REPUBLIQUE ALGERIENNE DEMOCRATIQUE ET POPULAIRE
Ministère de l'Enseignement Supérieur et de la Recherche Scientifique
Université Mohamed Khider-BISKRA.

Faculté des sciences exactes et des sciences de la nature et de la vie

Département d'informatique

Machine Learning (ML)

Dr. TIBERMACINE Ahmed

Content Summary

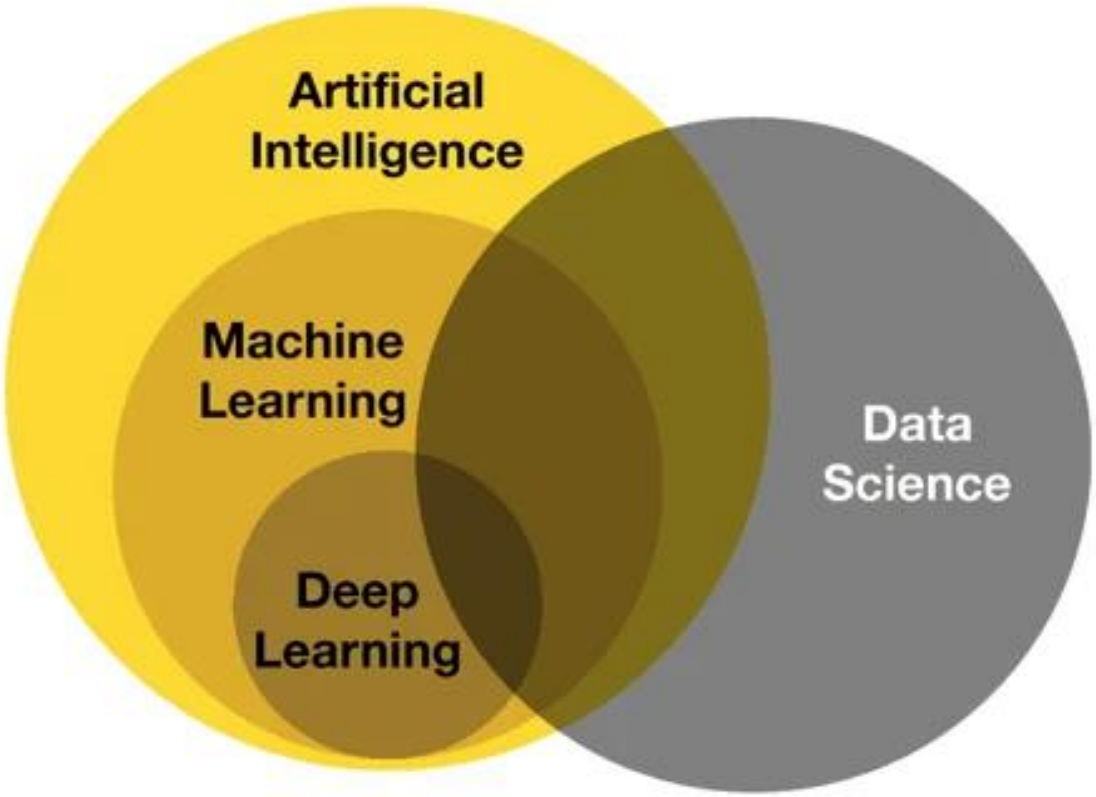
Chapter 1: : introduction to Machine Learning

Introduction

- From translation apps to autonomous vehicles, **Machine Learning** is the **driving force** behind these innovations.
- Training algorithms to make predictions from data.
- Explore different types of machine learning and key terminology.

AI AND ML?

- **AI & ML**: Create systems enabling computers to perform tasks requiring human-like intelligence through advanced algorithms.



Artificial Intelligence (AI)

- **AI**: Machines mimic human intelligence, learning and problem-solving independently in computer science.

- **AI** aims to make thinking machines capable of intelligent decision-making.

Machine Learning (ML)

- **ML** enhances computer intelligence by learning from data,
- aiming to create algorithms that discern patterns,
- enabling predictions or decisions in unfamiliar situations.

AI vs ML

- **Scope:** AI covers techniques like rule-based systems, NLP, and robotics. ML, a subset, concentrates on learning patterns from data.

- **Learning:** AI includes rule-based, heuristic, and pre-programmed techniques; ML centers on learning patterns from data.

