جامعة المستقبل
AL MUSTAQBAL UNIVERSITY


# قسم الانظمة الطبية الذكية

## المرحلة الثالثة

# Third lecture

**Subject: Artificial Intelligence AII**

**Class: Third**

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University of Information Technology
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College of Medical Informatics
Intelligent Medical Systems Department

# Machine Learning Course

*Lecture One*

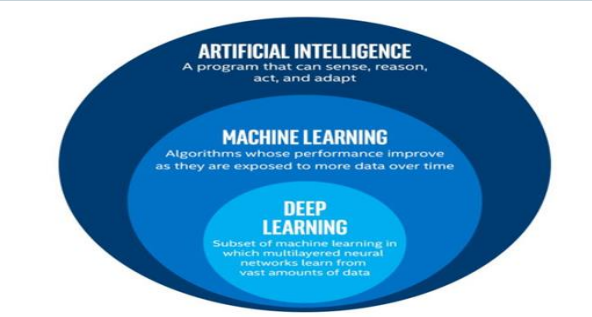
*By: Dr. Muneera Abed Hmdi*

# What is Artificial intelligence

- ***Artificial intelligence AI focuses on modern Machine learning (ML) , techniques before we discuss it, lets review what is Artificial intelligence (AI)?***

- ***Artificial intelligence (AI)*** is technology that enables computers and machines to simulate human learning, comprehension, problem solving, decision making, creativity and autonomy.

***Another Definition:***




- ***Artificial intelligence (AI)*** is the capability of a machine to imitate intelligent human behavior. It enables the machine to think without any human interventions so that the machine will be able to take its own decision.

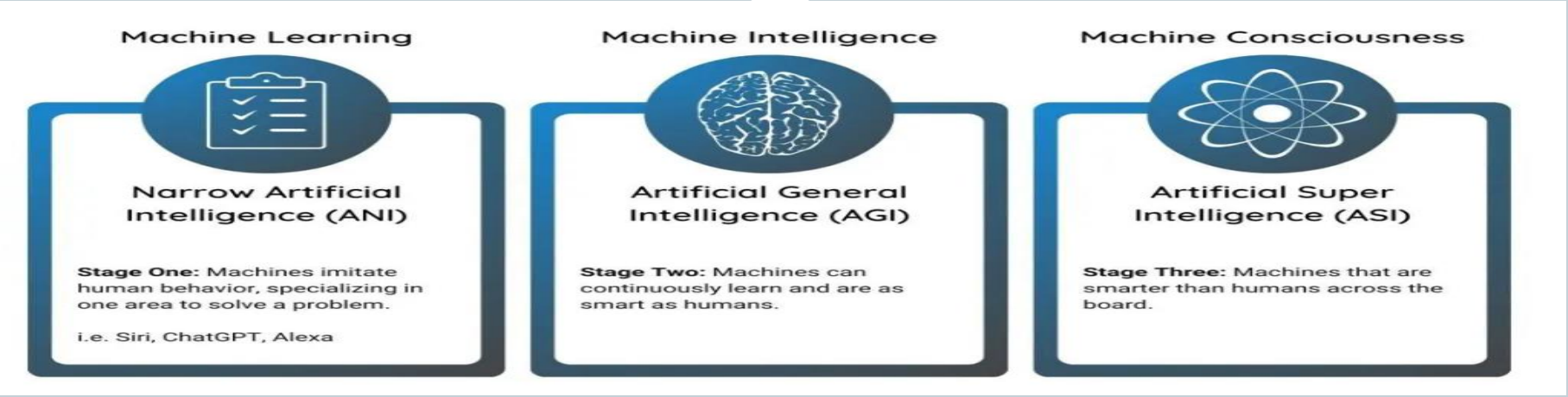
# *Types of Artificial Intelligence*

- ***Narrow AI***, also known as Weak AI, refers to AI systems designed to perform specific tasks efficiently. These systems excel in one area but lack the ability to generalize their knowledge beyond that specific task. Examples of narrow AI include voice assistants like Siri and Alexa, recommendation algorithms, and facial recognition software.

- ***General AI***, also known as Strong AI or Human-Level AI, aims to possess human-like intelligence. This type of AI would have the ability to understand, learn, and apply knowledge across different domains, like how humans can adapt to various situations. Achieving General AI is a significant scientific and technological challenge that researchers and experts are actively working on.

- ***Superintelligent AI,*** surpasses human intelligence in almost every aspect. It would possess superior cognitive abilities and problem-solving skills, enabling it to outperform humans in various complex tasks.

# *Types of Artificial Intelligence*




- ***E.g.*** of artificial narrow intelligence (ANI), smart speaker, self-driving care, web search.

- ***E.g.*** of artificial general intelligence (AGI), ChatGPT, Bard.
- ***E.g.*** of artificial supper intelligence (ASI), Can do anything a huma can do.

# What Is Deep Learning?

- ***Machine learning (ML):*** Is the practice of using ***algorithms*** to ***analyze*** data, ***learn*** from that data, and then ***make predictions*** about new data.

