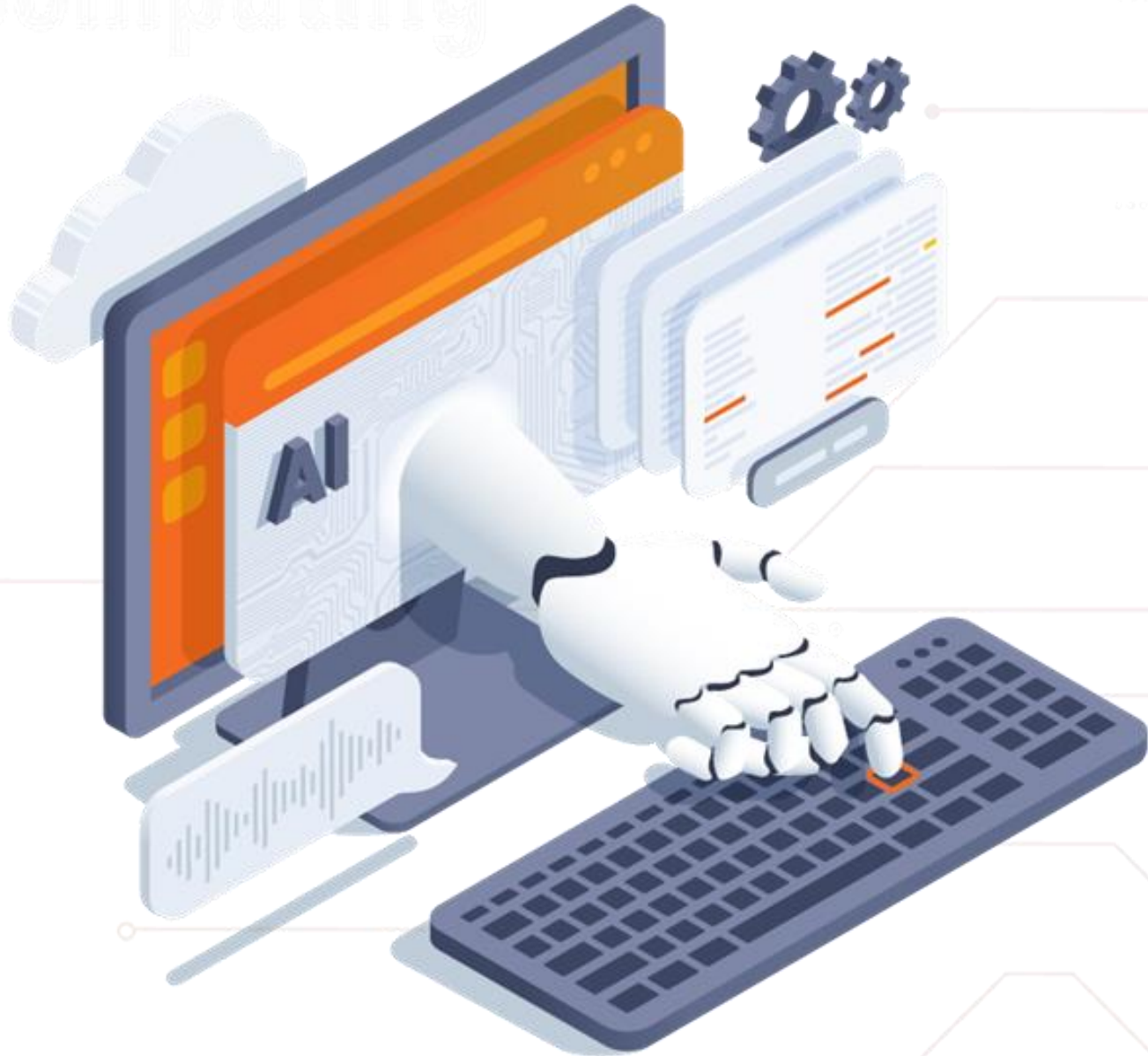


Cloud
Computing

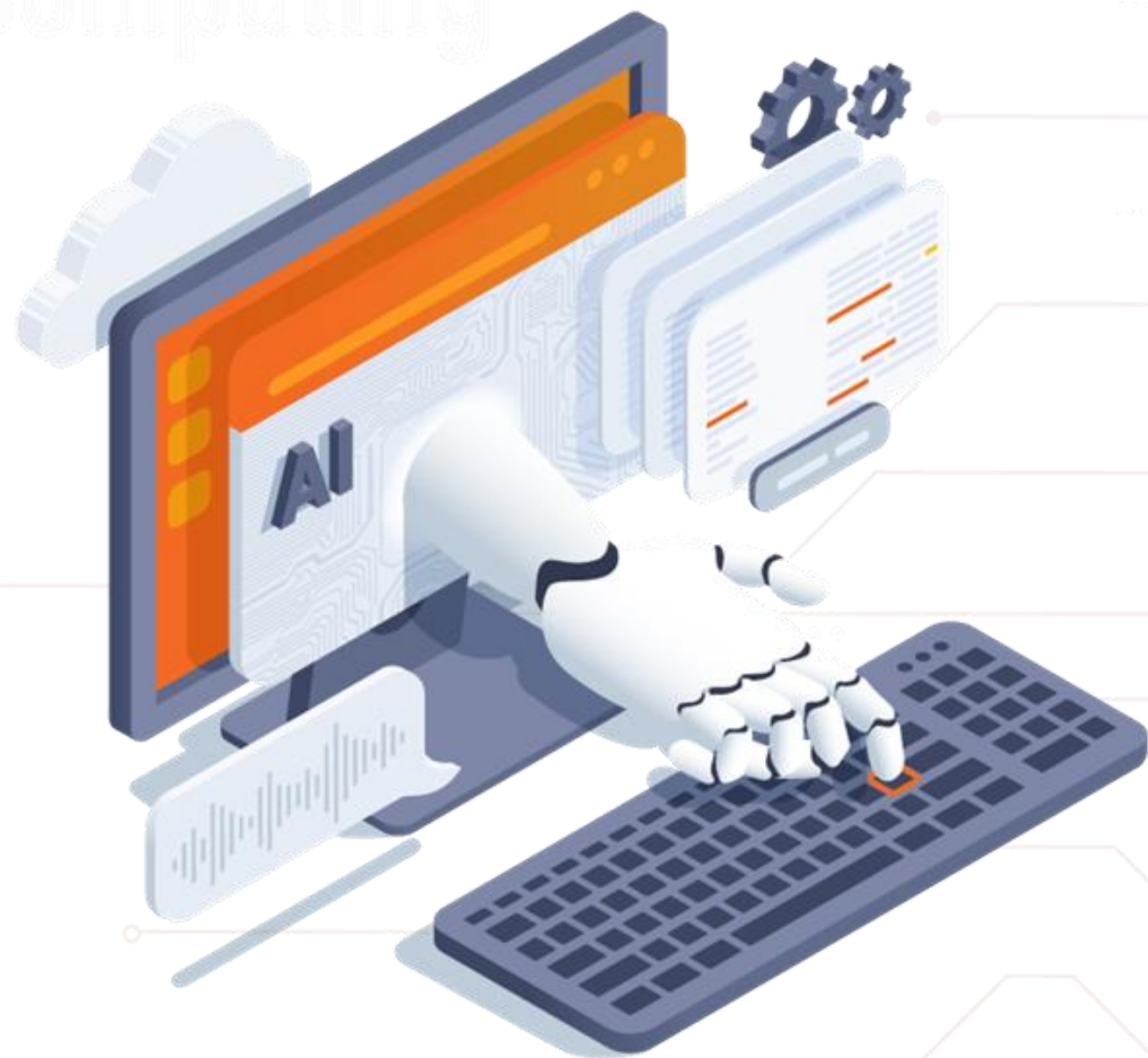


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Introduction to Artificial Intelligence

DATA AND
ARTIFICIAL INTELLIGENCE
Computing



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Fundamentals of Machine Learning and Deep Learning

Learning Objectives

By the end of this lesson, you will be able to:

- 👁 Discuss the meaning of machine learning and its relationship with AI
- 👁 Describe the relationship between machine learning and statistical analysis
- 👁 Explain the process of machine learning
- 👁 List and compare the types of machine learning



Learning Objectives

By the end of this lesson, you will be able to:

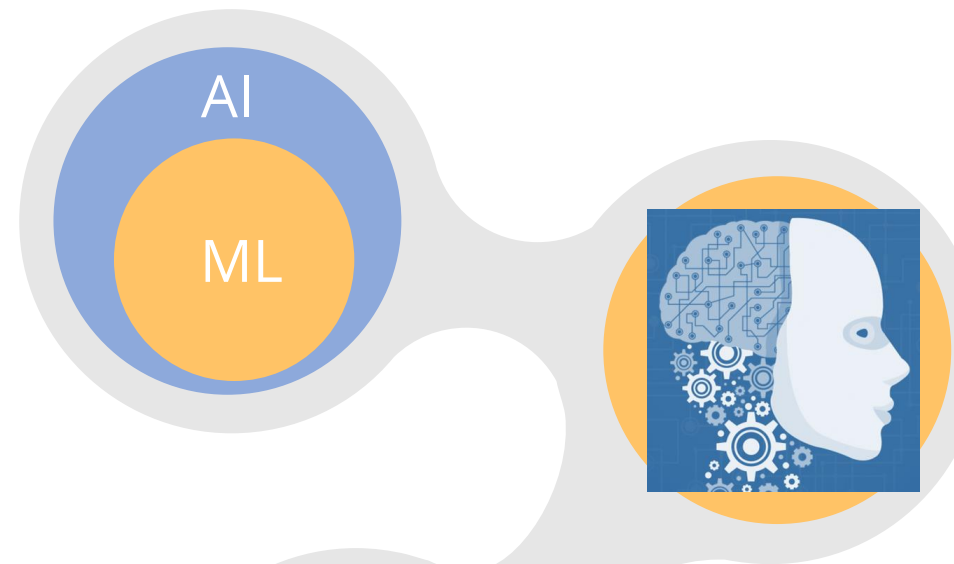
- 👁️ Analyze different algorithms of machine learning
- 👁️ Explore the meaning of deep learning and artificial neural networks



Meaning of Machine Learning

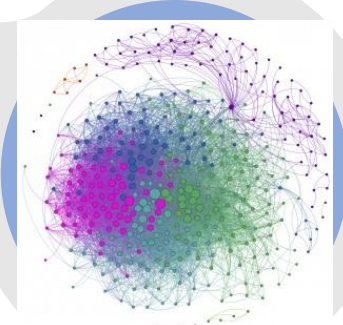
Meaning of Machine Learning

Machine learning (ML) is an application of **artificial intelligence**.



It involves teaching a computer to recognize **patterns** in the data and creating **rules** rather than programming it in traditional methods.

It provides an ability to machines to automatically learn and improve from experience without being explicitly programmed.



The process of learning begins with observations or data, such as direct experience, or instructions to look for patterns in the data.

Definition of Machine Learning

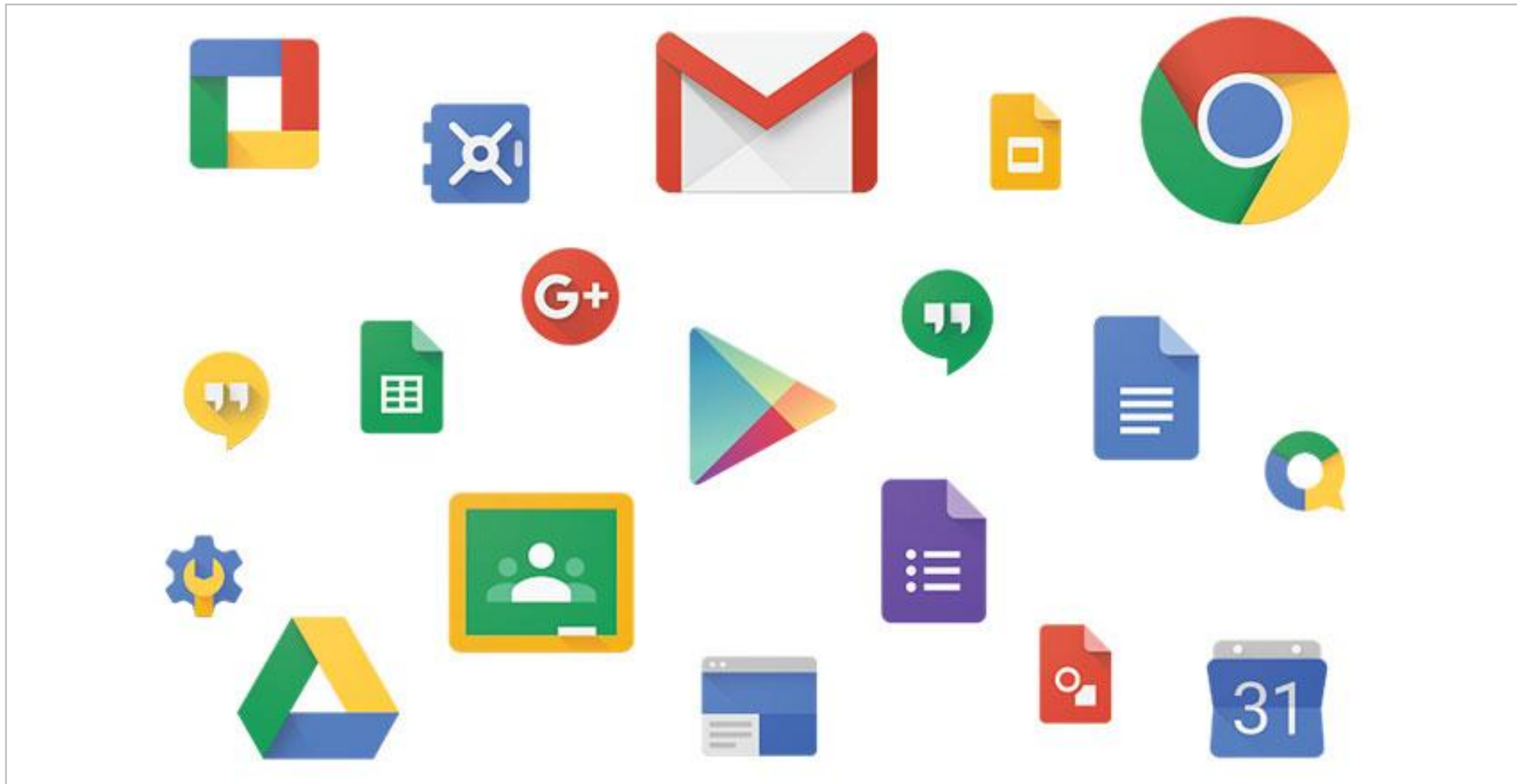
“

Machine learning can be defined as an approach to achieve artificial intelligence through systems or software models that can learn from experience to find patterns in a set of data.

”

Google Utilizing AI

Google uses artificial intelligence and machine learning in almost all of its applications.



Google Utilizing AI



Google Photos uses machine learning in **smart search** to display photos related to the keywords you searched for and animate similar photos from your albums into quick videos.



The **Smart Compose** and **Smart Reply** features of **Gmail** uses AI to suggest phrases and complete sentences when you draft an email or a reply. The spam filter uses artificial neural networks to analyze and flag spam messages.



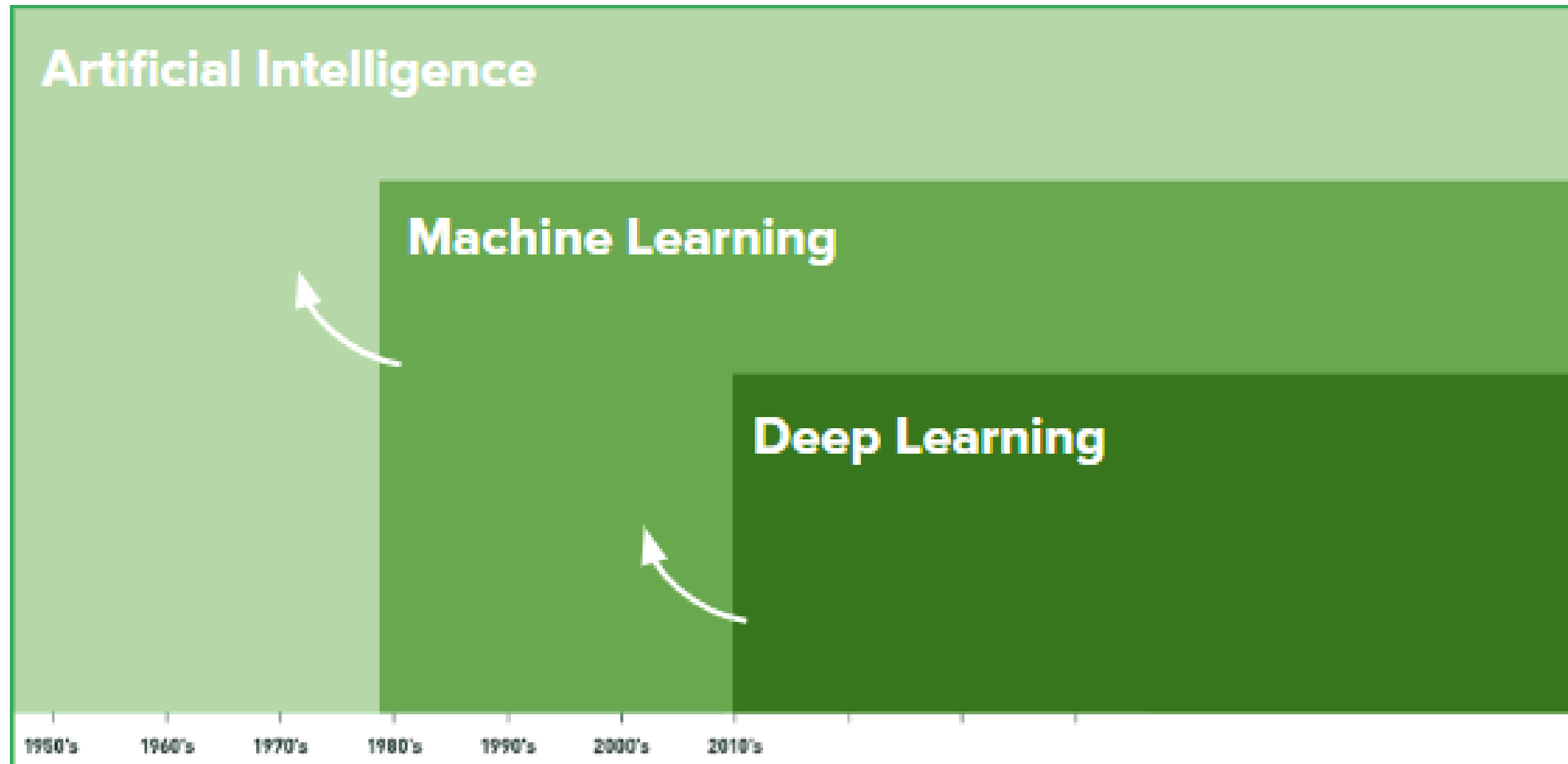
Google Assistant has recently launched a new feature called **Google Duplex** that lets AI take over some real-world task such as booking a haircut appointment over phone.



The feature **Talk to Books** lets you make a statement or ask a question and surfaces relevant passages from the books using machine learning.

Relationship Between AI, ML, and DL

- AI gained popularity in 1950, ML in 1980, and DL in 2010.
- Deep learning is a subset of machine learning, which is a subset of artificial intelligence.



Relationship Between Machine Learning and Statistical Analysis

Importance of Data and Statistical Analysis

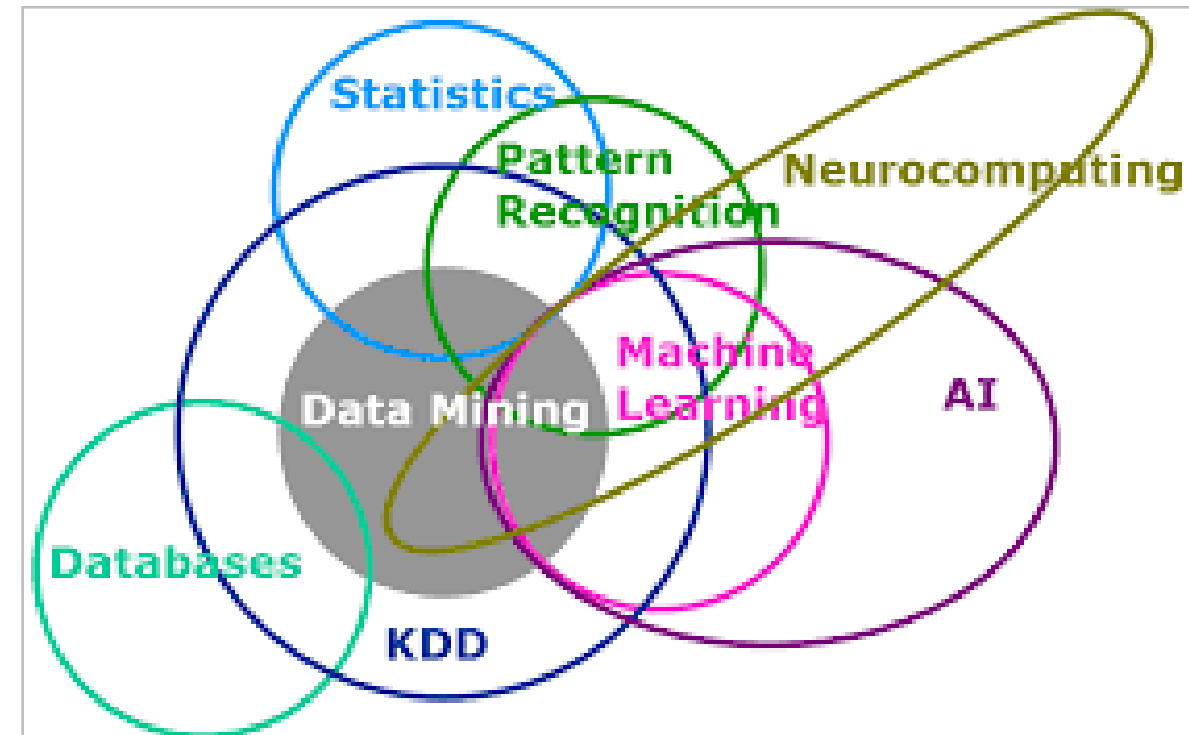


- Machine learning depends largely on data to study patterns.
- A large amount of data and statistical analysis of this data is required for ML.
- **Statistical analysis** involves collecting and scrutinizing the data sample to identify trends.
- A **statistical model** is a formalization of relationships between variables in the form of mathematical equations.

Machine Learning and Statistical Analysis

Machine learning

- **Machine learning** is a subset of artificial intelligence in the field of computer science.
- Machine learning is associated with high-dimensional data.



Statistical Analysis

- **Statistical analysis** belongs to the field of mathematics and deals with finding a relationship between variables to predict an outcome.
- Statistical analysis deals with low-dimensional data.



The goals of machine learning and statistical analysis are same, but the formulations are significantly different.