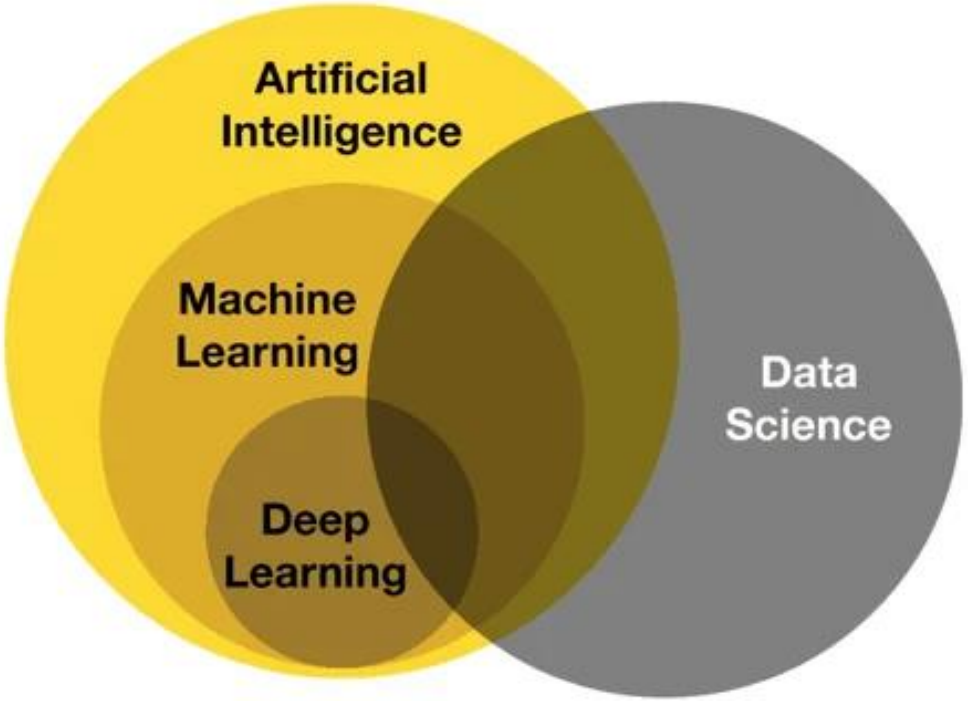
AI vs ML

- **Training:** ML models improve with labeled data training, while AI systems, sometimes rule-based, may not always require explicit training.

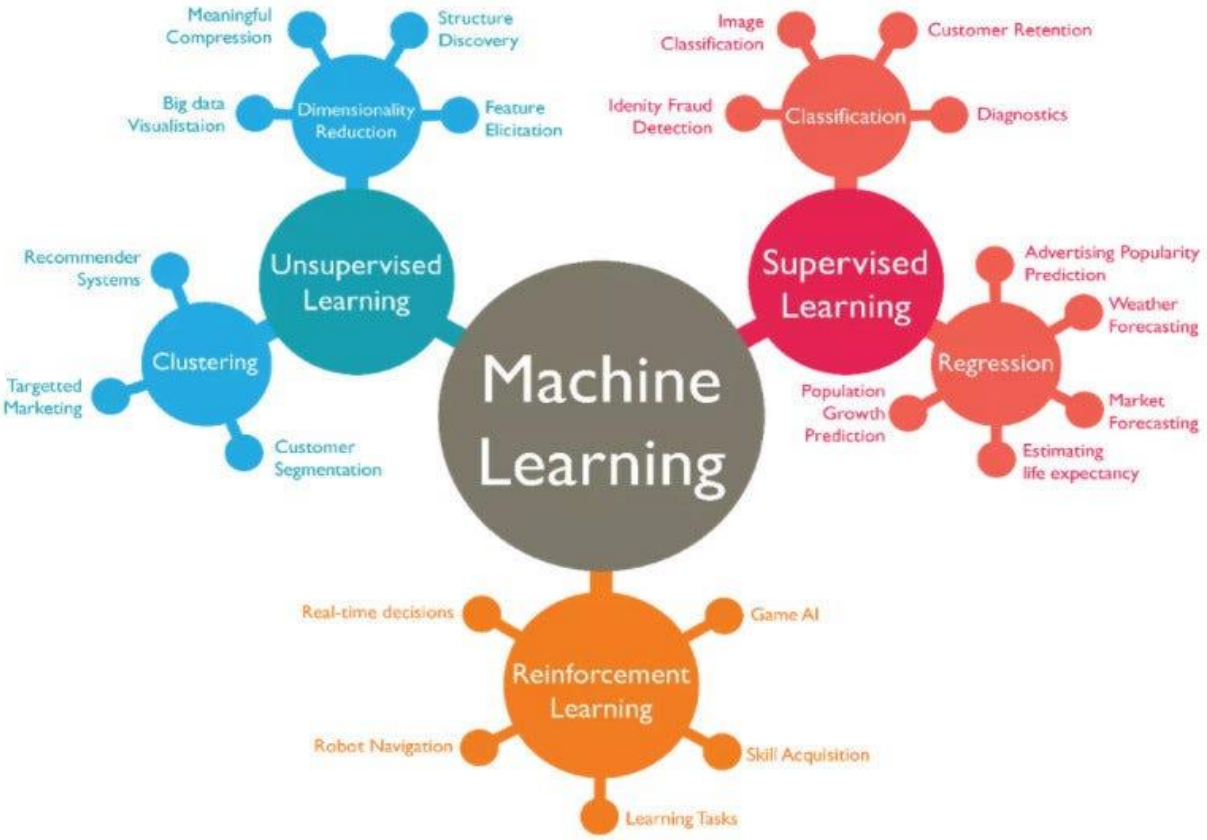
- **Flexibility:** AI systems can be rule-based and may not adapt to new data without manual intervention. ML models can adapt and improve their performance with more data.

AI vs ML

- AI and ML frequently overlap, with ML techniques integral to AI systems.
- The evolving technology blurs the boundaries between AI and ML, both shaping the future of automation and intelligent systems.