- ***Machine learning (ML):*** Allows the systems to ***make decisions*** autonomously without any external support. These ***decisions*** are made when the machine can learn from the data and understand the ***underlying patterns*** that are contained within it. Then, through ***pattern matching*** and ***further analysis***, they return the ***outcome*** which can be ***classification or prediction***.

- ***Deep learning (DL):*** Is advanced or sophisticated techniques that can be used to implement Machine Learning. In other words, is a subset of machine learning that uses artificial neural networks to process and analyze information. Neural networks are composed of computational nodes that are layered within deep learning algorithms. Each layer contains an input layer, an output layer, and a hidden layer.

# What is Artificial intelligence AII

- ***Artificial intelligence AII course provides a broad introduction to modern machine learning, including:***

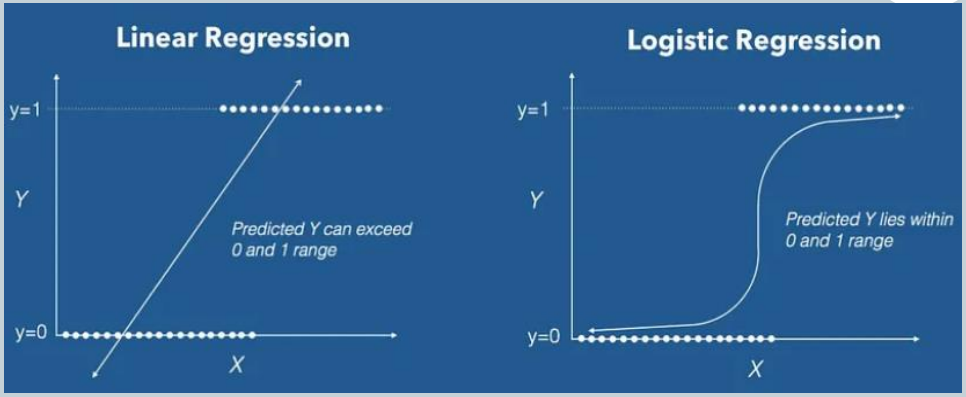
- ***Supervised learning algorithms*** (Linear regression, logistic regression, decision trees, support vector machine and neural networks).

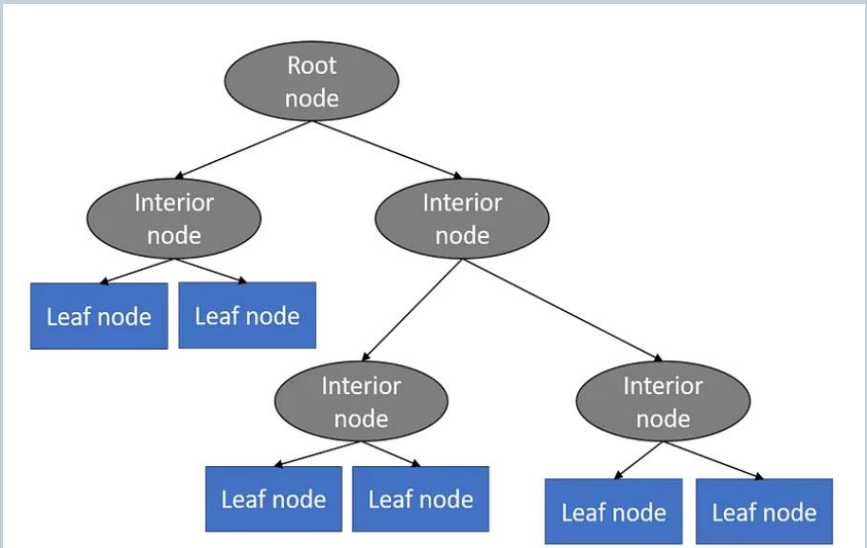
- ***Unsupervised learning*** (clustering, dimensionality reduction, recommender systems).

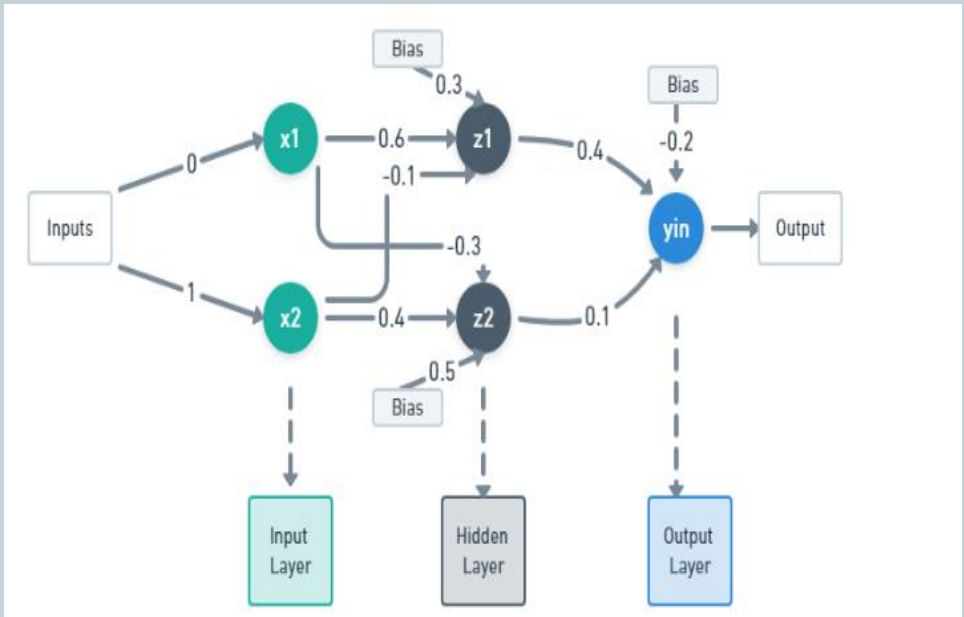
- Some of the ***best practices in machine learning innovation*** (evaluating and tuning models to improve the performance of ML models, and more).