Formulations of ML and Statistical Analysis

Machine learning

It takes away the deterministic function f out of the equation:

Output(Y) ----- > Input (X)

Statistical Analysis

It tries to estimate the function f :

Dependent Variable (Y) = f (Independent Variable)
+ Error Function

Naming Conventions of ML and Statistical Analysis

Machine learning	Statistics
Network, graphs	Model
Weights	Parameters
Learning	Fitting
Generalization	Test set performance
Supervised learning	Regression/classification
Unsupervised learning	Density estimation, clustering
Large grant = \$1,000,000	Large grant = \$50,000
Nice place to have a meeting: Snowbird, Utah, French, Alps	Nice place to have a meeting: Las Vegas in August

Process of Machine Learning

Approach of Machine Learning



ML leverages on existing data, images, and videos to train algorithms and models.



Numerous set of examples are fed into the system and are called **training sets**.



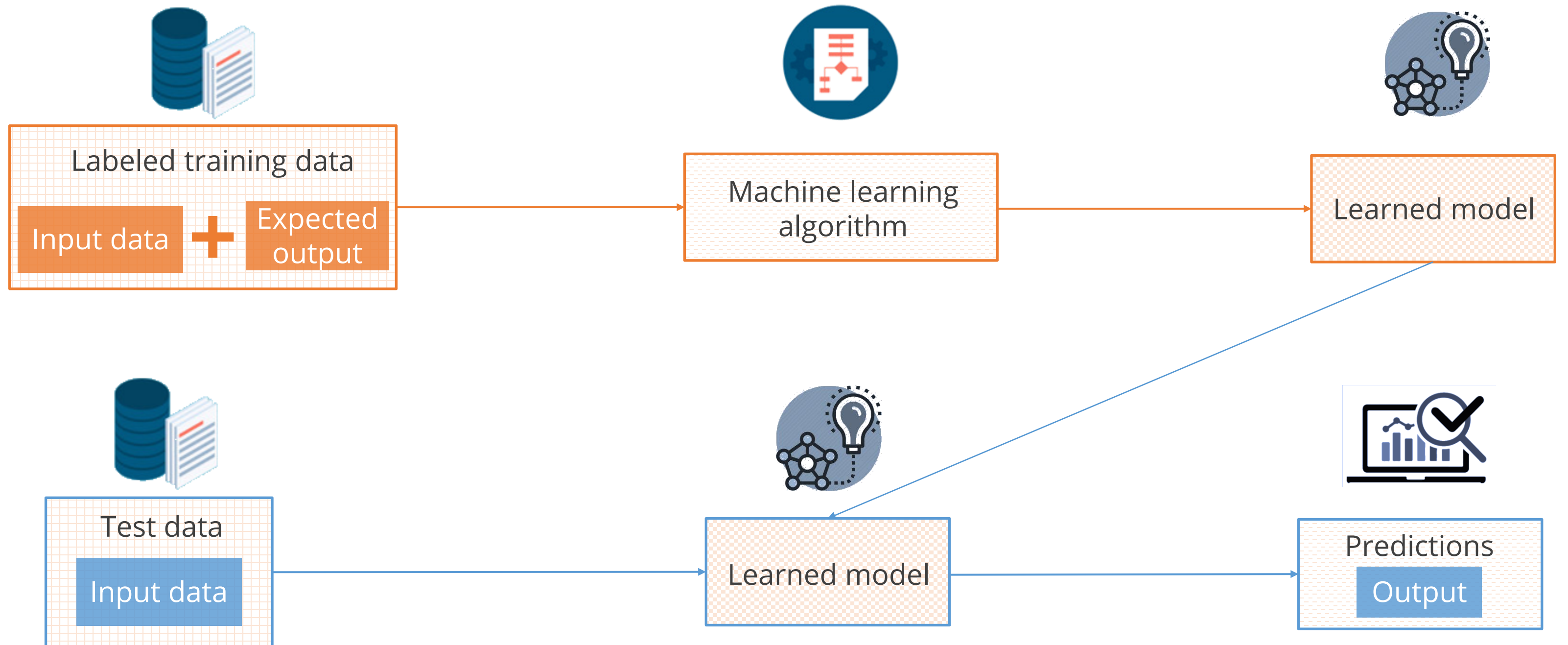
The **larger** the training set, the more **accurate** the AI system would be.



Each item in a training set is labeled either **0** or **1**.

Machine Learning Process

A machine learning process can be divided into two phases: **training** and **testing**.



Machine Learning Process

Training Phase



Labeled training data

Input data + Expected output

Machine learning algorithm

Learned model

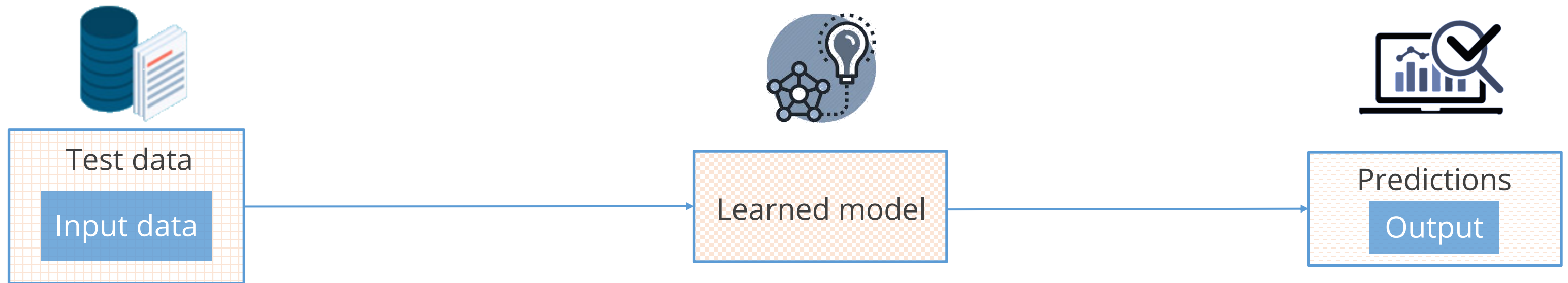
Labeled data is given as input into the algorithm along with the expected output or labels. This is called the **training data**.

The algorithm studies the patterns in the data and works out a **logic** based on the training data input and output.

A machine learning **model** is derived, which can then be used with test dataset.

Machine Learning Process

Testing Phase



The **test data** contains only the inputs, and the output is generated by the system based on the logic derived from the training data.

The system classifies the test data based on the patterns learned from the training data.

The patterns from the test data and the logic of the learned model are used to make predictions and derive output.

Types of Machine Learning

Types of Machine Learning

There are four main types of machine learning:

Supervised Learning

Unsupervised Learning

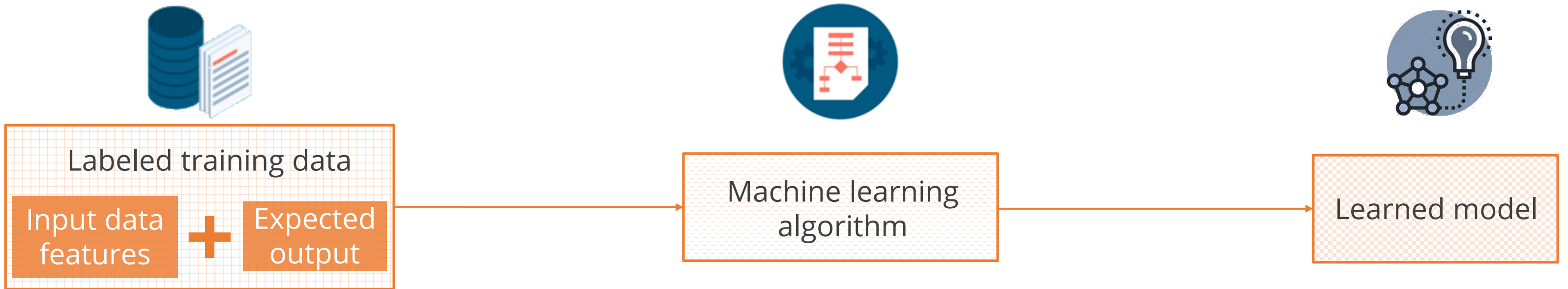
Semi-supervised Learning

Reinforcement Learning

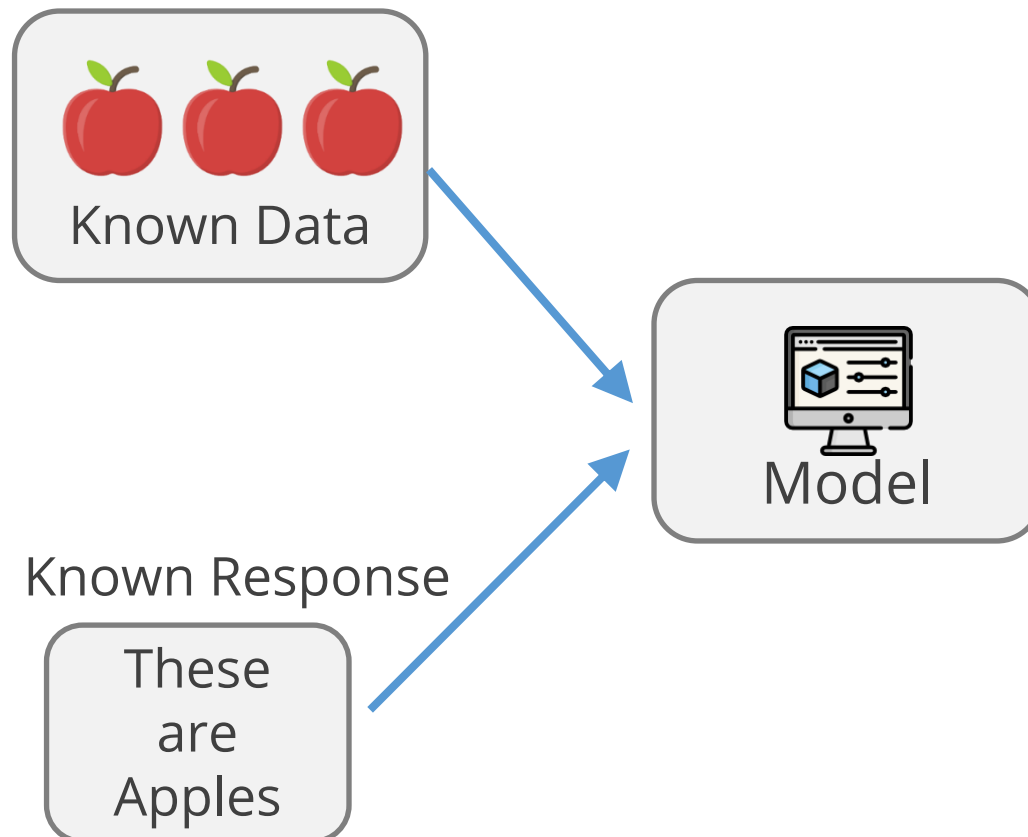
Meaning of Supervised Learning

- In case of **supervised learning**, the ML program is provided with training data along with the expected output or rules to categorize this data also known as labels.
- The ML system uses this set of inputs and outputs to predict the output for future unseen inputs. It works well in the classification.

Supervised Learning Process



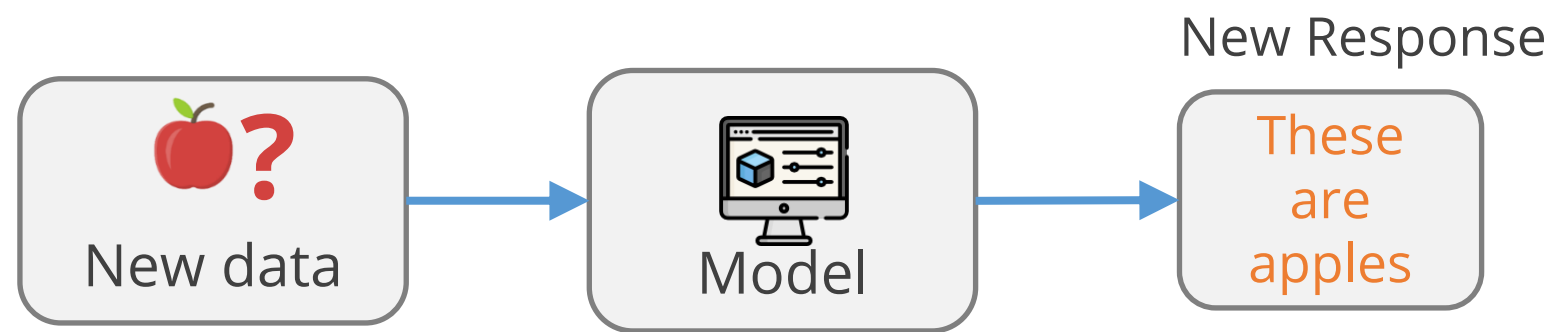
Supervised Learning Example



Step one: Train the model

- Provide images of apples along with the expected response to the model. This is called the labeled data.

Supervised Learning Example



Step two: Test the model

- The model learns from the labeled data.
- Provide a set of images to the model again without the expected output.
- The output of the model is, "These are apples."

Supervised Learning Example



Predicting house prices based on various features

Number of
rooms

Bathrooms

Garage space

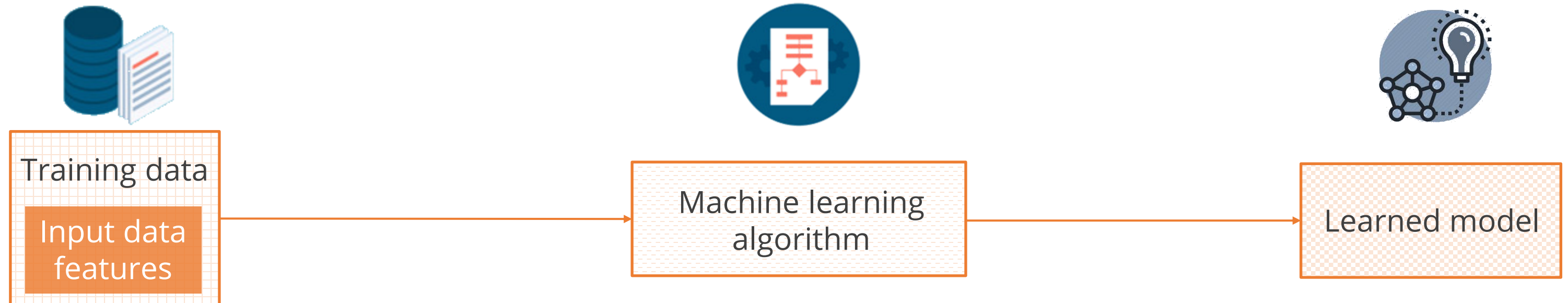
Year it was built

Location

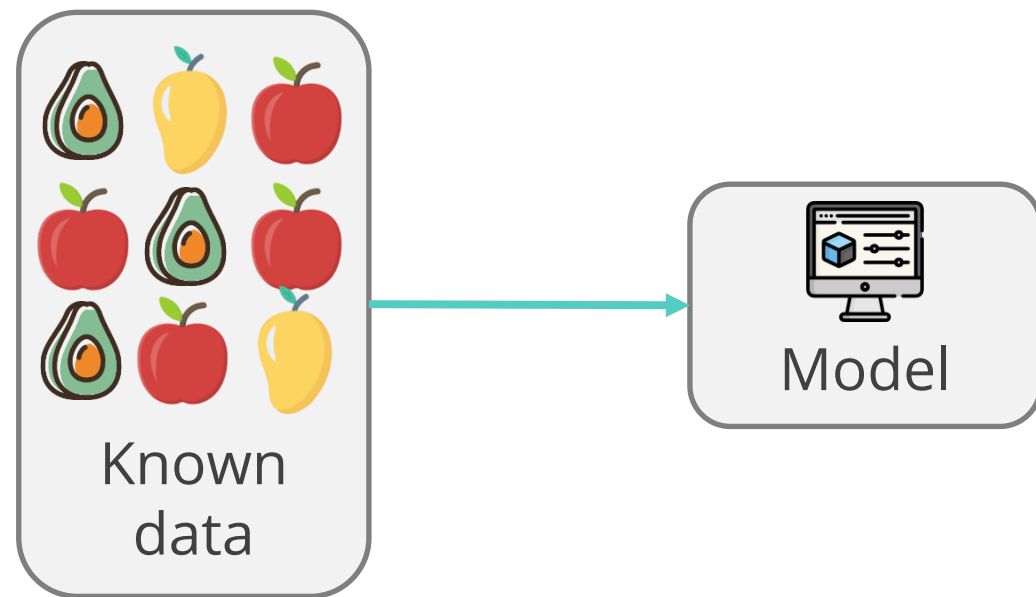
Meaning of Unsupervised Learning

- In case of **unsupervised learning**, the machine learning algorithm learns from an unlabeled dataset. Only the input data is used by the algorithm to train the model.
- The algorithm is expected to find patterns and anomalies from this input data.
- This method is mostly used in fraud detection, customer segmentation, and MRI analysis.

Unsupervised Learning Process



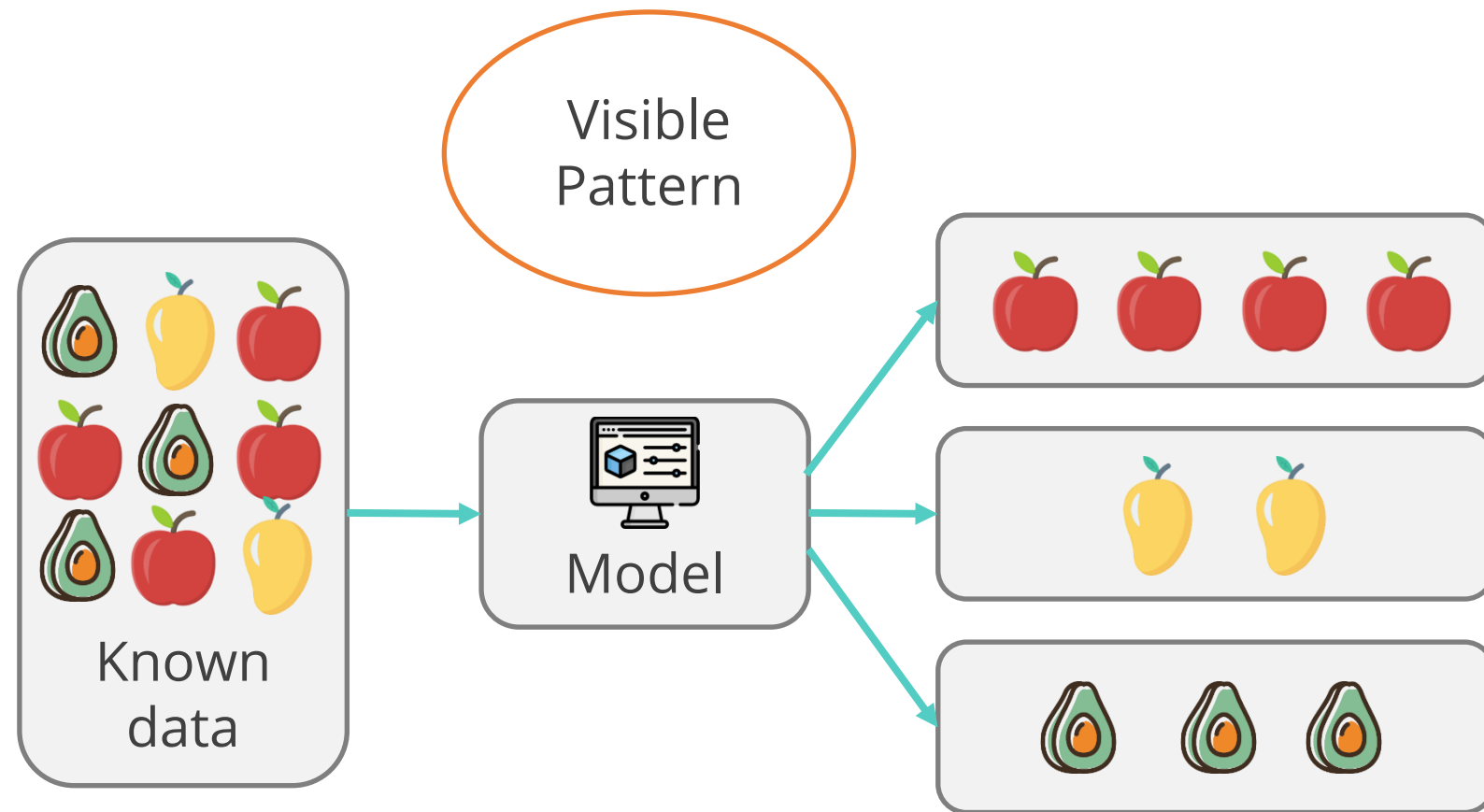
Unsupervised Learning Example: Image Identification



Step one: Input unlabeled data

- We provide the system with a data that contains photos of different kinds of fruits without the expected output. This is called the **unlabeled data**.
- The goal of unsupervised learning models is to understand the output from given data and notice patterns, trends, and similarities.

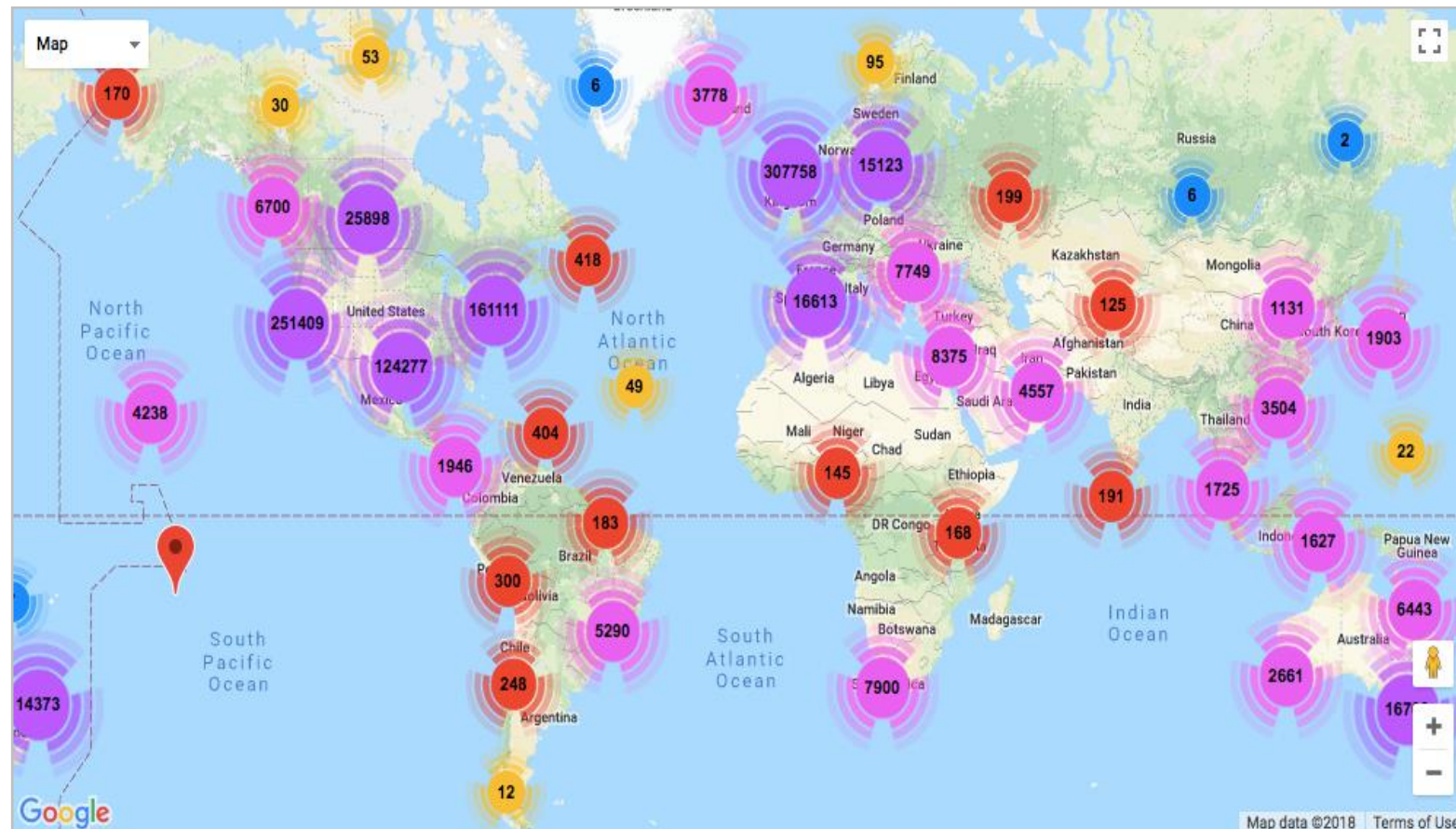
Unsupervised Learning Example: Image Identification



Step two: Train the model

- The model identifies the patterns like shape, color, and size in the data.
- It groups the fruits based on these features, attributes, or qualities.