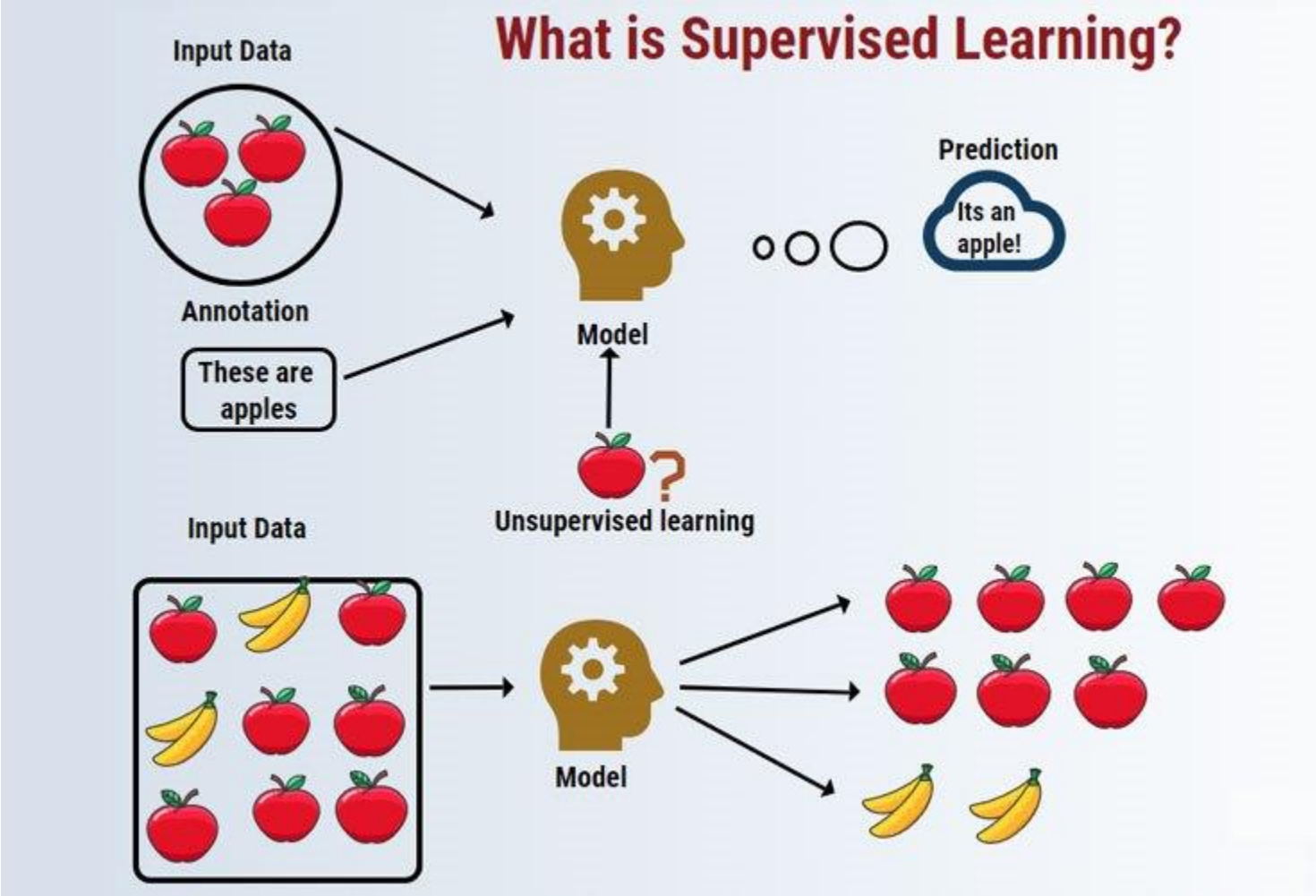


Types of Machine Learning



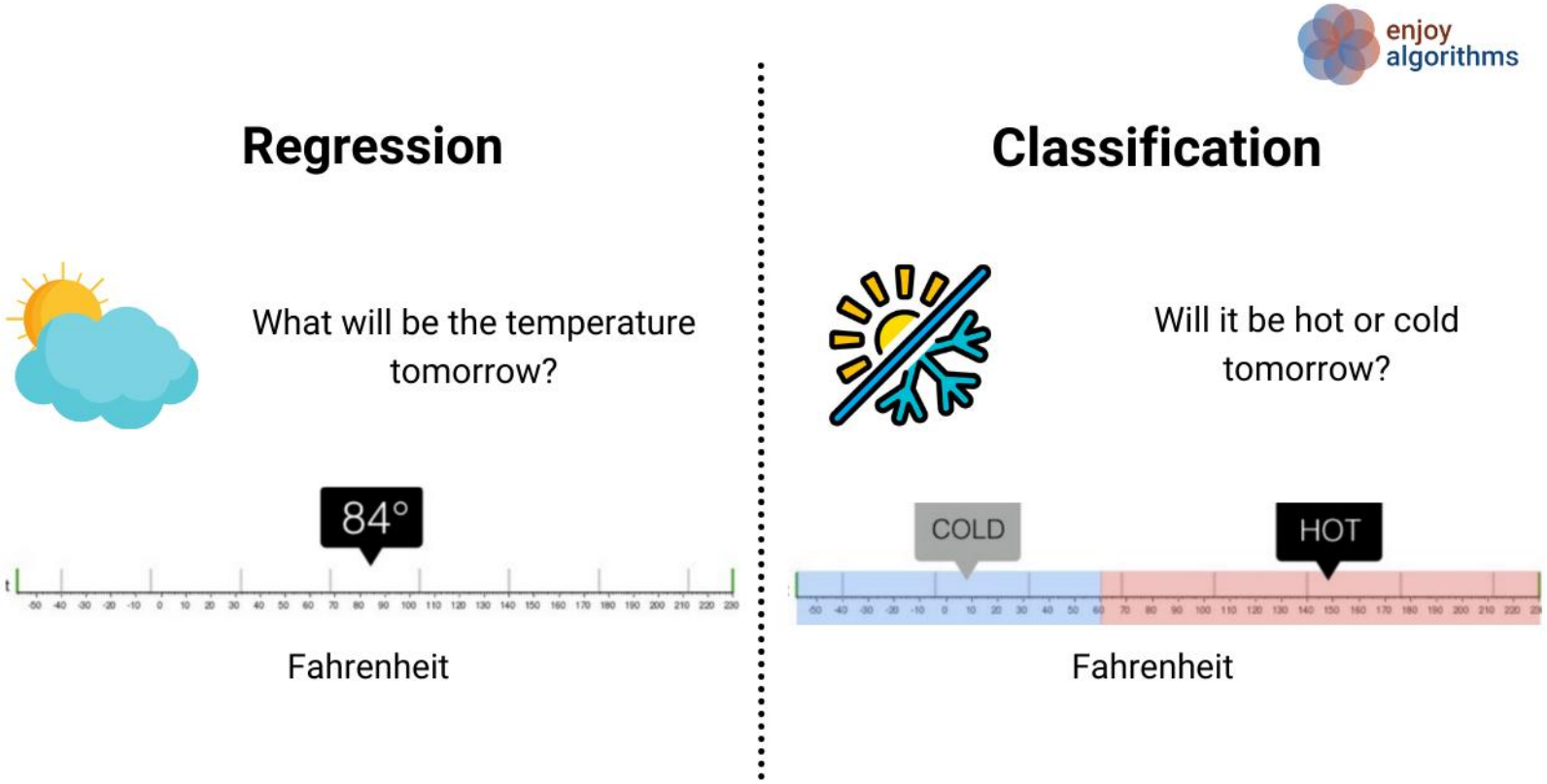
Types of Machine Learning

- **Supervised Learning**



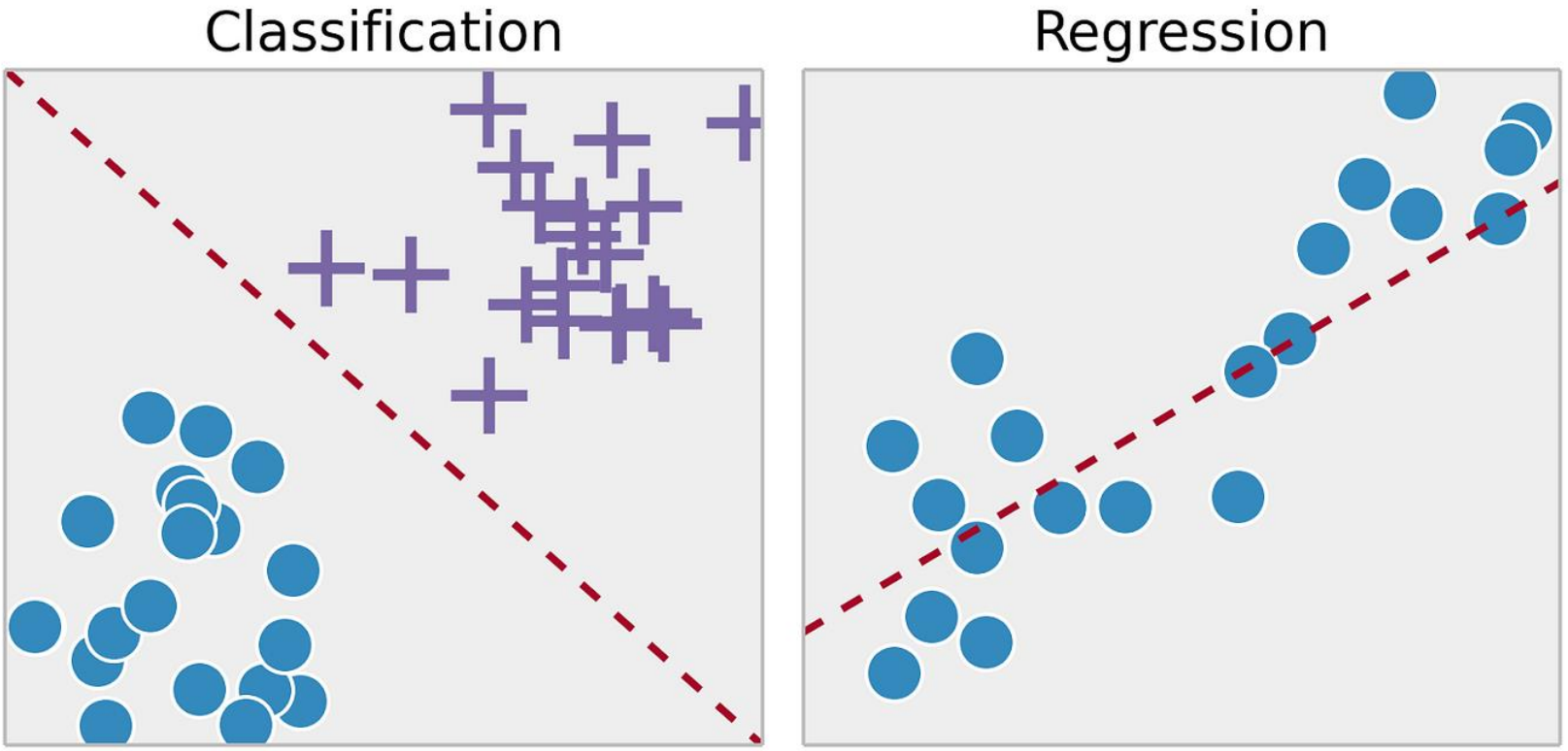
Types of Machine Learning

- **Supervised Learning (SL)**