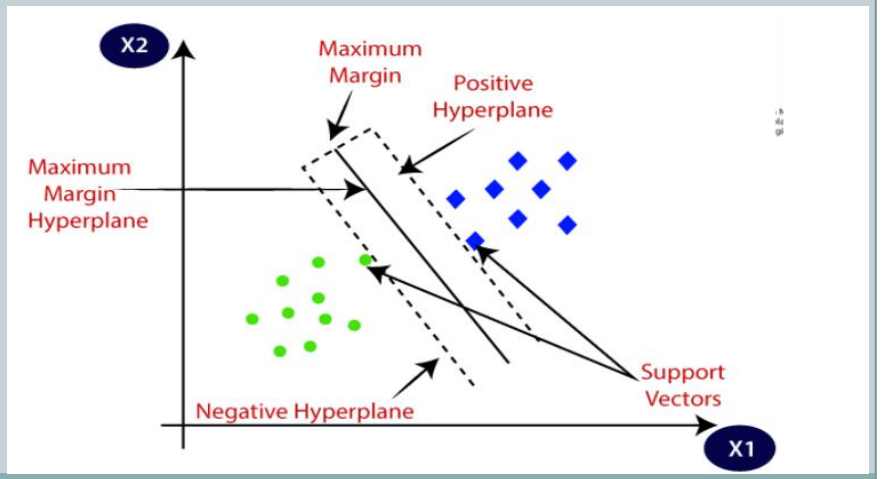
- At the end of this course, students will gain the ***practical know-how to quickly and powerfully apply machine learning*** to challenging real-world problems.

