Importance and Impact of Machine Learning in Automation

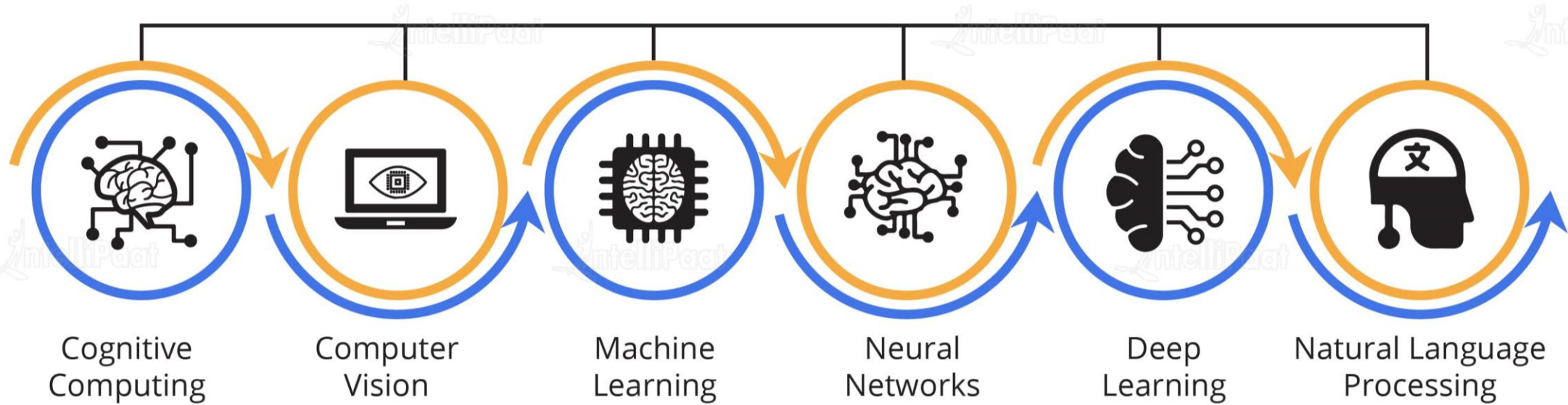Dr.T.Poongothai
Professor
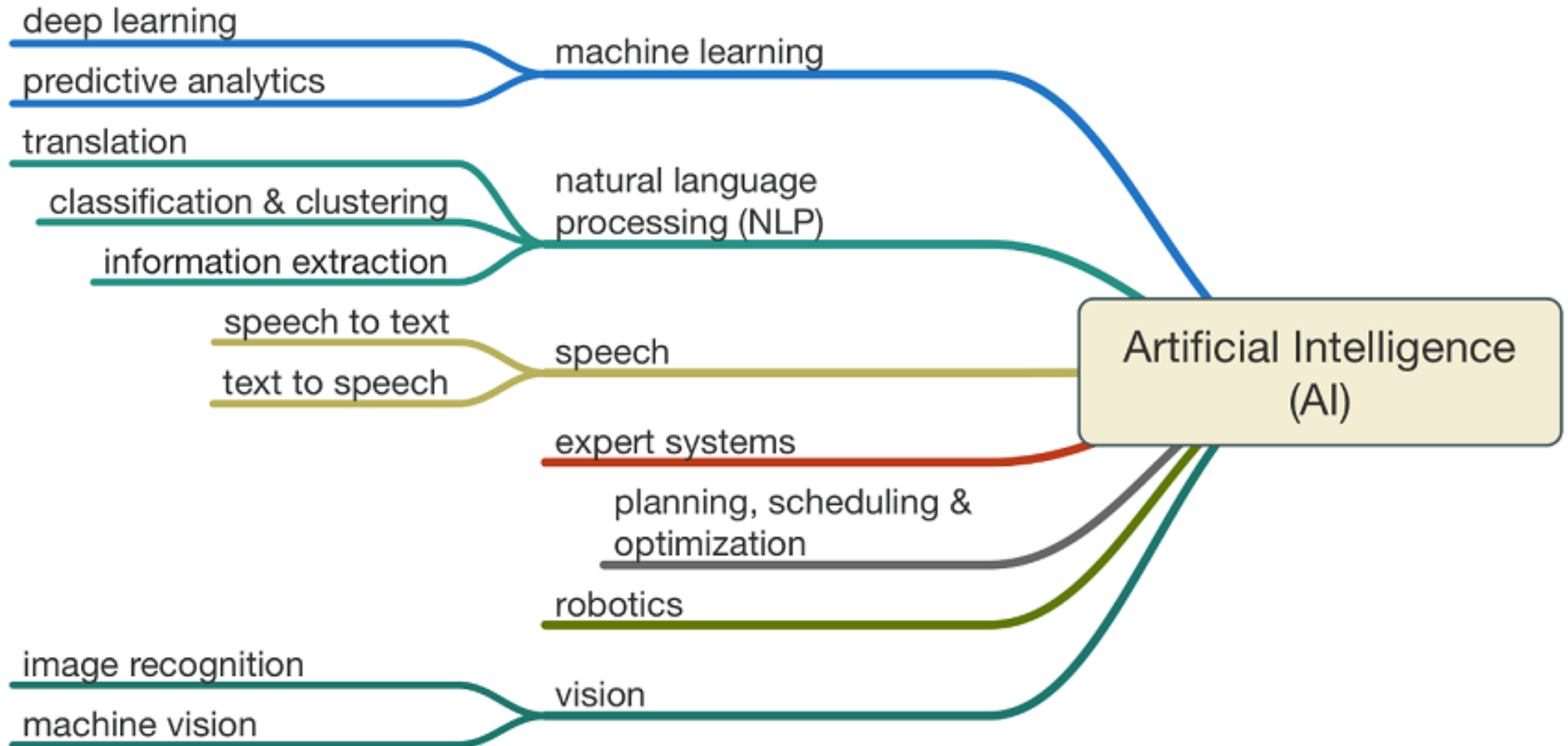Department of CSE
St. Martin's Engineering College

History of AI

- The term Artificial Intelligence (AI) was coined by John McCarthy, an American computer scientist in 1956.

- Marvin Minsky divided AI into different subfields

- He defined AI as

- Artificial Intelligence is concerned with the design of intelligence in an artificial device.

- It is the science and engineering of making intelligent machines
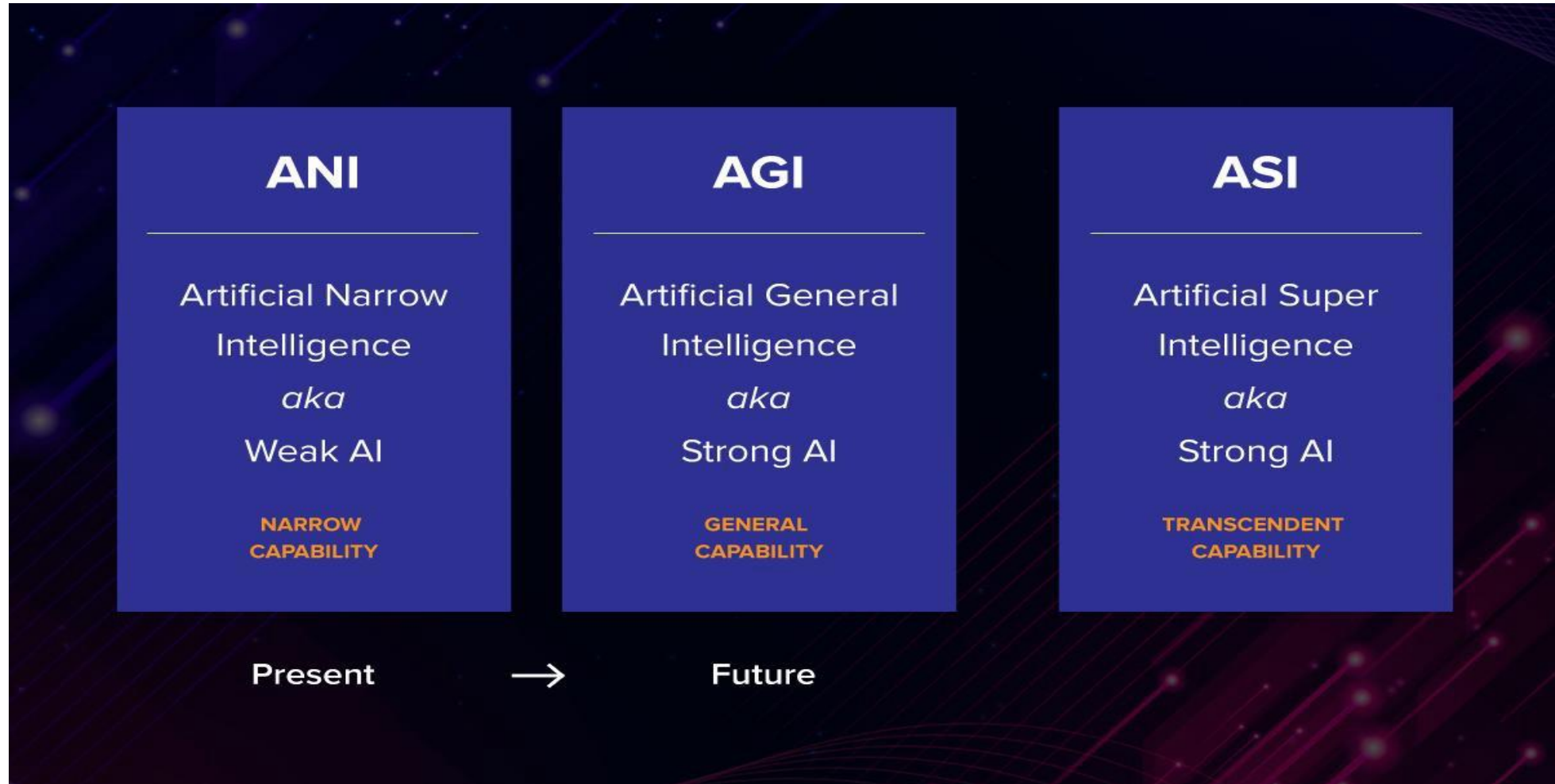
Artificial Intelligence

Cognitive Computing · Computer Vision · Machine Learning · Neural Networks · Deep Learning · Natural Language Processing

Artificial Intelligence

Types of AI

ANI	AGI	ASI
Artificial Narrow Intelligence	Artificial General Intelligence	Artificial Super Intelligence
aka	*aka*	*aka*
Weak AI	Strong AI	Strong AI
NARROW CAPABILITY	**GENERAL CAPABILITY**	**TRANSCENDENT CAPABILITY**

Present → Future

Narrow/Weak AI

- Good at performing a particular task, but it will not pass for human in any other field outside of its defined capacities.

- Always, task specific in nature
  - Can do specific task well but would not be able to swap with other task.
  - Google PageRank is sophisticated AI and is considered best when it comes to ranking pages.

- Implementations such as Deep Blue, AlphaGo, Alexa and Siri are examples of Weak AI

General / Strong AI

- Ability of machines to think like human in variety of situations or replicate human cognition completely.

- Make their own decisions without human input.