Types of Machine Learning

- **Supervised Learning (SL)**



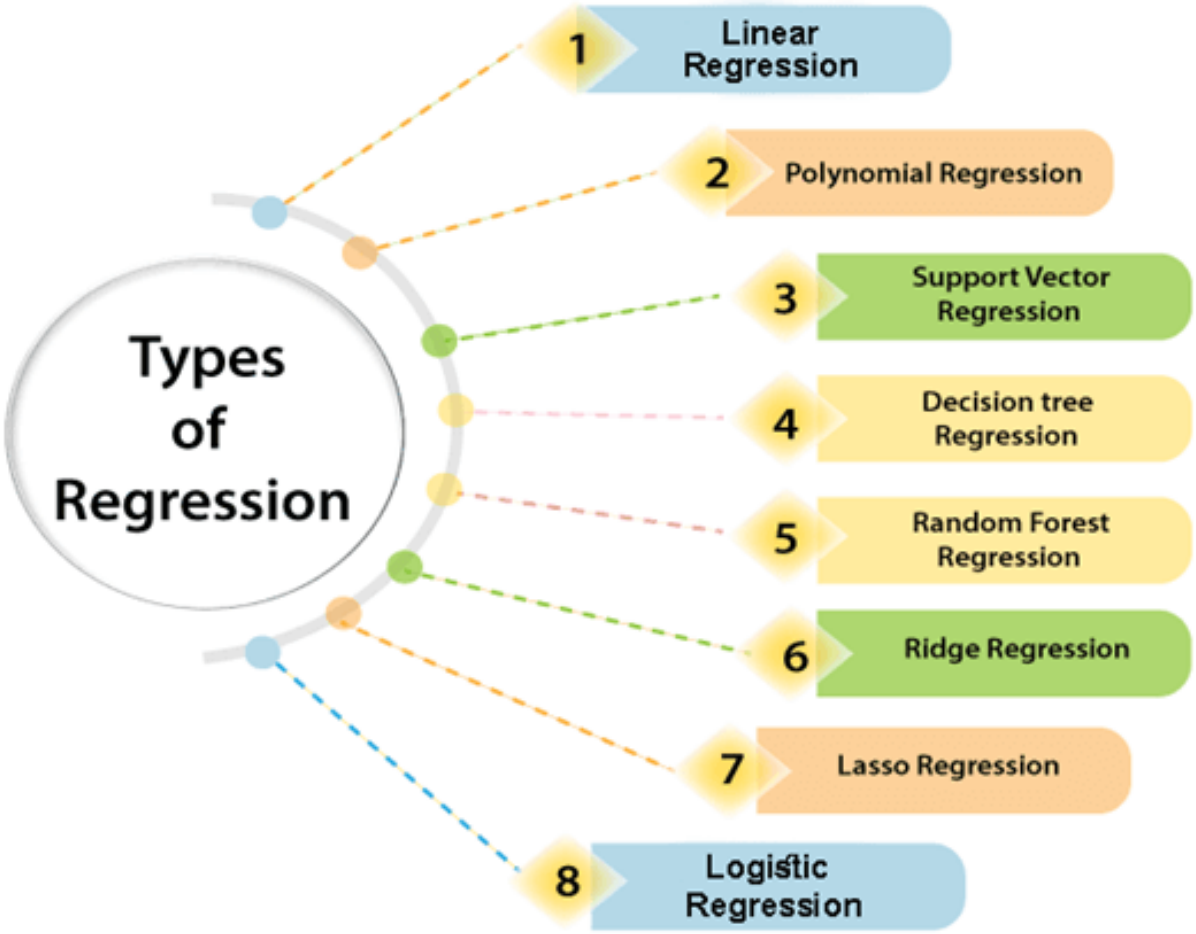
Types of Machine Learning

- **Supervised Learning (SL): Regression vs Classification**

	Regression	Classification
Description	A a regression model seeks to predict a continuous quantity.	A classification model seeks to predict some class label.
Type of algorithm	Supervised learning algorithm	Supervised learning algorithm
Type of response variable	Continuous	Categorial
How to assess model fit	Root mean squared error	Percentage of correct classifications