# Examples of Supervised learning algorithms

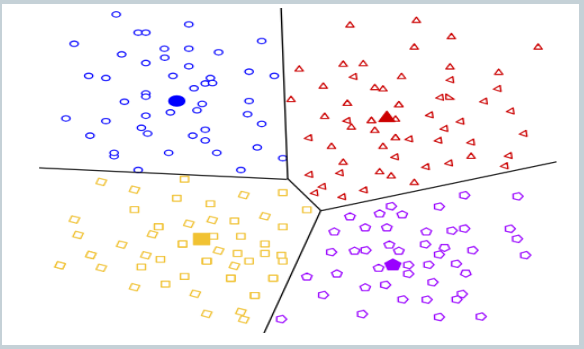


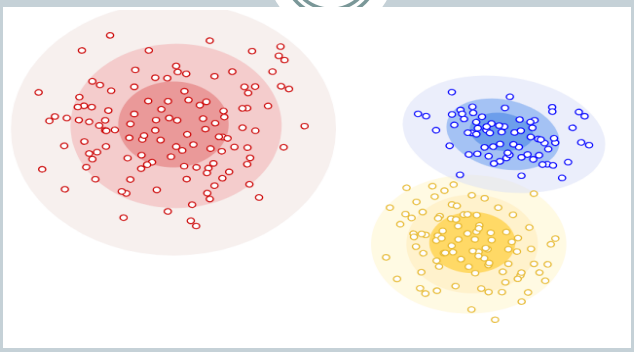



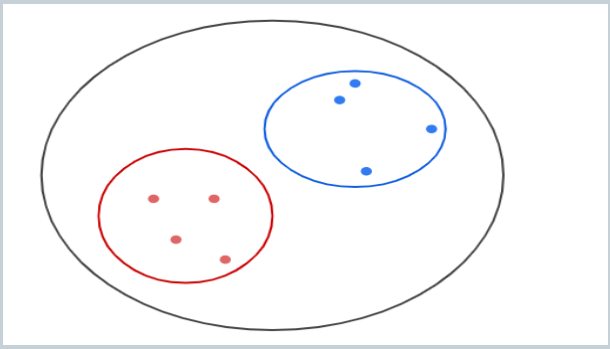



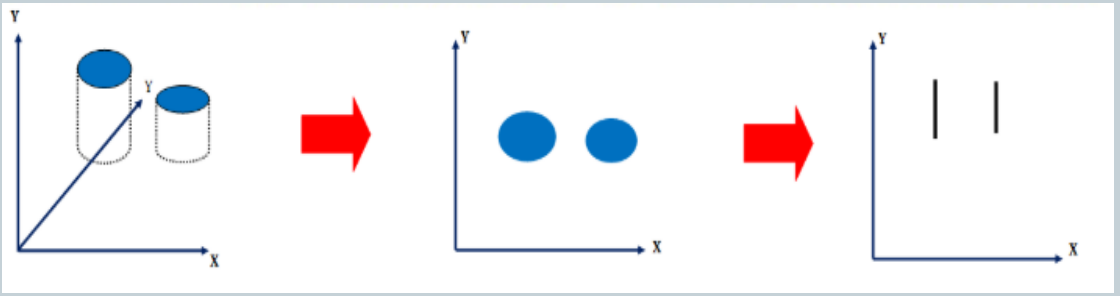



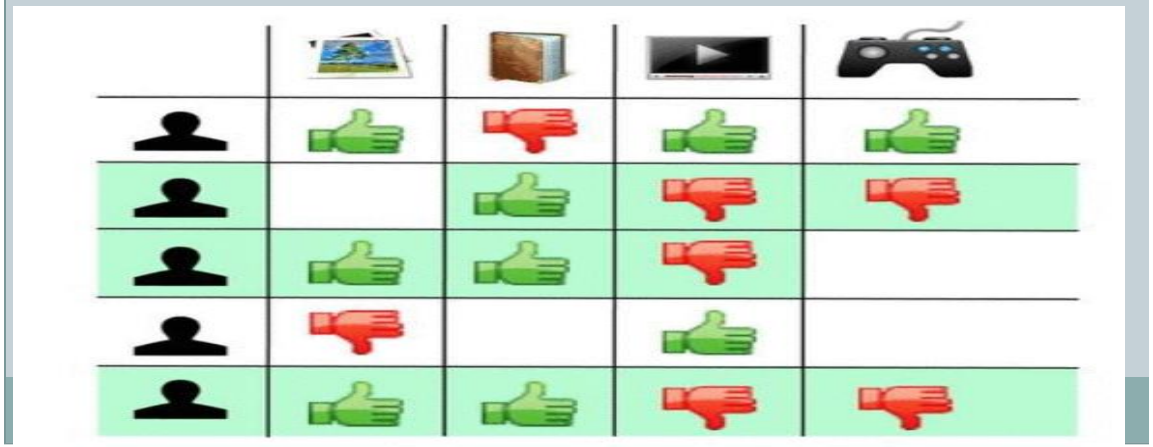
# Examples of Unsupervised learning algorithms