- Focuses on building intelligence that can handle any task or problem in any domain

- Ability to reason, solve puzzles, represent knowledge and common sense, and the ability to plan.

Artificial Super Intelligence

- Hypothetical AI that doesn't just mimic or understand human intelligence and behaviour.

- Capability of computers will surpass humans.

- Posits a world in which a computer's cognitive ability is superior to a human's.

- It would surpass humans in all things: coding, maths, writing books, prescribing medicine, creating new species and much, much more.

AI Milestones

1956 — The first Dartmouth College summer AI conference is organized by John McCarthy, Marvin Minsky, Nathan Rochester of IBM and Claude Shannon

1965 — Joseph Weizenbaum (MIT) builds ELIZA, an interactive program that carries on a dialogue in English language on any topic

1978 — Herbert A. Simon wins the Nobel Prize in Economics for his theory of bounded rationality, one of the cornerstones of AI known as "satisficing"

1993 — Vernor Vinge publishes The Coming Technological Singularity, predicting that, within the next 30 years, humankind would have the ability to create "superhuman intelligence"

1997 — The Deep Blue chess machine (IBM) defeats the (then) world chess champion, Garry Kasparov

2009 — Google builds self-driving car

2011 — IBM's Watson computer defeated television game show Jeopardy! champions Rutter and Jennings

2016 — Google DeepMind's AlphaGo defeats 3x European Go champion Fan Hui by 5 games to 0

2017 — Google's AlphaGo Zero - an improved version of AlphaGo - learns by playing only against itself and beat its predecessor 89:11 after only 40 days

Machine Learning

Formal Definition of ML

- Tom M. Mitchell – "A computer program is said to learn from experience *E* with respect to some class of tasks *T* and performance measure *P*, if its performance at tasks in *T*, as measured by *P*, improves with experience *E*"

- Arthur Samuel - "Field of study that gives computers the ability to learn without being explicitly programmed"

ML Vs AI

- AI stands for Artificial Intelligence, where intelligence is defined as the ability to acquire and apply knowledge

- ML stands for Machine Learning, where learning is defined as the acquisition of knowledge or skills through experience or being taught.

Benefits of ML

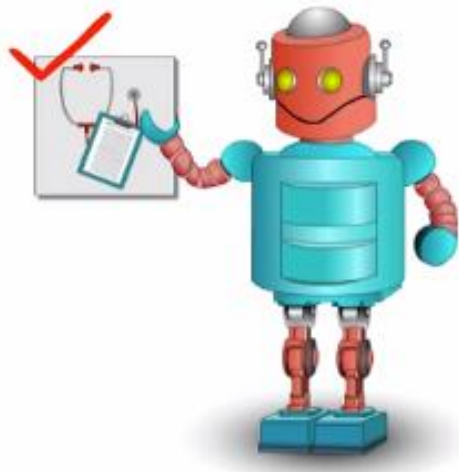Simplifies Product Marketing and assists in accurate sales forecasts
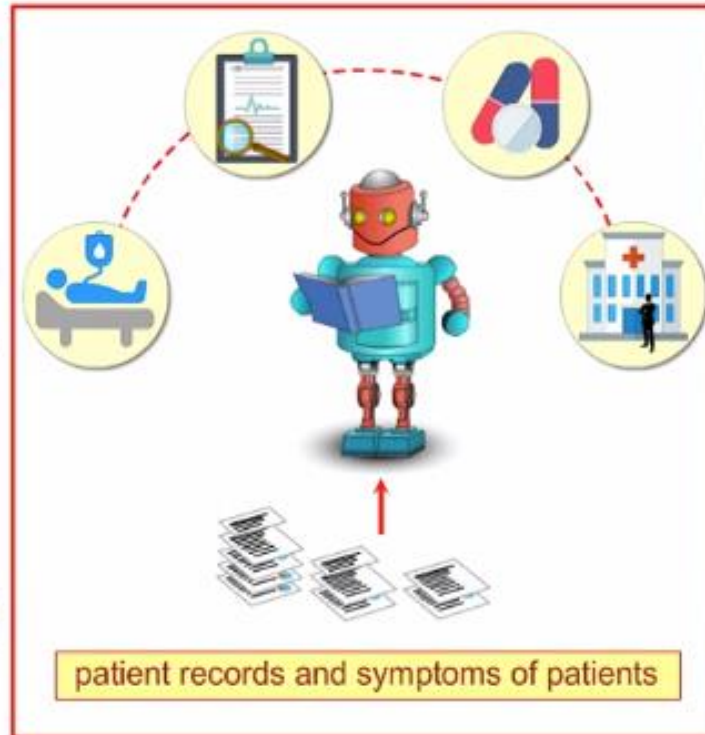
Interpretation of past customer behaviour
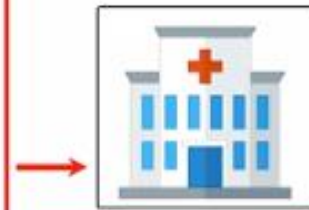
BEST OFFER

Better Predictions

Benefits of ML

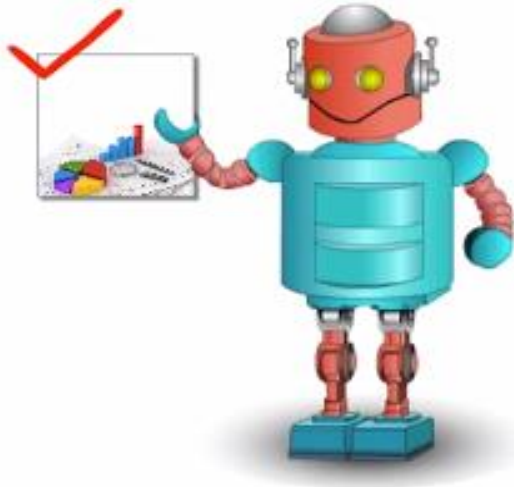Facilitates accurate medical prediction and diagnosis

