

Introduction and applications of AI, ML and DL

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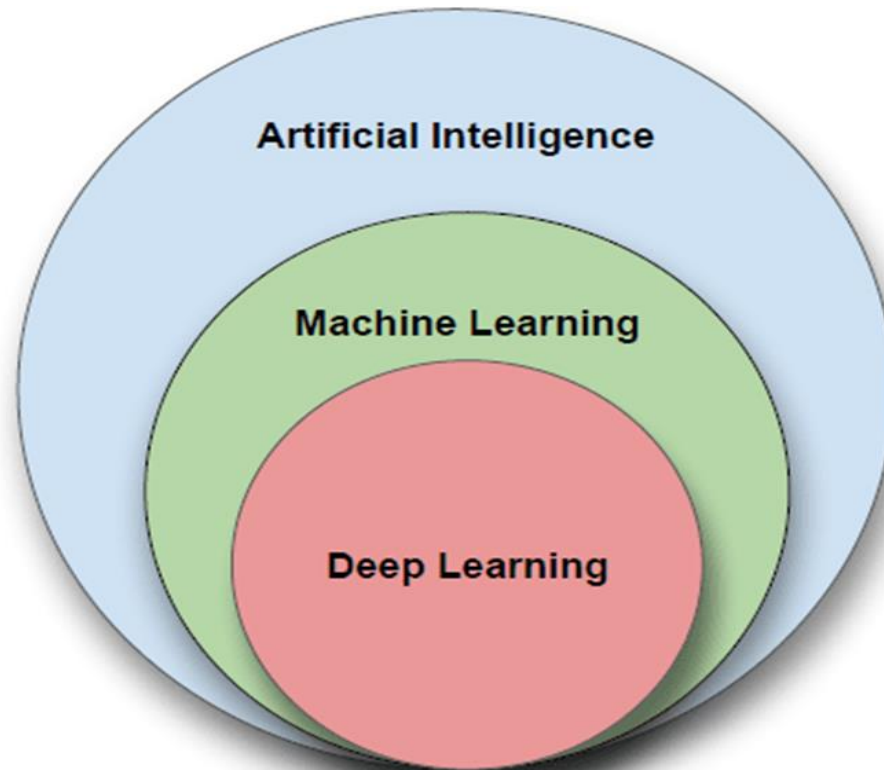
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Introduction

- Artificial intelligence is the ability of machines to replicate or enhance **human intellect**, such as **reasoning and learning from experience**.
- **Artificial Intelligence (AI)** is the most trending field of computer science. It has been used in computer programs for years, but it is now applied to many other products and services. Therefore, it's essential to know that AI is not a single field but a combination of various fields.
- AI uses techniques from probability theory, signal processing, and algorithm design to solve practical problems. In addition, the AI field draws upon computer science, mathematics, psychology, and linguistics.

Broad overview

- AI is the machine-displayed intelligence that simulates human behavior or thinking and can be trained to solve specific problems. AI is a combination of **Machine Learning** techniques and **Deep Learning**.