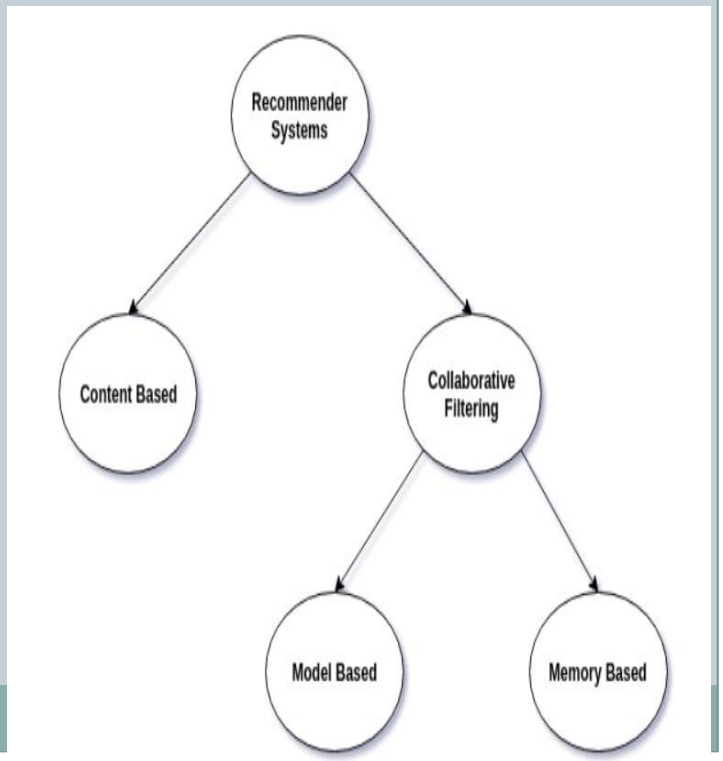






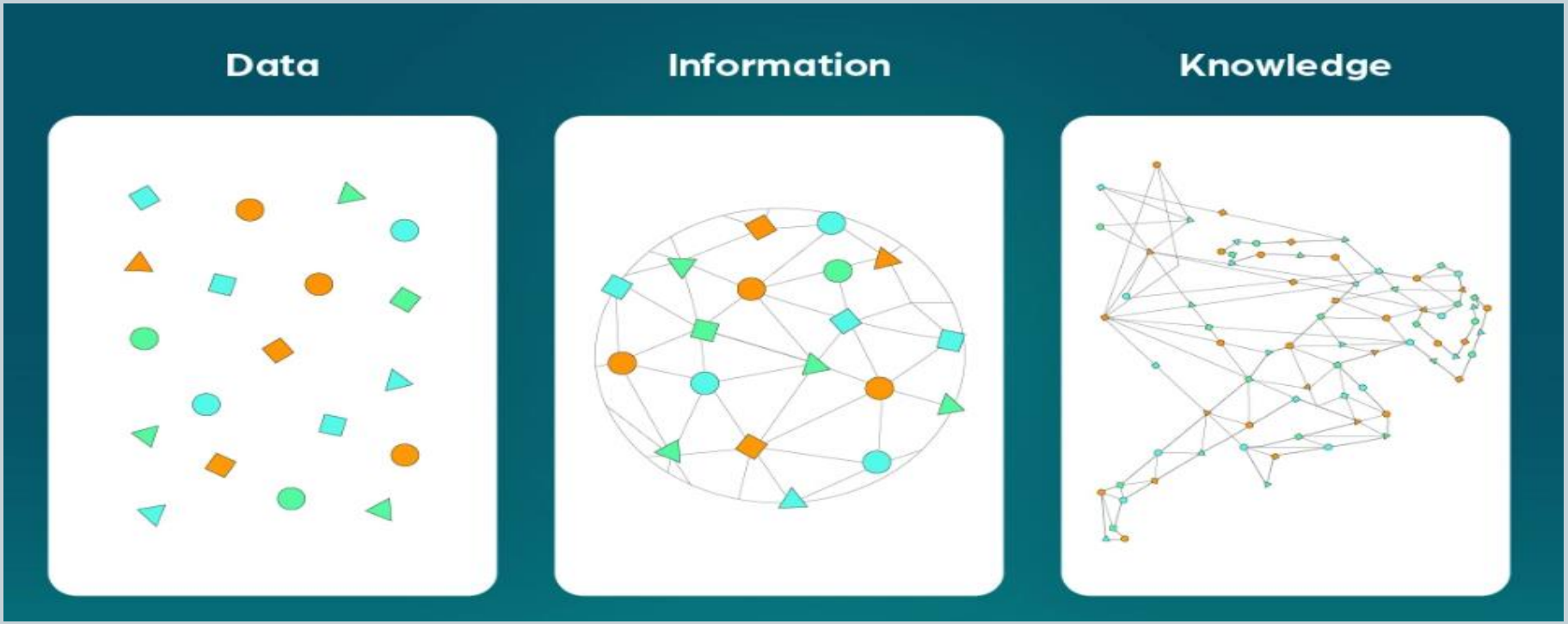




# *Knowledge, Reasoning and Planning*

- ***Knowledge, Reasoning and Planning in AI:*** Refers to the ***way information, knowledge, and data*** are structured, stored, and used by AI systems to reason, learn, and make decisions.



# *Data, Information and Knowledge*

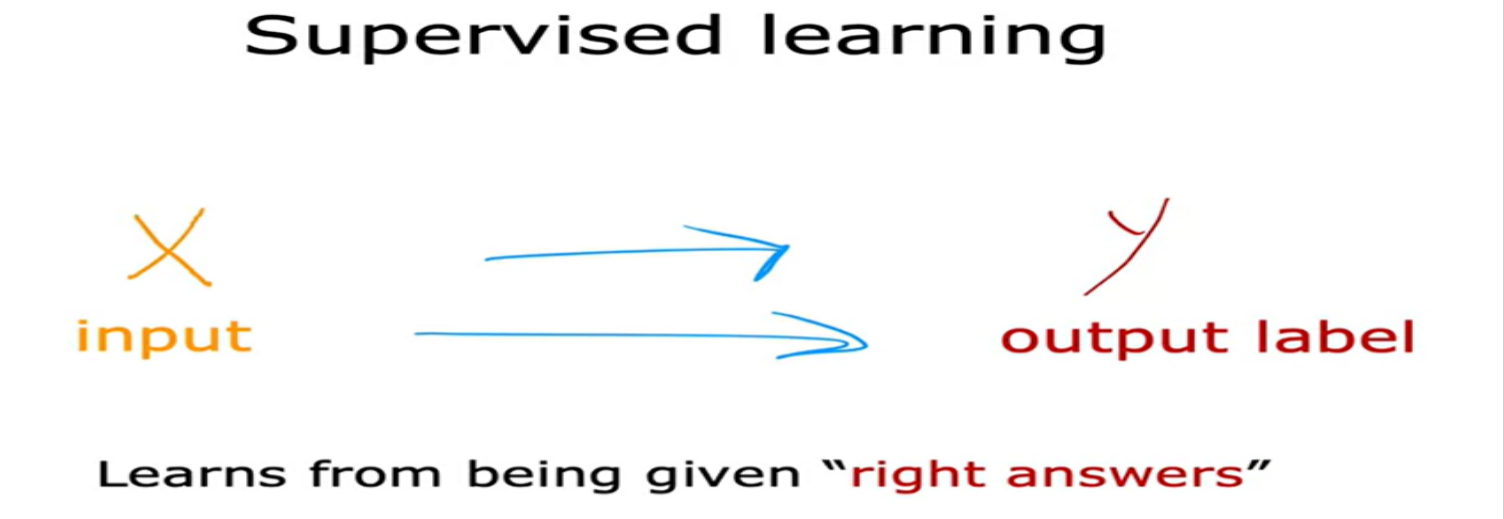
- ***Data*** refers to raw, unprocessed ***facts and figures*** that lack context or interpretation on their own. This information can be difficult to understand or apply without extra processing.