Healthcare Industry

patient records and symptoms of patients

Improved healthcare with minimal cost

Benefits of ML

Improves precision of financial rules and models

Financial Sector

Loan underwriting

Algorithmic trading

Fraud detection
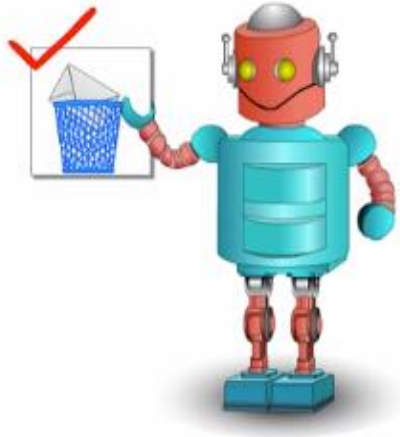
Portfolio management

Portfolio management

Detection and analysis of anomalies and nuances

Benefits of ML

Detects spam easily

SPAM FILTER

Inbox   Spam

Increases the efficiency of Predictive Maintenance in the Manufacturing Industry

Corrective Maintenance
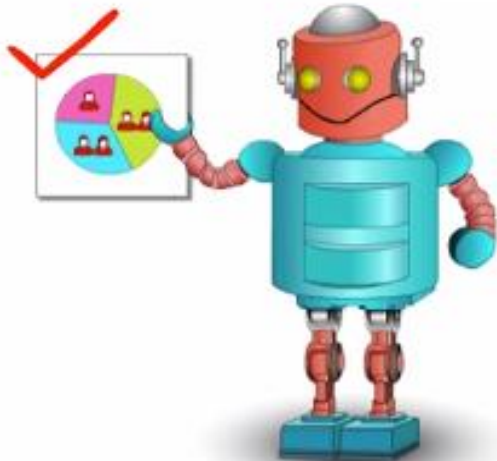
Breakdown

Preventive Maintenance

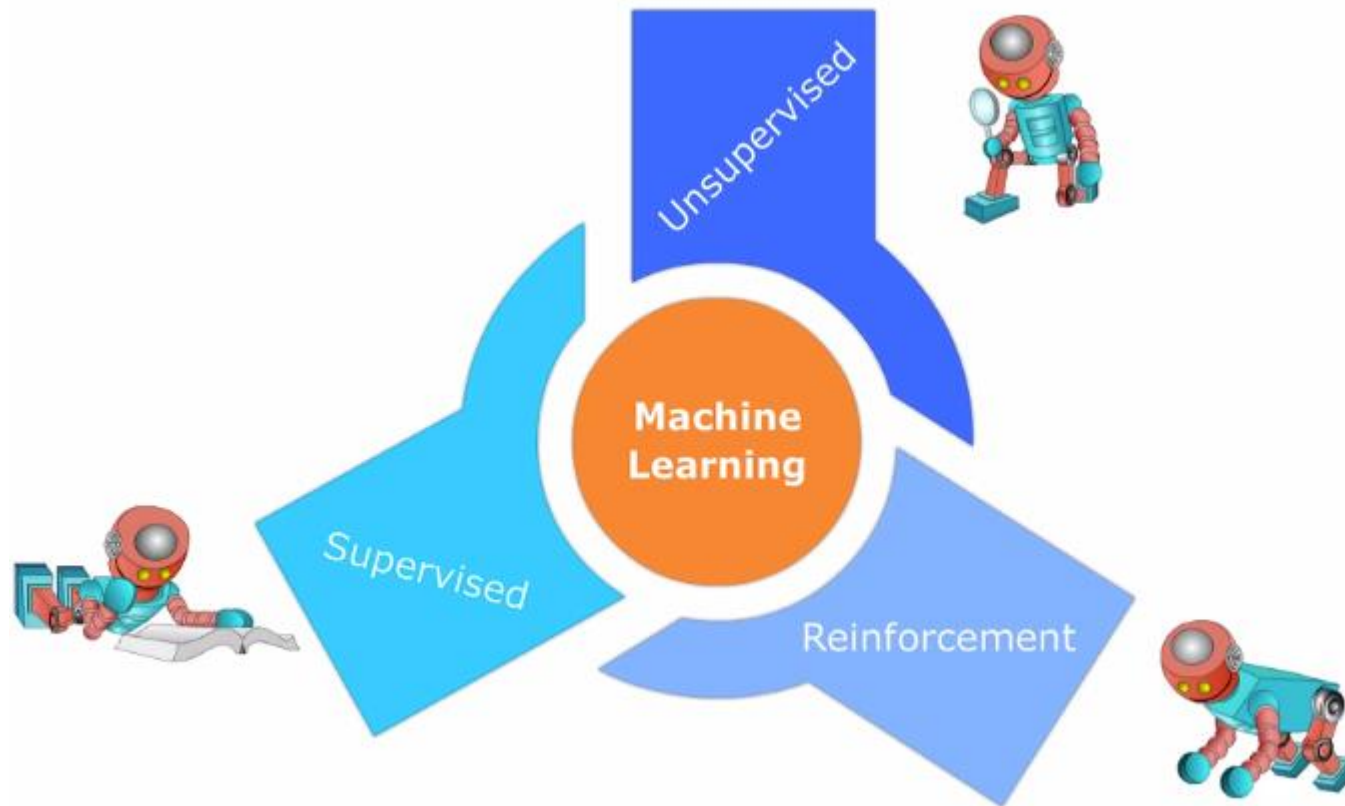Costly and Inefficient

Predictive Maintenance

Highly Efficient

Benefits of ML

Helps in better customer segmentation and accurate lifetime value prediction

Data-driven Marketing

Lead Data

ML Algorithm

High Potential

Website Visitors

Medium Potential

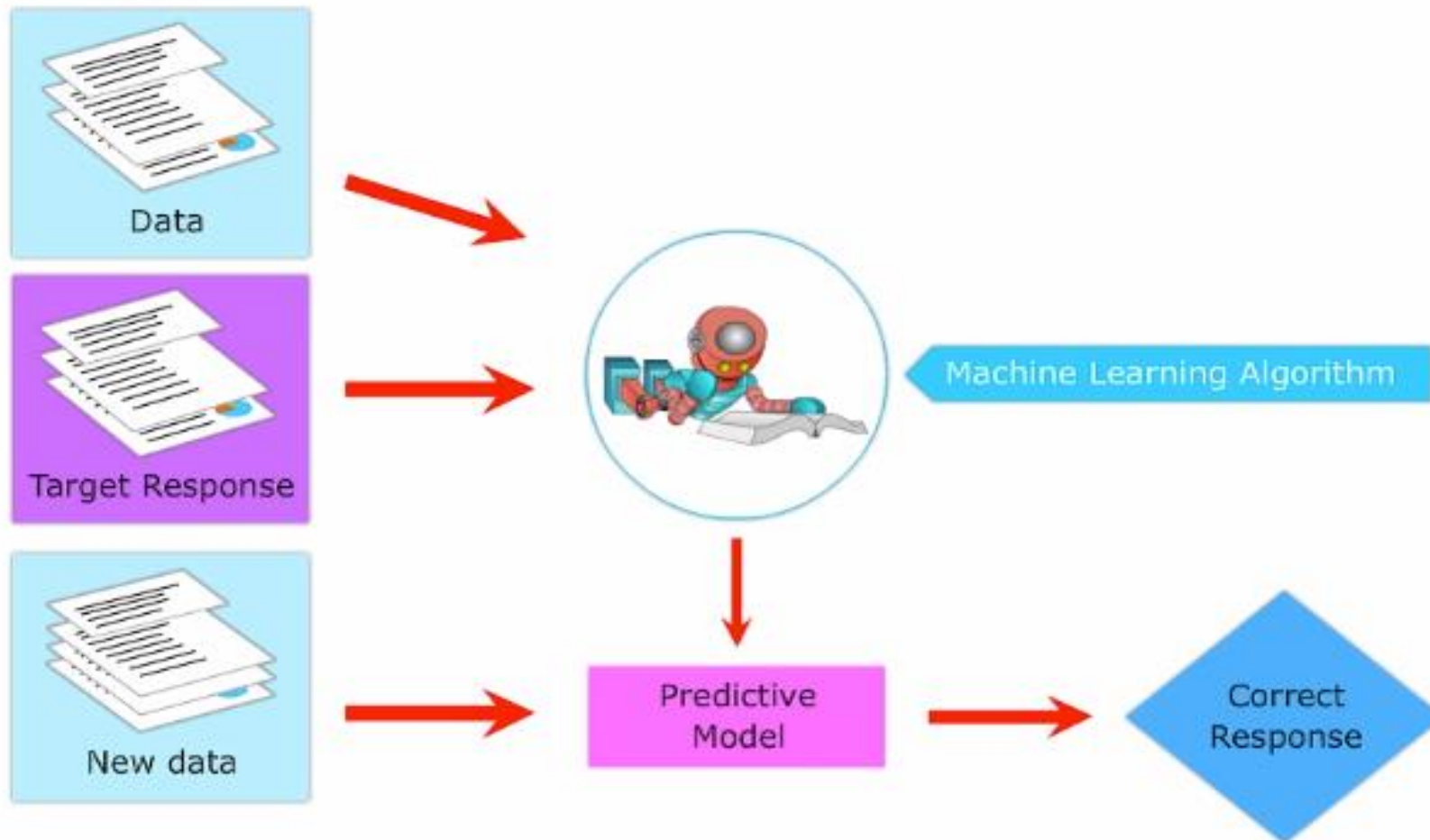Email Campaigns

Low Potential

Prospective Customer
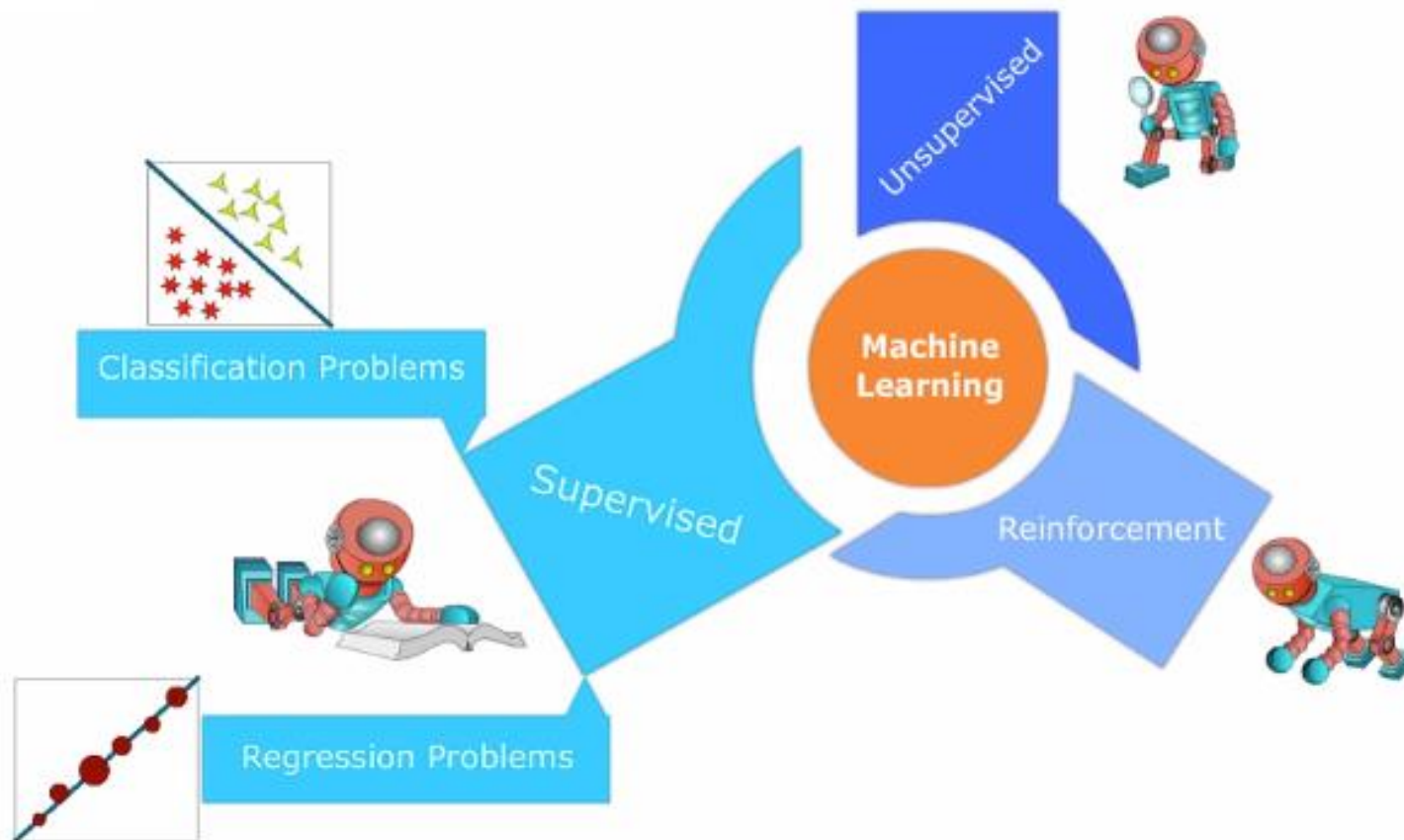
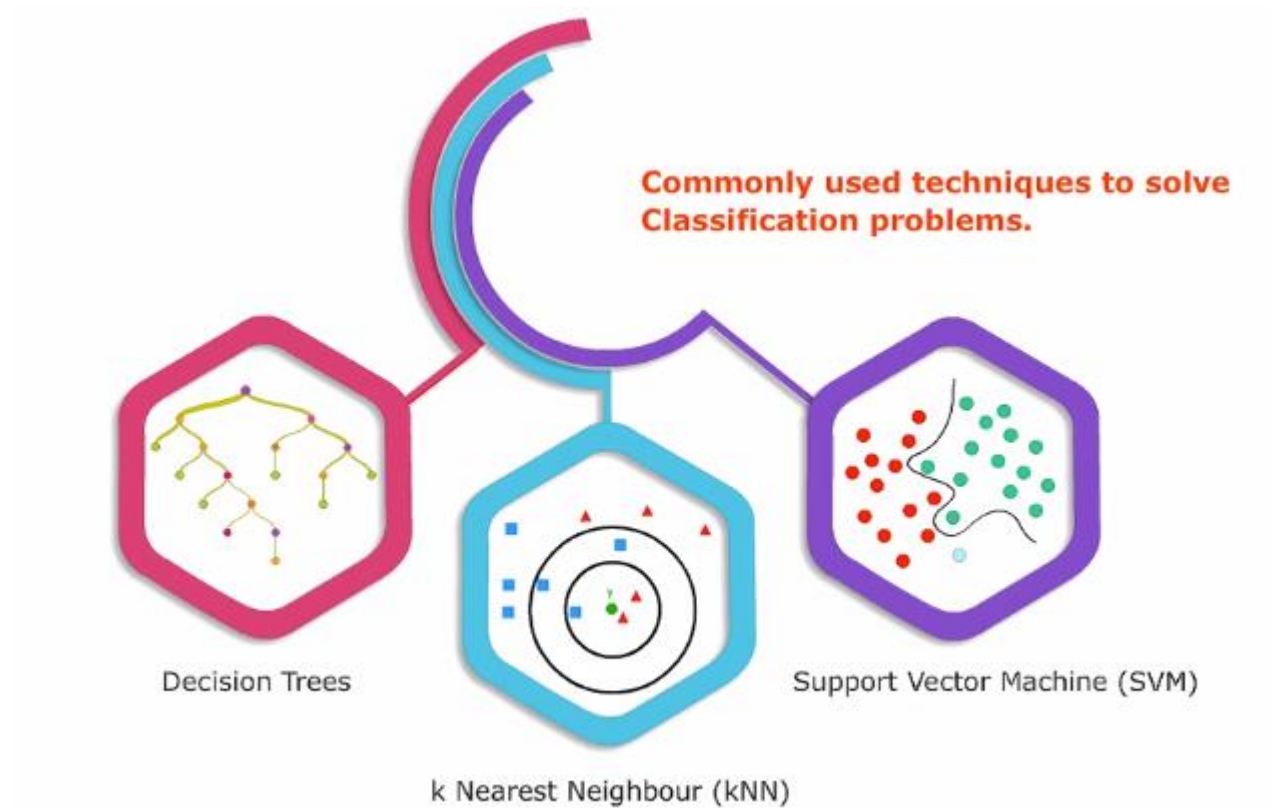# Types of Machine Learning

