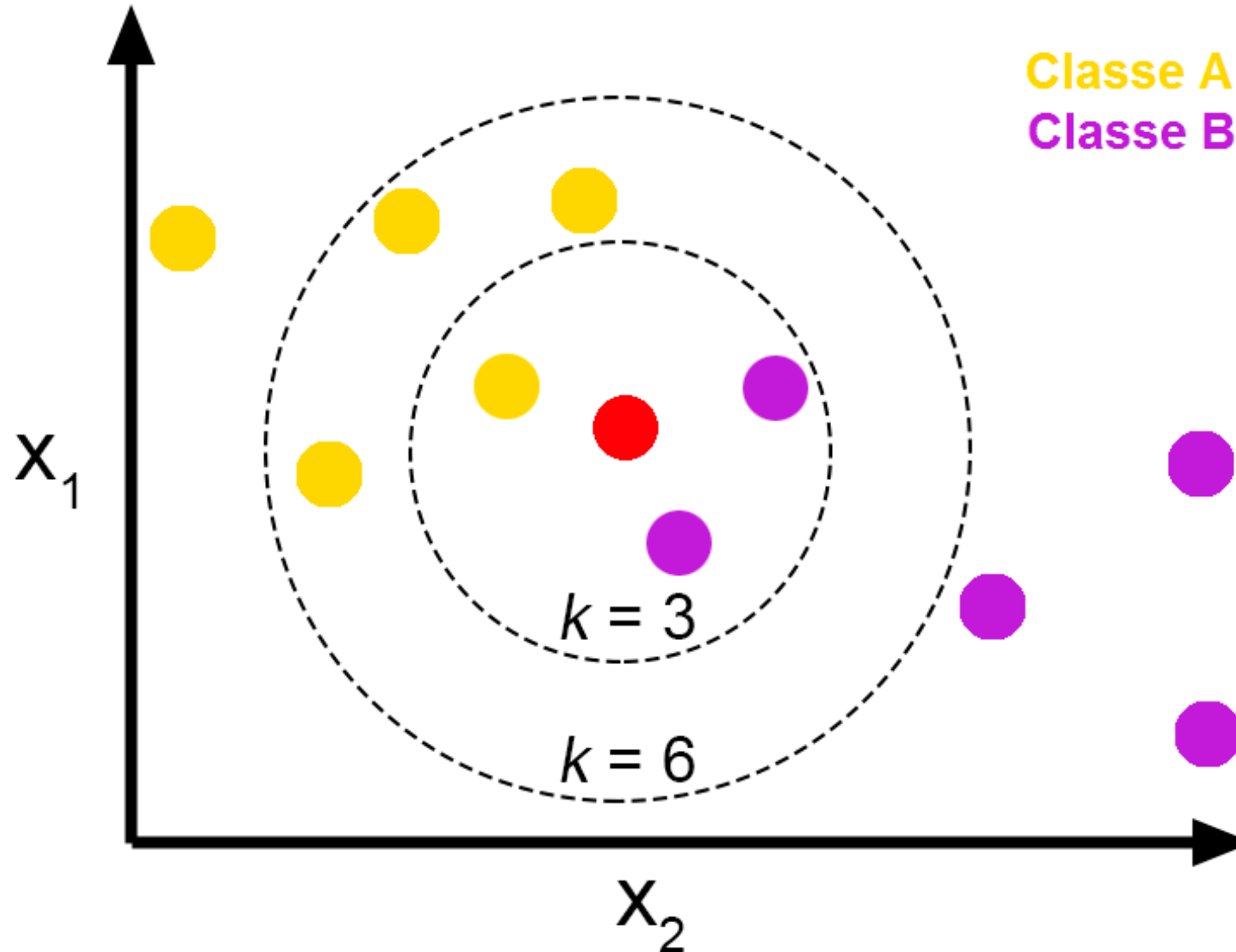


# Random Forest



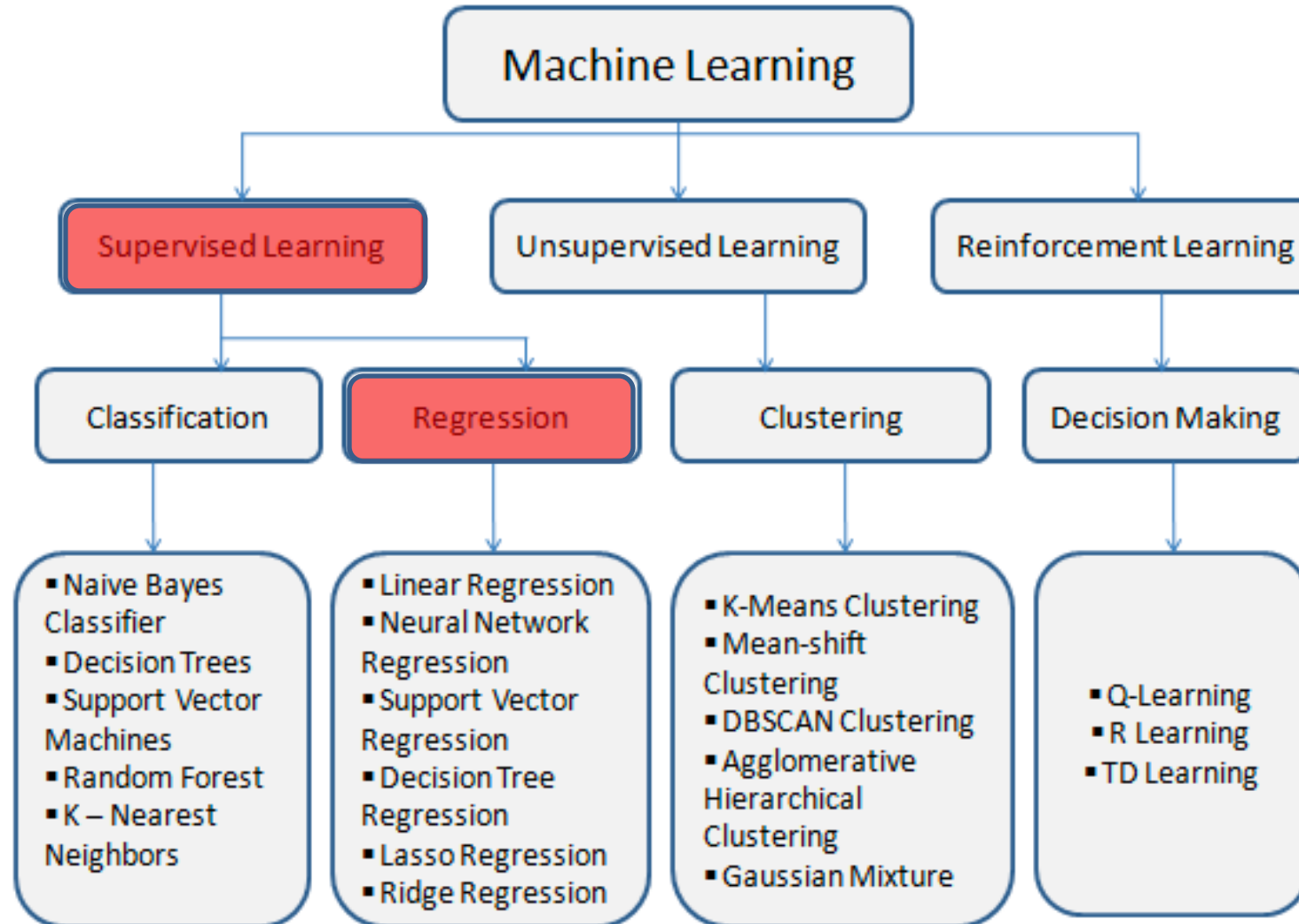


# K-Nearest Neighbors



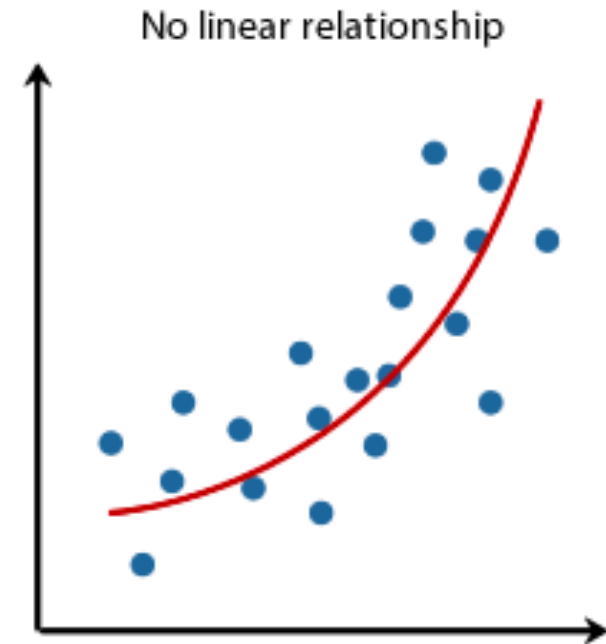
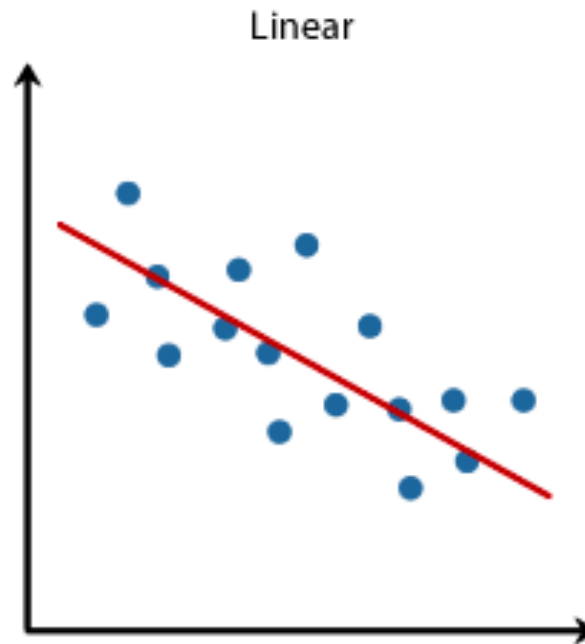
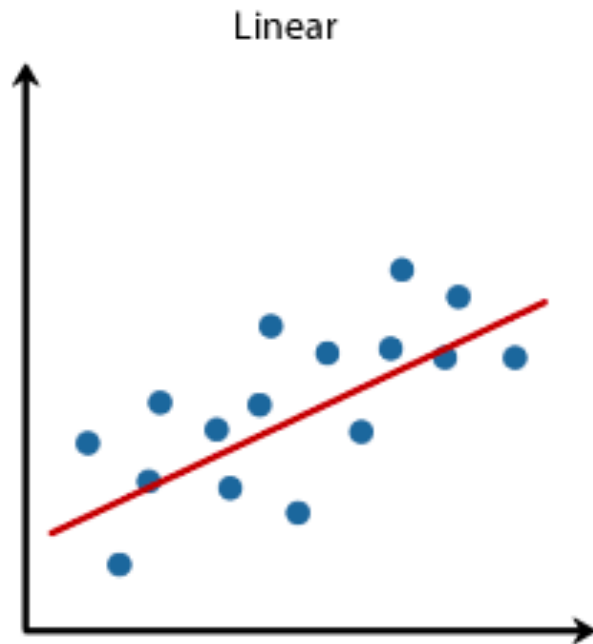