- ***Information*** is data that has been processed, organized, or structured to convey meaning and significance. The transformation from data to information generally involves several key steps (***Data Collection, Cleaning, Analysis, Interpretation and Presentation***).

- ***Knowledge*** is information that has undergone further analysis, synthesis, and refinement, resulting in a deeper understanding and more profound insights.

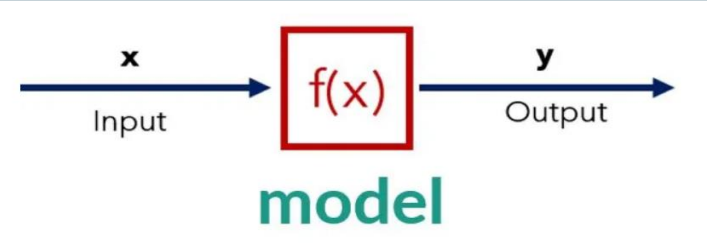
# *Introduction to Machine Learning*

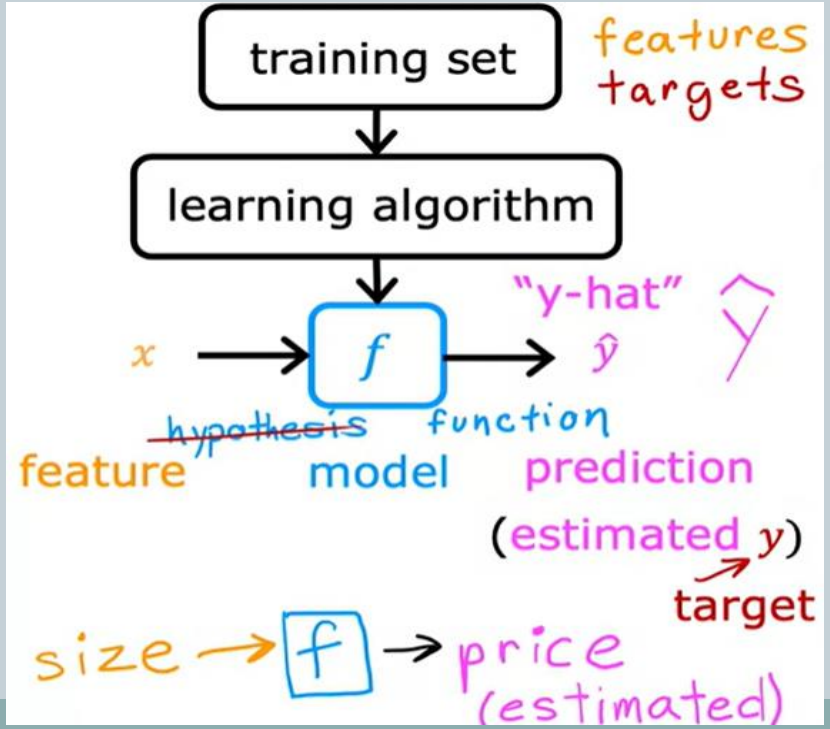
- Most ML models use ***supervised learning***, where an algorithm maps inputs to outputs based on a set of labeled data by humans. The model learns from these labeled examples to determine patterns in that data during a process called model training. The model can then make predictions on new data.



# *Introduction to Machine Learning*

- ***Machine learning*** is fundamentally built upon data, which serves as the foundation for training and testing models. Data consists of ***inputs*** (features) and ***outputs*** (labels). A ***model*** learns patterns during training and is tested on unseen data to evaluate its performance and generalization.



# Why we need Machine Learning? *What Its Applications*

**- Why we need Machine Learning?**

- Machine learning can ***learn, train*** from data and solve/***predict complex solutions*** which cannot be done with traditional programming. It enables us with better ***decision making*** and ***solve*** complex business problems in optimized time. Machine learning has applications in various fields, like Healthcare, finance, educations, sports and more.

1. **Solving Complex Business Problems:**

- It is too complex to tackle problems like Image recognition, Natural language processing, disease diagnose etc. with Traditional programming. Machine learning can ***handle*** such problems by learning from examples or making predictions, rather than following some rigid rules.

# *Machine Learning Applications*

## 2. Handling Large Volumes of Data:

- Expansion of Internet and users is producing massive amount of data. Machine Learning can process these data effectively and analyze, predict useful ***insights*** from them. For example, ML can analyze millions of everyday transactions to detect any ***fraud activity*** in real time. Social platforms like Facebook, Instagram use ML to analyze billions of post, like and share to predict next recommendation in your feed.