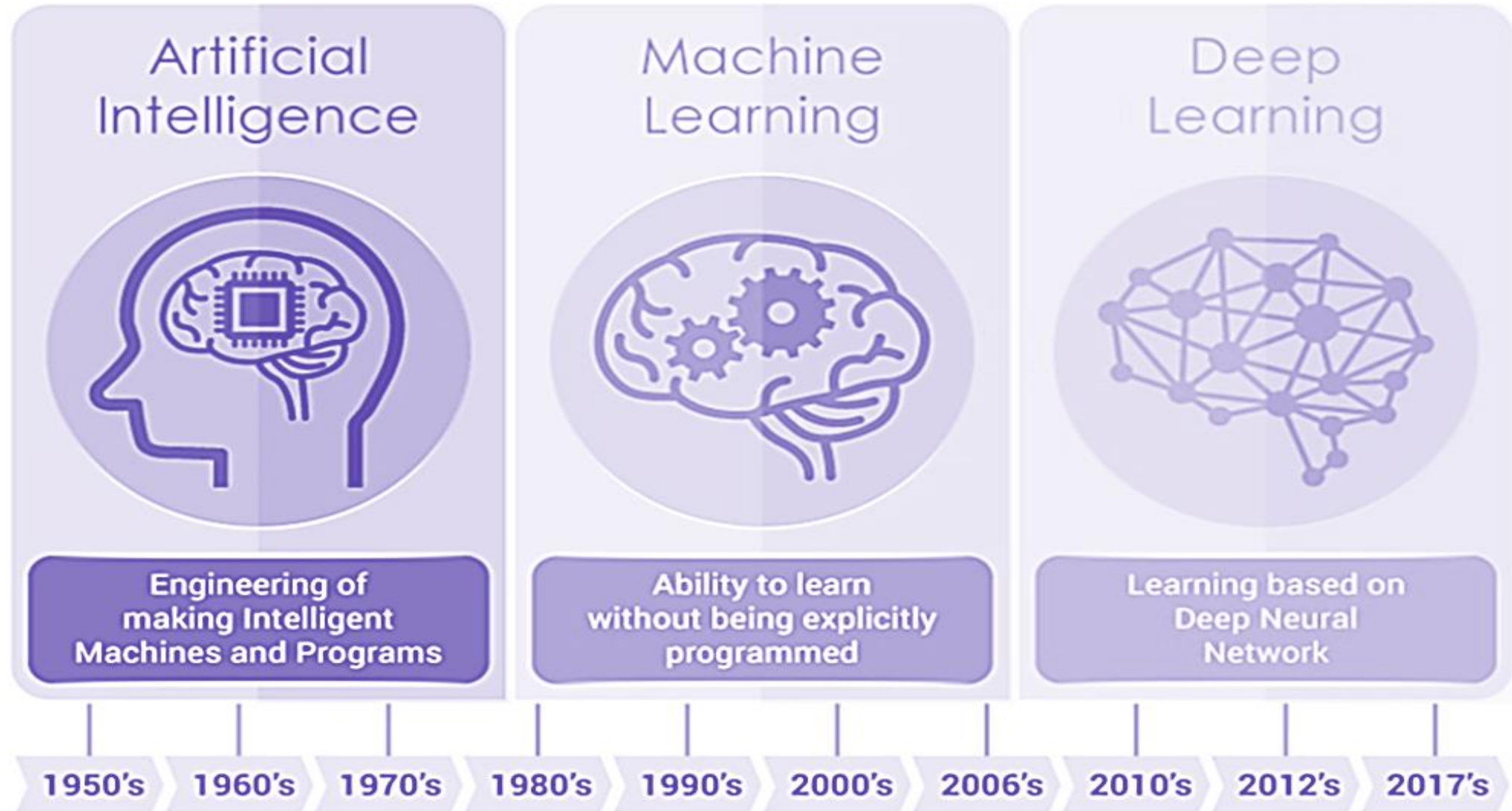
ML is a subset of AI

DL is a subset of ML

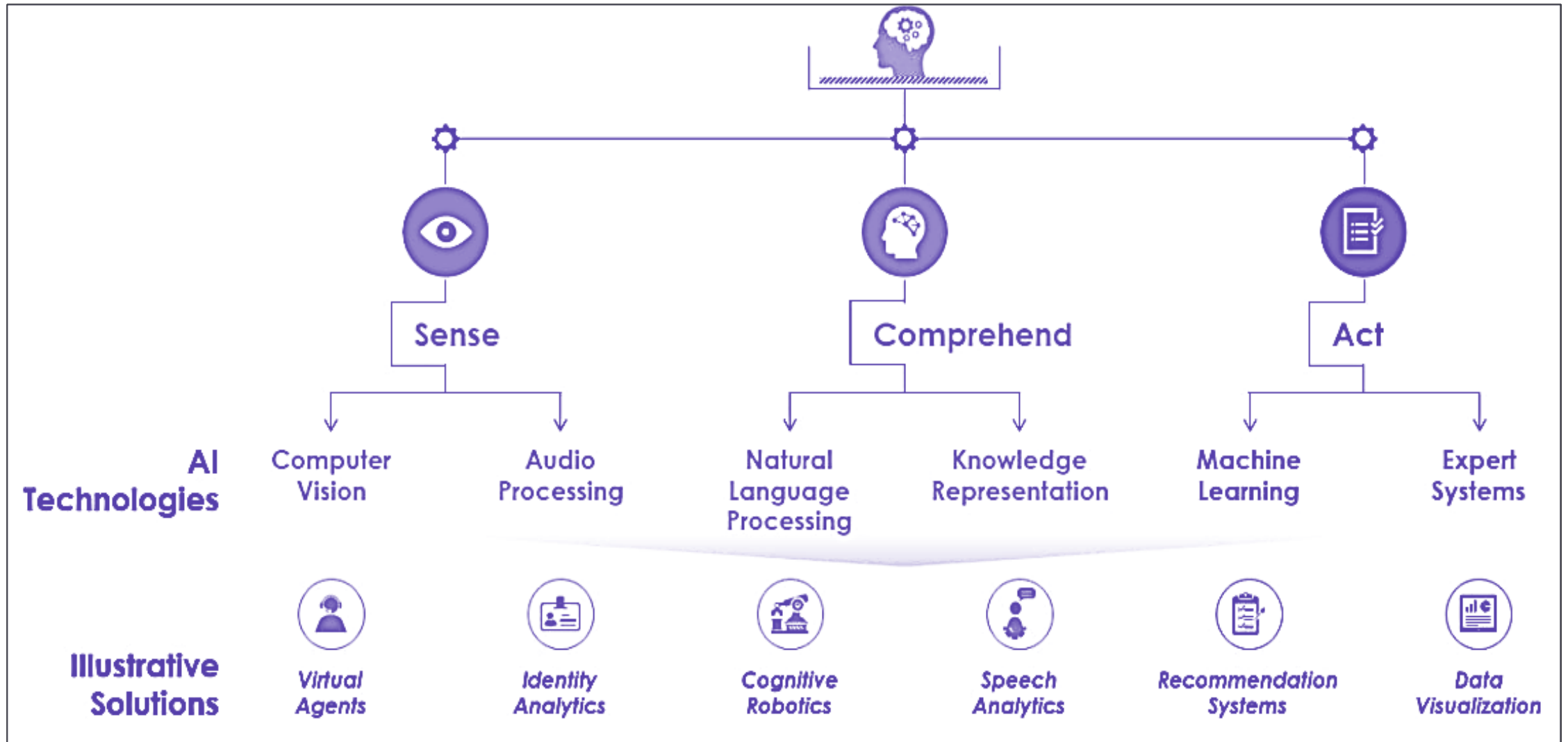
What is AI?

- Artificial Intelligence (AI) is the general term for being able to make computers do things that require intelligence if done by humans. AI can be broken down into two major fields, **Machine Learning** (ML) and **Neural Networks** (NN). Both are subfields under Artificial Intelligence, and each one has its methods and algorithms to help in solving problems.
 - **Deep learning** is a subset of machine learning that uses multi-layered artificial neural networks.

Timeline of AI



Sub-fields associated with AI



Main topics in AI

Topics:

- Planning
- Learning
- Expert systems
- Reasoning
- Knowledge representation
- Interacting with environment
 - Vision
 - Speech
 - NLP
 - Robotics

The Turing Test

- Alan Turing 1950: can machine think?
- For full test needs
 - NLP
 - ML
 - Knowledge representation
 - Automated reasoning
 - Vision
 - Robotics