# Regression





# Regression

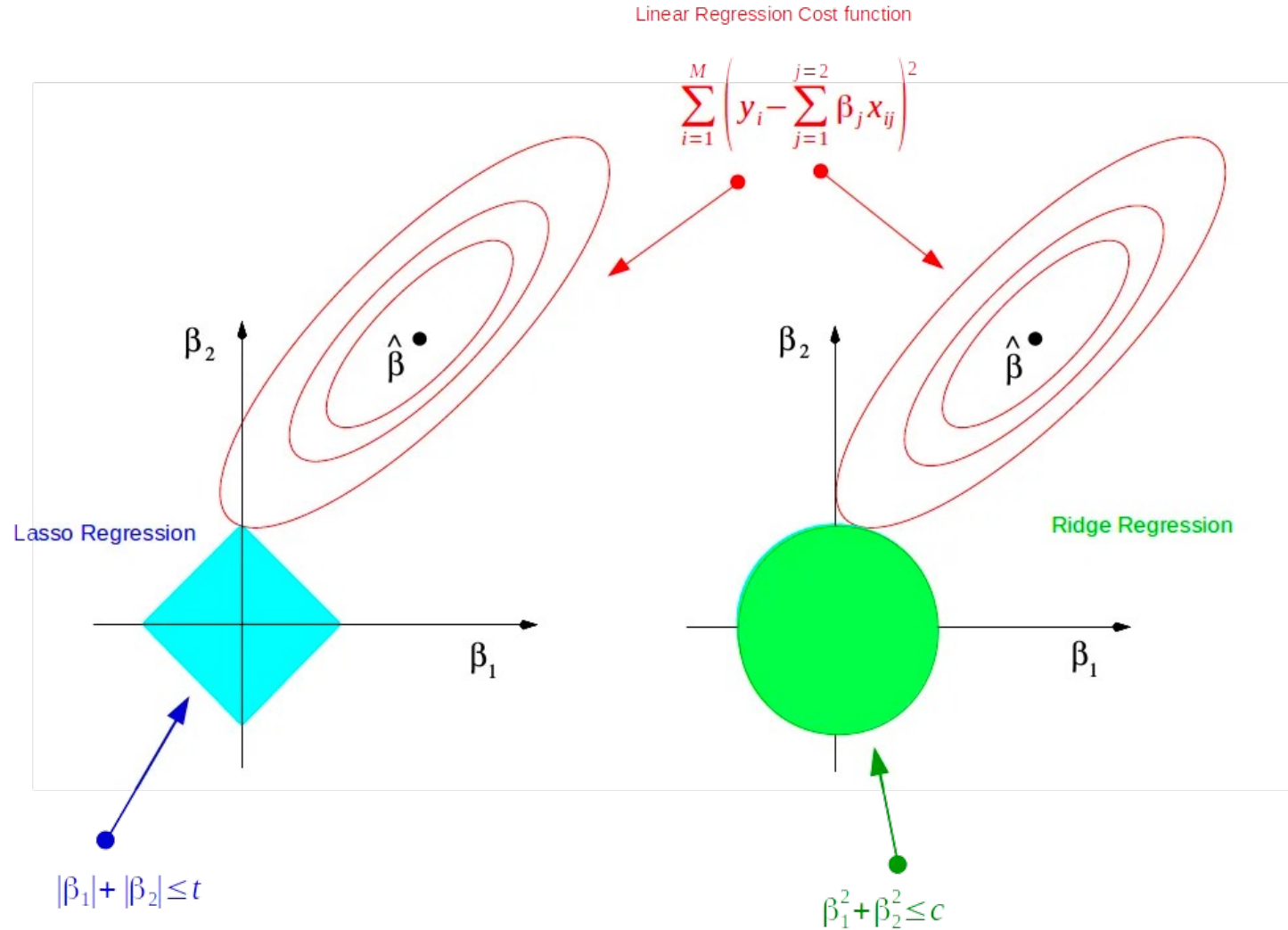






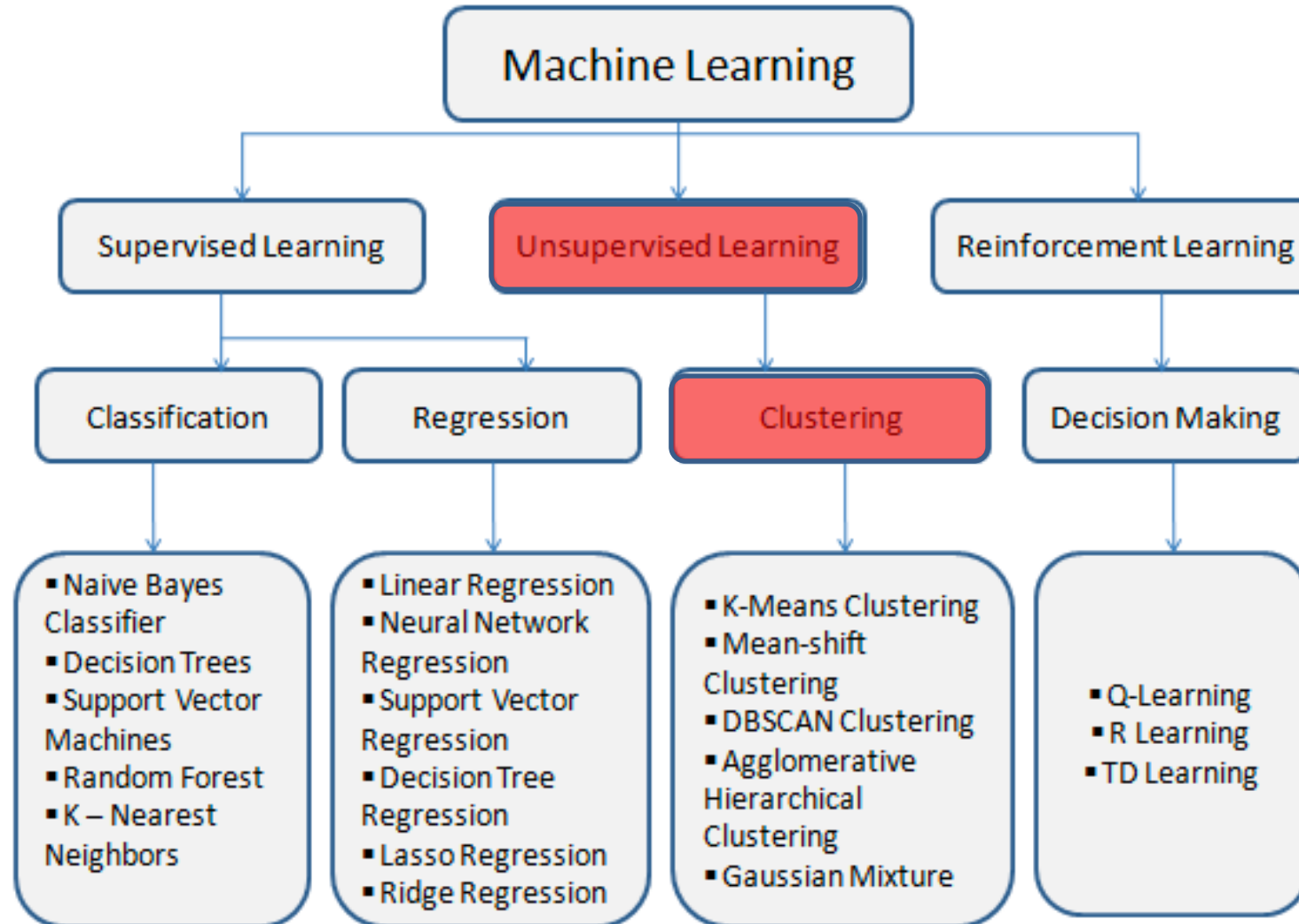
# Lasso v.s. Ridge Regression

## Dimension Reduction of