## *3. Automate Repetitive Tasks:*

- With Machine Learning, we can automate time-consuming and repetitive tasks, with better accuracy. ***Gmail*** uses ML to filter out Spam emails and ensure your Inbox stay clean and spam free. Using traditional programming or handling these manually will only make the system error-prone. ***Customer Support chatbots*** can use ML to solve frequent occurring problems like Checking order status, Password reset etc. ***Big organizations*** can use ML to process large amount of data (like Invoices etc.) to extract historical and current key insights.

# *Machine Learning Applications*

**4. Personalized User Experience:**

All social-media, Over-the-top (OTT) and E-commerce platforms uses Machine learning to recommend better feed based on user preference or interest. ***Netflix*** recommends movies and TV shows based on what you've watched. E-commerce platforms suggesting products you are likely to buy.

**5. Self Improvement in Performance:**

ML models can ***improve themselves*** based on more data, like user-behavior and feedback. For example, Voice Assistants (***Siri, Alexa, Google Assistant***) – continuously improve as they process millions of voice inputs.

# *Benefits of Machine Learning*

- Automates ***repetitive tasks***, freeing up human resources for more complex work. It also streamlines processes, leading to increased efficiency and productivity.

- Can analyze vast amounts of data to ***identify patterns and trends*** that humans might miss. This allows for better decision-making based on real-world data.

- ***Personalizes user experiences*** across various platforms. From recommendation systems to targeted advertising, ML tailors' content and services to individual preferences.

- Empowers robots and machines to ***perform complex tasks*** with greater accuracy and adaptability. This is revolutionizing fields like manufacturing and logistics.

# *Challenges of Machine Learning*

- ***ML Algorithms*** are only as good as the data they are trained on. ***Biased data*** can lead to discriminatory outcomes, requiring careful data selection and monitoring of algorithms.
- ML Relies heavily on ***data***, security brakes can expose sensitive information. Additionally, the use of ***personal data*** raises privacy concerns that need to be addressed.
- ***Complex*** ML models can be difficult to understand, making it challenging to explain their decision-making processes. This lack of transparency can raise questions about accountability and trust.
- Automation through ML can lead to ***job displacement*** in certain sectors. Addressing the need for ***retraining and reskilling*** the workforce is crucial.

# *Types of Machine Learning*

- ***Machine learning implementations are classified into four major categories, depending on the nature of the learning response available to a learning system which are as follows:***

## 1. Supervised learning:

- Is a category of machine learning that uses ***labeled datasets*** to train algorithms to predict outcomes and recognize patterns. The algorithms are given labeled training data ***to learn the relationship between the input and the outputs***.

- **Example –** Consider the following data regarding patients entering a clinic . The data consists of the gender and age of the patients and each patient is labeled as “healthy” or “sick”.

| Gender | Age | Label |
|---|---|---|
| M | 48 | sick |
| M | 67 | sick |
| F | 53 | healthy |
| M | 49 | sick |
| F | 32 | healthy |
| M | 34 | healthy |
| M | 34 | healthy |

# *Classification of Machine Learning*

## 2. Unsupervised learning:

- Is a type of machine learning algorithm used to draw inferences from datasets consisting of input data without labeled responses. In unsupervised learning algorithms, classification or categorization is not included in the observations. ***Example:*** Consider the following data regarding patients entering of a clinic. The data consists of the gender and age of the patients.

| Gender | Age |
|---|---|
| M | 48 |
| M | 67 |
| F | 53 |
| M | 49 |
| F | 34 |
| M | 21 |

# *Classification of Machine Learning*

**3. Reinforcement learning (RL):**

- Is a branch of machine learning involves learning through experience. In RL, an agent learns to achieve a goal in an uncertain, potentially complex environment by performing actions and receiving feedback through rewards or penalties.

- ***For example —*** Consider teaching a dog a new trick: we cannot tell him what to do, what not to do, but we can reward/punish it if it does the right/wrong thing.

# *Classification of Machine Learning*

## 4. Semi-supervised learning:

- Semi-supervised learning is a broad of machine learning techniques that utilizes both labeled and unlabeled data; in this way, as the name suggests, it is a hybrid technique between supervised and unsupervised learning.