Unsupervised Learning Example: Litterati

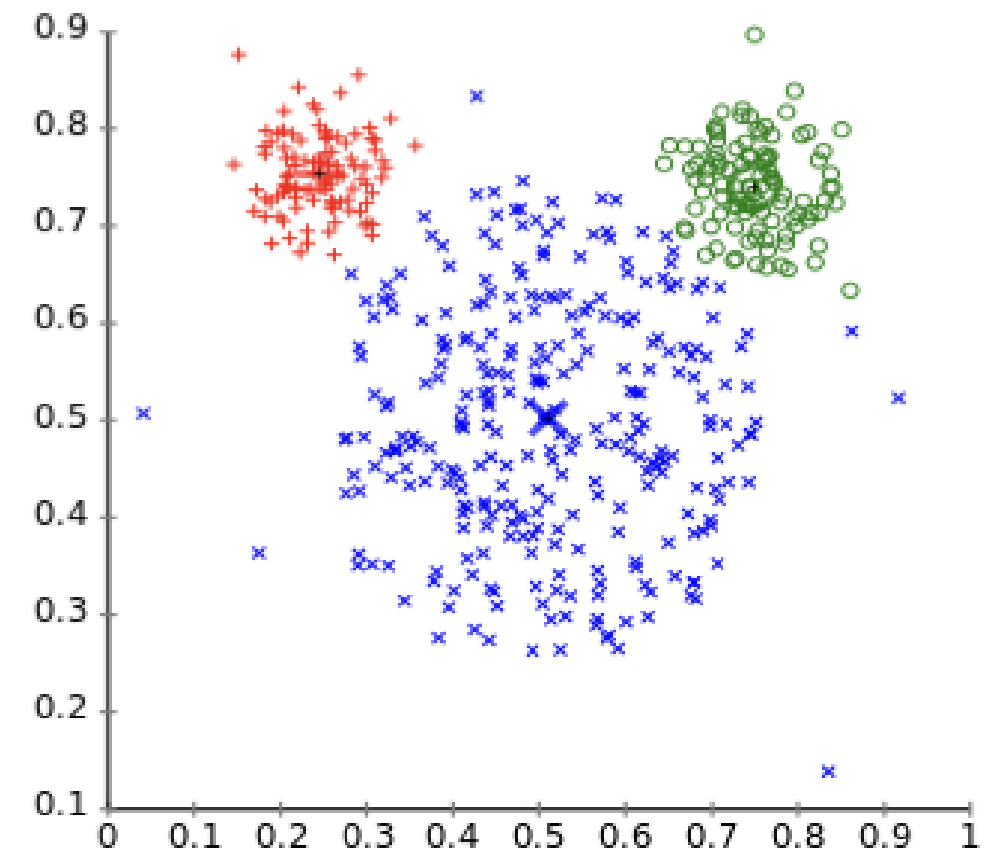
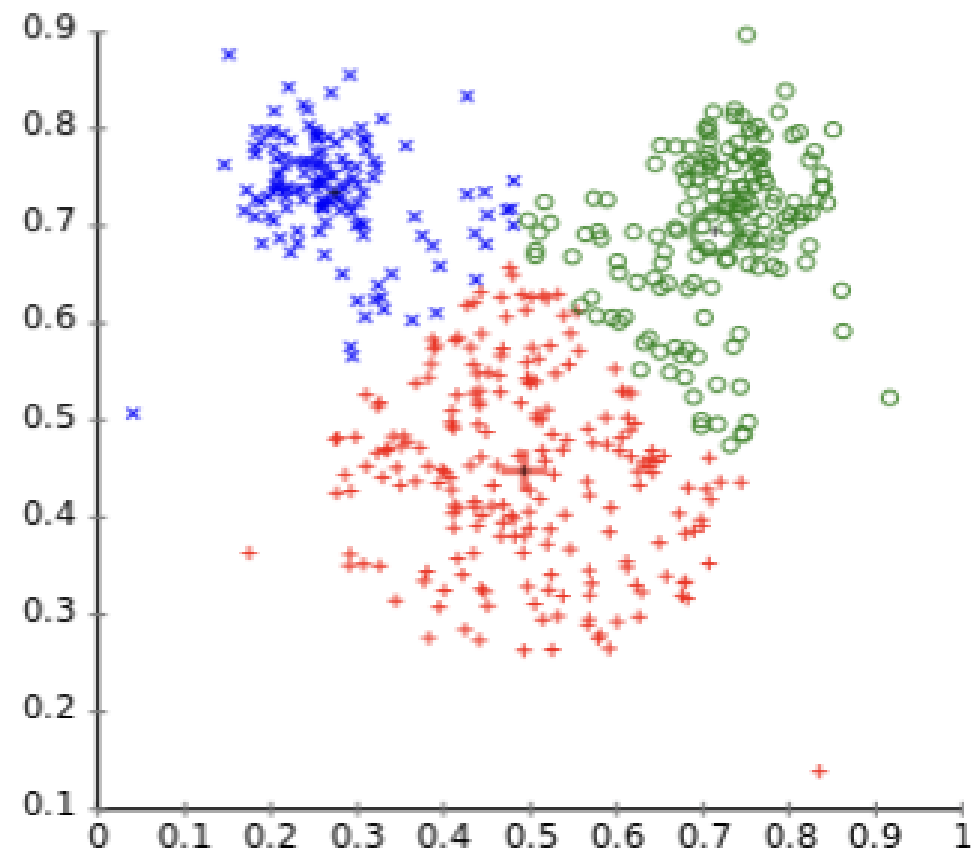
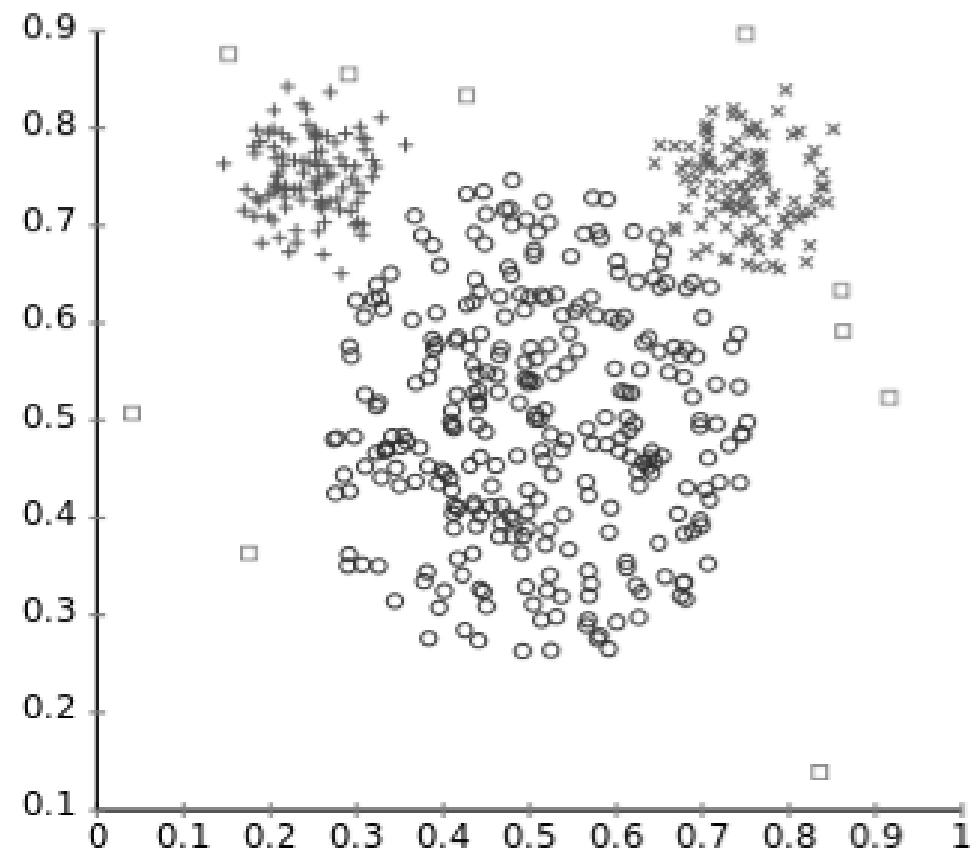


- **Litterati**, the global database for litter, uses unsupervised learning to organize geographical litter locations using clustering.

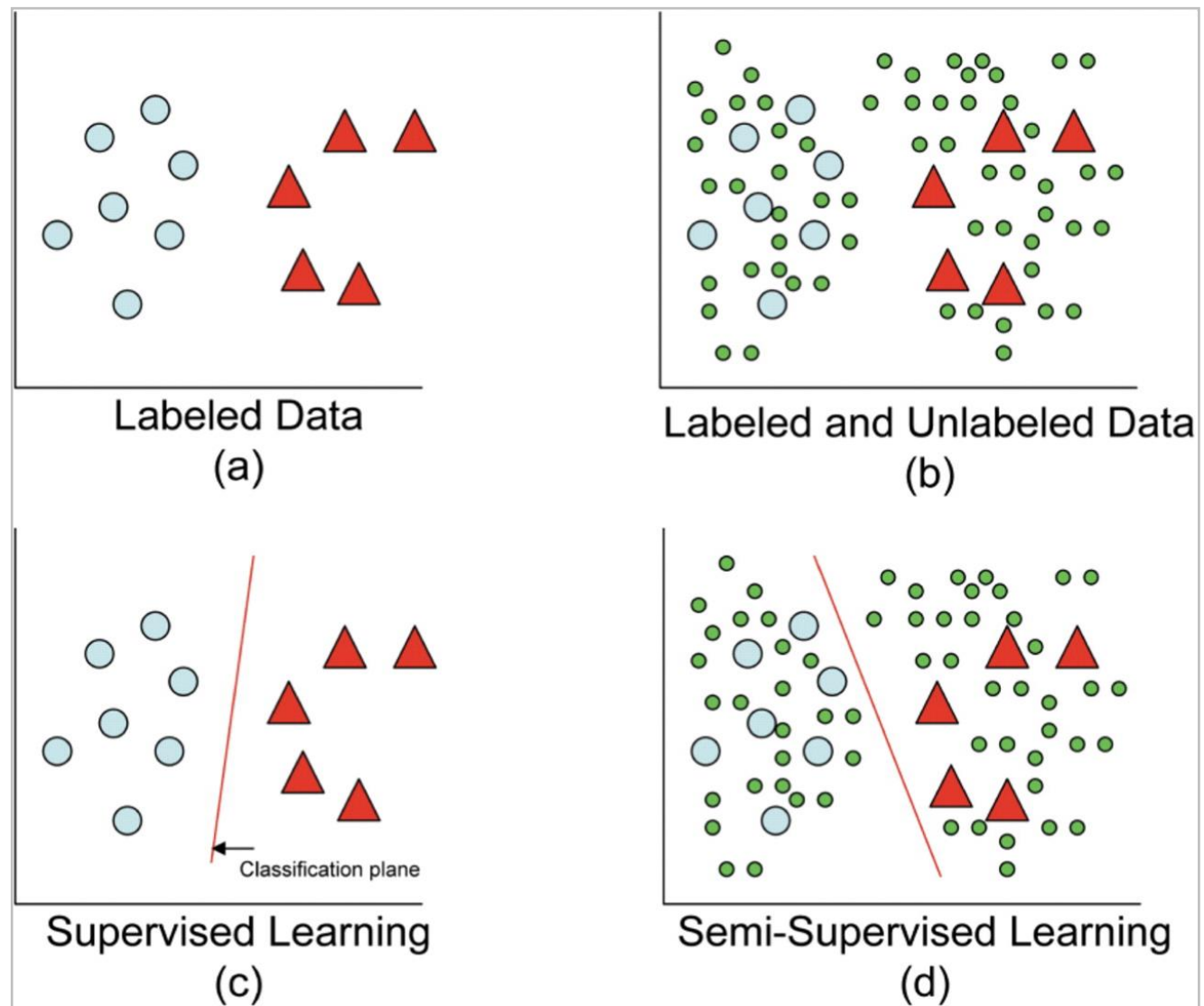
Unsupervised Learning Example: Mouse Clicks

- Unsupervised learning is used to understand the users' mouse clicks on a web page or a website.
- It helps companies understand the user browsing patterns.

Different cluster analysis results on "mouse" data set:
Original Data k-Means Clustering EM Clustering

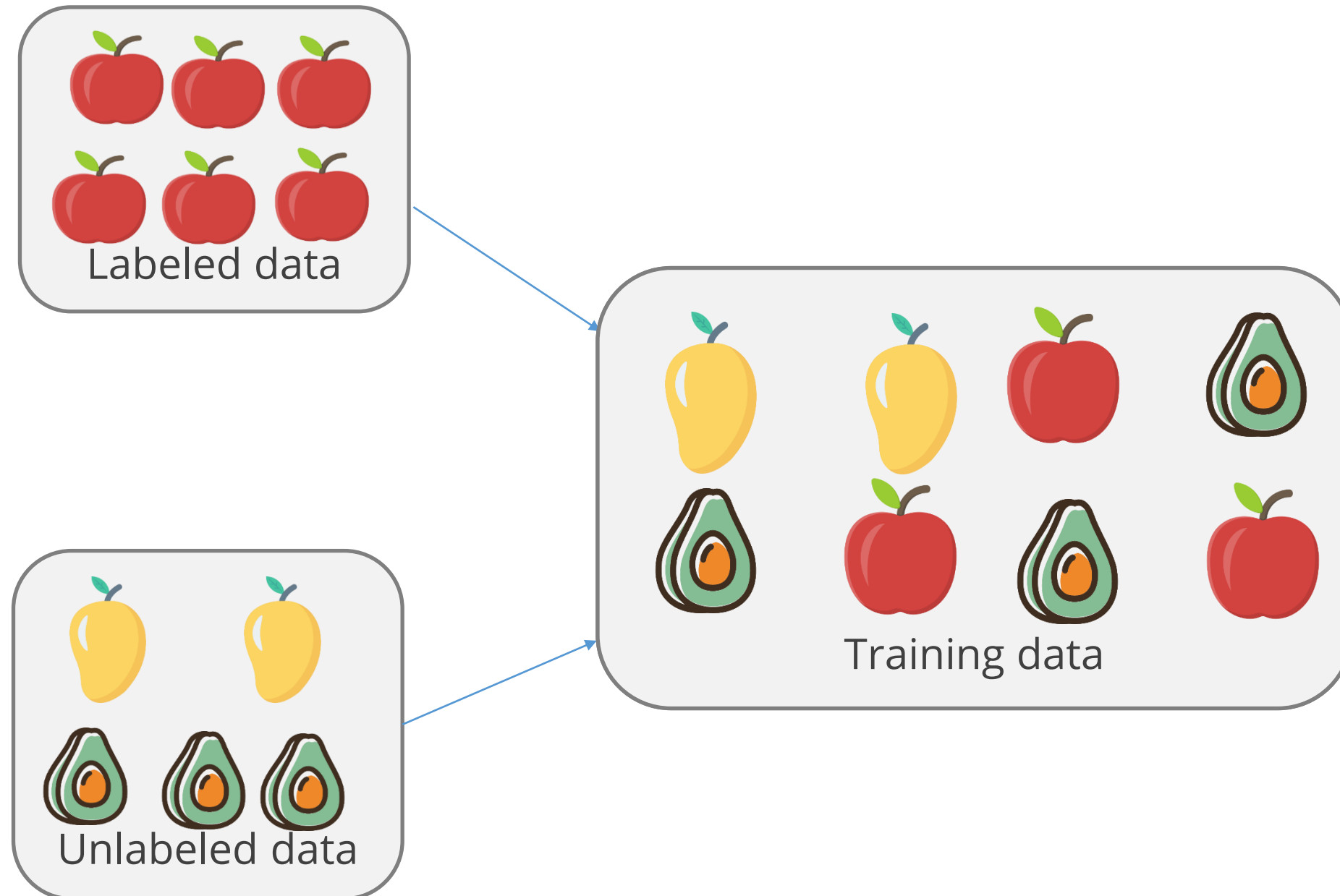


Meaning of Semi-supervised Learning



- **Semi-supervised learning** is a hybrid approach and is a combination of supervised and unsupervised learning.
- It uses a combination of labeled and unlabeled data.

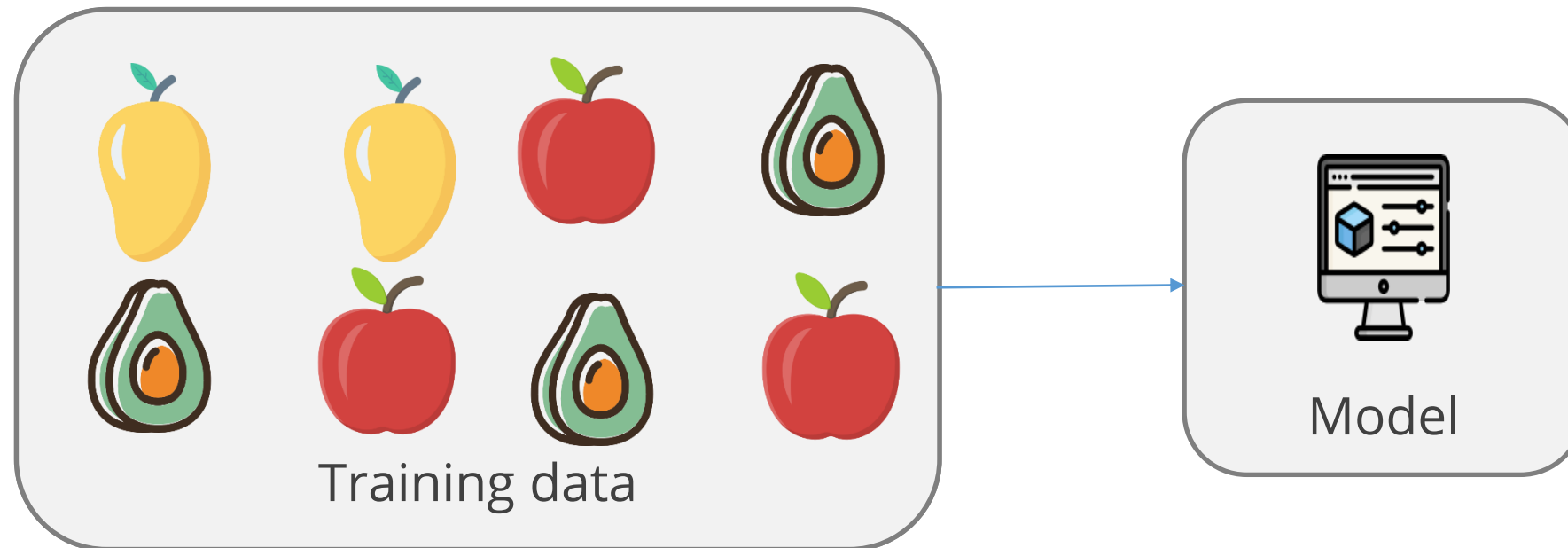
Semi-supervised Learning Example



Step one: Collect and group data

- Collect and group labeled and unlabeled data for training.

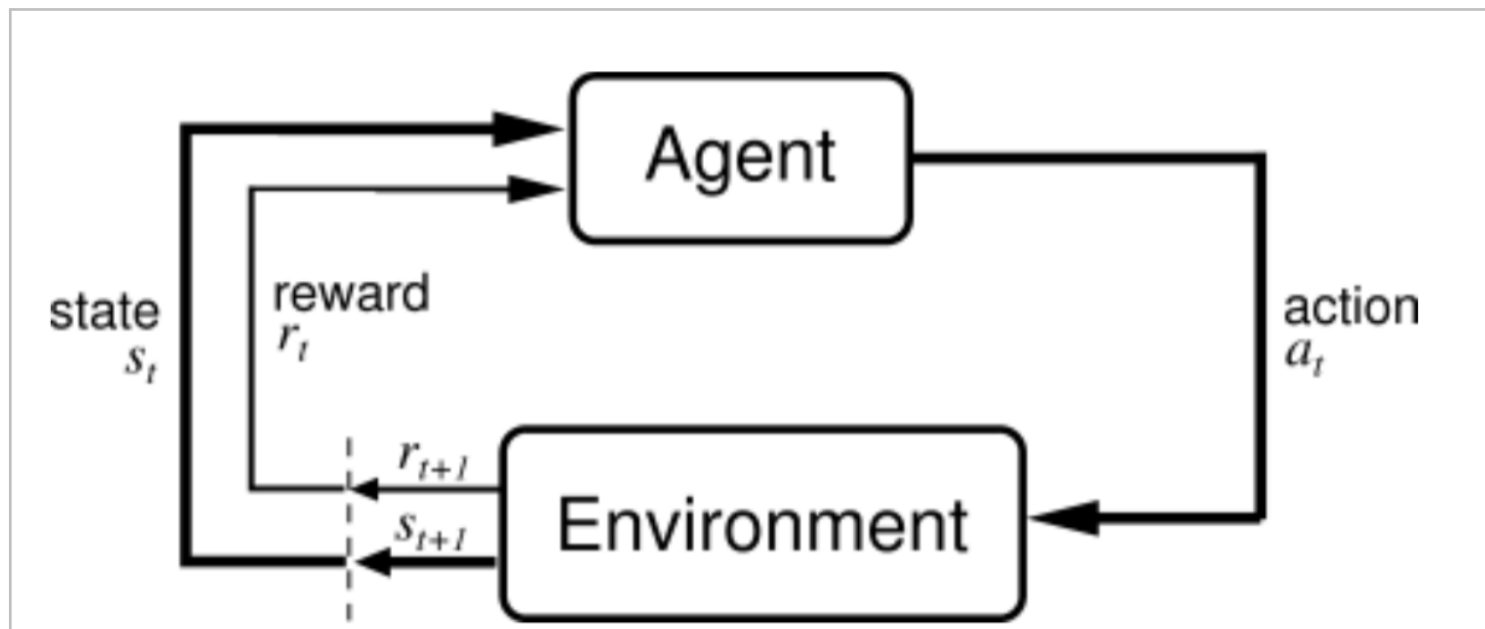
Semi-supervised Learning Example



Step two: Input data

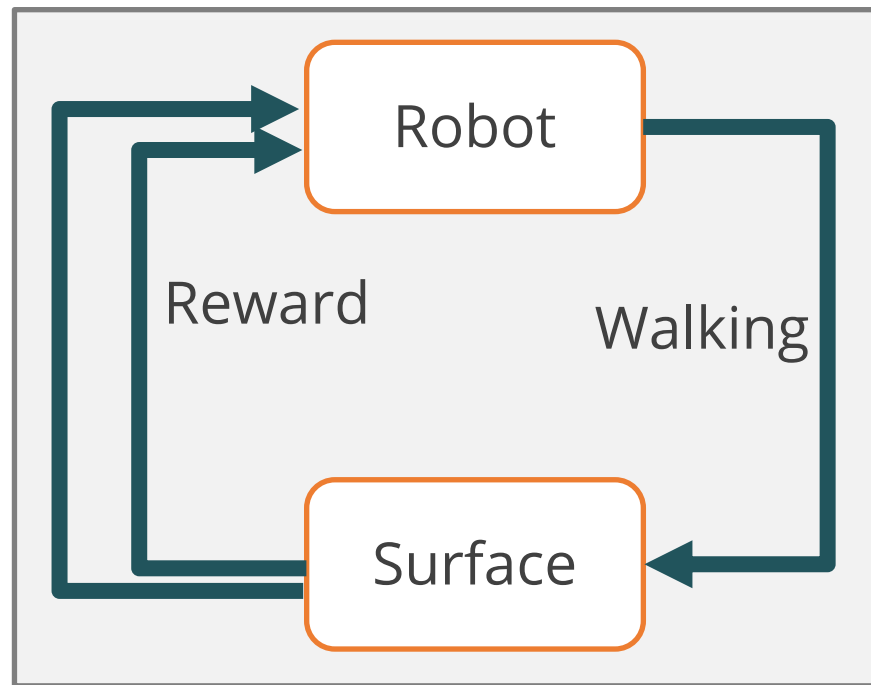
- Feed all the training data into the model.