Feature Space with LASSO

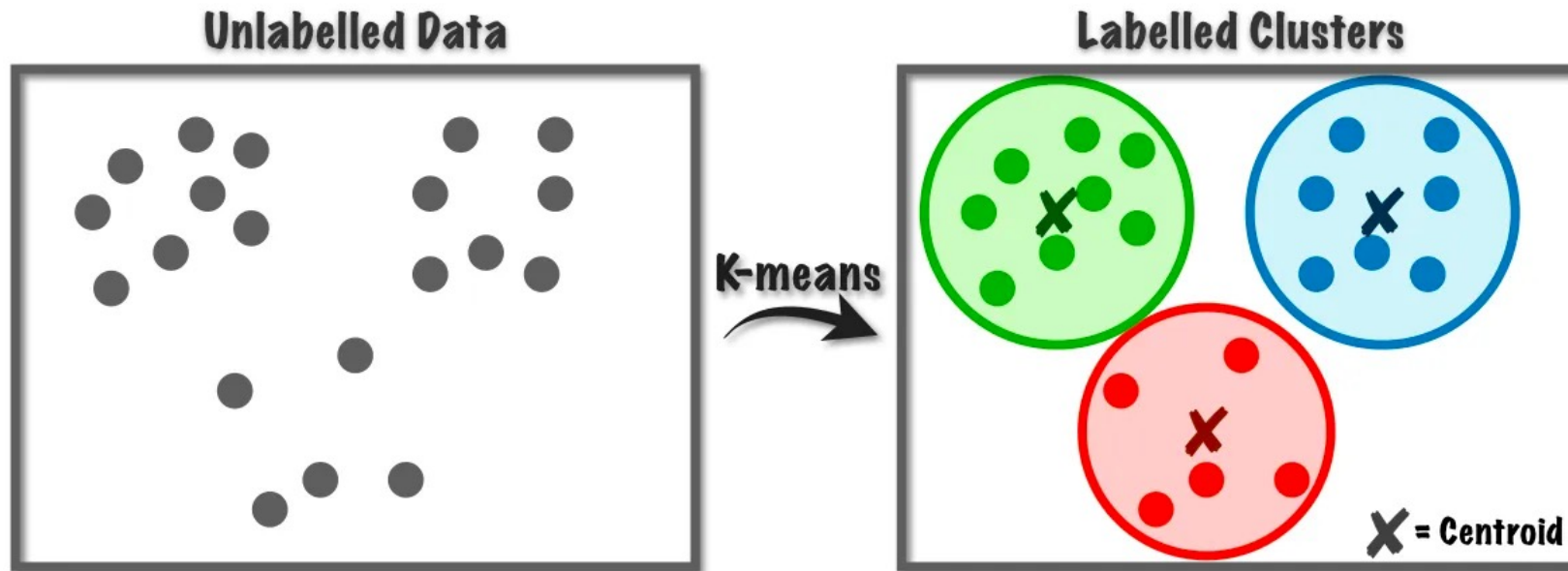




# Clustering



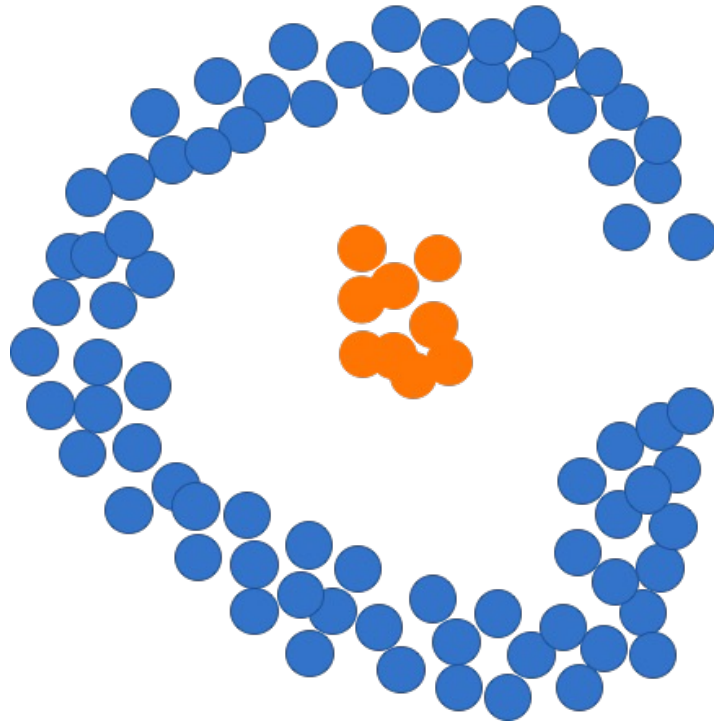
# K-Means Clustering





# DBSCAN Clustering

DBSCAN