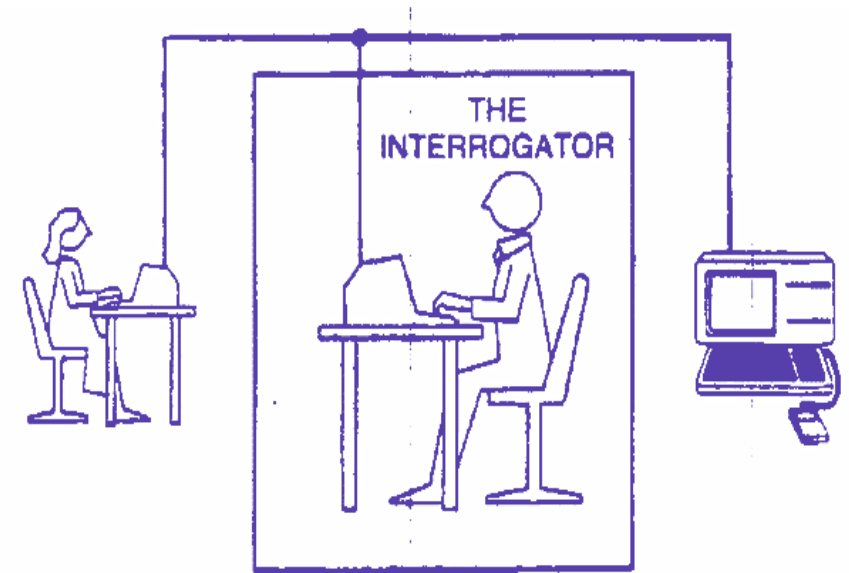


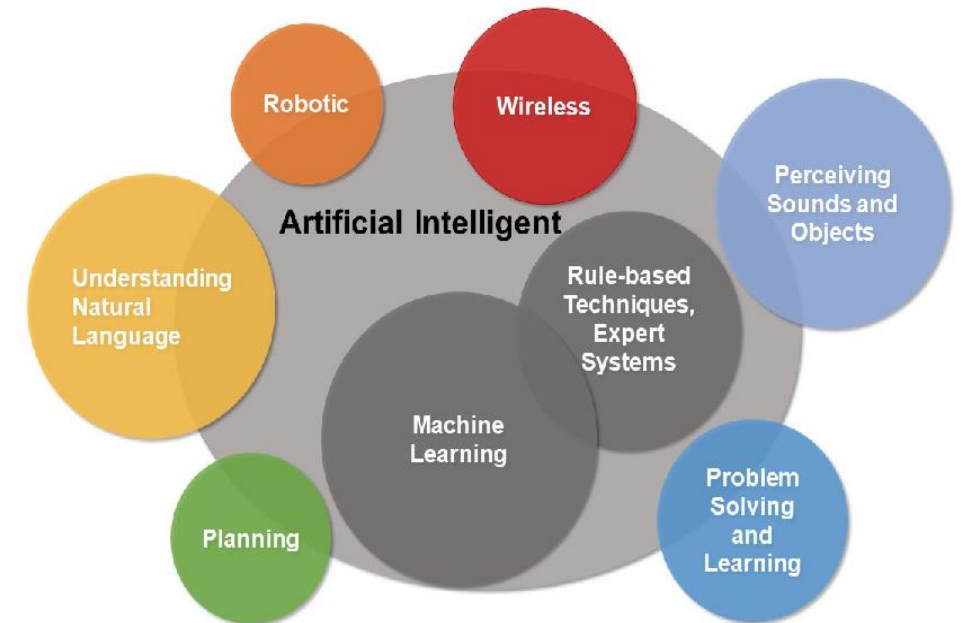
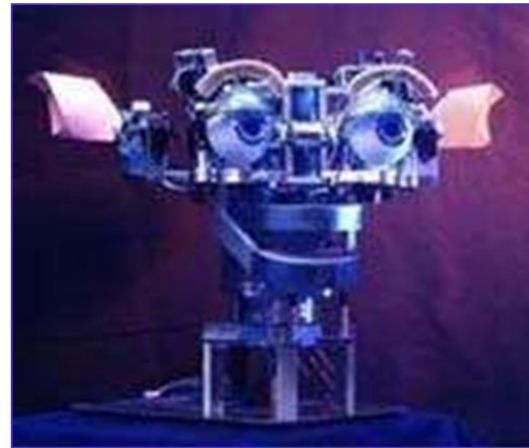
Figure 1.1 The Turing test.

Applications of AI

Wireless,
Recommendation System,
Healthcare,

Autonomous Vehicles,
Navigation,
Automobiles,

Facial Recognition,
Robotics,
Marketing
Biomedical etc.



Applications of AI in communication

Artificial Intelligence (AI) Applications in wireless communication are - mobility management, sensing and localization, smart signalling, and interference management.

Recently, Qualcomm Technologies prototyped the AI-enabled air interface and announced the Snapdragon X70 5G modem-RF, the world's first 5G modem with a dedicated AI processor.