Meaning of Reinforcement Learning



- **Reinforcement learning** is a type of machine learning that allows the learning system to observe the environment and learn the ideal behaviour.
- The learning system (agent) observes the environment, selects and takes certain actions, and gets rewards in return (or penalties in certain cases).
- The feedback is given to the system or agent in a loop.
- The agent learns the strategy or policy (choice of actions) that maximizes its rewards over time and tries to maximize the cumulative reward.

Reinforcement Learning Example: Robot



- **Robot** is an agent trying to manipulate the environment, which is the surface.
- This happens as the robot walks and tries to go from one state to another.
- It gets a **reward** for accomplishing a sub module of the task (taking couple of steps).



Reinforcement Learning Example: Robot



- In a manufacturing unit, a robot uses deep reinforcement learning to identify a device from one box and put it in a container.
- The robot learns this by means of a rewards-based learning system, which incentivizes it for the right action.

Selecting the ML Approach

The data modeling approach for machine learning is based on the **structure and volume of the data** at hand, regardless of the use case. Any of the following approaches can be chosen considering all the factors.

Supervised Learning

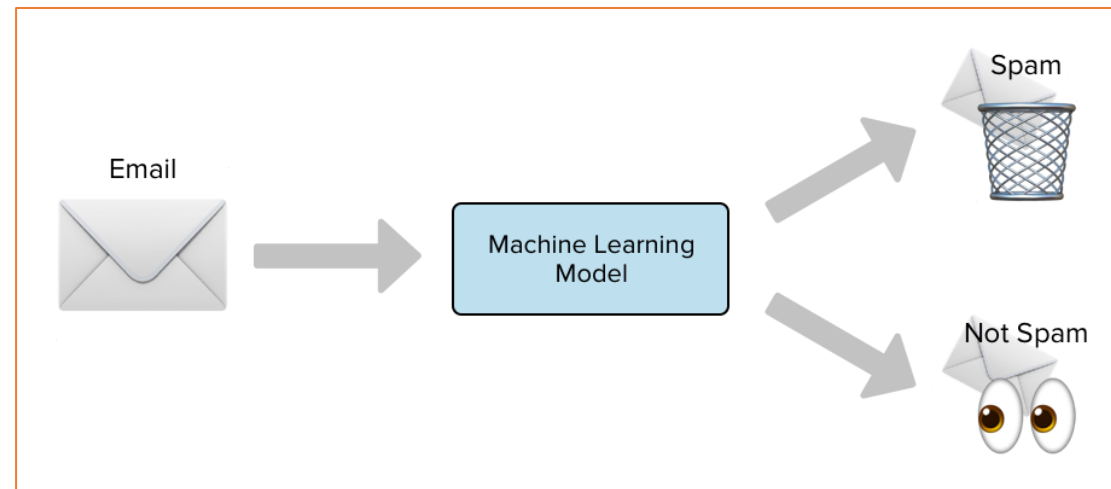
Unsupervised Learning

Semi-supervised Learning

Reinforcement Learning

Quiz Time

Guess what ML approach is used by spam detection?



Supervised Learning

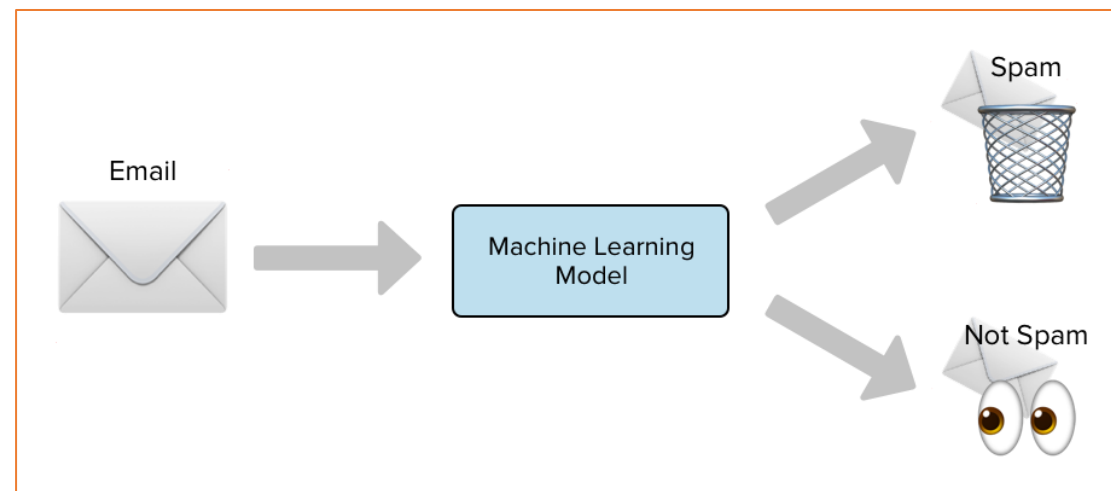
Unsupervised Learning

Semi-supervised Learning

Reinforcement Learning

Quiz Time

Guess what ML approach is used by spam detection?



Supervised Learning

Unsupervised Learning

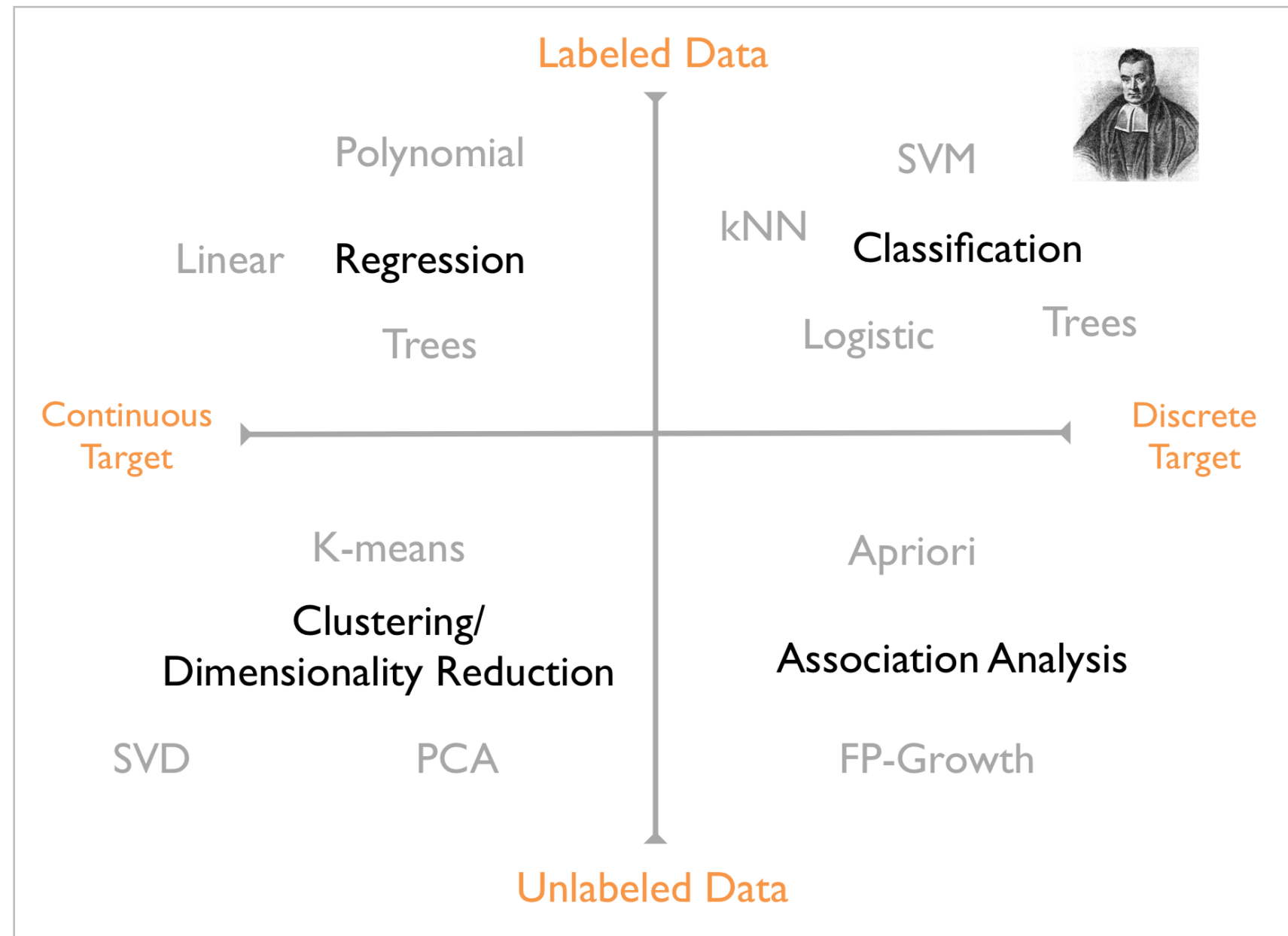
Semi-supervised Learning

Reinforcement Learning

Algorithms of Machine Learning

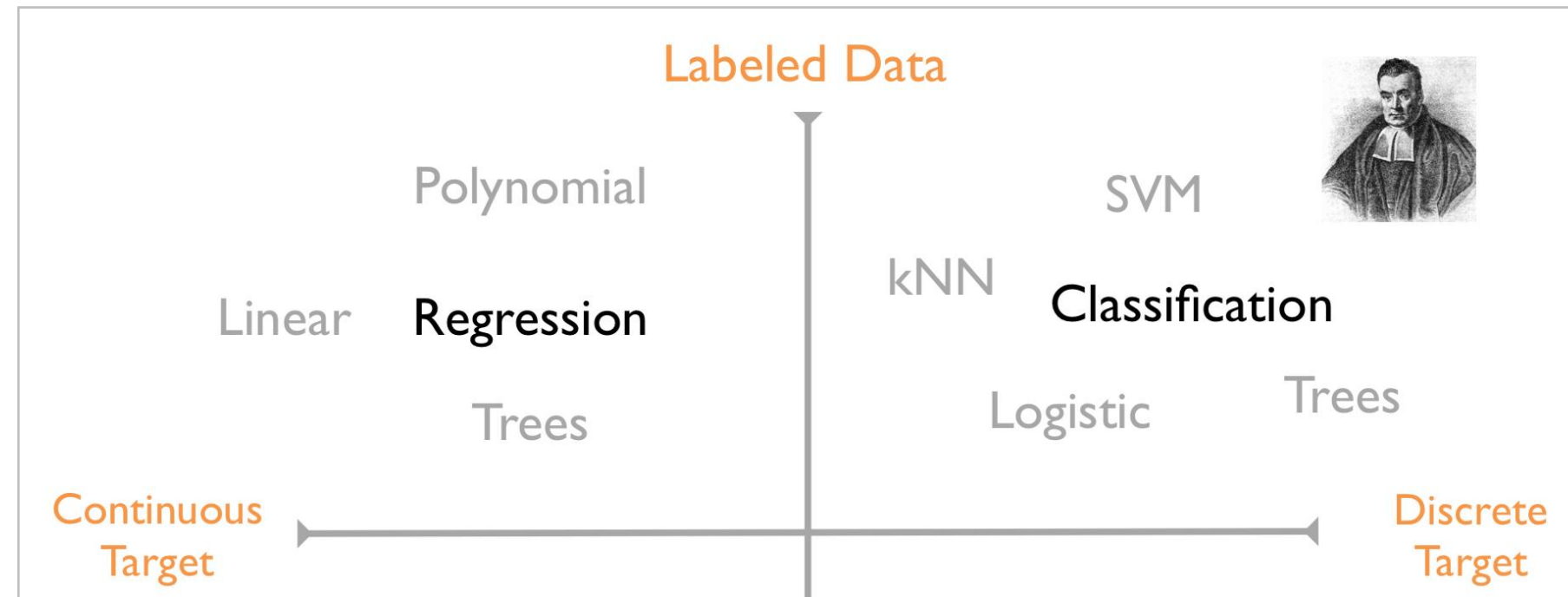
Machine Learning Algorithms

- There are four main types of **machine learning algorithms**.
- The choice of the algorithm depends on the type of data in the use case.

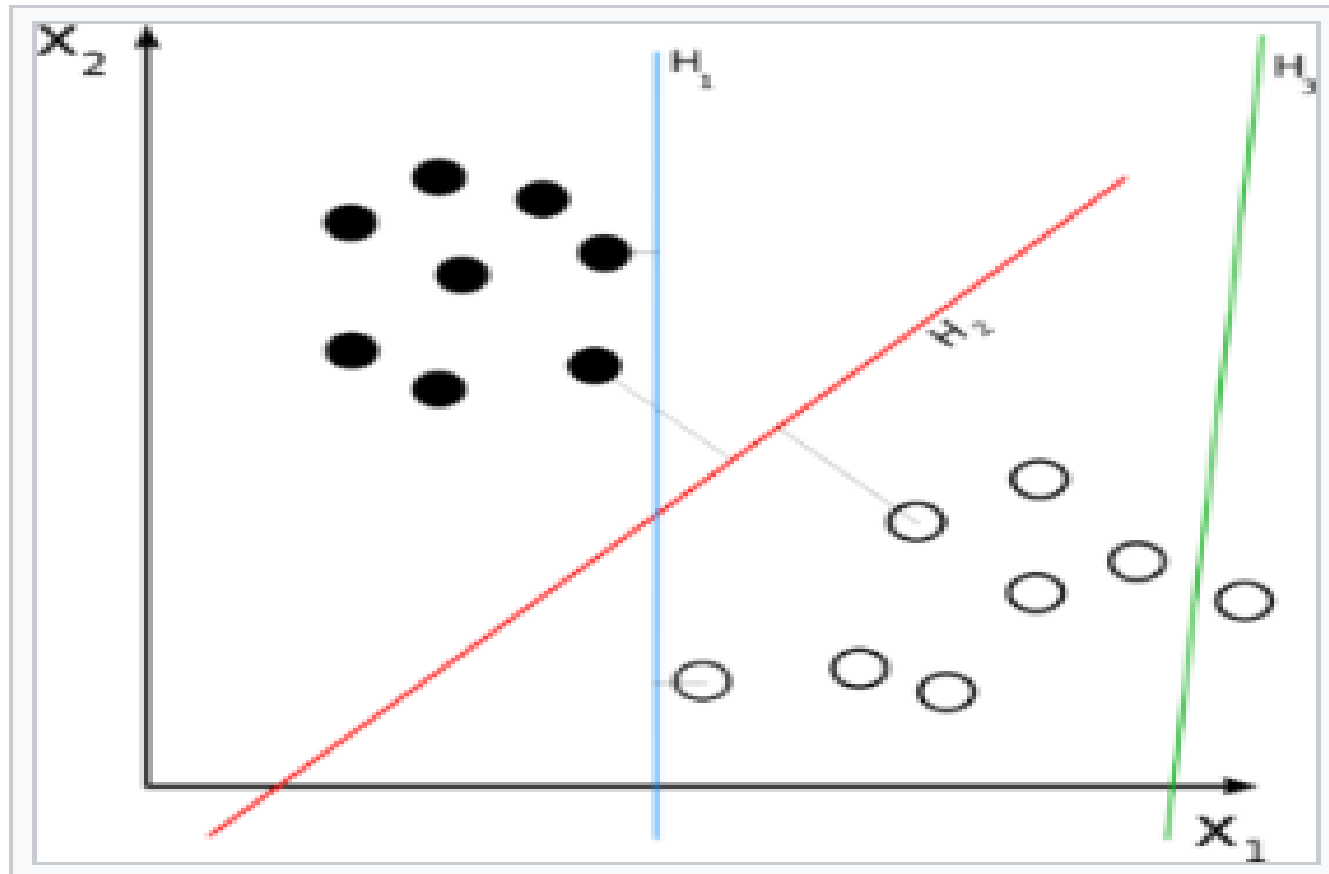


Types of Supervised Learning

The two main types of supervised learning that use labeled data are **regression and classification**.

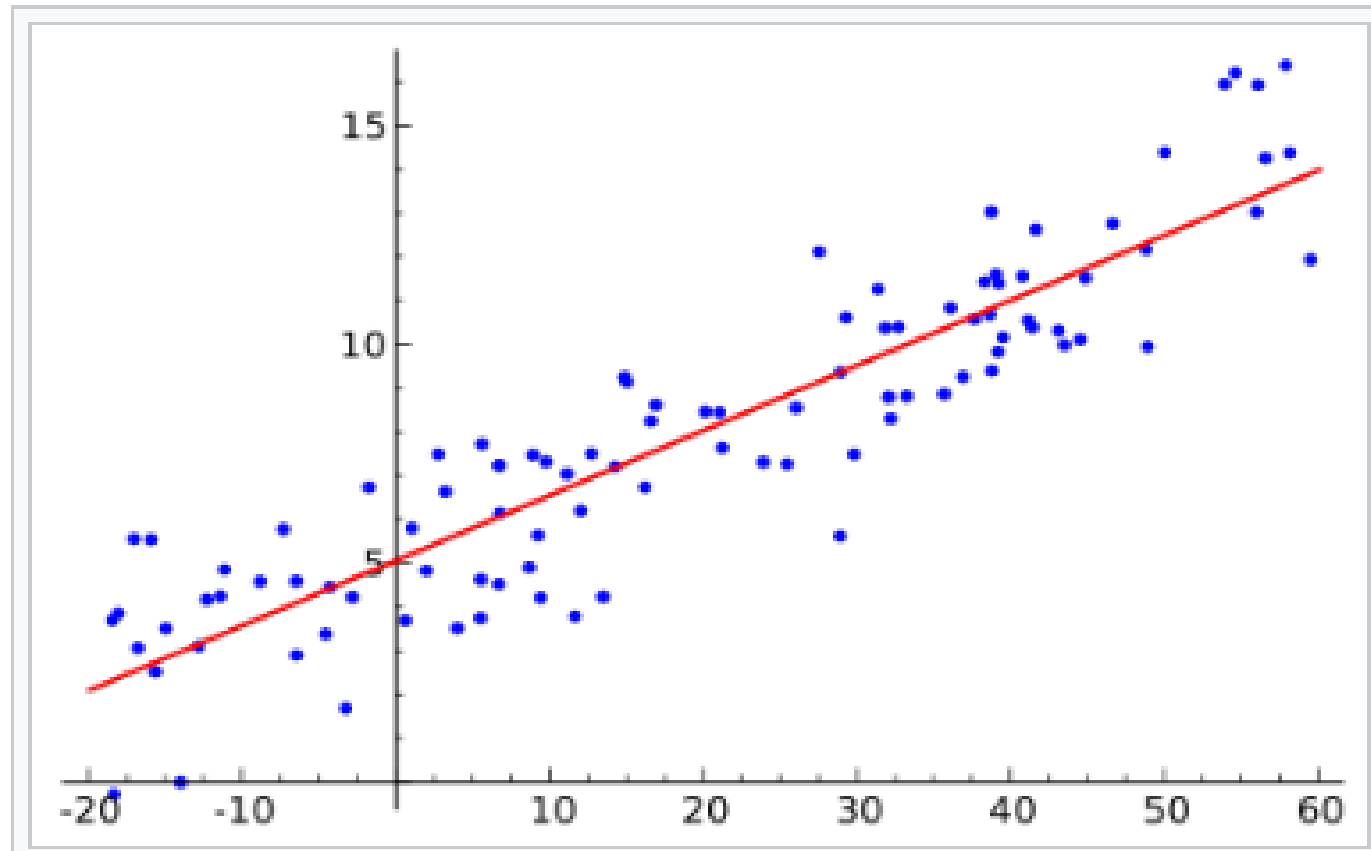


Classification



- **Classification** is applied when the output has finite and discrete values.
- For example, social media sentiment analysis has three potential outcomes: positive, negative, or neutral.

Regression

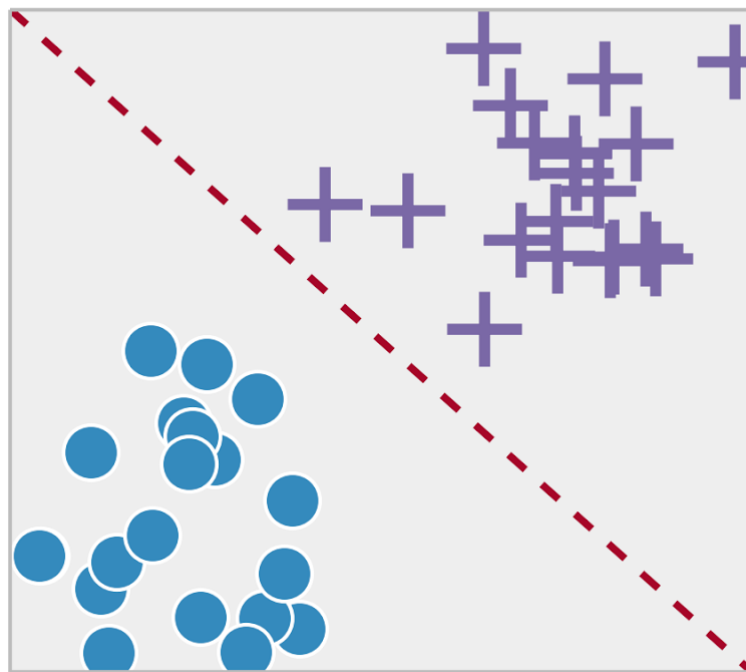


- **Regression** is applied when the output is a continuous number.
- A simple regression algorithm: $y = wx + b$. For example, relationship between environmental temperature (y) and humidity levels (x).