Supervised Learning

Supervised Learning

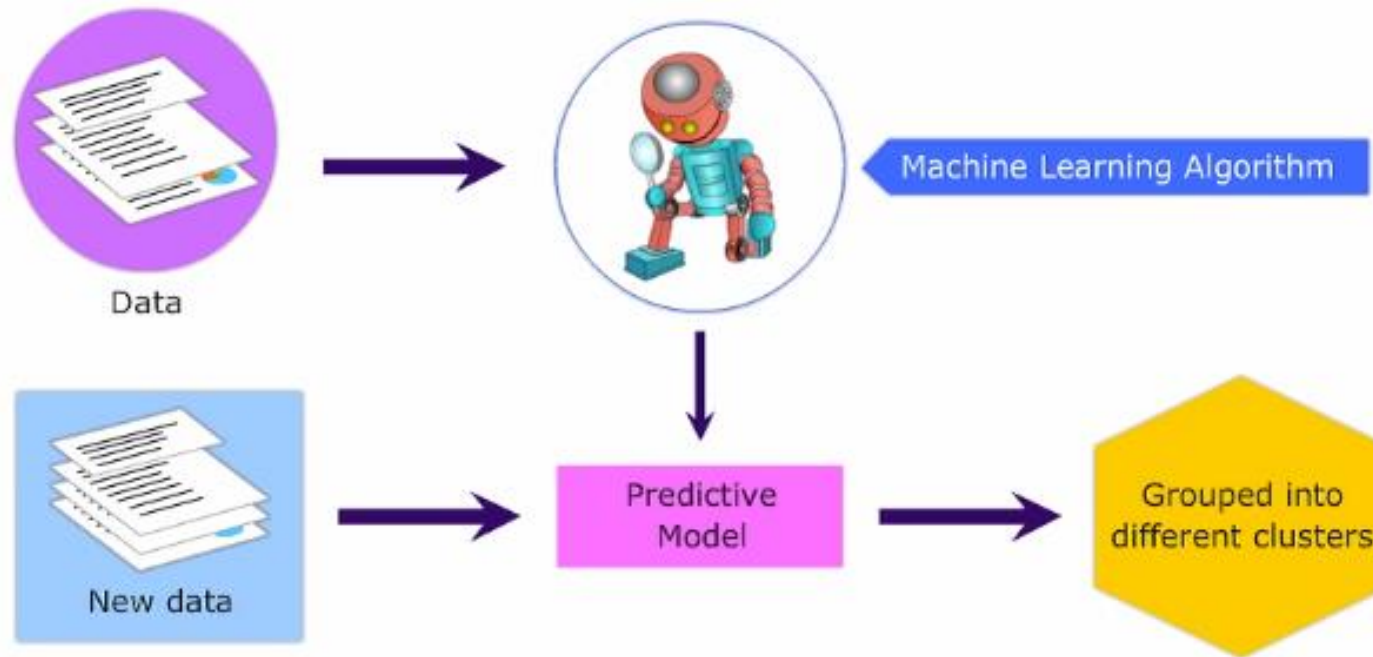# Classification Techniques

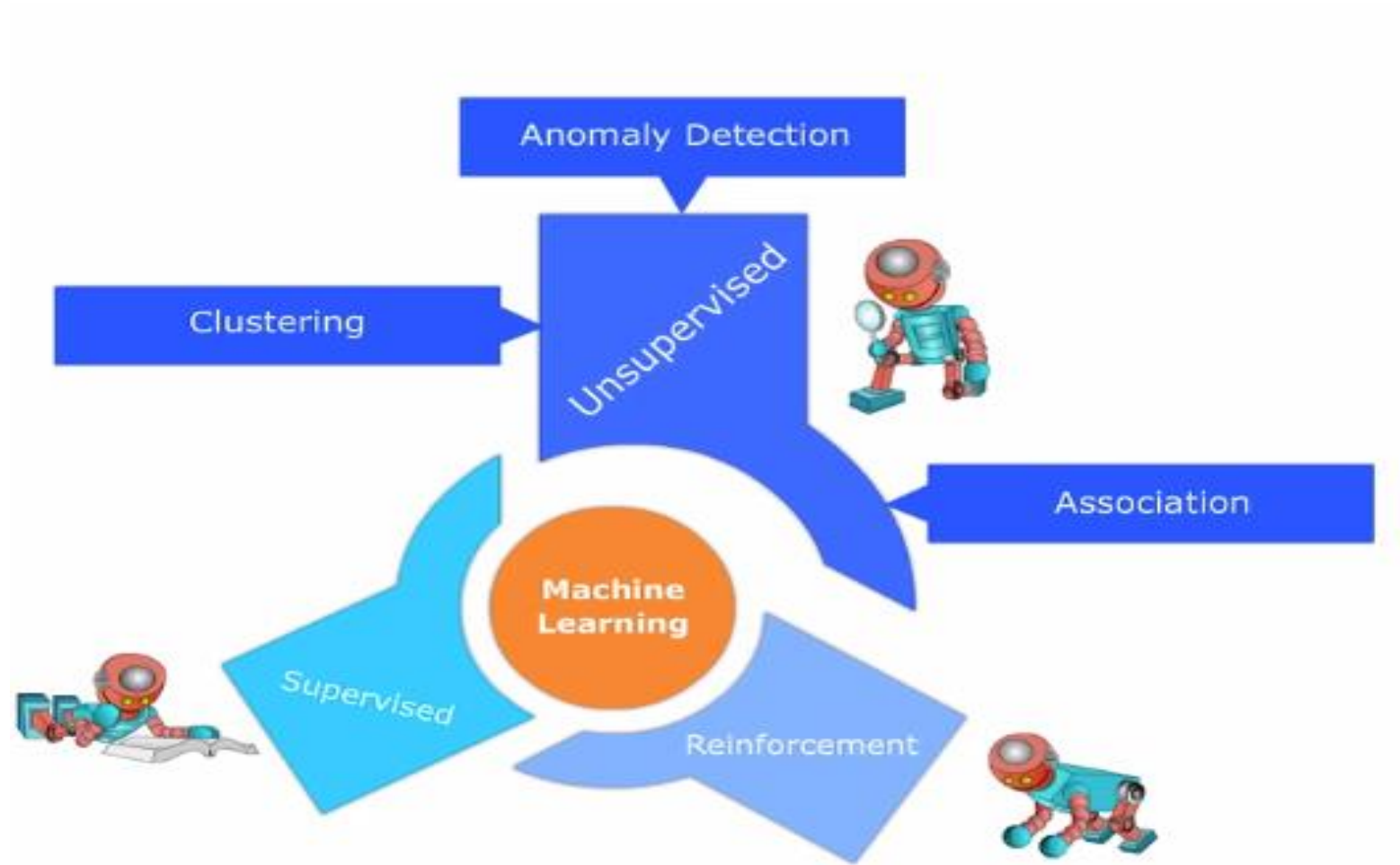# Regression Problems

- Linear Regression

- Logistic Regression

Unsupervised Learning

Unsupervised Learning

Clustering
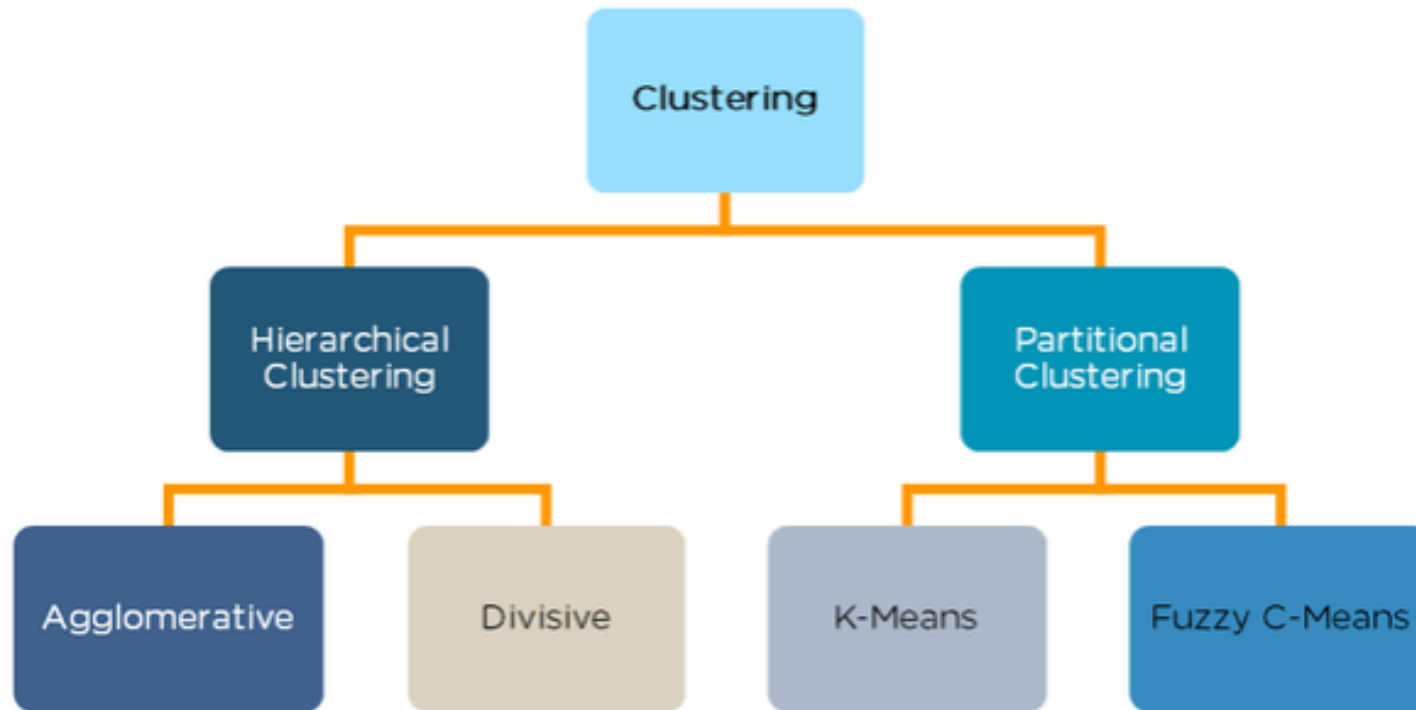
Reinforcement Learning