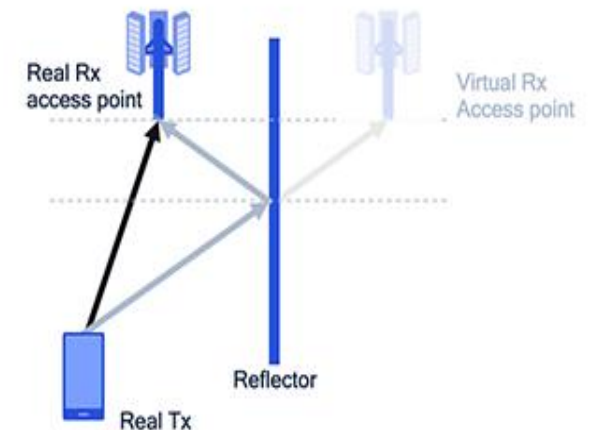
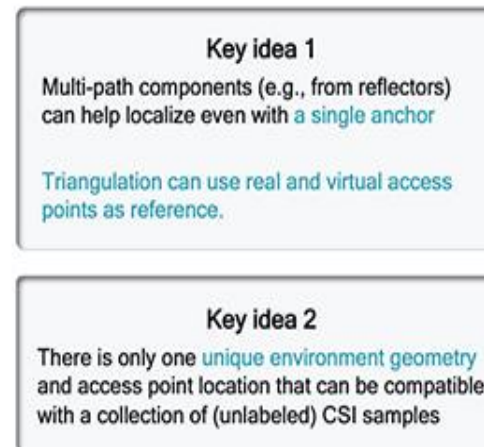
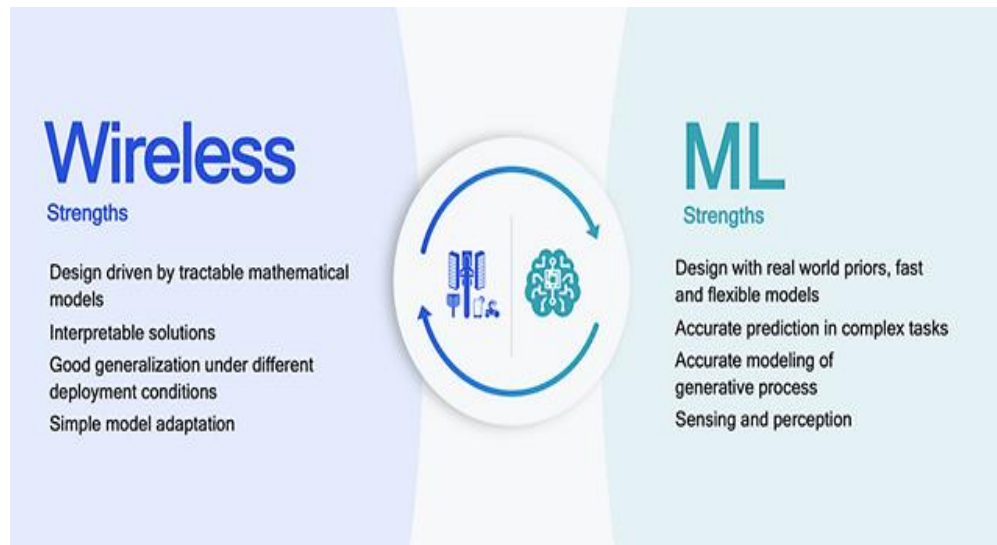
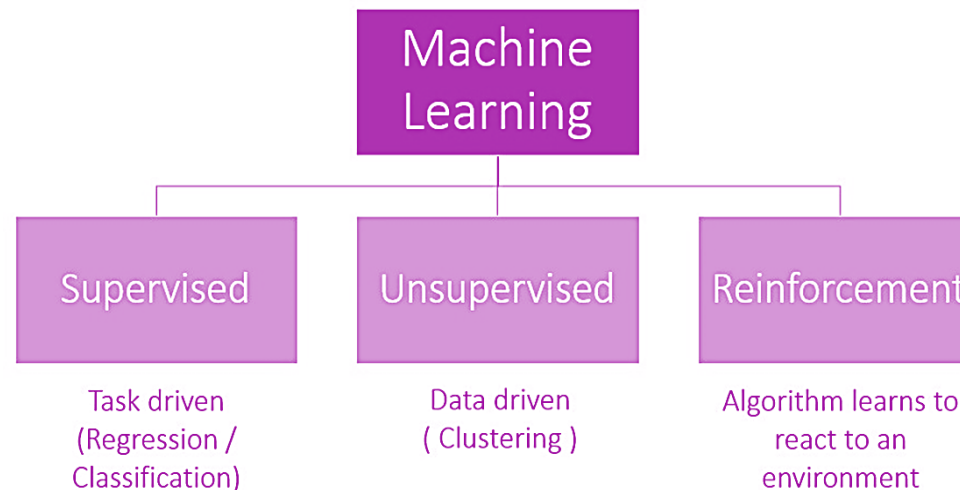


Fig. AI in wireless communication

Machine Learning

- **Machine learning** is programming computers to optimize a performance criterion using example data or past experience.
- It is a subfield of **artificial intelligence**, which is broadly defined as the capability of a machine to imitate intelligent human behaviour.