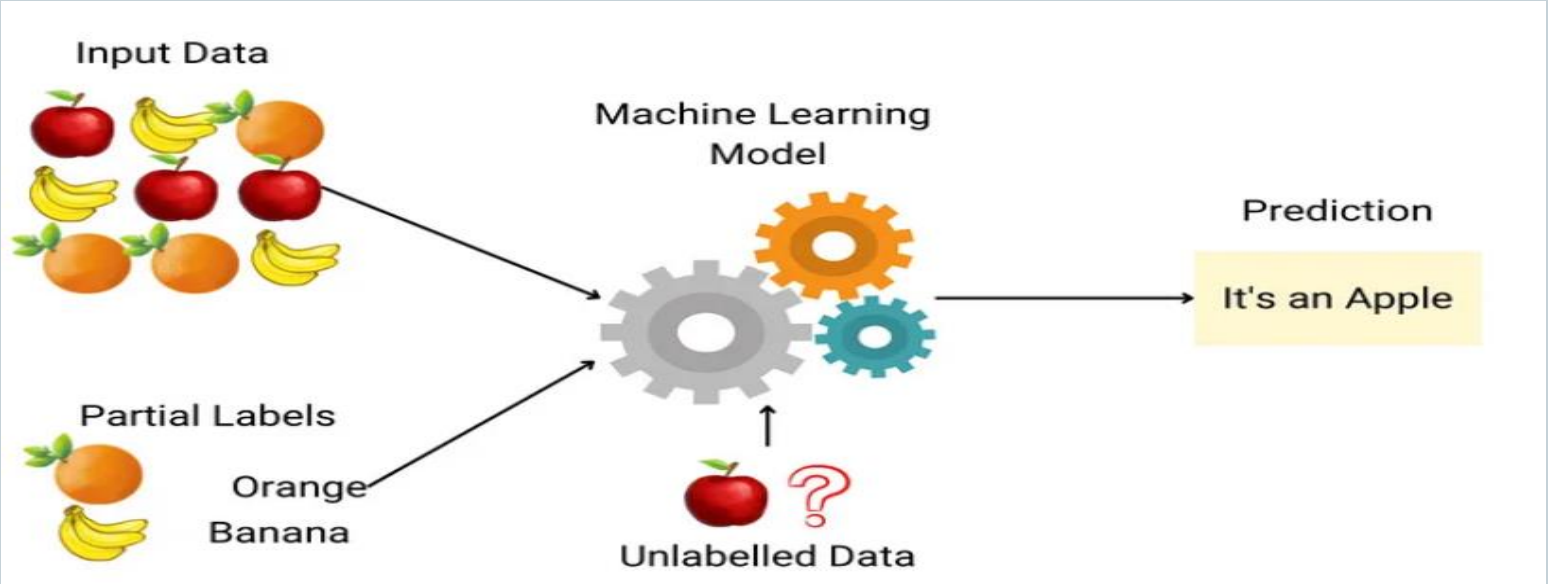
- ***Example***: Imagine, you have collected a large set of ***unlabeled data*** that you want to train a model on. Manual labeling of all this information will probably cost you a lot, besides taking months to complete the annotations. That's when the semi-supervised machine learning method comes to use.

- Instead of adding tags to the entire dataset, you go through and hand-label just for a small part of the data and use it to train a model, which then is applied to the ocean of unlabeled data.

# *Classification of Machine Learning*

## 4. Semi-supervised learning:

- Semi-supervised learning is the type of machine learning that uses a combination of a small amount of labeled data and a large amount of unlabeled data to train models.



# *Categorizing of ML problems*

## ❑ Categorizing of ML problems based on Required Output

***Another categorization of machine-learning tasks arises when one considers the desired output of a machine-learned system:***

1. ***Classification:*** When inputs are divided into two or more classes, the learner must produce a model that assigns unseen inputs to one or more (multi-label classification) of these classes. This is typically tackled in a supervised way. Spam filtering is an example of classification, where the inputs are email (or other) messages, and the classes are “spam” and “not spam”.

***2. Regression:*** This is also a supervised problem, A case when the outputs are continuous rather than discrete.

***3. Clustering:*** When a set of inputs is to be divided into groups. Unlike in classification, the groups are not known beforehand, making this typically an unsupervised task.

# *Examples of Machine Learning in Action*

- ***Some examples to illustrate supervised learning applications:***

## Supervised Learning

1. ***Filtering Your Inbox:*** Spam filters use machine learning to analyze emails and identify spam based on past patterns. They learn from emails you mark as spam and not spam, becoming more accurate over time.

2. ***Recommending Your Next Purchase***: E-commerce platforms and streaming services use machine learning to analyze your purchase history and viewing habits. This allows them to recommend products and shows you're more likely to enjoy.

3. ***Smart Reply in Emails***: Machine learning powers features like "Smart Reply" in Gmail, suggesting short responses based on the content of the email.

# *Examples of Machine Learning in Action*

## ➢ Unsupervised Learning

***1. Grouping Customers:*** Machine learning can analyze customer data (purchase history, demographics) to identify customer segments with similar characteristics. This helps businesses tailor marketing campaigns and product offerings.

***2. Anomaly Detection:*** Financial institutions use machine learning to detect unusual spending patterns on your credit card, potentially indicating fraudulent activity.

***3. Image Classification in Photos:*** Facial recognition in photos on social media platforms is powered by machine learning algorithms trained on vast amounts of labeled data.

# *Examples of Machine Learning in Action*

- ***Beyond Categories***

***1. Self-Driving Cars:*** These rely on reinforcement learning, a type of machine learning where algorithms learn through trial and error in a simulated environment.

2. ***Medical Diagnosis:*** Machine learning algorithms can analyze medical images (X-rays, MRIs) to identify abnormalities and aid doctors in diagnosis.