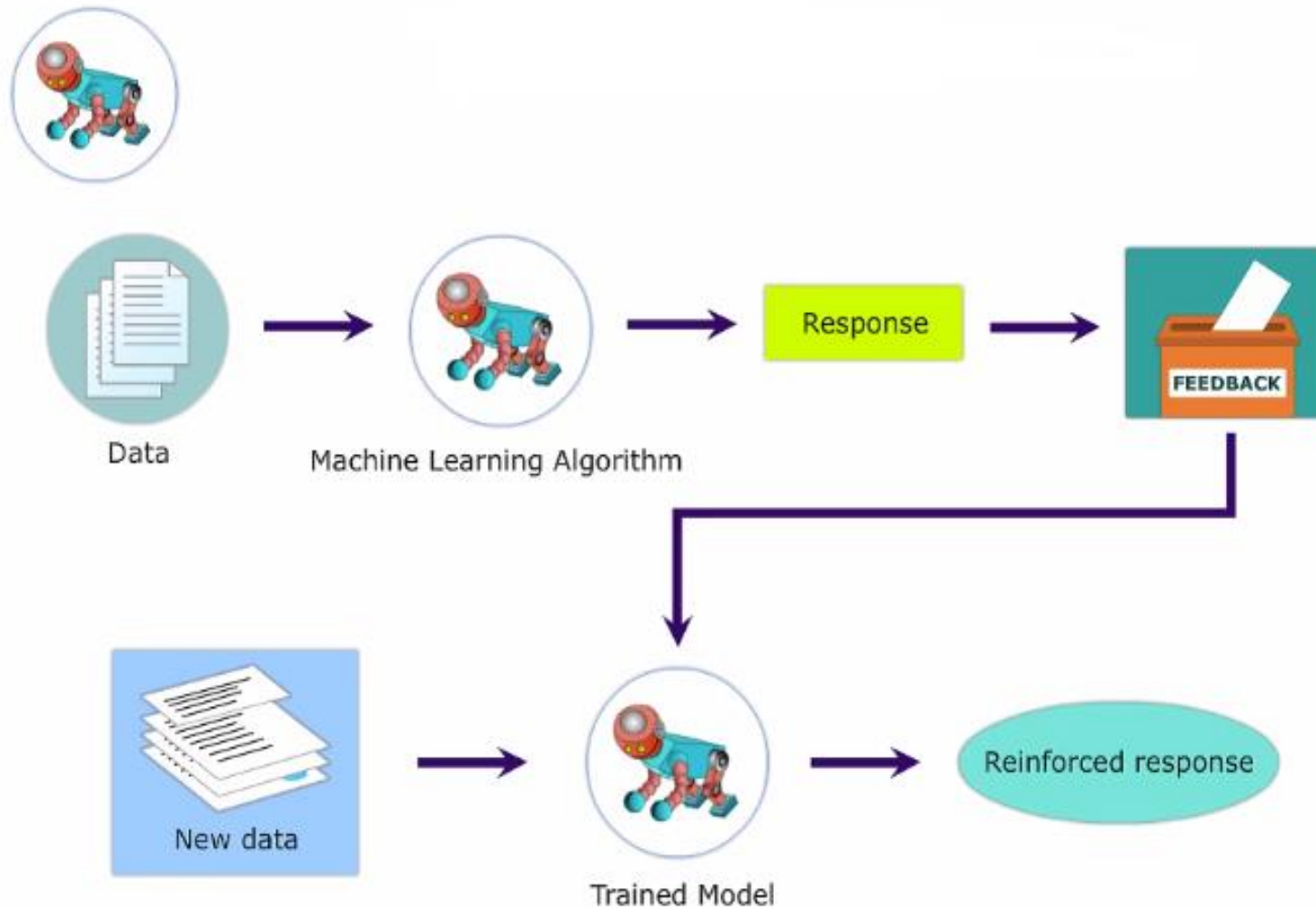
Ensemble method
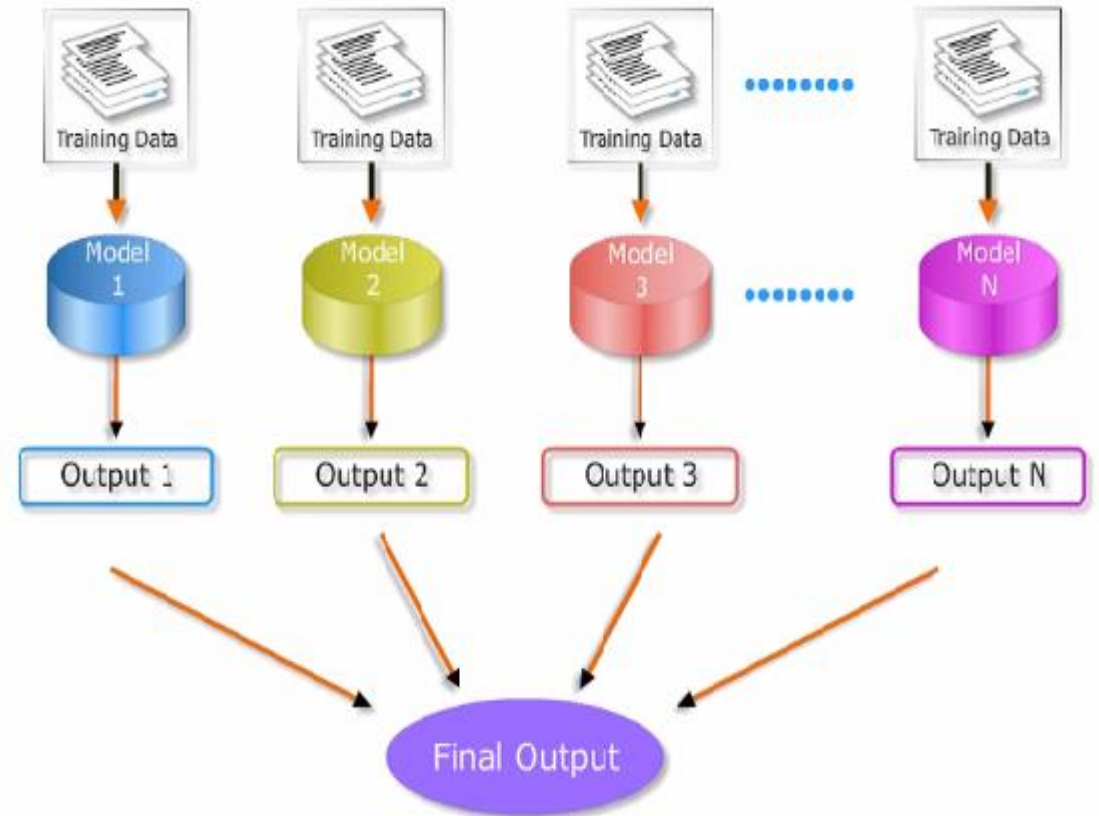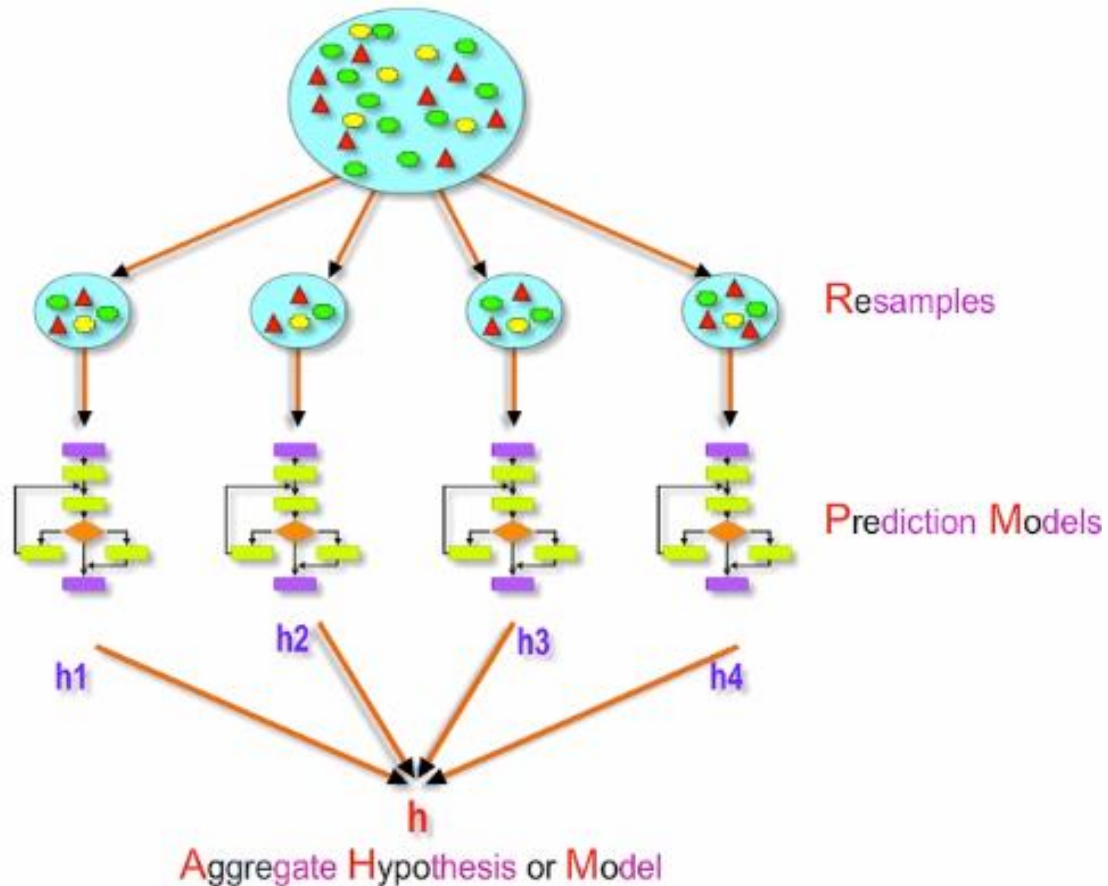
Ensemble by Voting
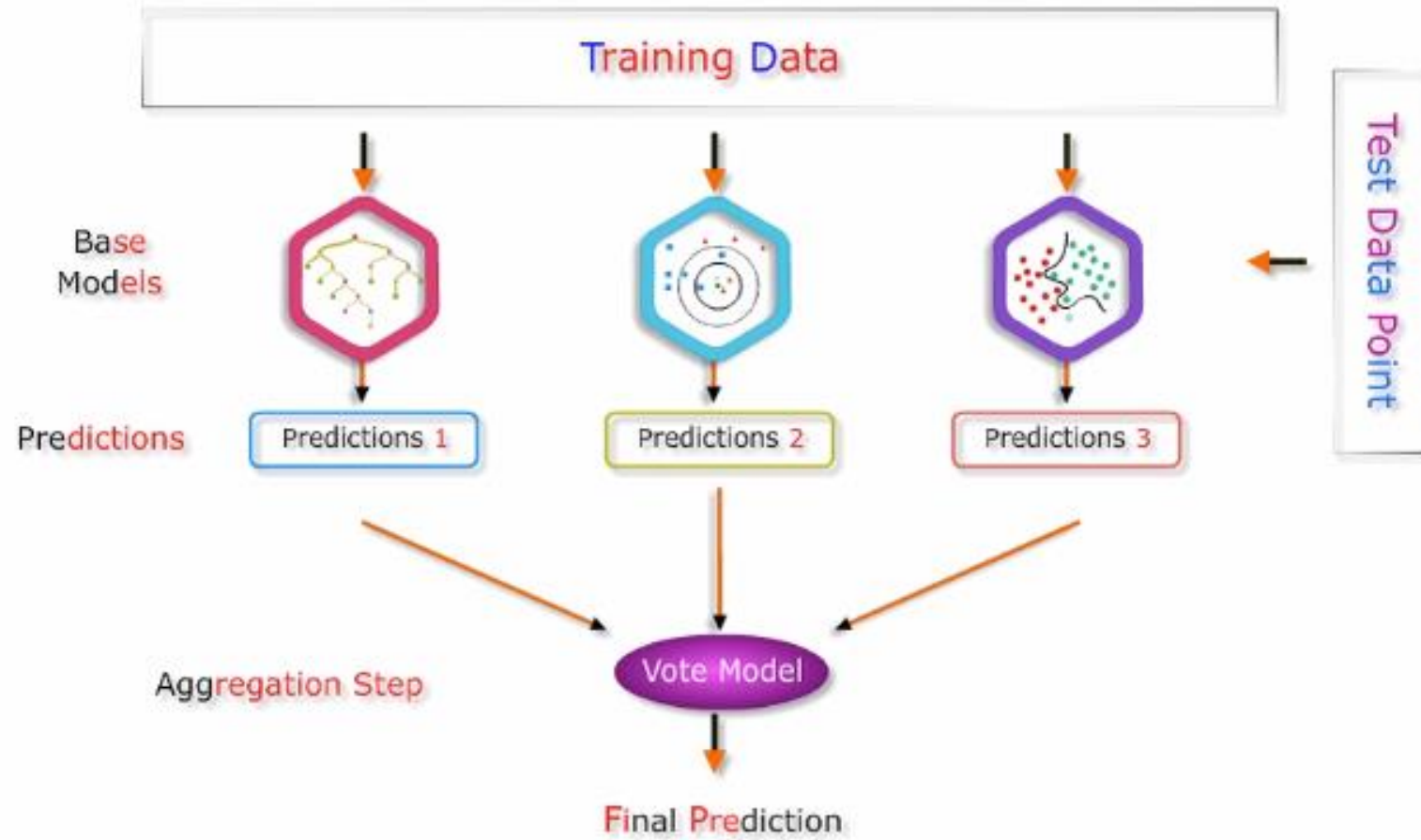
Bagging
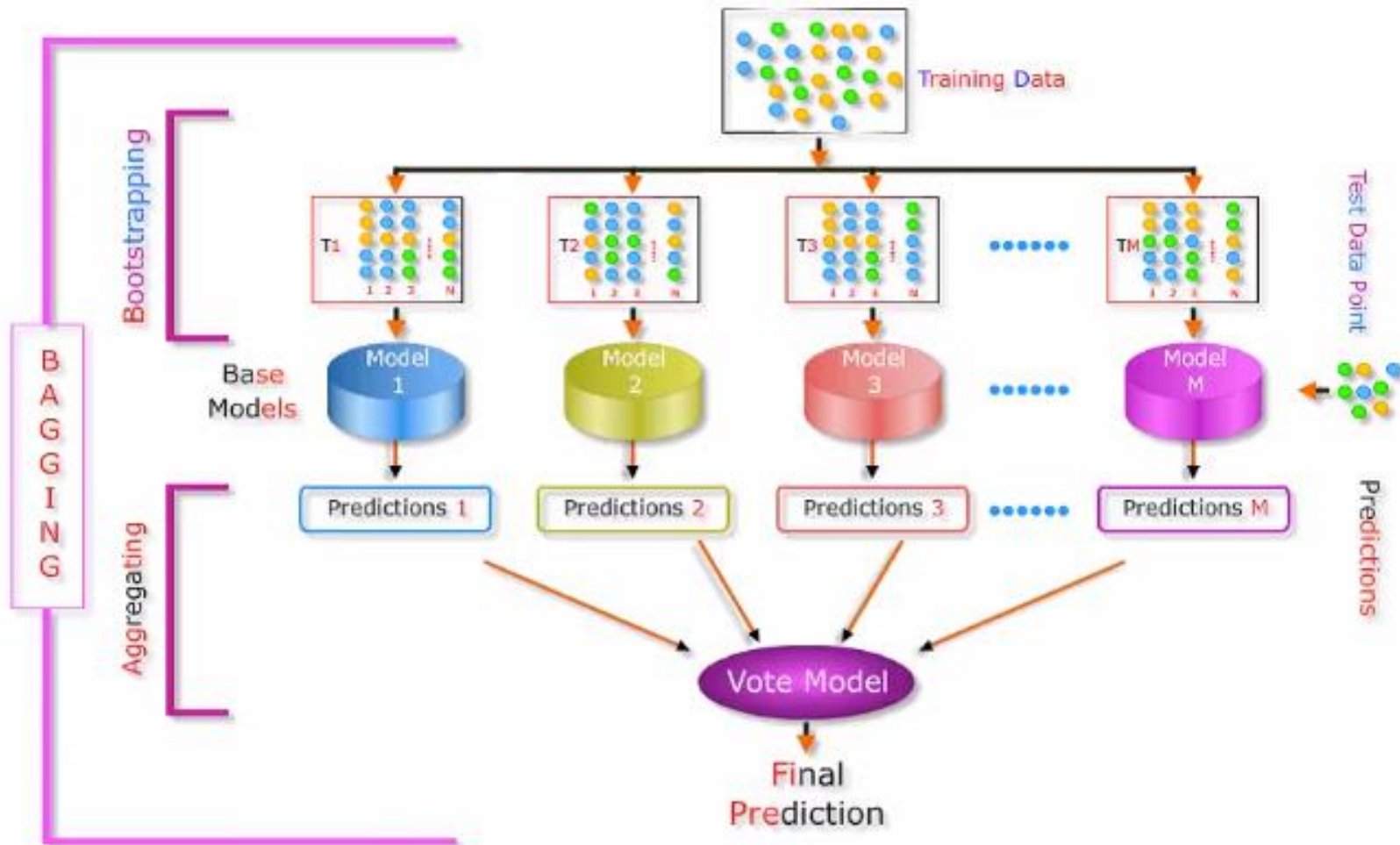
Boosting
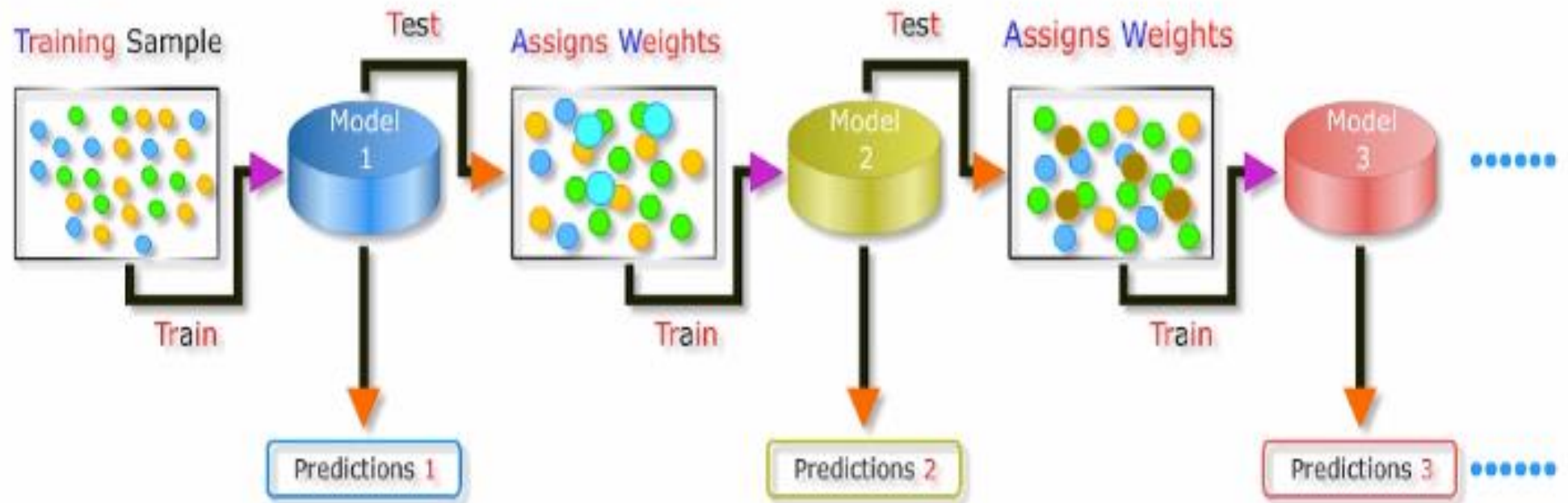
Choice of Machine Learning Algorithm