Types of Machine Learning



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- **Supervised machine learning**, is a subcategory of machine learning and artificial intelligence. It is defined by its use of labelled datasets to train algorithms that to classify data or predict outcomes accurately.
- **Unsupervised machine learning**, uses machine learning algorithms to analyze and cluster unlabelled datasets. These algorithms discover hidden patterns or data groupings without the need for human intervention.
- **Reinforcement Learning (RL)** is the science of decision making. It is about learning the optimal behaviour in an environment to obtain maximum reward

SUPERVISED
LEARNING



UNSUPERVISED
LEARNING

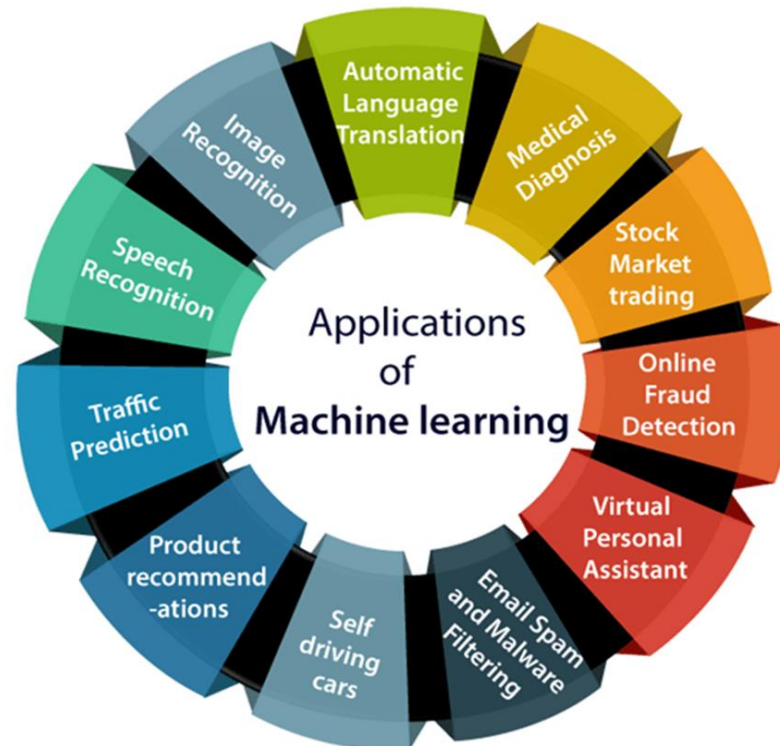


REINFORCEMENT
LEARNING



Applications of ML

Machine learning is a buzzword for today's technology, and it is growing very rapidly day by day. We are using machine learning in our daily life even without knowing it such as Google Maps, Google assistant, Alexa, etc.