Classification vs. Regression

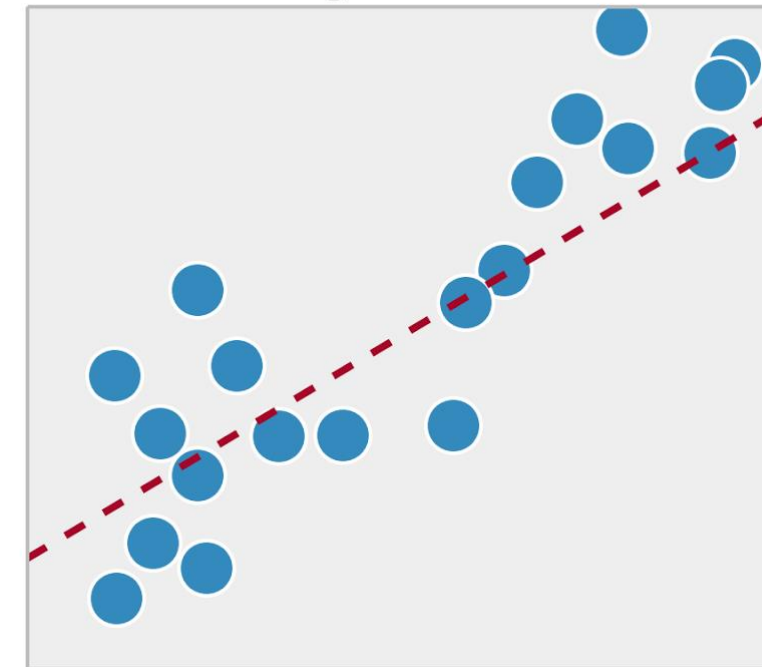
By fitting to the **labeled training set**, you can find the most optimal model parameters to predict unknown labels on other objects (test set).

Classification



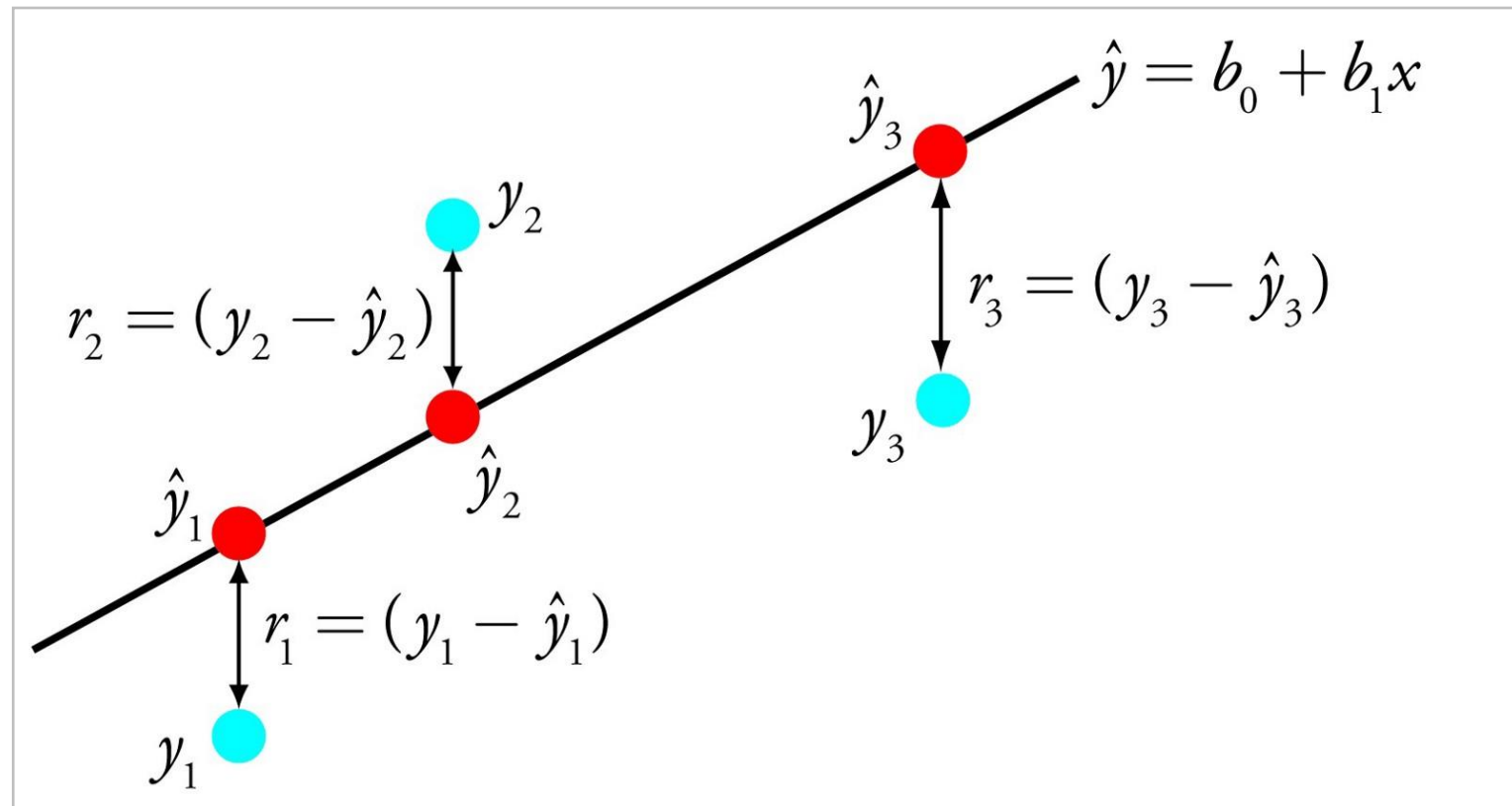
If the label is a real number, we call the task **regression**. For example, finding actual value of house price based features like location, construction year, etc.

Regression



If the label is from the limited number of unordered values, we call it **classification**. For example, classifying images of animals into separate groups (labels) of dogs and cats.

Linear Regression



- **Linear regression** is an equation that describes a line that represents the relationship between the input variables (x) and the output variables (y).
- It does so by finding specific weightings for the input variables called **coefficients** (B).

Quiz Time

Which of these is a use case for linear regression?



Spam detection

Google Translate

Car mileage based on brand, model, year, weight, etc.

Robot learning to walk

Quiz Time

Which of these is a use case for linear regression?



Spam detection

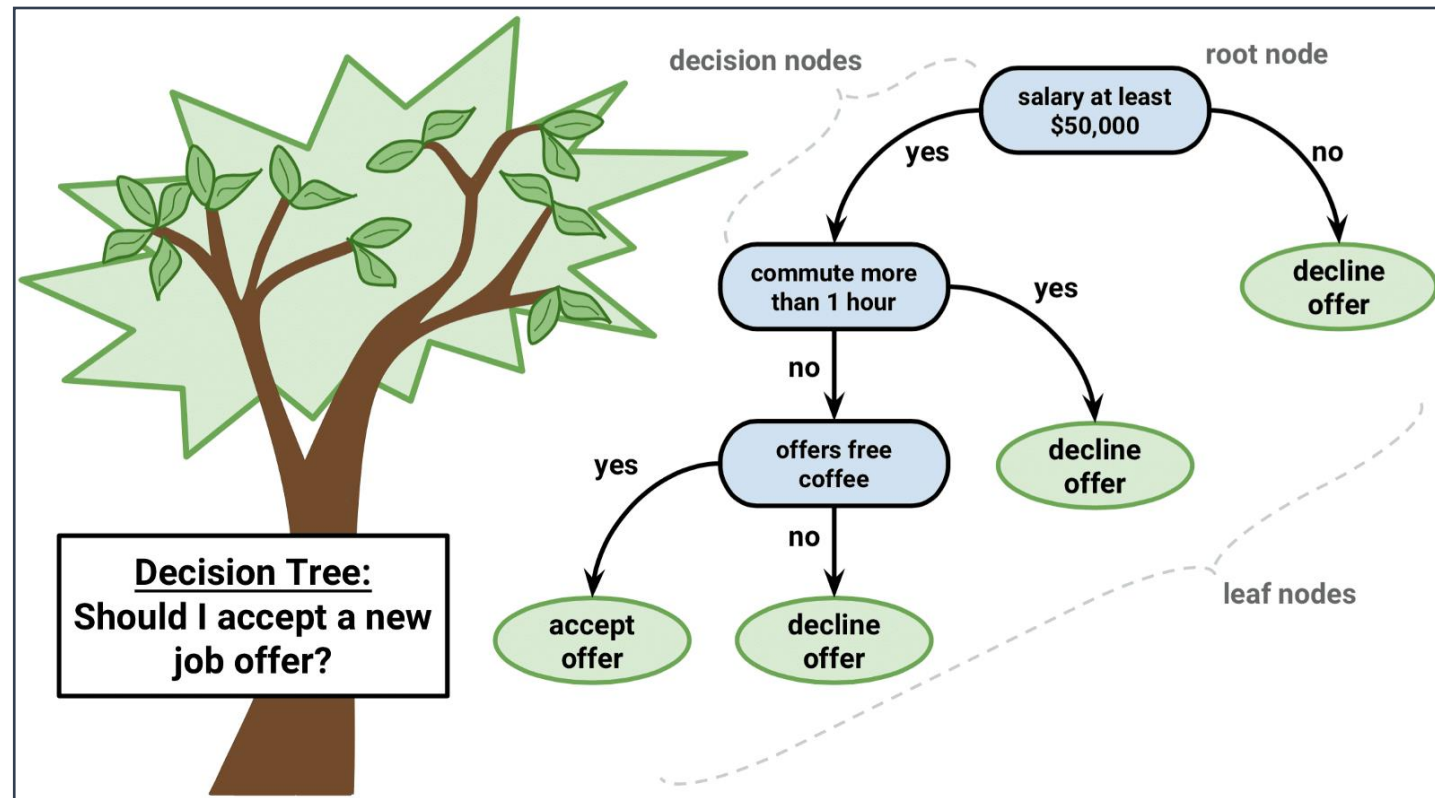
Google Translate



Car mileage based on brand, model, year, weight, etc.

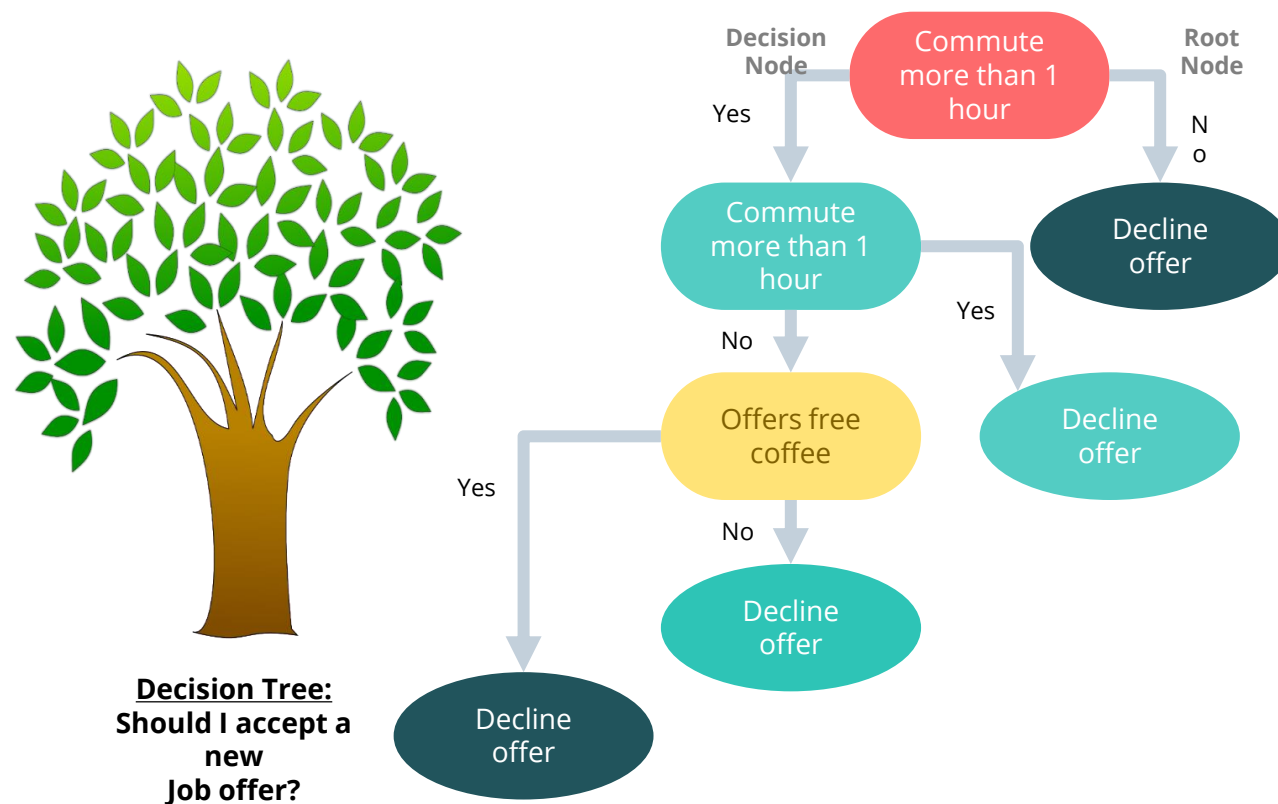
Robot learning to walk

Meaning of Decision Tree



- A **decision tree** is a graphical representation of all the possible solutions to a decision based on a few conditions.
- It uses predictive models to achieve results.
- A decision tree is drawn upside down with its root at the top.

Classification and Regression Trees



- The tree splits into branches based on a condition or internal node.
- The end of the branch that doesn't split anymore is the decision/leaf.
- In this case, the condition whether the employee accepts or rejects the job offer is represented as green oval shaped boxes.
- This tree is called as **classification tree** as the target is to classify whether the job is accepted by the employee or not.
- Regression trees are represented in the same manner, but they predict continuous values like price of a house.
- Decision tree algorithms are referred to as **CART or Classification and Regression Trees**.
- Each node represents a single input variable (x) and a split point on that variable, assuming the variable is numeric.

Quiz Time

Can you think of a use case for
decision tree?

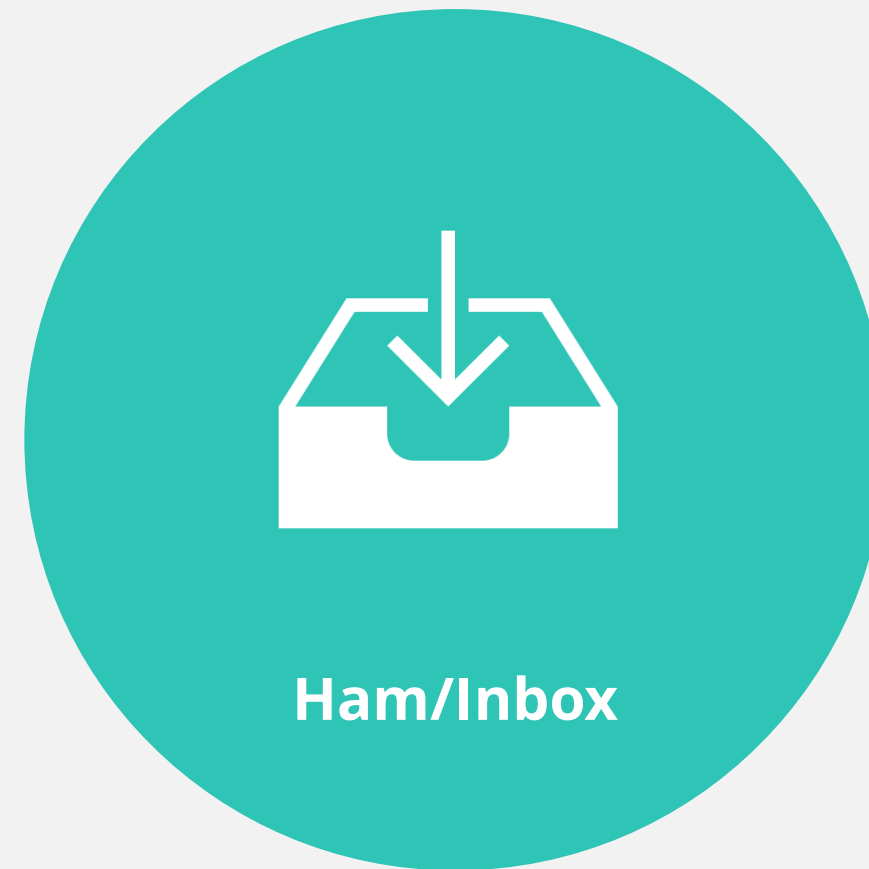


Naive Bayes

- **Naive Bayes** is a simple but surprisingly powerful algorithm for predictive modeling.
- The model comprises of two types of probabilities: the probability of each class and the conditional probability of each class based on the value of x .
- Once calculated, this probability model can be used to make predictions for new data using **Bayes theorem**.
- The probabilities can be easily estimated as bell curve when your data is real valued.

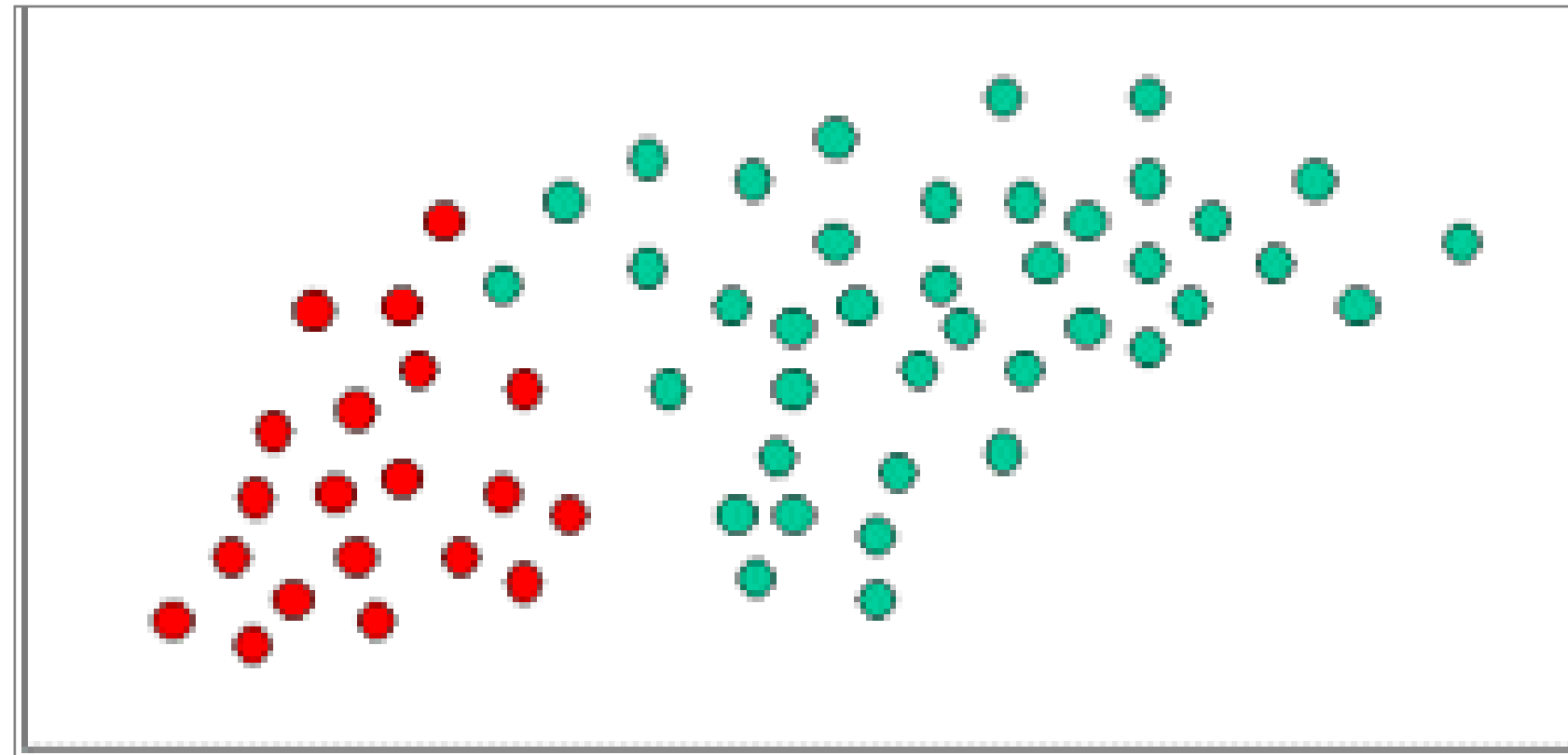
Naive Bayes Example

How does an email client classify between valid and spam emails?