Types of Machine Learning

- **Supervised Learning (SL): Regression**

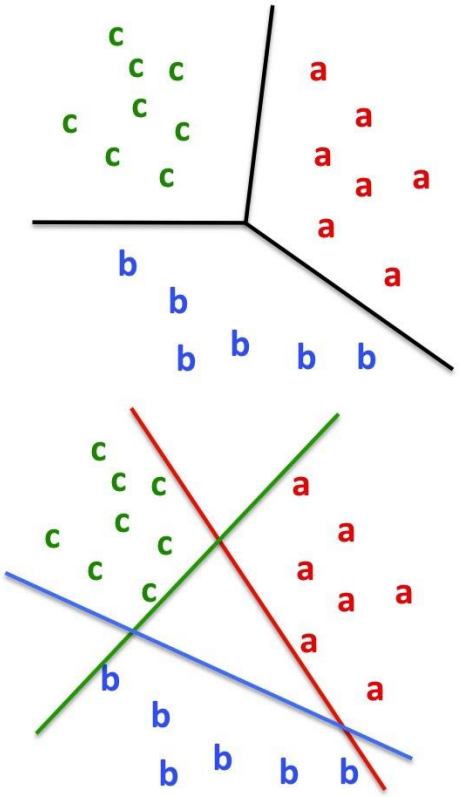


Types of Machine Learning

- **Supervised Learning (SL): Classification**

Multi-class vs. Binary classification

- Multi-class:
  - classes mutually exclusive:
    - instance is either a or b or c
    - even if it's an outlier
  - NB, kNN, DT, logistic
- Binary:
  - one-vs-rest:
    - {a} vs {not a}, {b} vs {not b}
  - classes may overlap
    - instance can be both a and b
    - can be in none of the classes
  - SVM, logistic, perceptron



Types of Machine Learning

Supervised Learning Algorithms

Regression

- Linear
- Polynomial
- Ridge Regression
- Lasso Regression

Classification

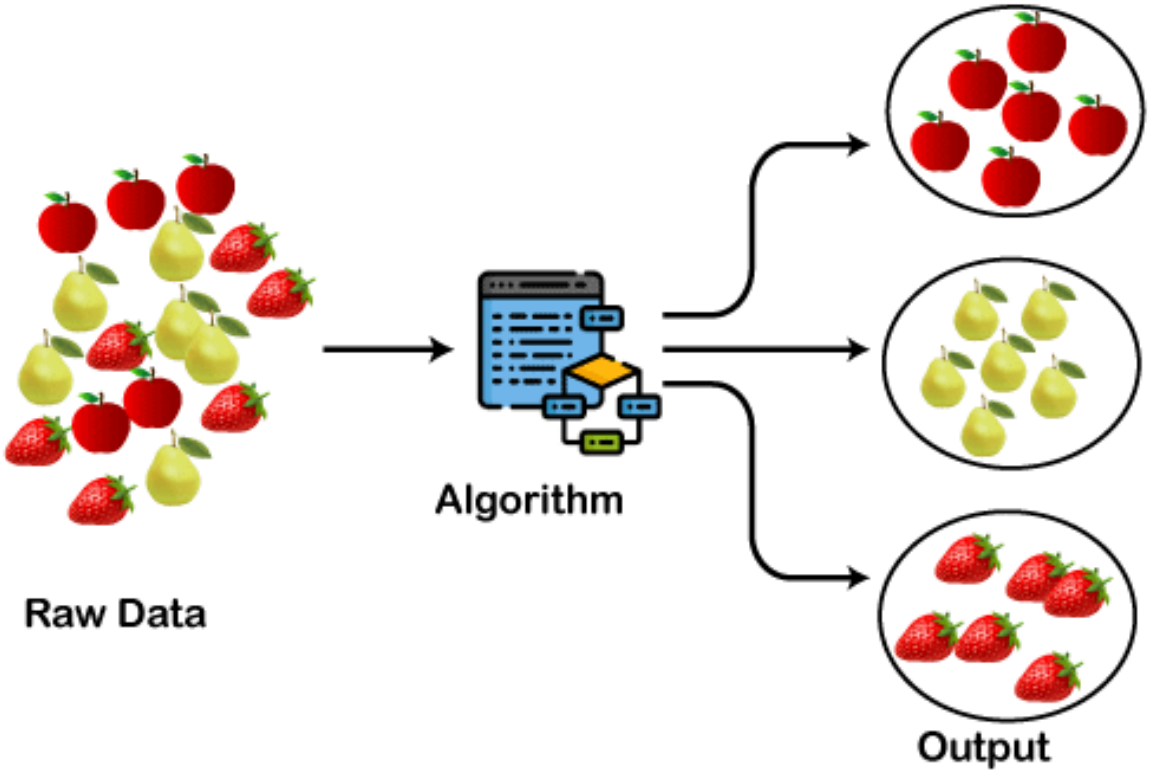
- Logistic Regression
- Linear Discriminant Analysis
- Naïve Bayes

Regression & Classification

- Decision Trees
- K- Nearest Neighbors (KNN)
- Support Vector Machine (SVM)