- Classical ML
  - Simple data clear features

- Reinforcement Learning
  - No data but we have an environment to interact with

- Ensemble Approach
  - When quality is a real problem

- Deep Learning
  - Complicated data
  - Unclear Features

Steps in Machine Learning Process

- Data Collection
- Data Preparation (Pre-processing)
- Choose a model
- Train the model
- Test the model
- Parameter tuning
- Make predictions

Machine Learning Process
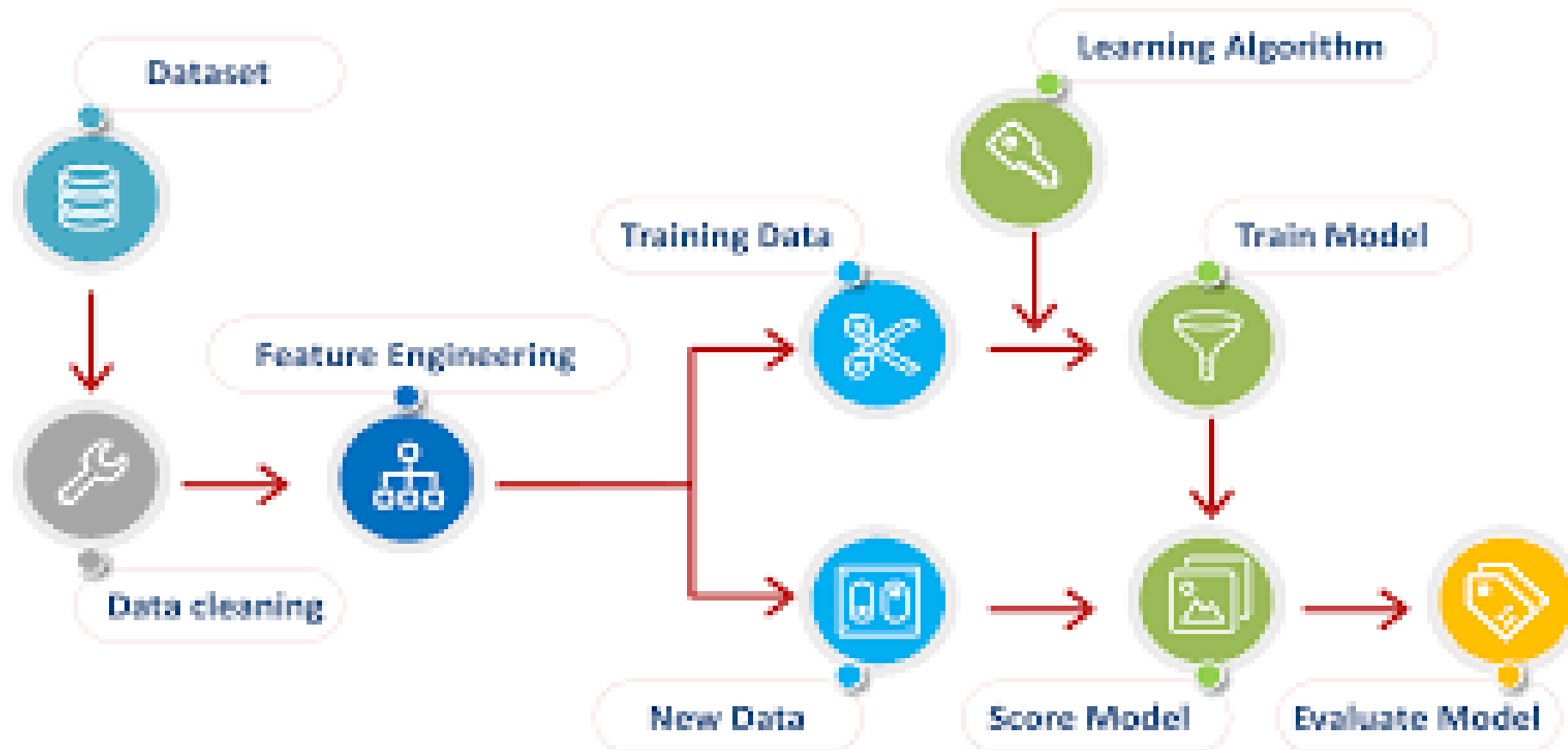
What is Data?