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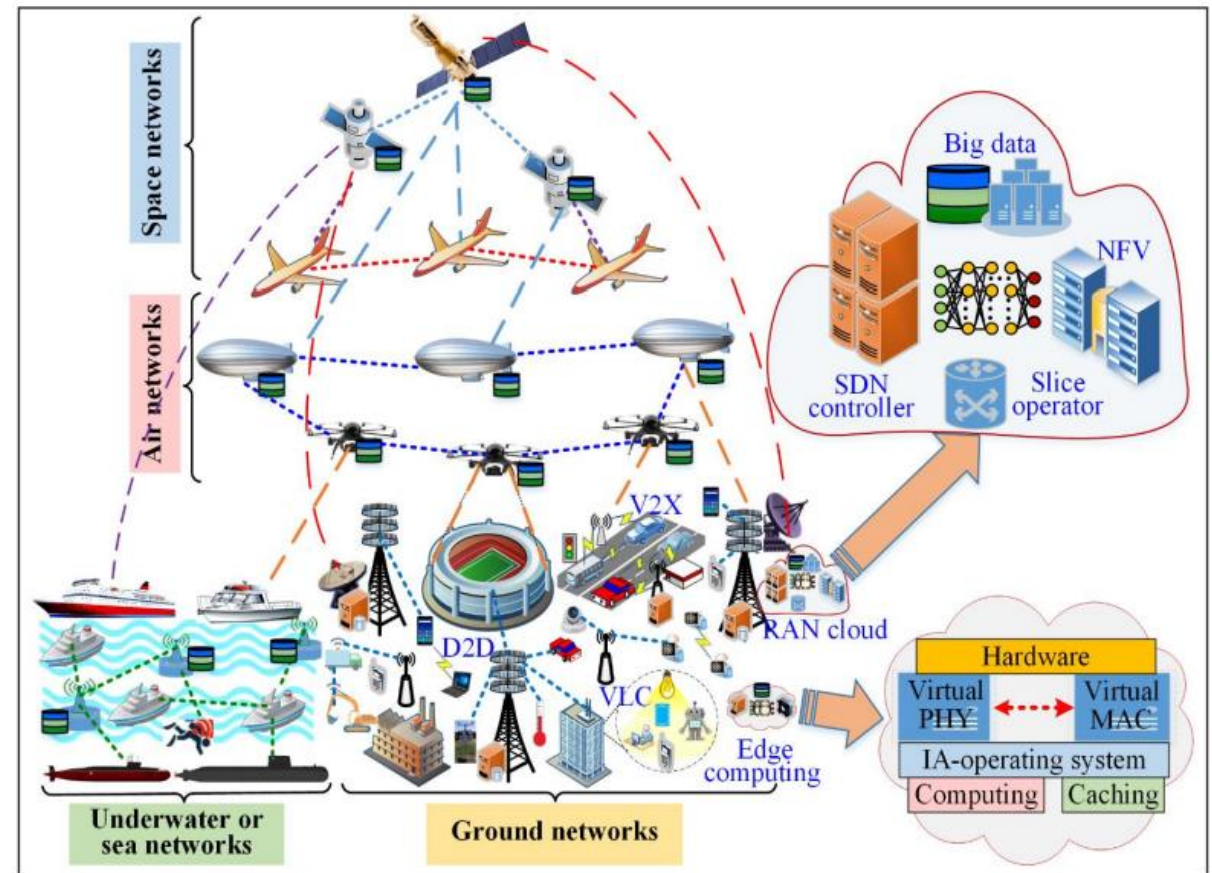


Fig: Fish detection and Species classification

Applications of ML in Communication

Applications of ML in wireless communication focuses on the applications in clustering, base station switching control, user association and routing

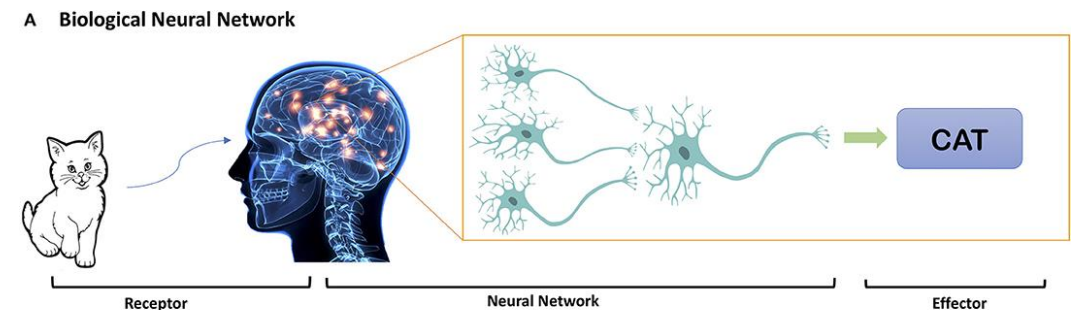
- V2X: vehicle to everything;
- VLC: visible light communication;
- RAN: radio access networks;
- SDN: software-defined networking;
- NFV: network function virtualization;
- PHY: physical layer;
- MAC: medium access control.