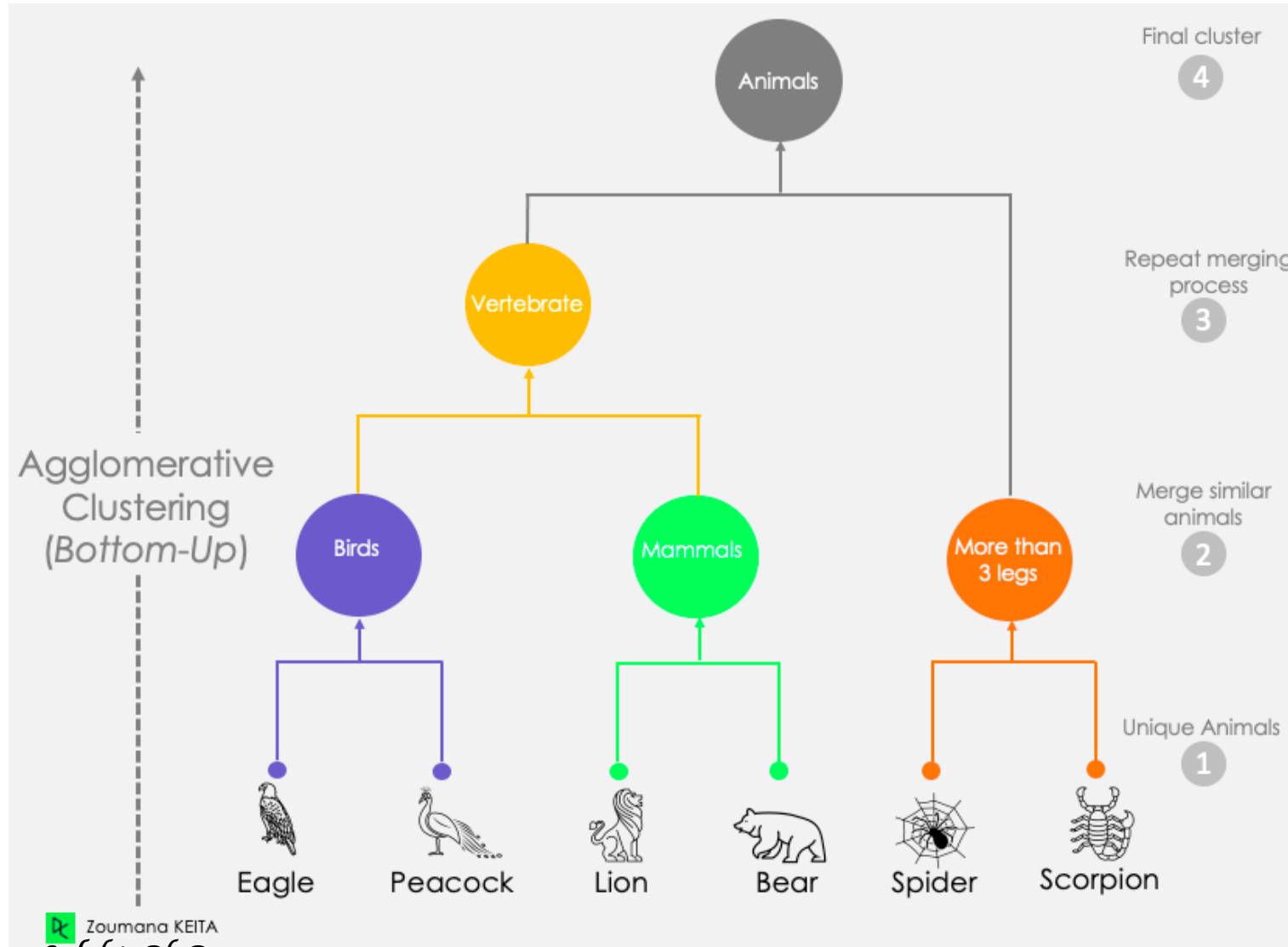


K-Means





# Hierarchical Clustering



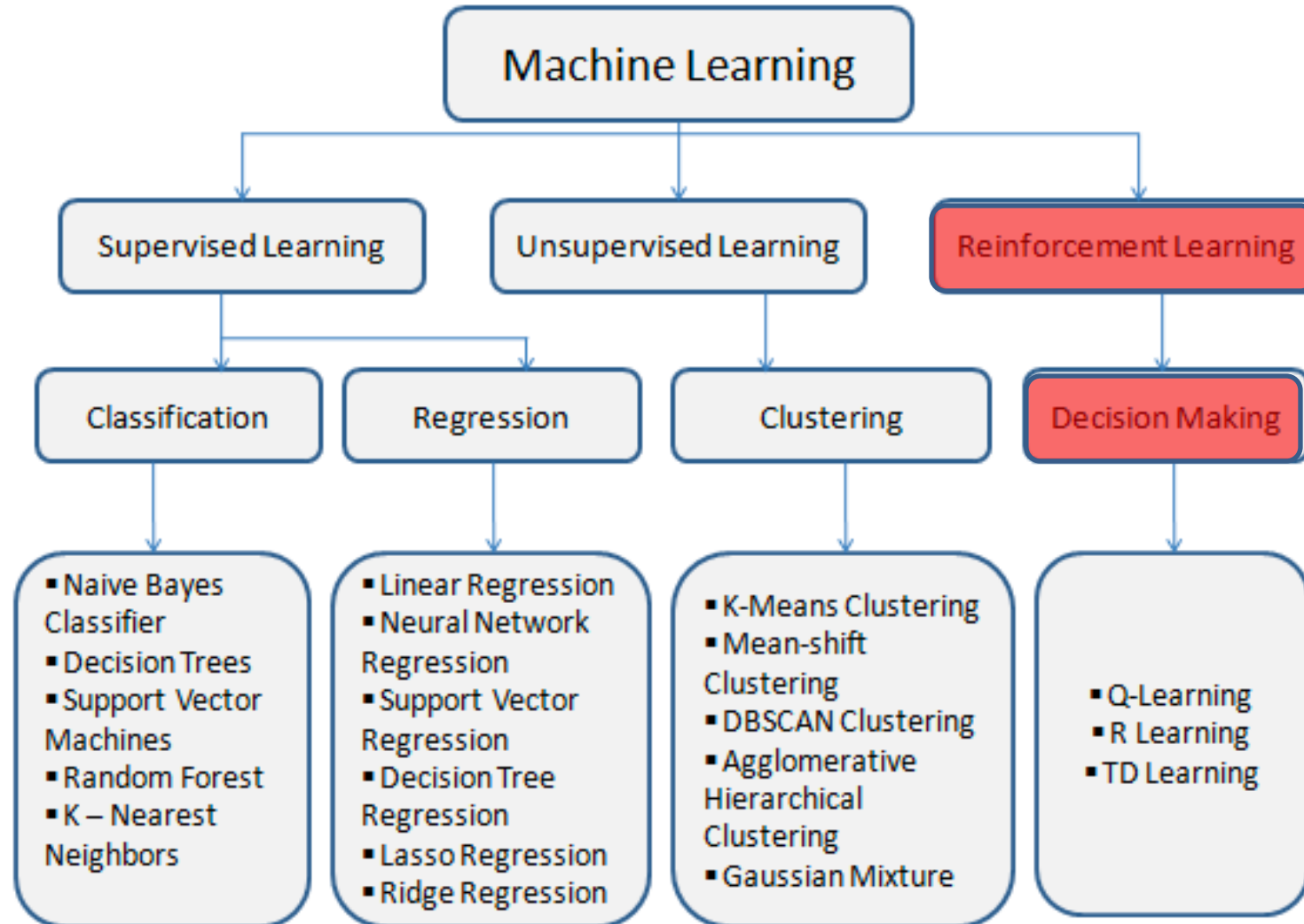
Zoumana KEITA

Instructor: Khayyam Salehi, Ph.D.