- **Data** is comprised of facts and statistics collected together for reference or analysis.

- **Big Data** is a term that describes the large volume of data – both structured and unstructured – that generated in a business on a day-to-day basis.

Forms of data

Volume	Velocity	Variety	Veracity*
Data at Rest	**Data in Motion**	**Data in Many Forms**	**Data in Doubt**
Terabytes to exabytes of existing data to process	Streaming data, milliseconds to seconds to respond	Structured, unstructured, text, multimedia	Uncertainty due to data inconsistency & incompleteness, ambiguities, latency, deception, model approximations
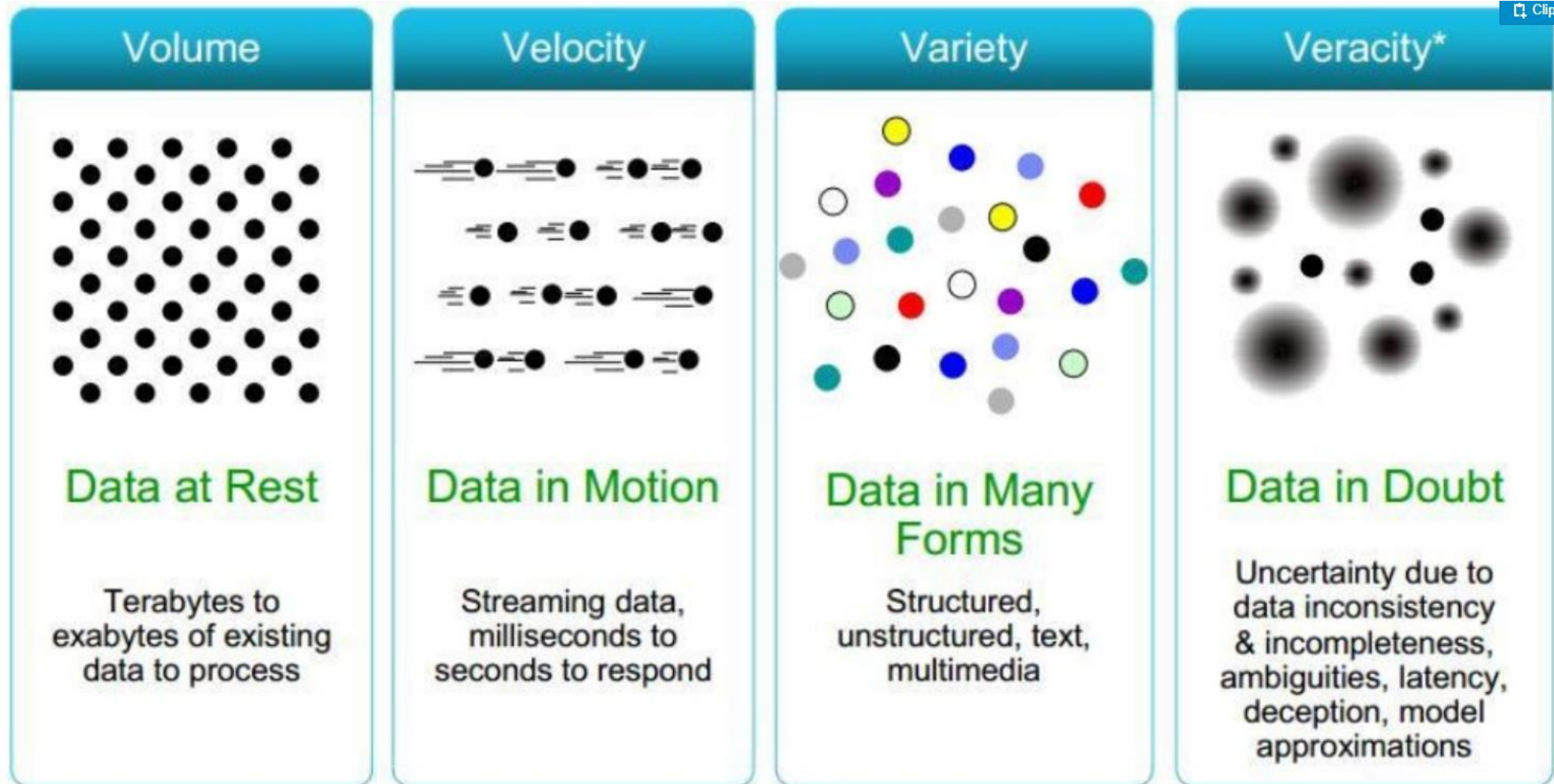
Machine Learning Dataset

- Google Dataset Search
  - https://datasetsearch.research.google.com/
- Kaggle
  - https://www.kaggle.com/datasets
- UCI Machine Learning Repository
  - https://archive.ics.uci.edu/ml/datasets.php

Machine Learning tools

- Weka
- R
- RapidMiner
- Google Colab
- Apache Mahout
- Accord.NET

Weka

- Waikato Environment for Knowledge Analysis (Weka)
- Open source software tool written in Java
- Features
  - Data preparation
  - Classification
  - Regression
  - Clustering
  - Visualization and
  - Association rules mining.

R

- R is a programming language for data analysis and statistics.

- It is open source and free

- RStudio IDE

- Features
  - Statistical Inference
  - Data Analysis
  - Machine learning algorithms

Rapid Miner

- Rapid Miner is a Data Science Platform for quickly analyzing data

- Not a opensource

- No programming skills required

- Features
  - Through GUI, it helps in designing and implementing analytical workflows.
  - It helps with data preparation.
  - Result Visualization.
  - Model validation and optimization.

Google Colab

- Google Colab is a cloud service which supports Python.
- Opensource
- colab.research.google.com
- Supports PyTorch, Keras, TensorFlow, and OpenCV libraries

Apache Mahout

- Apache **Mahout** is an open source project that is primarily used for creating scalable machine learning algorithms.

- Written in Java

- It works for large data sets.

- Features
  - It provides algorithms for Pre-processors, Regression, Clustering, Recommenders, and Distributed Linear Algebra.
  - Java libraries are included for common math operations.
  - It follows Distributed linear algebra framework.

Accord .NET

- Accord.NET is a framework for scientific computing in .NET
- Opensource
- It provides algorithms for
  - Numerical linear algebra.
  - Numerical optimization
  - Statistics
  - Artificial Neural networks.
  - Image, audio & signal processing.
  - It also provides support for graph plotting & visualization libraries.

ML Libraries

- Numpy
- Seaborn
- Sklearn
- PyTorch
- Keras
- TensorFlow
- Theano
- Pandas
- OpenCV

Anaconda

- Anaconda is the data science platform for data scientists and researchers

- Open-source distribution for python and R

- Used for data science, machine learning and deep learning

- Availability of more than 300 libraries

- Installation of Anaconda
  - go to https://www.anaconda.com/distribution/

Impact of ML and AI

Intelligent Gaming

IBM's Deep Blue defeated Gary Kasparov in chess

Google DeepMind's AlphaGo, defeated Lee Sedol, the Go world champion, in 2016.

Self-Driving Cars and Automated Transportation

- A car has to learn and adapt to the ever-changing behavior of other vehicles around it.

- Machine learning algorithms make autonomous vehicles capable of making decisions in real time. This increases safety and trust in autonomous cars.

- AI-powered cars have even surpassed human-driven cars in safety, according to a study with 55 Google vehicles that have driven over 1.3 million miles altogether.
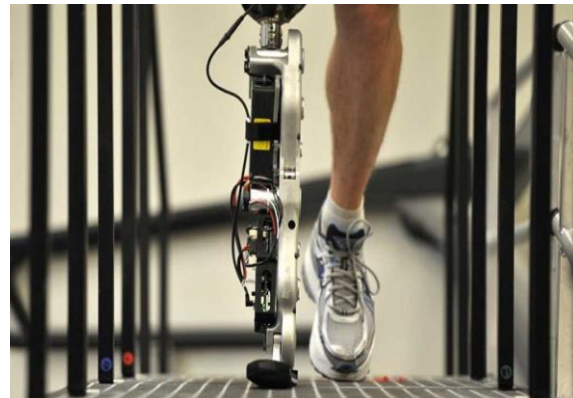
Cyborg Technology

The term cyborg became popular after the release of the movie *The Terminator* in 1984.

Cyborgs – machines with a metal endoskeleton inside, living tissue on the outside.

Cyborg tech is most useful as support for people who live with a disability.

Cyborg technology can replace missing limbs, damaged organs, and limited senses.

Taking Over Dangerous Jobs

Bomb Disposal - Today, robots (or more more technically, drones) are taking over these risky jobs. Saved thousands of lives.

Welding - produces noise, intense heat, and toxic substances found in the fumes. Without machine learning, these robot welders would need to be pre-programmed to weld in a certain location. However, advancements in computer vision and deep learning have enabled more flexibility and greater accuracy.

Environmental Protection

Machines can store and access more data than any one person could—including mind-boggling statistics

[IBM's Green Horizon Project](#) analyzes environmental data from thousands of sensors and sources to product accurate, evolving weather and pollution forecasts.

Exciting environment-oriented innovations are entering the market every day, from self-adjusting smart thermostats to distributed energy grids

Digital Empathy and Robots as Friends

Company in Japan has made the first big steps toward a robot companion—one that can understand and feel emotions

Introduced in 2014, Pepper the companion robot went on sale in 2015, with all 1,000 initial units selling out within a minute.

Boston Dynamics is one of the best-known company in the robotics space – Spot, Handle and Atlas.

The robot was programmed to read human emotions, develop its own, and help its human friends stay happy.

Improved Elder Care

- Elder care is a growing concern for many families.

- Elderly relatives could be assisted by [in-home robots](#) in their homes

- Medical and AI researchers have even piloted systems based on infrared cameras that can detect when an elderly person falls.