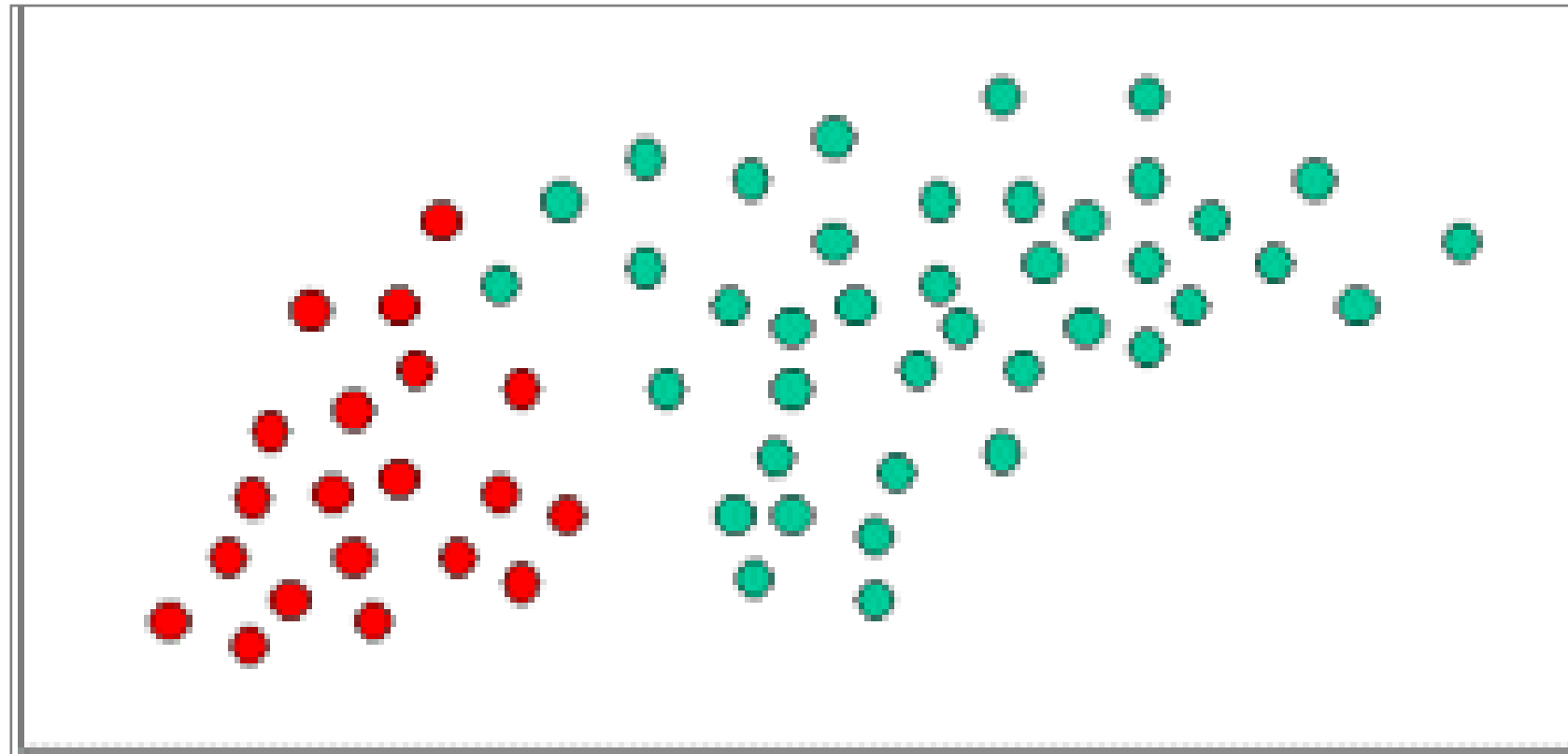
Naive Bayes Classification

- The objects can be classified as either green or red. The task is to classify new cases as they arrive.
- For Example, using Naïve Bayes, you can classify the class labels based on the current objects.
- Since there are twice as many green objects as red, it is reasonable to believe that a new case (which has not been observed yet) has same ratio.



Naive Bayes Classification

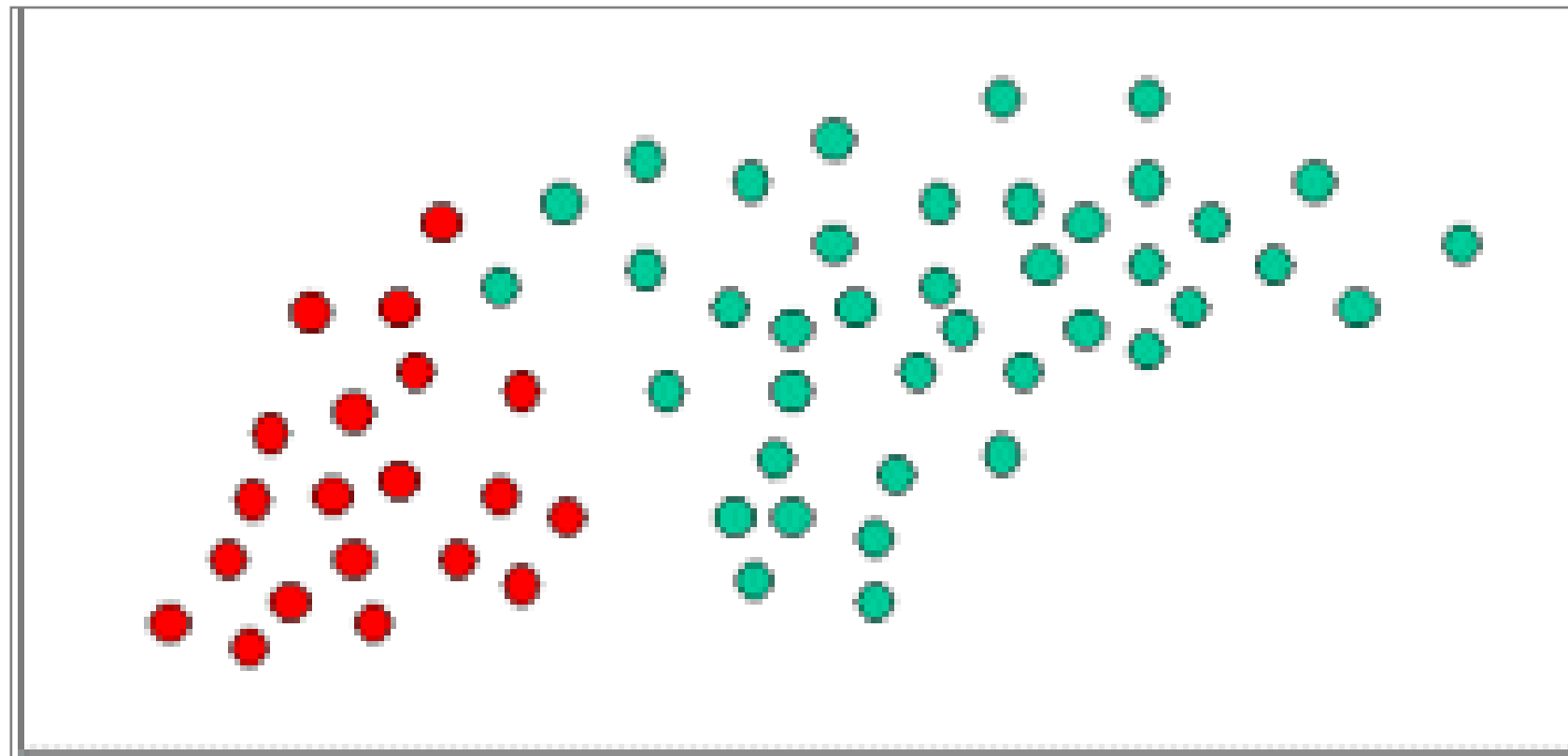
- In Bayesian analysis, this belief is known as **prior probability**.
- Prior probabilities are based on previous experience.
- Prior probability of green: number of green objects/total number of objects
- Prior probability of red: number of red objects/total number of objects



Naive Bayes Classification

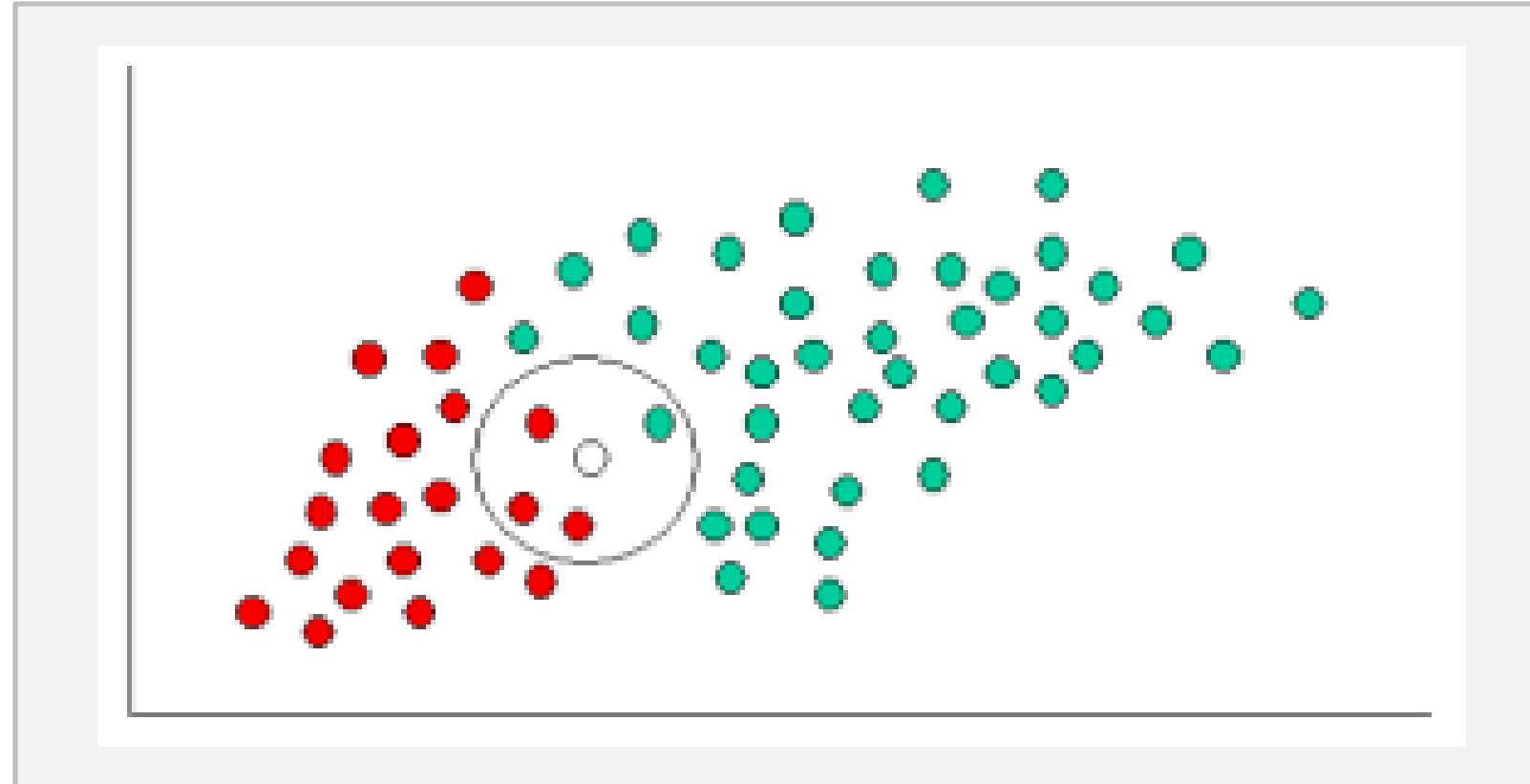
Since there is a total of 60 objects, 40 of which are green and 20 are red, prior probabilities for class membership are:

- Prior probability for green: $40/60$
- Prior probability for red: $20/60$ (number of red objects/total number of objects)



Naive Bayes Classification

- The more green (or red) objects there are in the vicinity of X, the more likely that the new cases will belong to that particular color.
- To measure the likelihood, draw a circle around X which encompasses a number of points irrespective of their class labels.
- Then, calculate the number of points in the circle that belong to each class label.



Naive Bayes Classification

CALCULATION OF LIKELIHOOD

In this illustration, it is clear that likelihood of X given GREEN is smaller than Likelihood of X given RED, since the circle encompasses 1 GREEN object and 3 RED ones.

$$\text{Likelihood of } X \text{ given GREEN} \propto \frac{\text{Number of GREEN in the vicinity of } X}{\text{Total number of GREEN cases}}$$

$$\text{Likelihood of } X \text{ given RED} \propto \frac{\text{Number of RED in the vicinity of } X}{\text{Total number of RED cases}}$$

$$\text{Probability of } X \text{ given GREEN} \propto \frac{1}{40} \quad \text{Probability of } X \text{ given RED} \propto \frac{3}{20}$$

Naive Bayes Classification

CALCULATION OF PRIOR PROBABILITY

- Although the prior probabilities indicate that X may belong to GREEN (given that there are twice as many GREEN compared to RED) the likelihood indicates otherwise.
- The class membership of X is RED (given that there are more RED objects in the vicinity of X than GREEN).
- In Bayesian analysis, the final classification is produced by combining both sources of information, i.e., the prior and the likelihood, to form a posterior probability using Bayes' rule (named after Rev. Thomas Bayes 1702-1761).

Naive Bayes Classification

CALCULATION OF PRIOR PROBABILITY

Posterior probability of X being GREEN \propto

Prior probability of GREEN \times Likelihood of X given GREEN

$$= \frac{4}{6} \times \frac{1}{40} = \frac{1}{60}$$

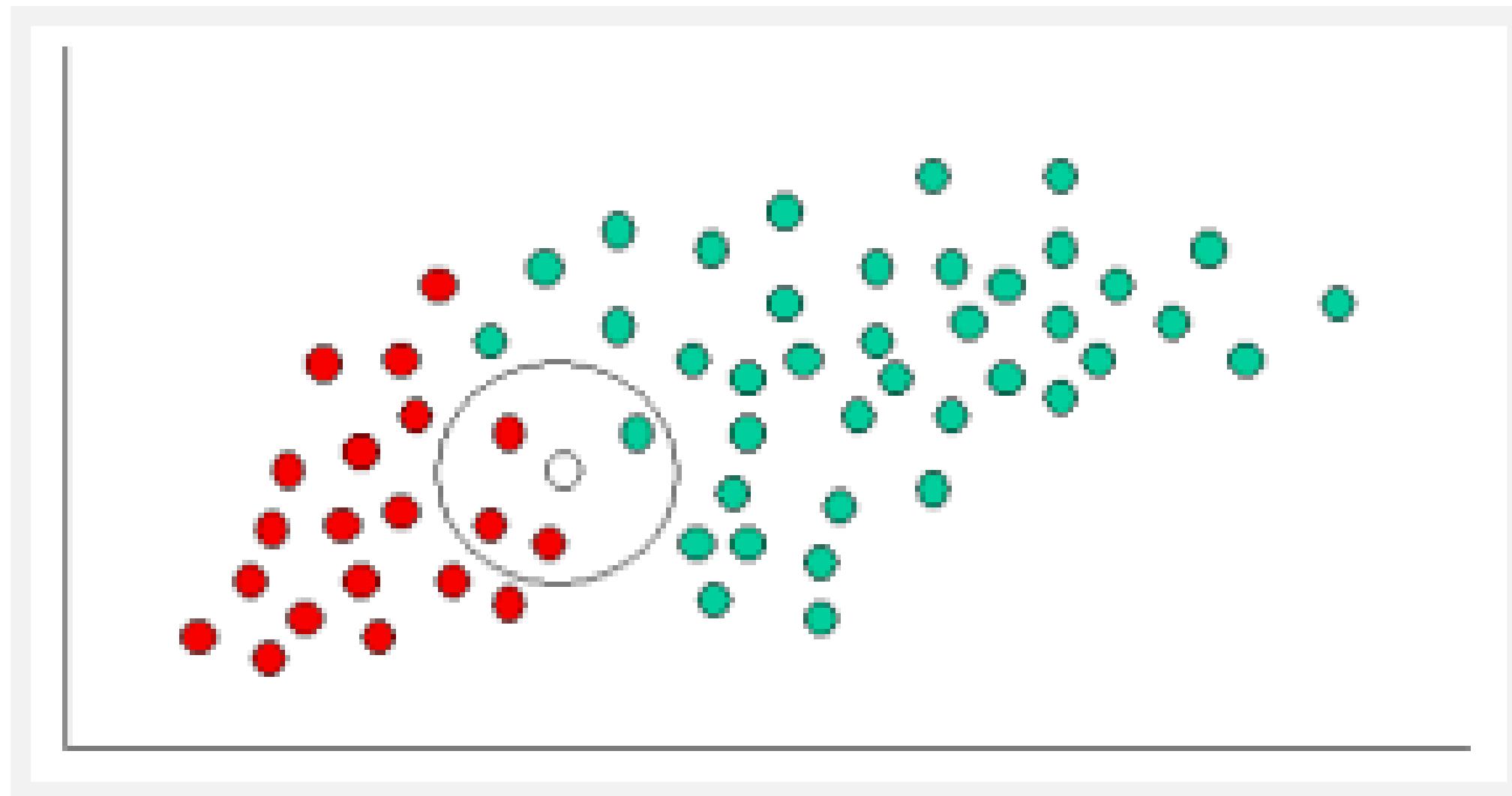
Posterior probability of X being RED \propto

Prior probability of RED \times Likelihood of X given RED

$$= \frac{2}{6} \times \frac{3}{20} = \frac{1}{20}$$

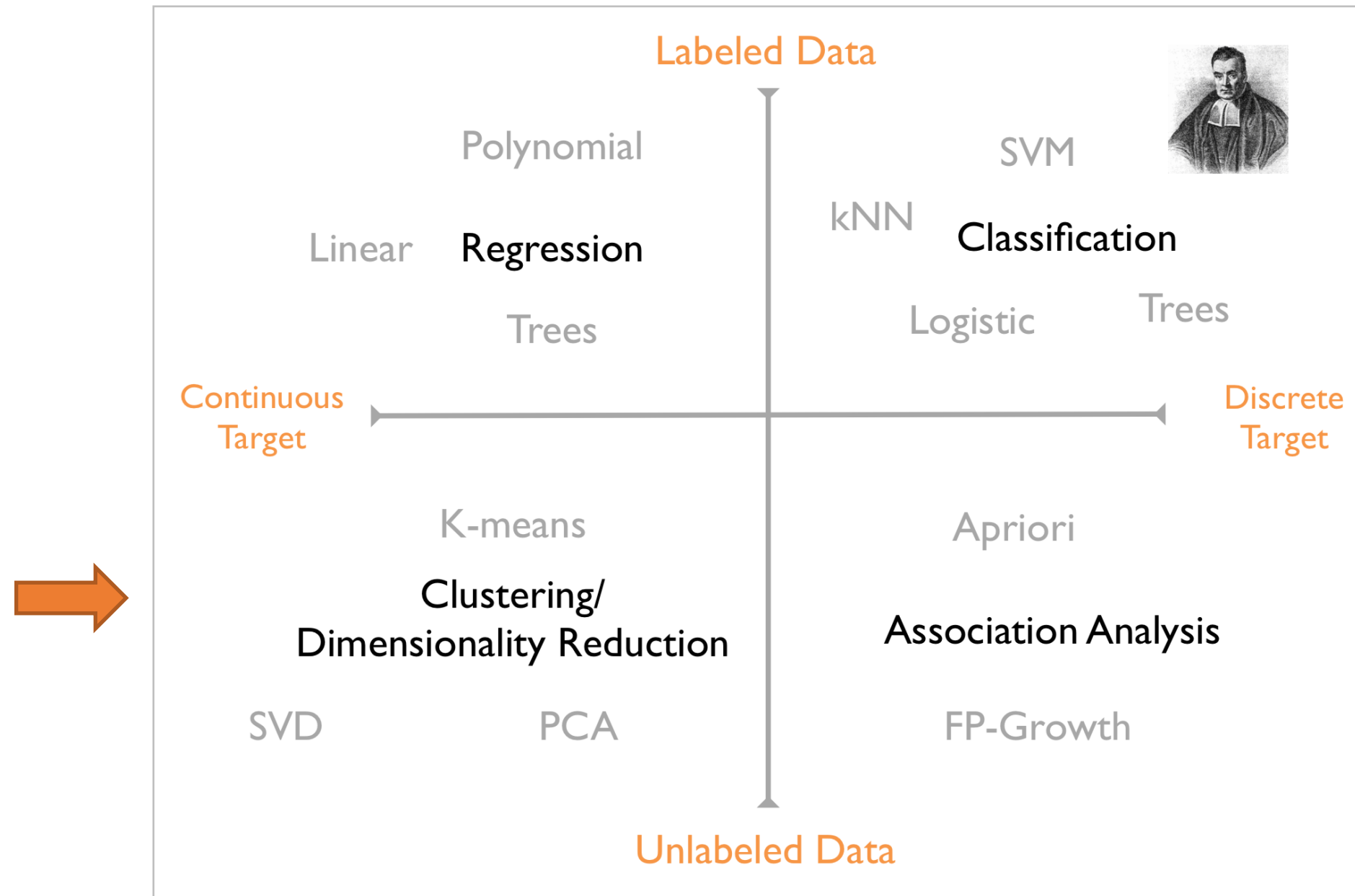
Naive Bayes Classification

Finally, we classify X as RED since its class membership achieves the largest posterior probability.



Machine Learning Algorithms

The next algorithm is K-Means clustering.



K-Means Clustering

- K-Means clustering is an algorithm that can be used for any type of grouping.
- Examples of K-Means clustering:
 - Group images
 - Detect activity types in motion sensors
 - Separate bots from anomalies
 - Segment by purchasing history
- Meaningful changes in data can be detected by monitoring to see if a tracked data point switches groups over time.

K-Means Clustering: Use Cases

Behavioral segmentation

Segment by purchase history

Segment by activities on application, website, or platform

Define personas based on interests

Create profiles based on activity monitoring

Inventory categorization

Group inventory by sales activity

Group inventory by manufacturing metrics

Sorting sensor measurements

Detect activity types in motion sensors

Group images

Separate audio

Identify groups in health monitoring

Detecting bots or anomalies

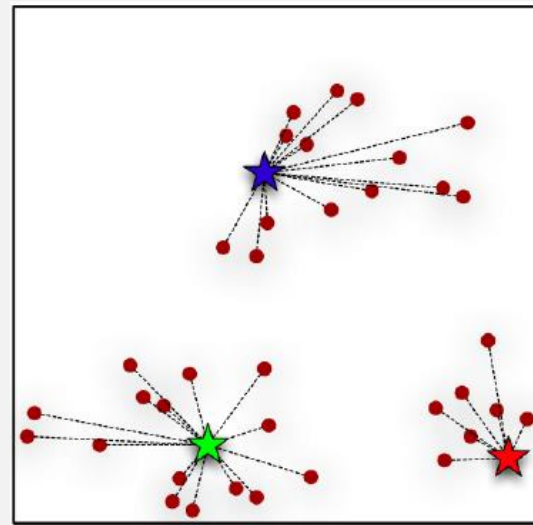
Separate valid activity groups from bots

Group valid activity to clean up outlier detection

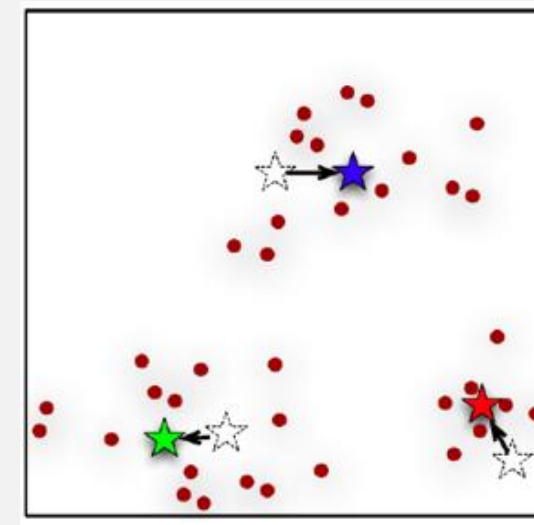
K-Means Clustering for Unsupervised Learning

- To run a K-Means algorithm, randomly initialize three points called the cluster centroids.
- There are three cluster centroids in the image given below since data is grouped into three clusters.