Types of Machine Learning

- **Unsupervised Learning**
-

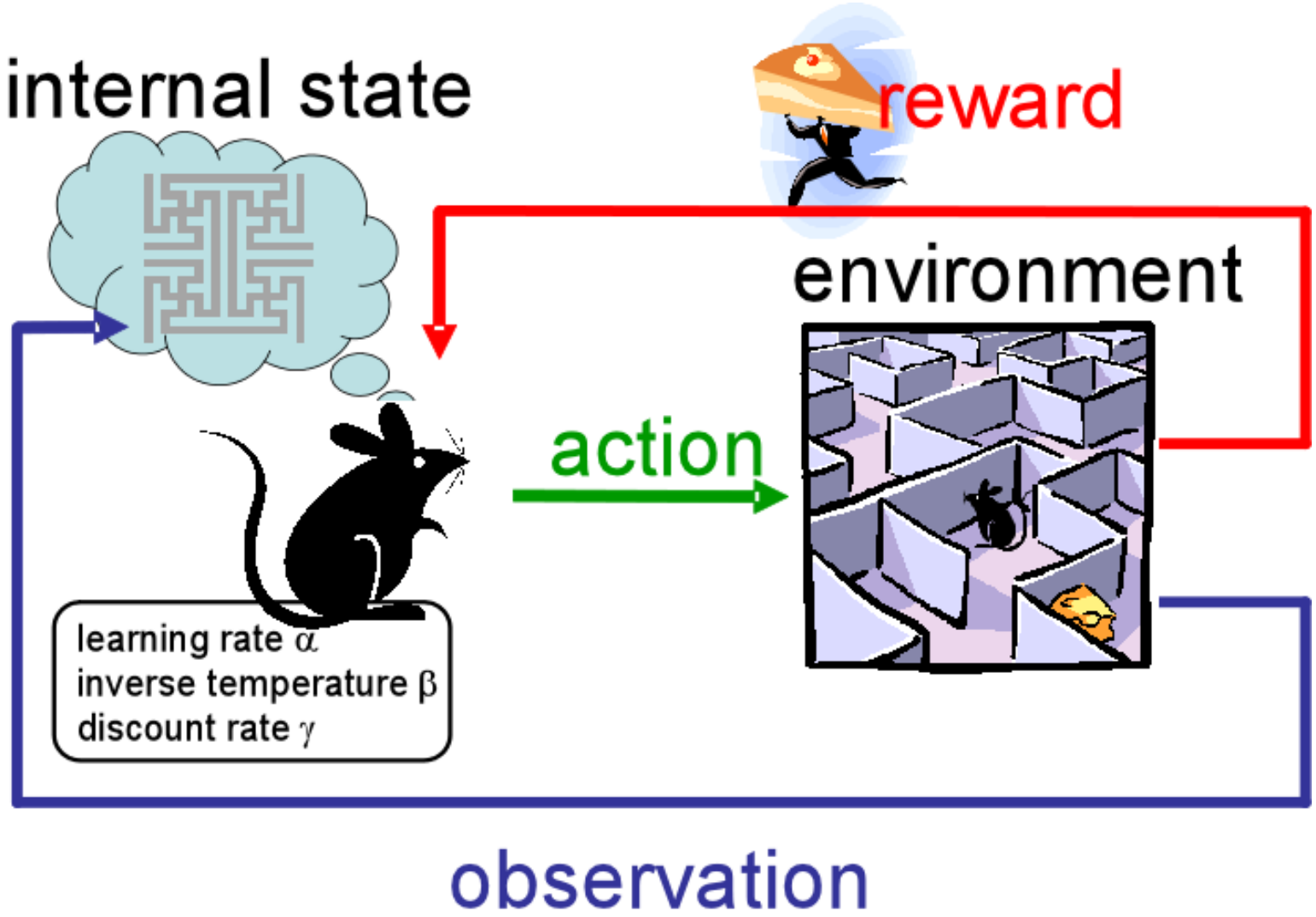


Types of Machine Learning

- **Unsupervised Learning: Tasks**

Types of Machine Learning

- **Reinforcement Learning (RL)**



Types of Machine Learning

- **Reinforcement Learning (RL): key components**

- **Agent**: The learner or decision-maker that interacts with the environment. It takes actions based on a policy.

- **Environment**: The external system with which the agent interacts. It provides feedback to the agent in the form of rewards and new states.

- **State**: A representation of the current situation or configuration of the environment. The state provides information to the agent about its surroundings.

- **Action**: The set of possible choices or decisions that the agent can make in each state. Actions lead to transitions to new states.

Types of Machine Learning

- **Reinforcement Learning (RL): key components**

- **Policy**: A strategy or mapping that defines the agent's behavior. It determines which actions the agent should take in each state.

- **Reward**: A numerical signal provided by the environment after each action taken by the agent. The reward indicates the immediate benefit or desirability of the action.

- **Value Function**: A function that estimates the expected cumulative reward an agent can achieve from a given state or state-action pair. It helps the agent evaluate the desirability of states or actions