- Researchers and medical specialists can also monitor alcohol and food consumption, fevers, restlessness, urinary frequency, chair and bed comfort, fluid intake, eating, sleeping, declining mobility, and more.

ELITE
DATA SCIENCE
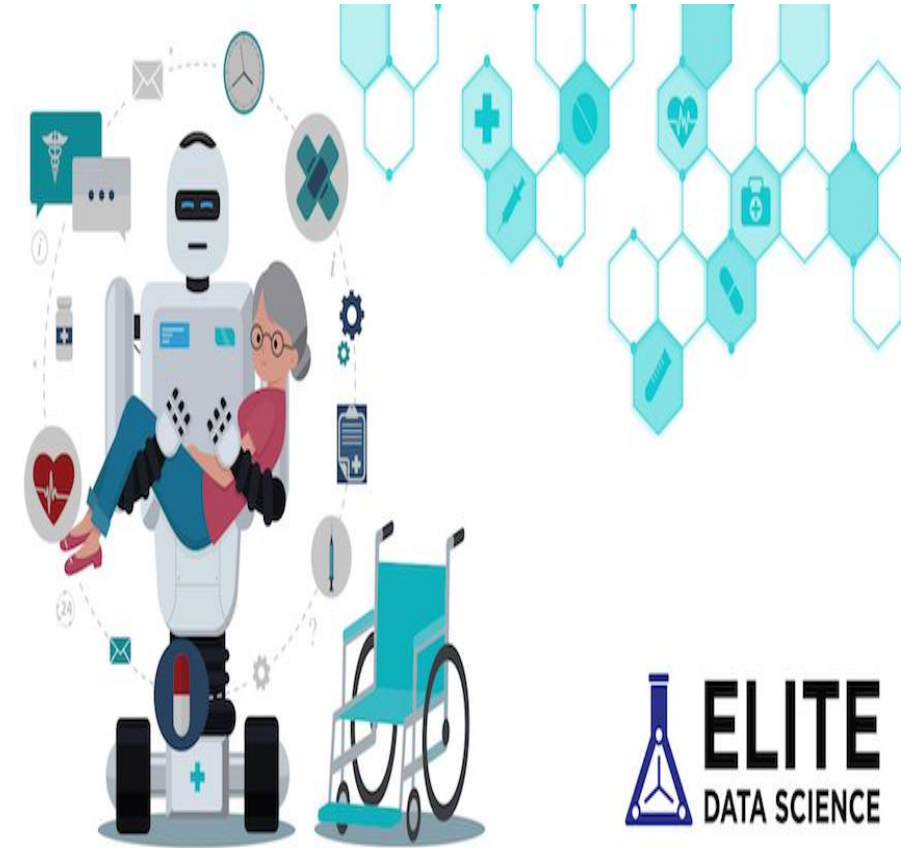
Enhanced Health Care

Hospitals that utilize machine learning to aid in treating patients

AI is also tackling some of medicine's most intractable problems, such as allowing researchers to better understand genetic diseases through the use of predictive models.

Deep learning models quickly provide real-time insights and, combined with the explosion of computing power, are helping healthcare professionals diagnose patients faster and more accurately,

Develop innovative new drugs and treatments, reduce medical and diagnostic errors, predict adverse reactions, and lower the costs of healthcare for providers and patients.

Innovations in Banking

Using location data and purchase patterns, AI can also help banks and credit issuers identify fraudulent behavior while it is happening. These machine learning based **anomaly detection models** monitor transaction requests. They can spot patterns in your transactions and alert users to suspicious activity.

They can even confirm with you that the purchase was indeed yours before they process the payment.

Personalized Digital Media

Machine learning has massive potential in the entertainment industry

Netflix, Amazon Prime, Spotify, and Google Play.

Used to eliminate buffering and low-quality playback, getting you the best quality from your internet service provider.

Data about consumers' viewing habits, helping streaming services offer more useful recommendations.

NLP (Natural Language Processing) algorithms help write trending news stories to decrease production time,

MIT-developed AI named Shelley is helps users write horror stories through deep learning algorithms and a bank of user-generated fiction

Home Security

Many homeowners look toward AI-integrated cameras and alarm systems. These cutting-edge systems use facial recognition software and machine learning to build a catalog of your home's frequent visitors, allowing these systems to detect uninvited guests in an instant.

AI-powered smart homes also provide many other useful features, like tracking when you last walked the dog or notifying you when your kids come home from school.

The newest systems can even call for emergency services autonomously

Smart Homes

AI could make housework and household management seamless.

AI-powered apps which allow the oven to communicate with the refrigerator and the pantry robot would act like home chefs

Cleaning could be schedule through sensor-to-appliance connections, after which robotic cleaners would work almost completely independently of humans.

Another advantage of smart homes would be a reduction of household waste and automated recycling, putting the household in better balance with the ecosystem.

Releasing humans from housework could deliver major benefits in terms of improving sustainability, saving time, and reducing stress.

Streamlined Logistics and Distribution

Shipping costs are still quite expensive

Improving efficiency through AI integration and automation will mean big reductions in shipping costs and increases in delivery speed.

Optimization opportunities in supply chain management, vehicle maintenance, and inventory will also make shipping faster, easier, and more environmentally friendly.

Object Detection

Object detection is a computer technology related to computer vision and image processing that deals with detecting instances of semantic objects of a certain class (such as humans, buildings, or cars) in digital images and videos.

Well-researched domains of object detection include face detection and pedestrian detection
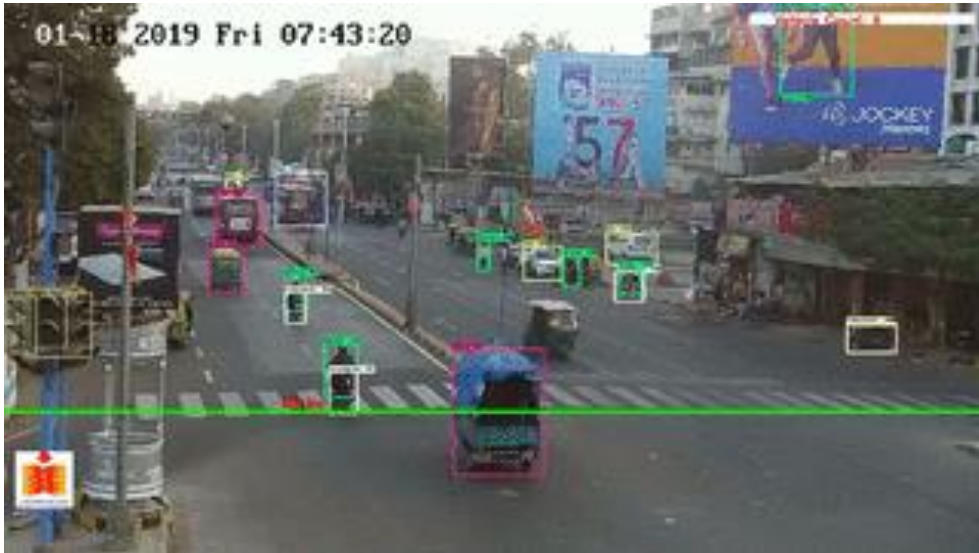
Object detection has applications in many areas of computer vision, including image retrieval and video surveillance.

Vehicle Detection
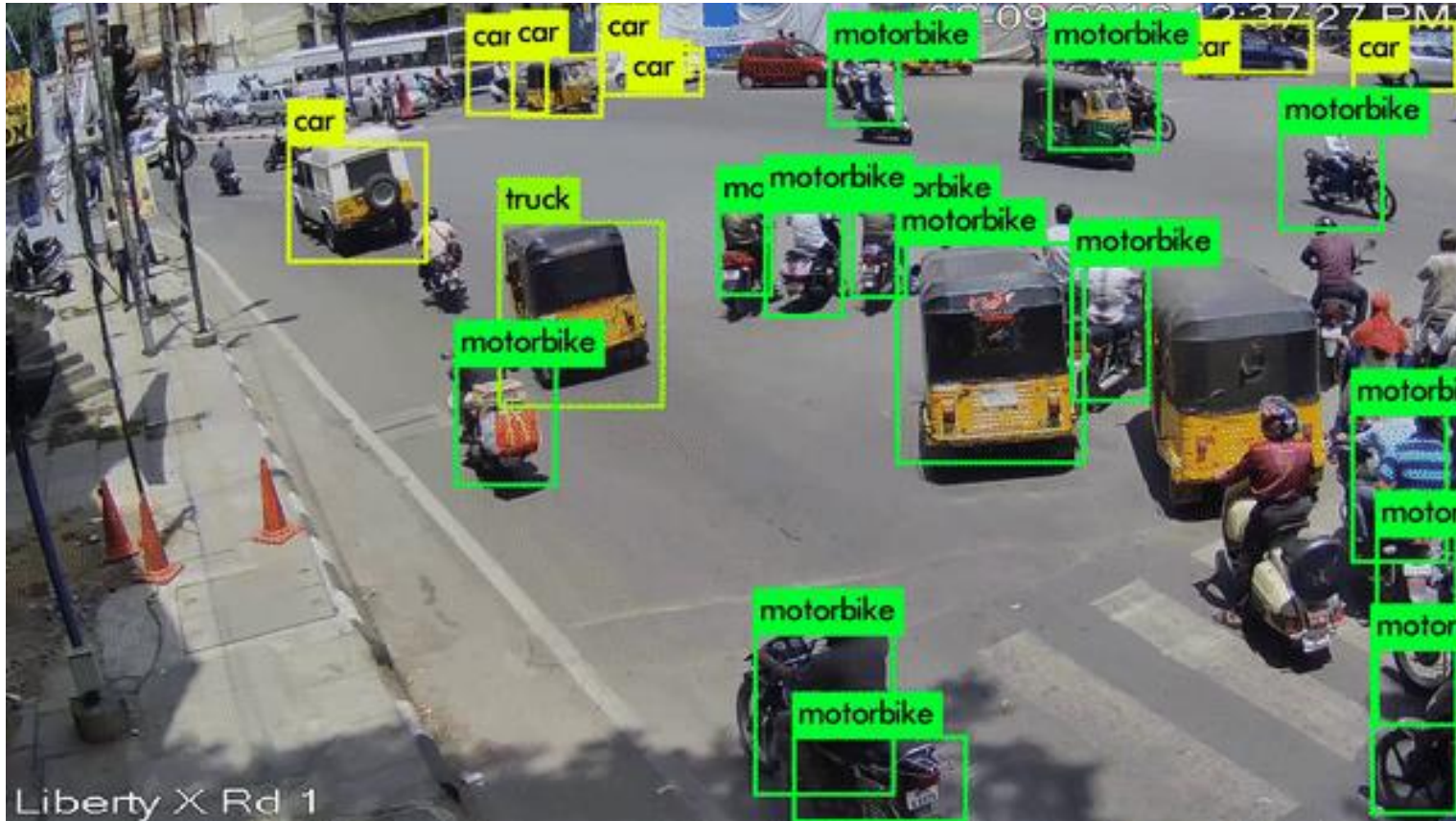
Vehicle Counting and Segmentation

"**Forced**" Entrepreneurship