K-Means is an iterative algorithm and it involves two steps:



Step 1: Cluster assignment



Step 2: Move centroid step

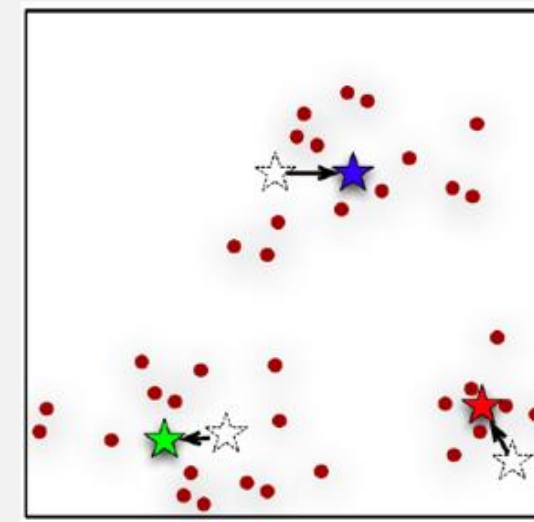
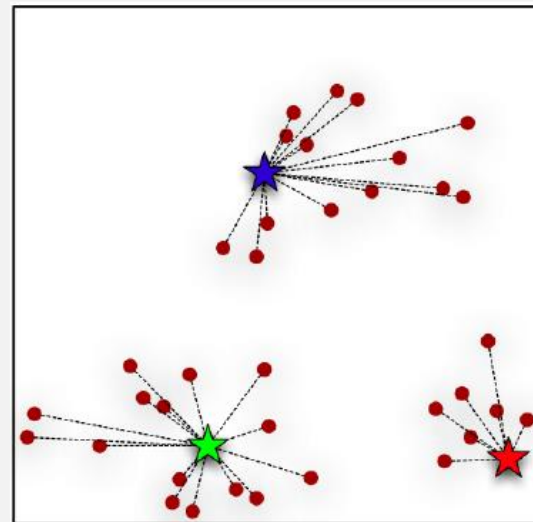
K-Means Clustering for Unsupervised Learning

Step 1:

Algorithm travels through data points, depending on which cluster is closer. It assigns it to red, blue, or green cluster.

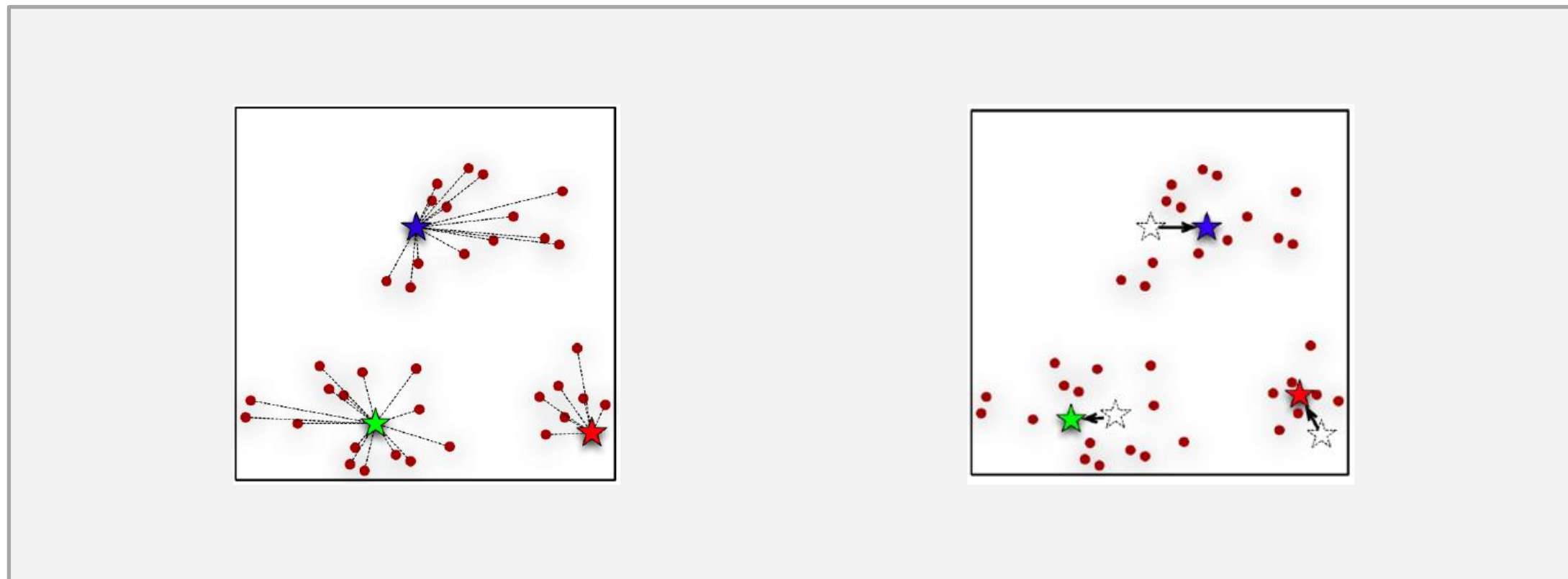
Step 2:

Algorithm calculates average of all points in cluster and moves centroid to the average location.



K-Means Clustering for Unsupervised Learning

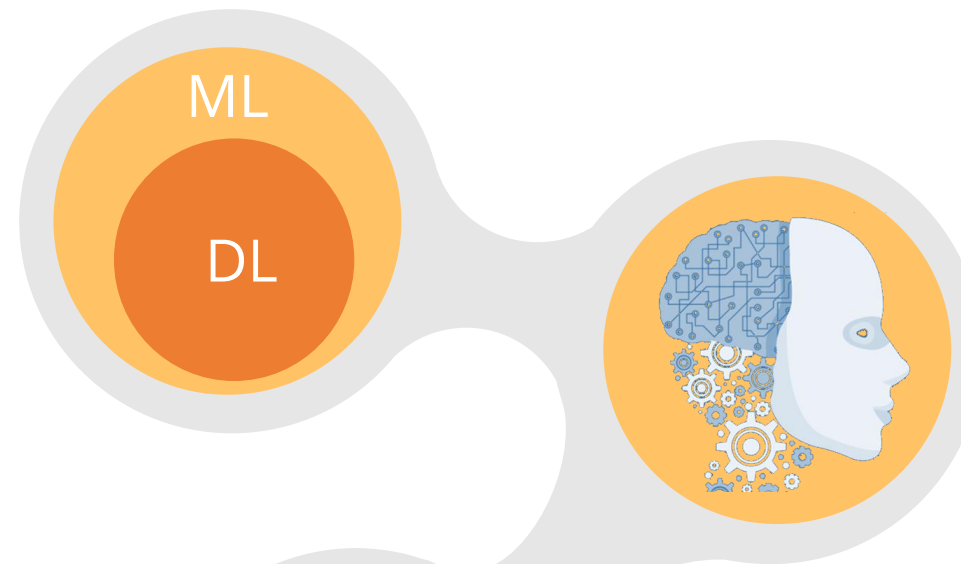
- Steps 1 and 2 are repeated until there are no changes in clusters or when the specified condition is met.
- K is chosen randomly, or elbow plot/silhouette score helps decide it.



Deep Learning

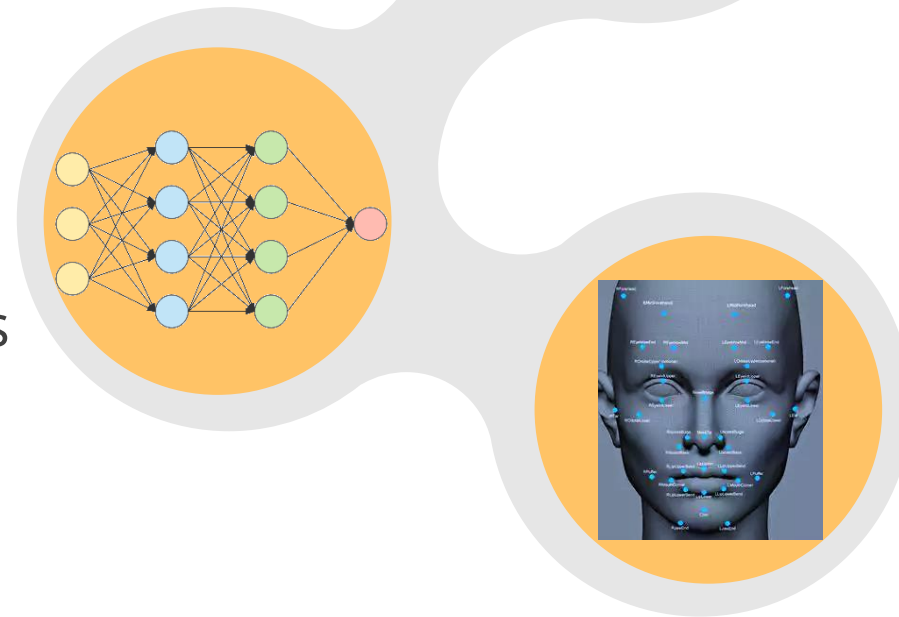
Introduction to Deep Learning

Deep learning (DL) is a subset of machine learning.



The term deep learning refers to **deep artificial neural networks**, and less frequently to deep reinforcement learning.

Deep Neural Networks or DNNs use techniques that mimic the human brain. The DNN algorithms are arranged in layers and they learn patterns of the patterns.



DNNs have set new records in accuracy for many problems such as **image recognition** and **recommender system**.

Definition of Deep Learning

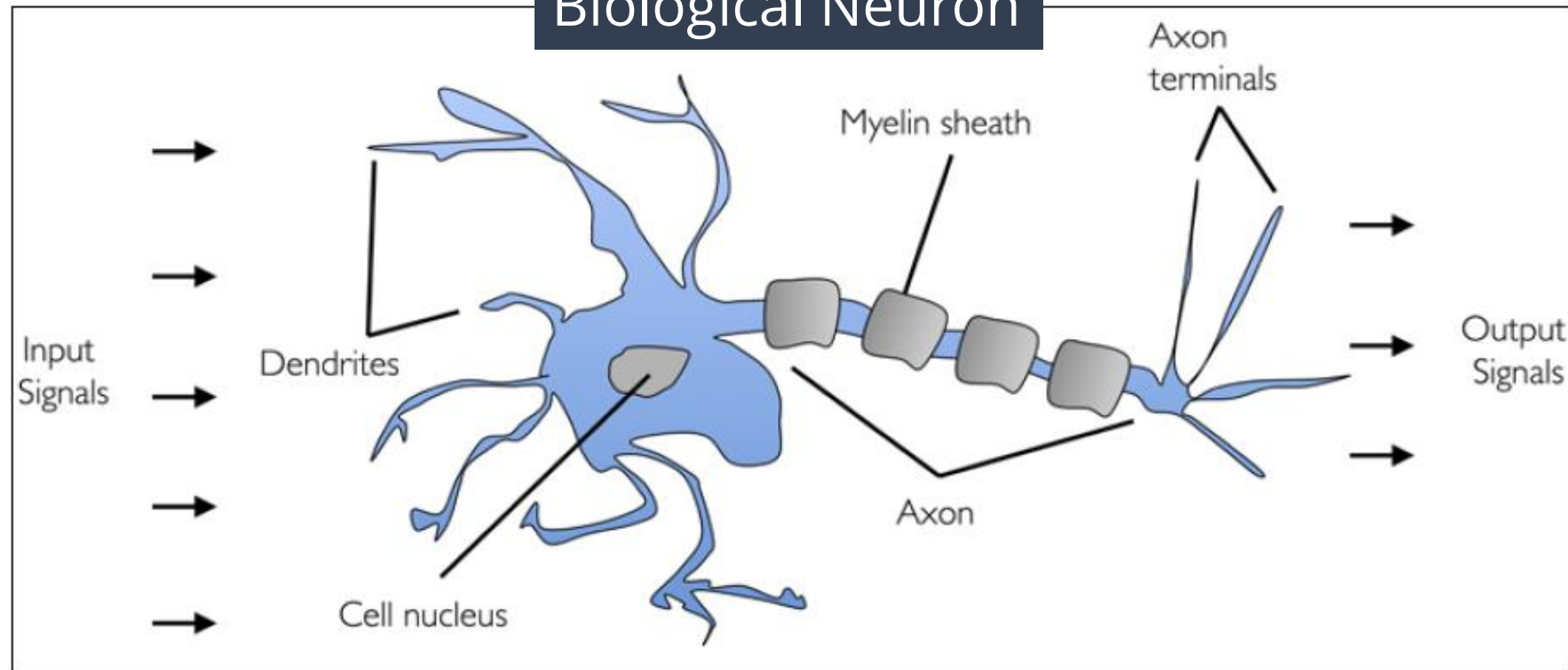
“

Deep learning is a specialized form of machine learning that uses supervised, unsupervised, or semi-supervised learning to learn from data representations. It is similar to the structure and function of the human nervous system, where a complex network of interconnected computation units work in a coordinated fashion to process complex information.

”

Neural Networks of Human Brain

Biological Neuron



- Our brain consists of approximately 86 billion interconnected **neurons**.
- Neurons are interconnected nerve cells in the human brain that are involved in processing and transmitting chemical and electrical signals.
- They take input and pass along outputs.
- Each neuron responds to certain stimuli and passes output to another.

Neural Networks of Human Brain



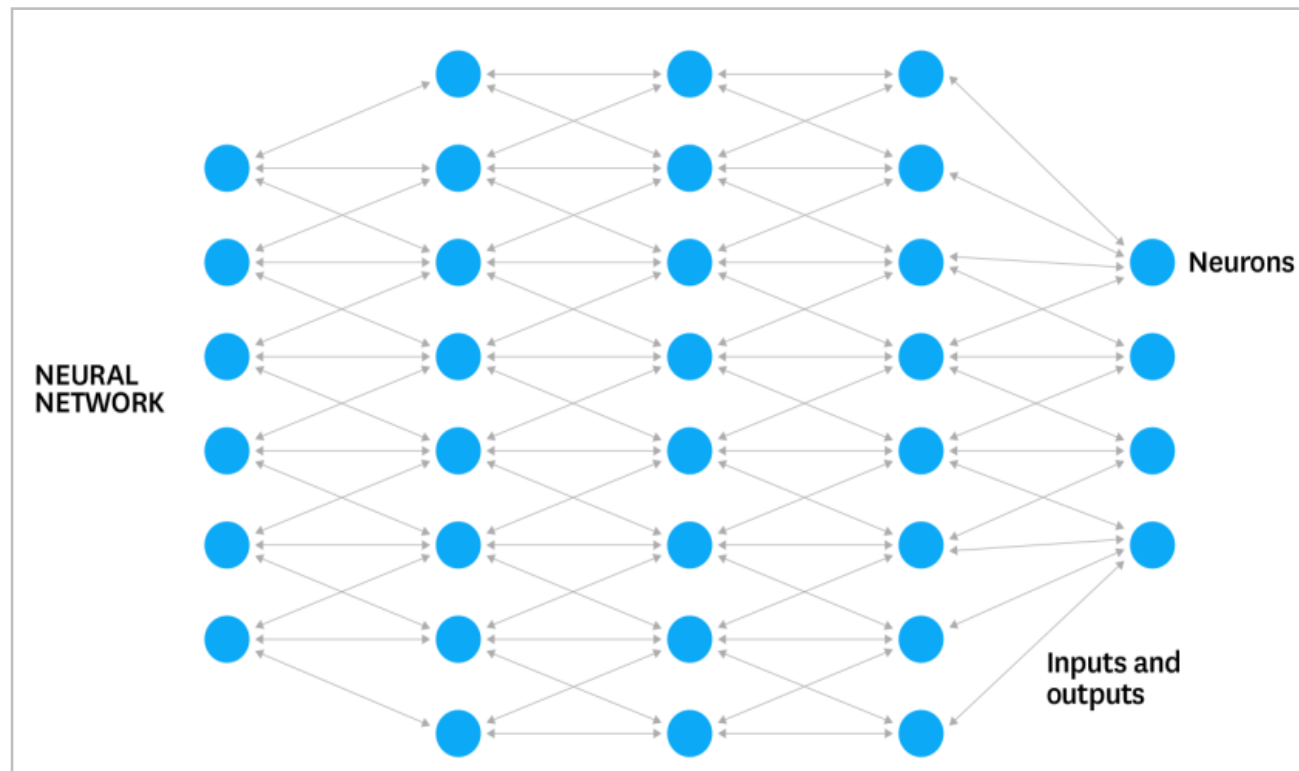
- A **human brain** can learn how to identify objects from photos.
- For example, the brain could use several neurons to understand and interpret that the animal seen is a dog (with details such as fur, eyes, tail, etc).
- Each of these neurons may have a different weightage (governed by how important the feature is) to the overall image.
- If all these neurons fire in the same direction, our brain tells us that we saw a dog.
- Furthermore, neurons also fire up to tell us that what kind of dog it is (Doberman, German shepherd etc).

Neural Networks of Human Brain



- Babies, from the time they are born until they grow up to be toddlers, learn to recognize and distinguish multiple objects like trees, dogs, cats, bottles etc.
- The more data you feed or teach them, the better their recognition capabilities become.
- Imagine the number of “**training**” examples of each they must have seen to be able to distinguish these things.
- The same goes for **machine learning and deep learning** applications like facial recognition, image/object recognition, etc. The more data we feed the model, the better it becomes.

Artificial Neural Networks



- Neural networks are a set of algorithms that are modeled loosely after the human brain and are designed to recognize patterns.
- The multiple layers of training are called **Artificial Neural Networks (ANN)**.
- Each input is separately weighted, and the sum is passed through a non-linear function known as an activation function or transfer function.

Artificial Neural Network: Definition

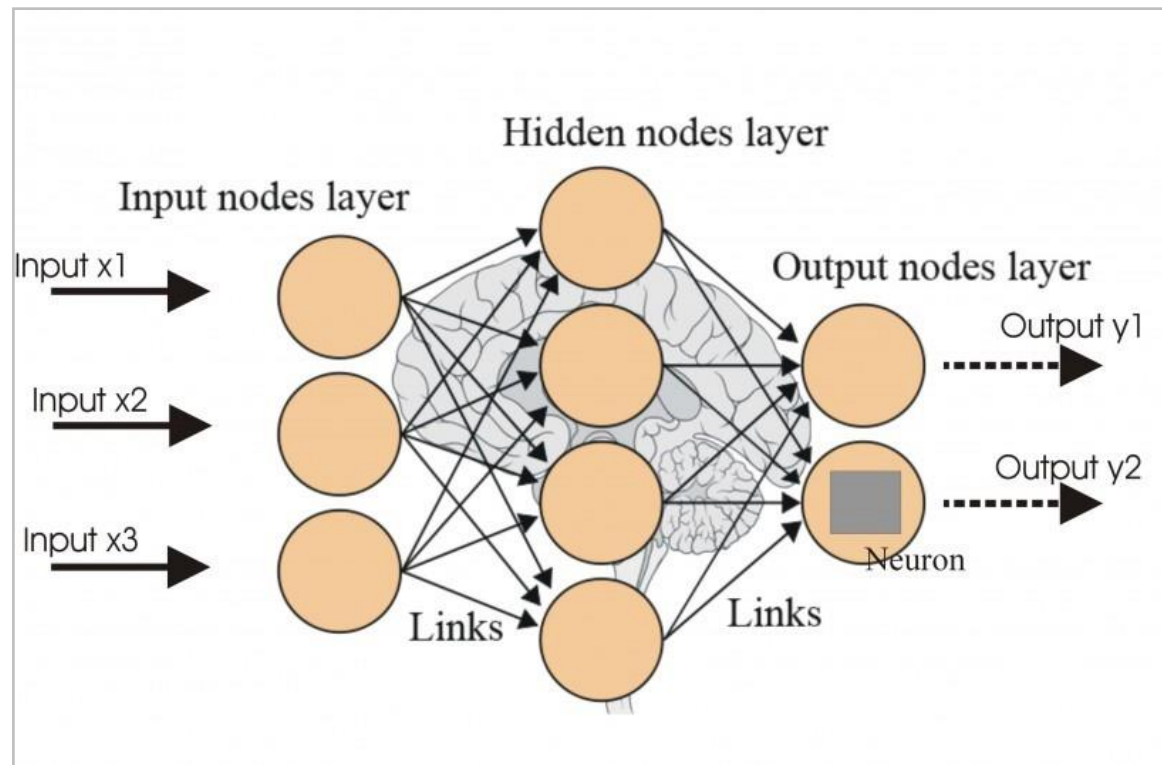
“

“Artificial Neural Network (ANN) is a computing system made up of a number of simple, highly interconnected processing elements which process information by their dynamic state response to external inputs.”

- Robert Hecht-Nielsen

”

Features of Artificial Neuron



- **Artificial neurons** interpret sensory data through machine perception, labeling, or clustering raw input.
- They recognize numerical patterns contained in vectors. These vectors contain real world data such as images, sound, text, or time series.
- Neural networks help to cluster and classify the raw input.
- They can be considered a clustering and classification layer on top of the data stored and managed.
- They classify labeled dataset based on expected results.
- They group unlabeled dataset based on the similarities in the inputs.

Definition of Perceptron

“

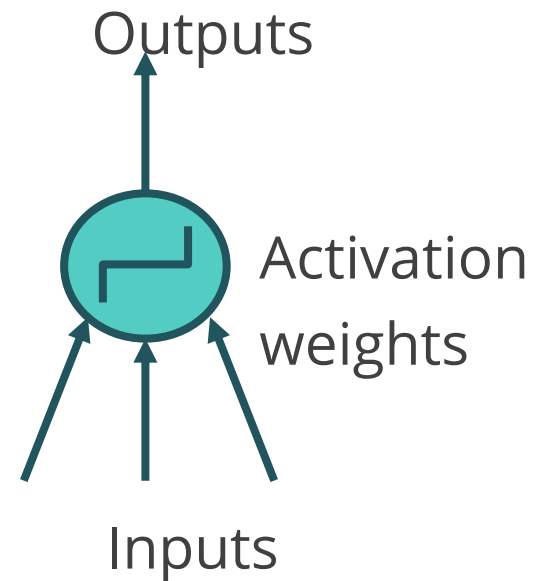
A **perceptron** is a neural network unit (an artificial neuron) that does certain computations to detect features or business intelligence in the input data.

”

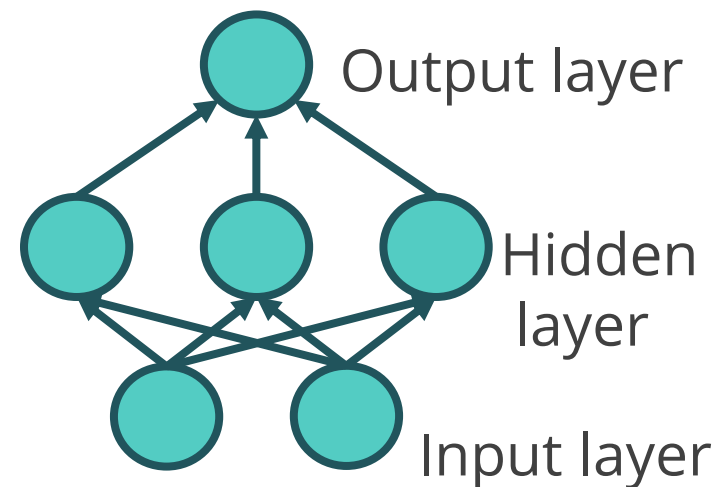
Meaning of Multilayer Perceptron

- The field of artificial neural networks is often called **neural networks or multilayer perceptron**.
- A perceptron is a single neuron model that is a precursor to larger neural networks.
- It investigates how simple models of biological brains can be used to solve difficult computational tasks like the predictive modeling in machine learning.
- The goal is to develop robust algorithms and data structures that can be used to model difficult problems.