<https://www.datacamp.com/tutorial/introduction-hierarchical-clustering-python>

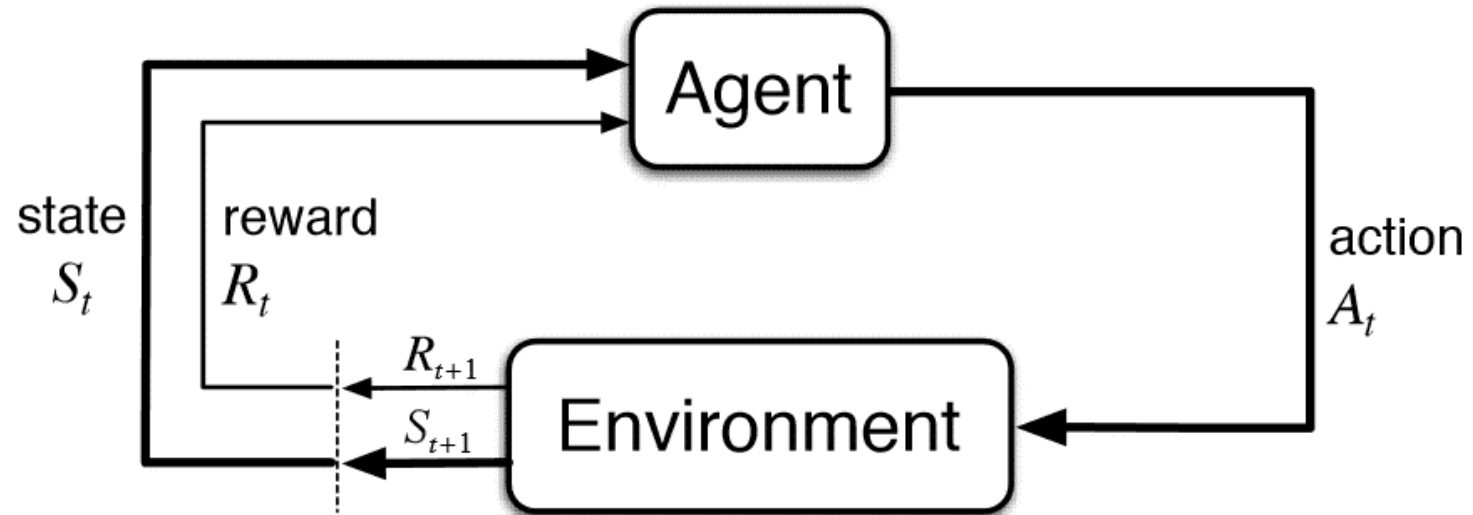


# Reinforcement Learning





# Q-Learning





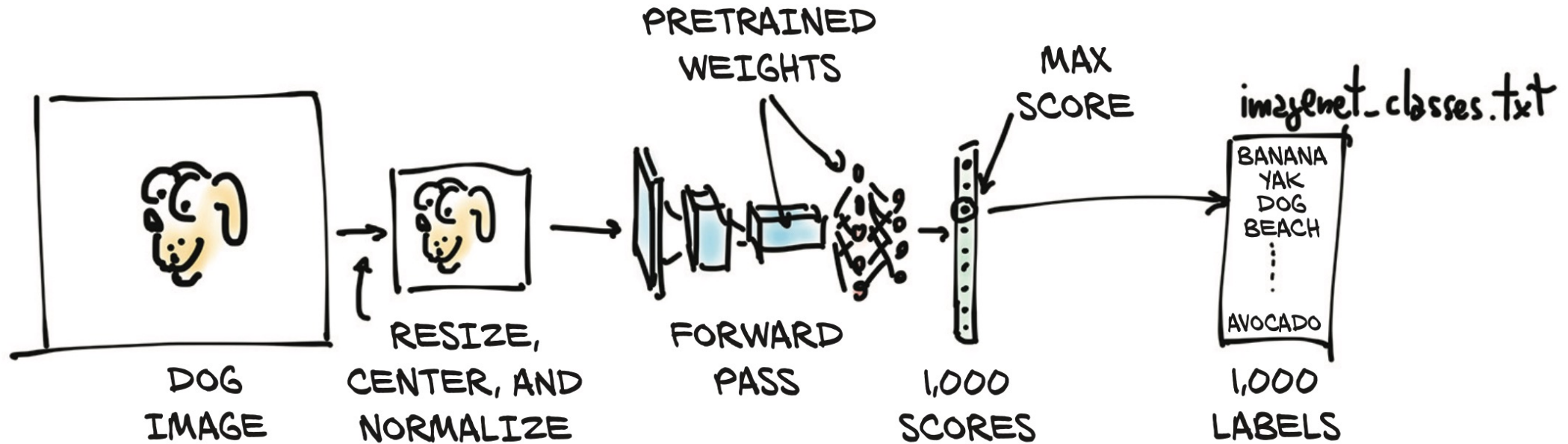
# Google DeepMind's Deep Q-Learning

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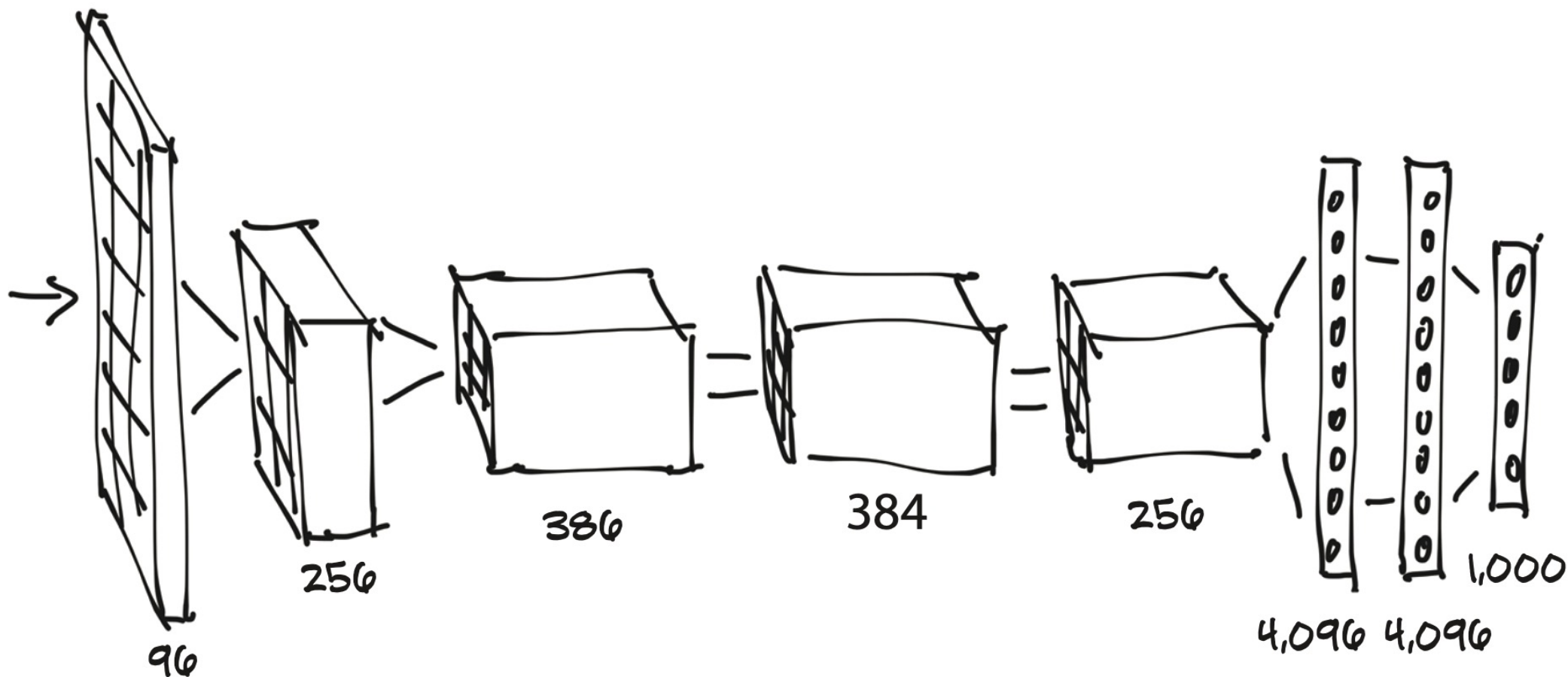




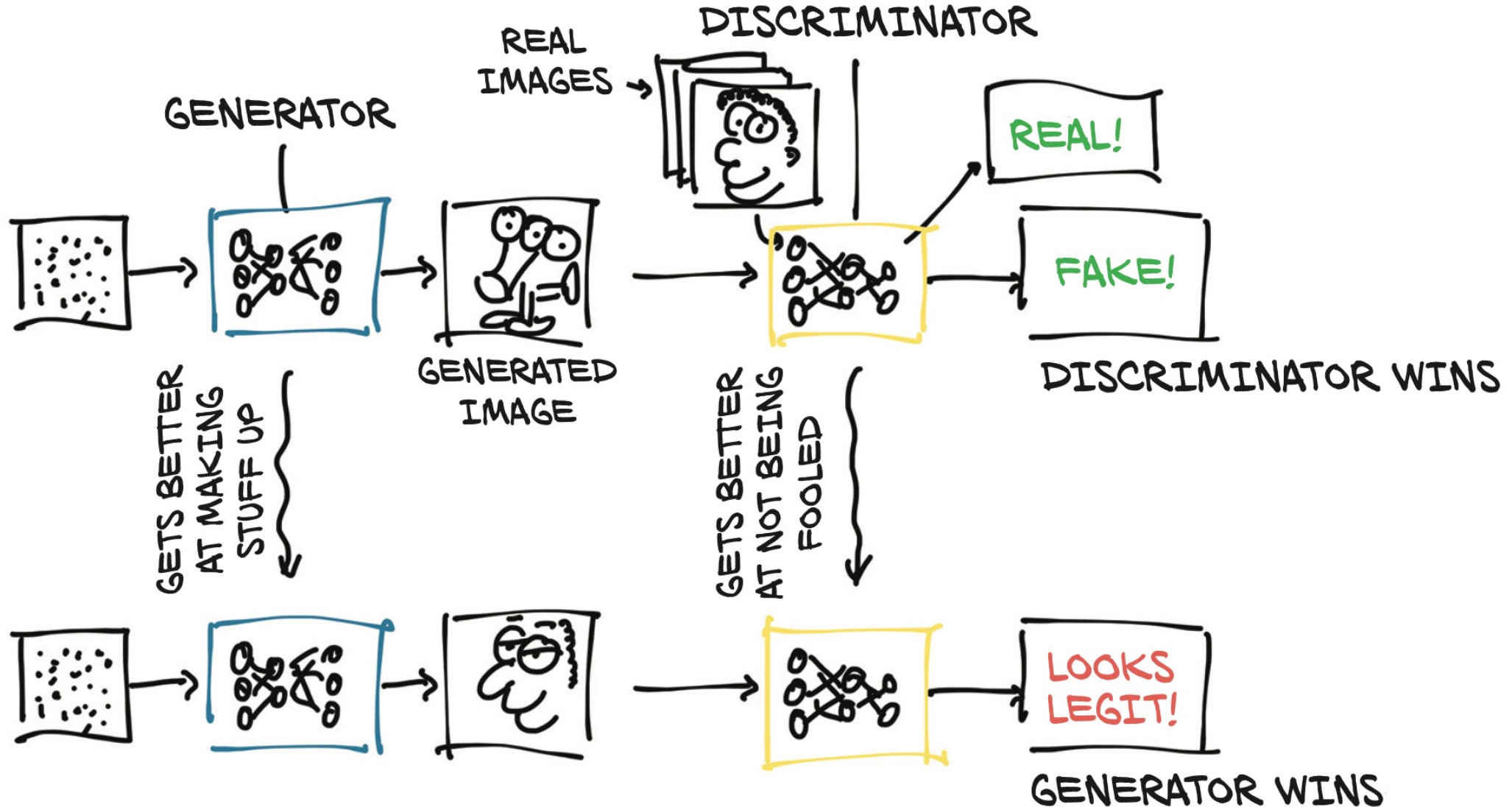
# The inference process



# AlexNet: winner of ILSVRC 2012



# The GAN game





# Why Deep Learning? Why now?

- Hardware
  - CUDA by NVIDIA: 2007 (<https://developer.nvidia.com/about-cuda>)
  - TPU by Google: 2016
- Datasets and benchmarks
  - Internet!
- Algorithmic Advances
  - Better activation functions
  - Better weight-initialization schemes
  - Better optimization schemes