Types of Machine Learning

- **Reinforcement Learning (RL)**

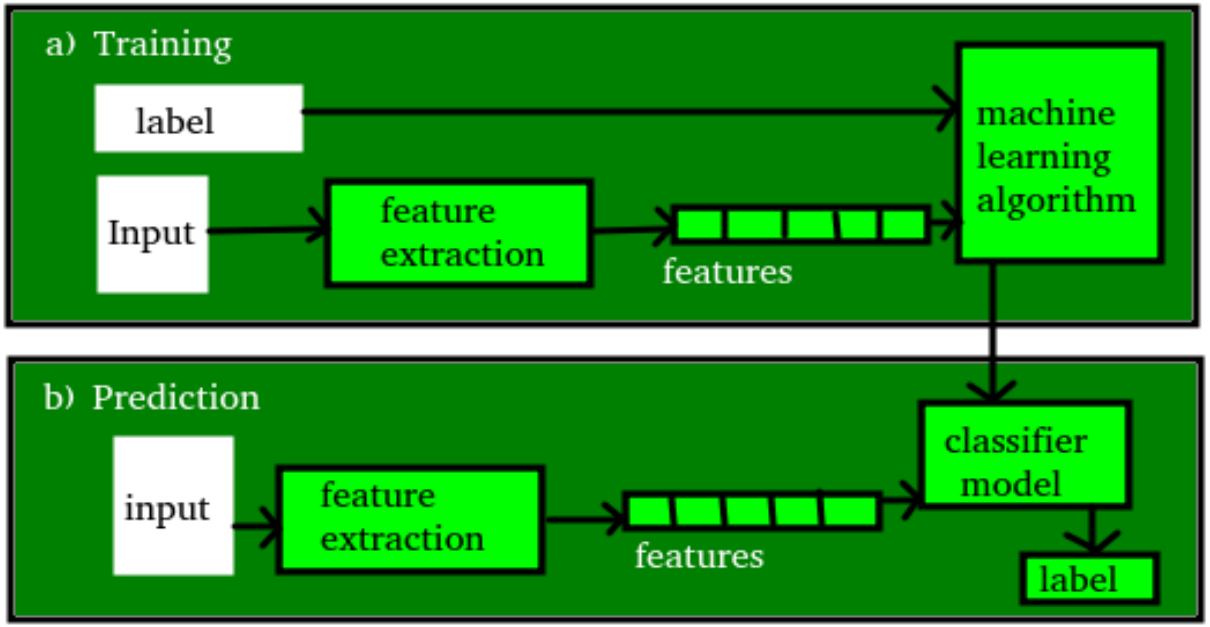
- **Algorithms**
  - Q-learning,
  - Deep Q-Networks (DQN),
  - Policy Gradient methods,
  - deep reinforcement learning: combines deep neural networks with RL techniques

Machine Learning

- **Terminologies of Machine Learning**
  - Model
  - Feature
  - Target (Label)
  - Training Process
  - Evaluation
  - Prediction

Machine Learning

- Terminologies of Machine Learning



Machine Learning

- **Terminologies of Machine Learning**
- **Overfitting**: occurs when a model learns the training data too well and performs poorly on new data.
- **Underfitting:** occurs when a model is too simple to capture the underlying patterns in the data

Machine Learning

- **Data in Machine Learning**

- **Data** is a crucial component in the field of Machine Learning. It refers to the set of observations or measurements that can be used to train a machine-learning model.

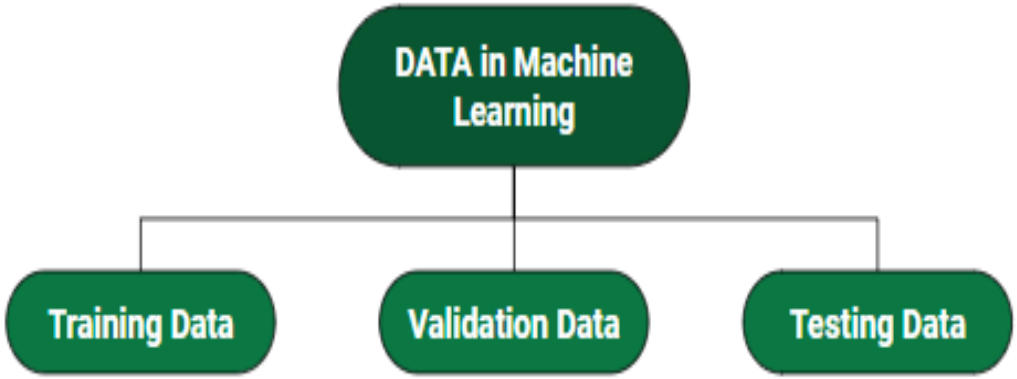
- **Data** can be any unprocessed fact, value, text, sound, or picture that is not being interpreted and analyzed. The quality and quantity of data available for training and testing play a significant role in determining the performance of a machine-learning model.

- **Machine learning algorithms** use **data** to learn patterns and relationships between input variables and target outputs, which can then be used for prediction or classification tasks.

Machine Learning

- **Data in Machine Learning**
- **How do we split data in Machine Learning?**

- **Training Set:** Used to train the model (70-80% of data).
- **Validation Set:** Used for hyperparameter tuning and model selection (10-15% of data).
- **Testing Set:** Used to assess the model's performance on unseen data (10-15% of data).
- These splits help ensure that the model generalizes well to new, unseen data an '



Machine Learning

- **Data in Machine Learning**
- **Different Forms of Data**

1. Structured Data
2. Unstructured Data
3. Quantitative Data
4. Qualitative Data

Types of Machine Learning

- **Machine Learning Workflow**
  1. Define the Problem
  2. Gather and Prepare Data
  3. Split the Data
  4. Choose a Machine Learning Algorithm
  5. Feature Selection/Extraction
  6. Model Training
  7. Hyperparameter Tuning
  8. Model Evaluation
  9. Iterate and Refine
  10. Model Deployment:
  11. Monitoring and Maintenance

Types of Machine Learning

- **Application of machine learning**

- **Healthcare**: Predicting disease outcomes, diagnosing medical conditions, and drug discovery.
- **Finance**: Credit scoring, fraud detection, and algorithmic trading.
- **Natural Language Processing (NLP)**: Language translation, sentiment analysis, and chatbots.
- **Computer Vision**: Image and video recognition, object detection, and facial recognition.
- **Recommendation Systems**: Personalized product recommendations in e-commerce and content recommendations in streaming services.
- **Autonomous Vehicles:** Self-driving cars and drones that use machine learning for navigation and decision-making.