Structure of Multilayer Perceptron



Model of a simple neuron



Model of a simple network

- A row of neurons is called a **layer**, and one network can have multiple layers.
- The architecture of the neurons in the network is often called the **network topology**.
- Layers after the input layer are called hidden layers because they are not directly exposed to the input.
- The simplest network structure is to have a single neuron in the hidden layer that directly outputs the value.
- The final hidden layer is called the output layer.

Online and Batch Learning

- Once configured, the neural network needs to be trained on the dataset.

Online learning

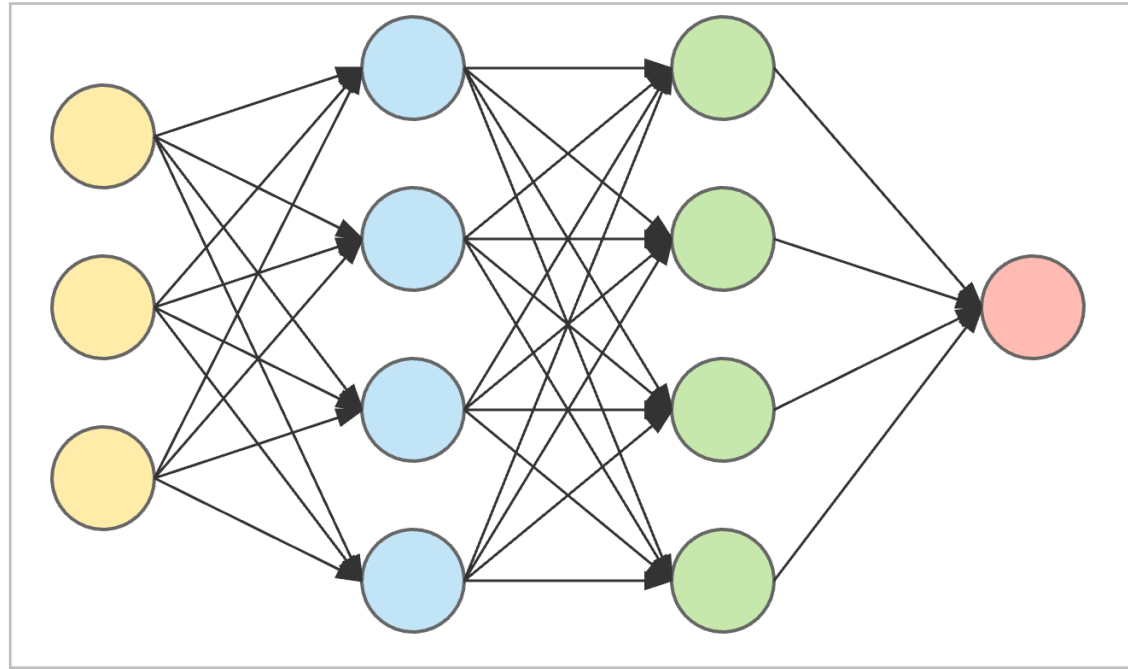
The weights in the network are updated from the errors calculated for each training example. This is called **online learning**.

Batch learning

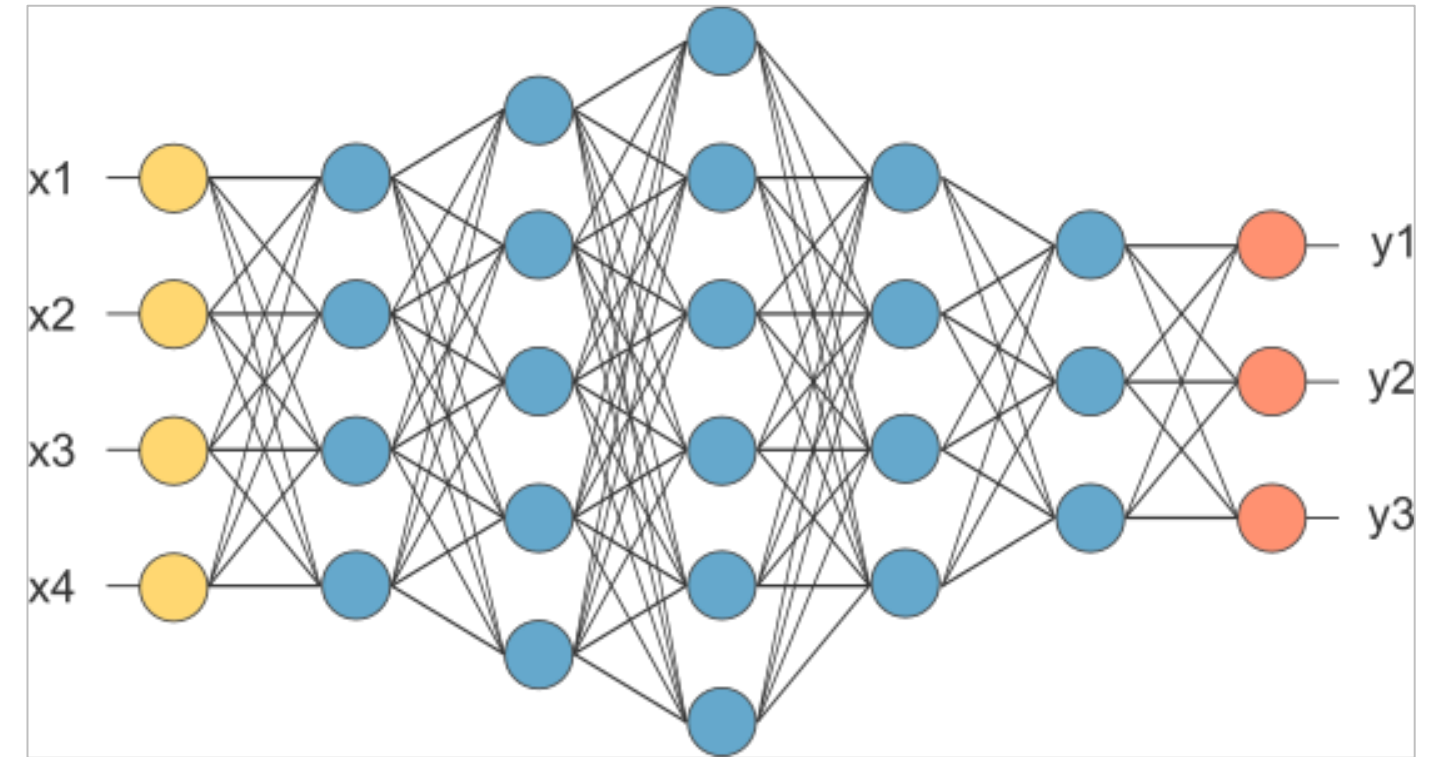
The errors can be saved up across all of the training examples, and the network can be updated at the end. This is called **batch learning**.

- Once a neural network has been trained, it can be used to make predictions.

Deep Neural Networks

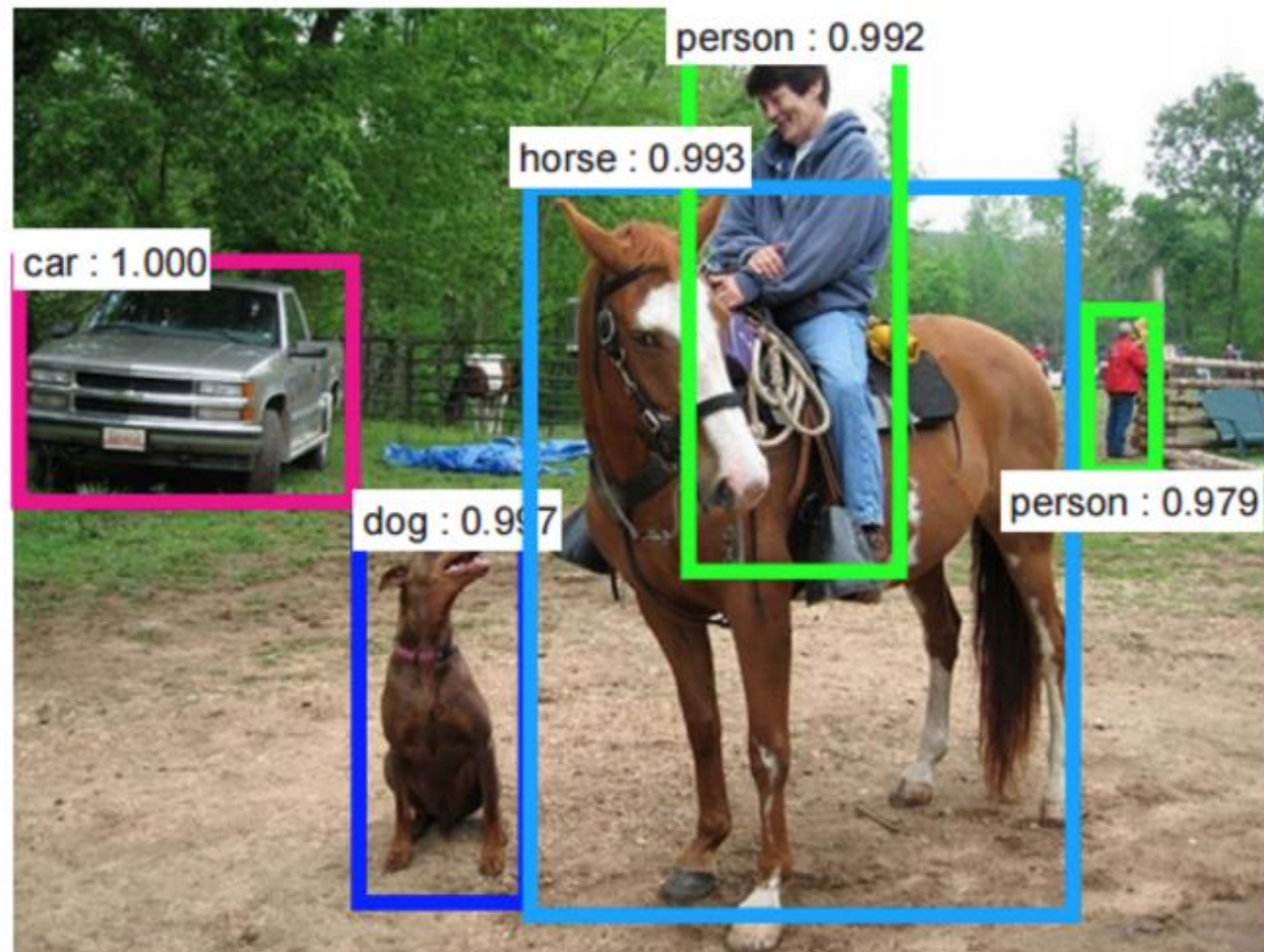


- **Artificial Neural Networks (ANN)** are multi-layer fully-connected neural nets.



- **Deep Neural Networks (DNN)** are layers that have more than one hidden layer between input and output layers.

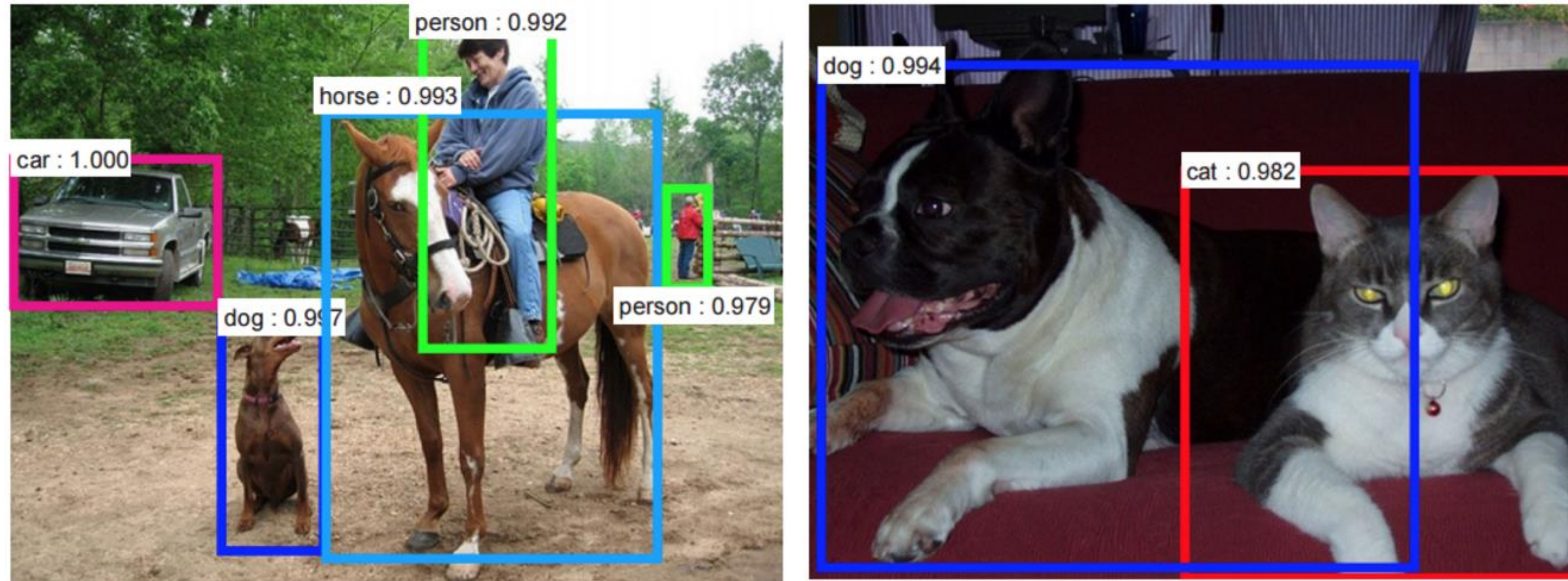
Convolutional Neural Networks (CNN)



Convolutional Neural Networks

- Convolutional Neural Networks (CNN) are neural networks mainly used for image processing and classification.

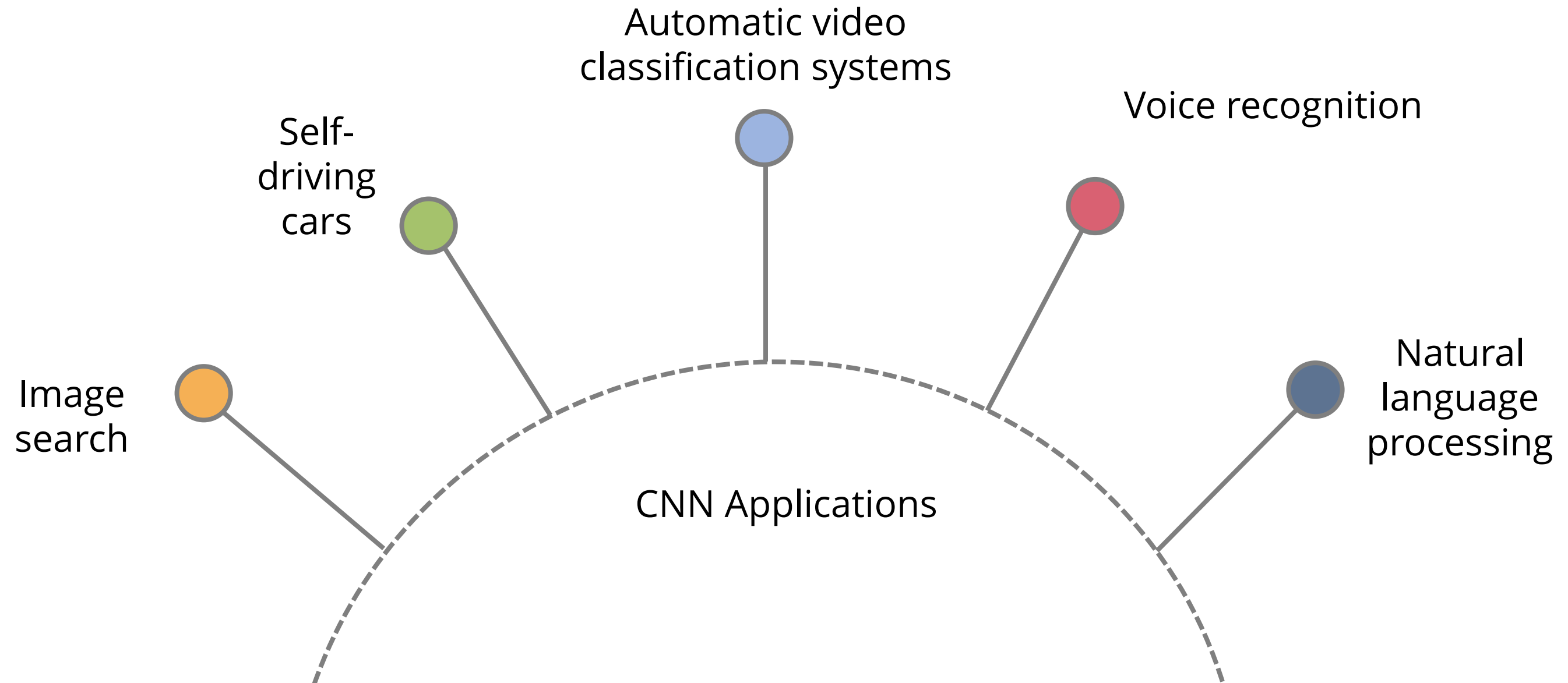
Convolutional Neural Network (CNN)



Until quite recently, computers were not good at tasks like recognizing a puppy in a picture or recognizing spoken words, which humans excel at.

Uses of CNN

CNN is trained and used in the following ways:



Quiz Time

Do you think artificial intelligence would surpass human intelligence?



Predicted Future: AI in News

Google develops artificial intelligence algorithm that predicts your death with 95% accuracy.

Singularity is predicted to be achieved by 2045 when computers will have the same level of intelligence as that of humans.

Forbes estimates that 85% of customer interactions will be managed by AI by 2020.

The world's leading car manufacturers predict driverless cars will be on the streets by 2020–2030.

Doomsday AI machines could lead to nuclear war, think tank paper warns.

Predicted Future of AI

1 The accelerating pace of change ...



2 ... and exponential growth in computing power ...

Computer technology, shown here climbing dramatically by powers of 10, is now progressing more each hour than it did in its entire first 90 years



Colossus

The electronic computer, with 1,500 vacuum tubes, helped the British crack German codes during WW II



UNIVAC I

The first commercially marketed computer, used to tabulate the U.S. Census, occupied 943 cu. ft.



Apple II

At a price of \$1,298, the compact machine was one of the first massively popular personal computers

3 ... will lead to the Singularity

COMPUTER RANKINGS

By calculations per second per \$1,000



Analytical engine

Never fully built, Charles Babbage's invention was designed to solve computational and logical problems



Power Mac G4

The first personal computer to deliver more than 1 billion floating-point operations per second

10²⁶ → 2045
Surpasses brainpower equivalent to that of all human brains combined

10²⁰
Surpasses brainpower of human in 2023



10¹⁵
Surpasses brainpower of mouse in 2015



10,000,000,000

100,000

1

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Future Forecasted Revenue of AI

The Future Of A.I.

Forecasted cumulative global artificial intelligence revenue 2016-2025, by use case (U.S. dollars)



Key Takeaways

- Machine learning algorithm learns from data, whereas statistical model is a formalization of relationships between variables.
- Supervised learning, unsupervised learning, and semi-supervised learning are the three types of machine learning.
- Reinforcement learning is an area of machine learning which is used when the training data has a feedback loop.
- A decision tree is a tree-like graph that uses the branching method to demonstrate every possible outcome of a decision.



Key Takeaways

- Naive Bayes' is a classification technique which assumes that the presence of a particular feature in a class is unrelated to the presence of any other feature.
- K-means clustering is a type of unsupervised learning, which is used to solve clustering problem.
- Neural networks are set of algorithms that are modeled loosely after the human brain and are designed to recognize patterns.





Knowledge Check

Knowledge Check

1

What are the different ways in which a machine can learn?

- A. Supervised and unsupervised
- B. Supervised, unsupervised, and semi-supervised
- C. Unsupervised and semi-supervised
- D. Supervised and semi-supervised



Knowledge Check

1

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- B. Supervised, unsupervised, and semi-supervised
- C. Unsupervised and semi-supervised
- D. Supervised and semi-supervised



The correct answer is **B**

Supervised, unsupervised, and semi-supervised

Knowledge Check

2

Give applications of each type of machine learning.

- A. Supervised: clustering, unsupervised: airplane booking, semi-supervised: Image recognition
- B. Supervised: web page classification, unsupervised: spam detection, semi-supervised: mapping or clustering
- C. Supervised and unsupervised: bioinformatics, semi-supervised: mapping or clustering
- D. Supervised: bioinformatics, unsupervised: supply chain carrier analysis, mapping/clustering, semi-supervised: web page classification



Knowledge Check

2

Give applications of each type of machine learning.

- A. Supervised: clustering, unsupervised: airplane booking, semi-supervised: Image recognition
- B. Supervised: web page classification, unsupervised: spam detection, semi-supervised: mapping or clustering
- C. Supervised and unsupervised: bioinformatics, semi-supervised: mapping or clustering
- D. Supervised: bioinformatics, unsupervised: supply chain carrier analysis, mapping/clustering, semi-supervised: web page classification



The correct answer is **D**

Supervised: bioinformatics, unsupervised: supply chain carrier analysis, mapping/clustering, semi-supervised: web page classification

Knowledge Check

3

What are some of the machine learning Algorithms?

- A. Decision trees, XGboost, Google Vision API
- B. Random forests, regression (linear and logistic) but not KNN
- C. Regression, decision trees, Naive Bayes, K-Means clustering
- D. XGboost, Adaboost, regression except Naive Bayes



Knowledge Check

3

What are some of the machine learning Algorithms?

- A. Decision trees, XGboost, Google Vision API
- B. Random forests, regression (linear and logistic) but not KNN
- C. Regression, decision trees, Naive Bayes, K-Means clustering
- D. XGboost, Adaboost, regression except Naive Bayes



The correct answer is **C**

Regression, decision trees, Naive Bayes, K-Means clustering

Knowledge Check

4

What is the basic concept of deep learning?

- A. Deep learning is a subset of machine learning in Artificial Intelligence (AI) with networks capable of learning unsupervised from data that is unstructured or unlabeled.
- B. Machine learning is a subset of deep learning in Artificial Intelligence (AI) that has human brain networks capable of learning unsupervised from data that is unstructured or unlabeled.
- C. Deep learning is a set of algorithms that are arranged one after another in tandem (like regression, KNN, Naive Bayes, decision trees), to enable maximum accuracy.
- D. None of the above



Knowledge Check

4

What is the basic concept of deep learning?

- A. Deep learning is a subset of machine learning in Artificial Intelligence (AI) with networks capable of learning unsupervised from data that is unstructured or unlabeled.
- B. Machine learning is a subset of deep learning in Artificial Intelligence (AI) that has human brain networks capable of learning unsupervised from data that is unstructured or unlabeled.
- C. Deep learning is a set of algorithms that are arranged one after another in tandem (like regression, KNN, Naive Bayes, decision trees), to enable maximum accuracy.
- D. None of the above



The correct answer is **A**

Deep learning is a subset of machine learning in Artificial Intelligence (AI) that has networks capable of learning unsupervised from data that is unstructured or unlabeled. Also known as Deep Neural Learning or Deep Neural Network.