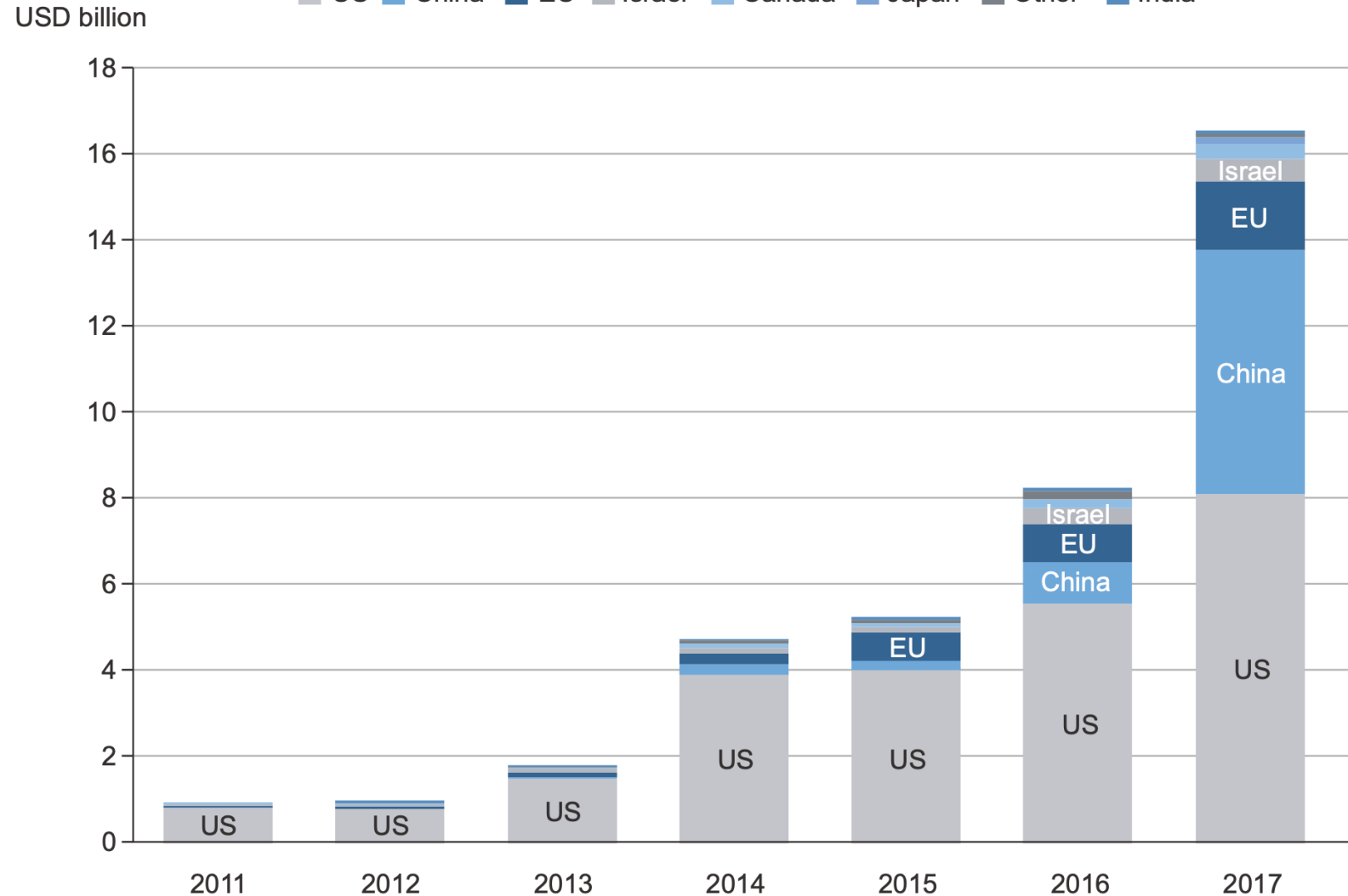


# A new wave of investment

Total estimated investments in AI start-ups, 2011–17 and first semester 2018

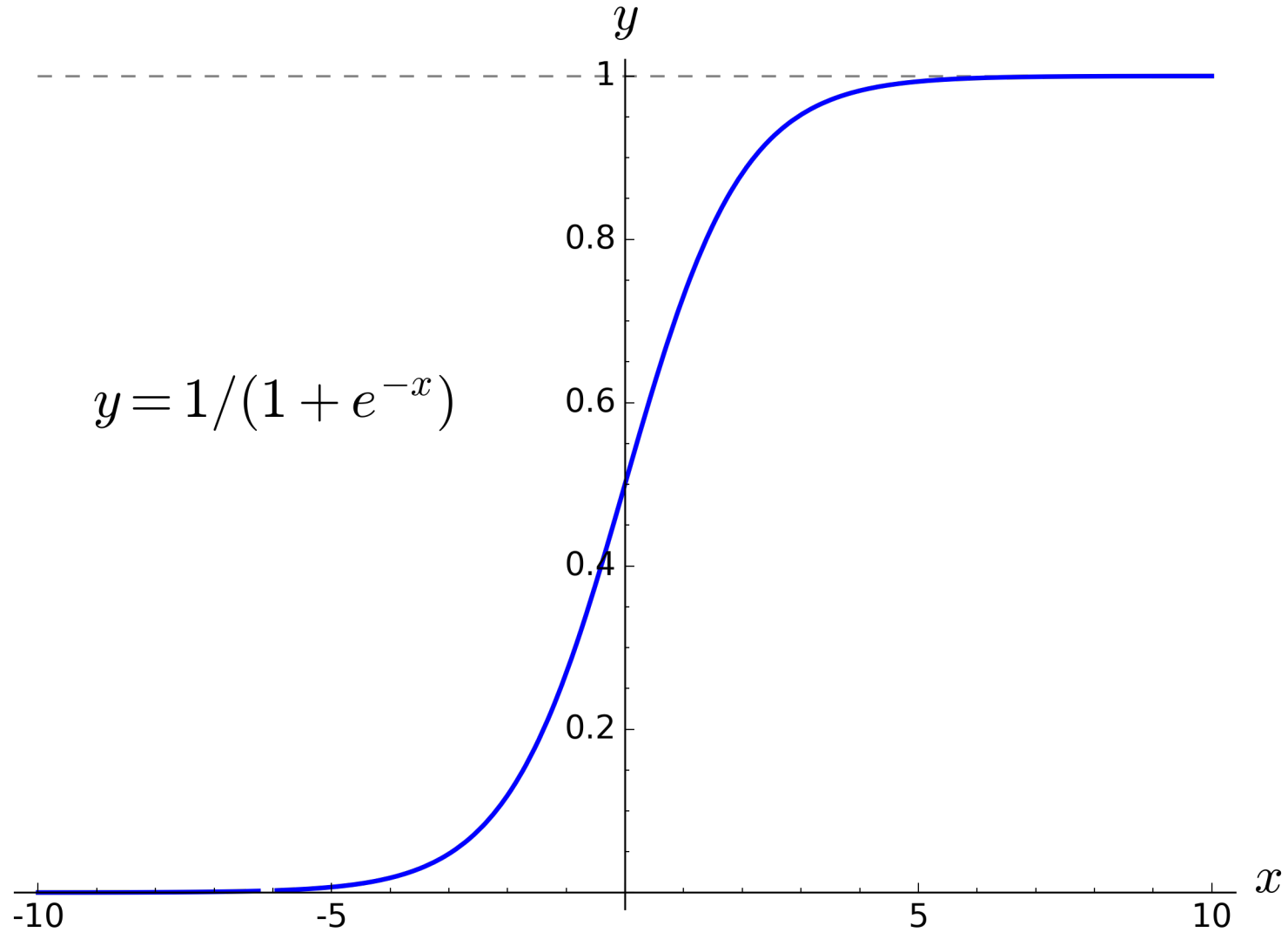
By start-up location

■ US ■ China ■ EU ■ Israel ■ Canada ■ Japan ■ Other ■ India





# Sigmoid & Deep Learning growth



# ***'The Godfather of A.I.' Leaves Google and Warns of Danger Ahead***

For half a century, Geoffrey Hinton nurtured the technology at the heart of chatbots like ChatGPT. Now he worries it will cause serious harm.

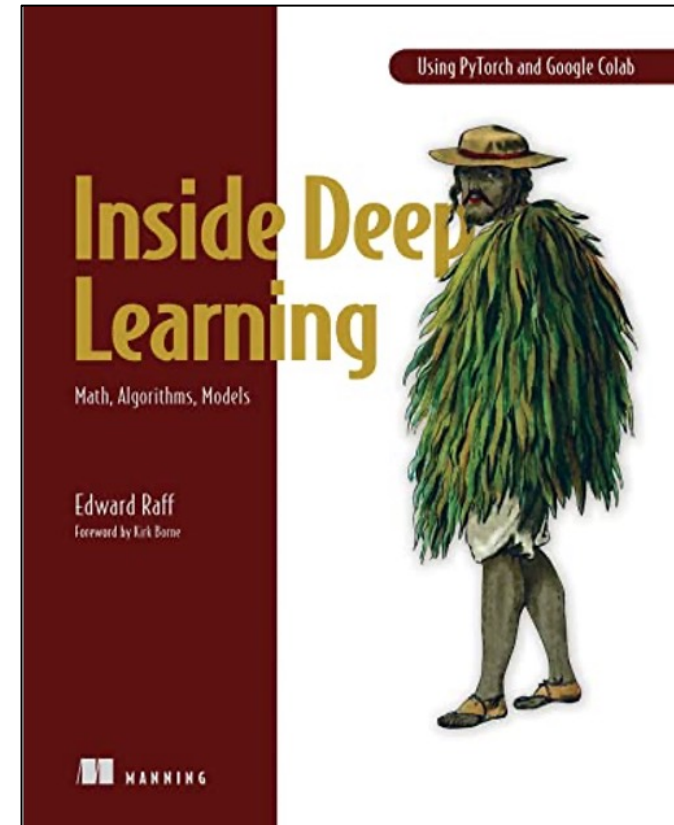
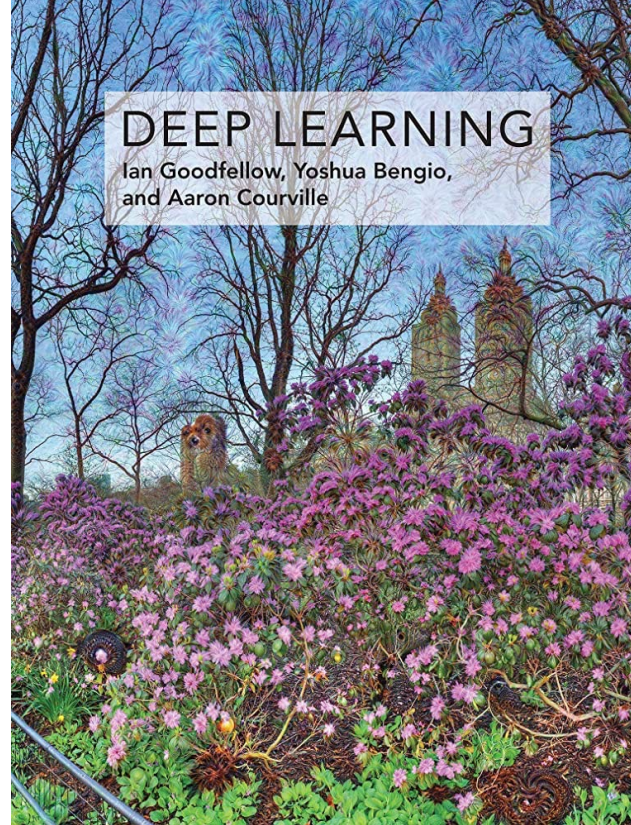
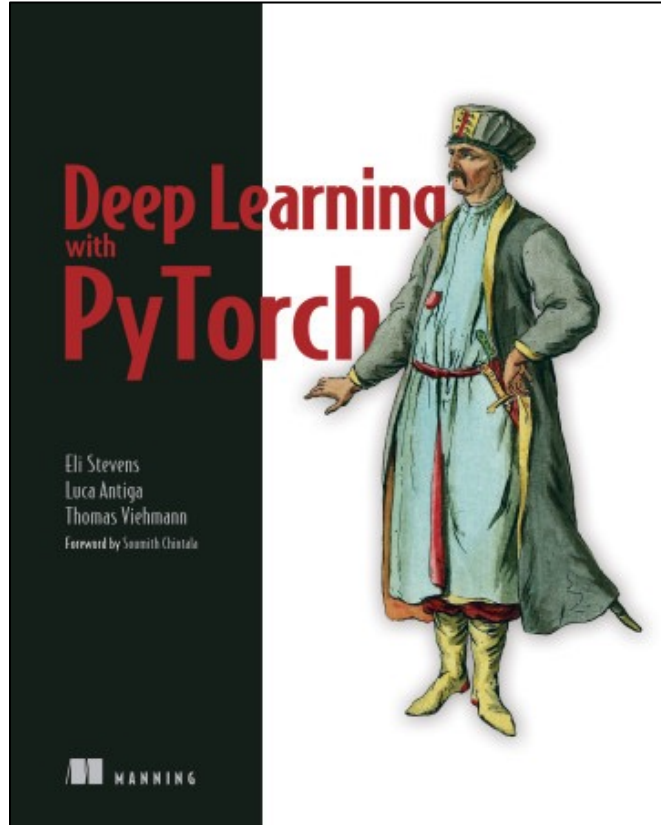


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<https://www.nytimes.com/2023/05/01/technology/ai-google-chatbot-engineer-quits-hinton.html>



# References





# References