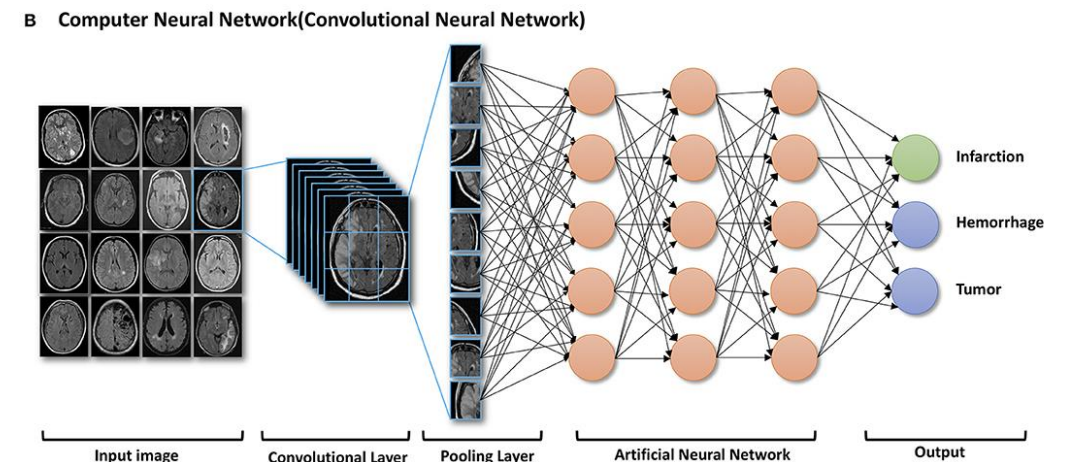
Deep Learning

- **Deep learning** is a subset of **machine learning**, which is essentially a neural network with three or more layers. These neural networks attempt to simulate the behavior of the human brain—allowing it to “learn” from large amounts of data.

- Image identification

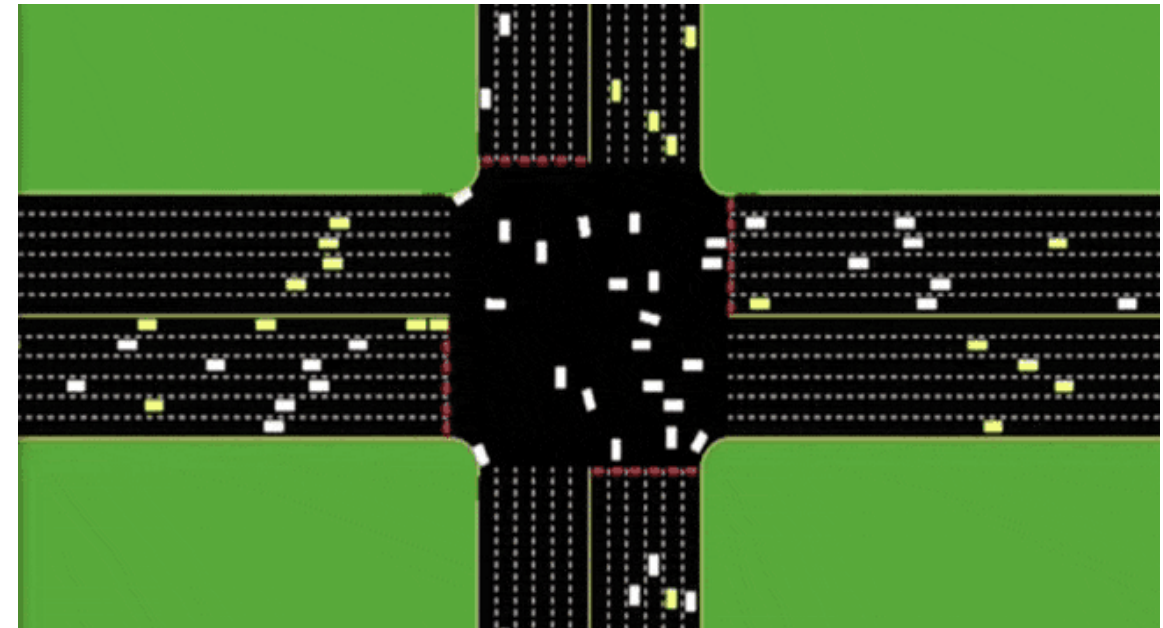


- Medical Image Analysis



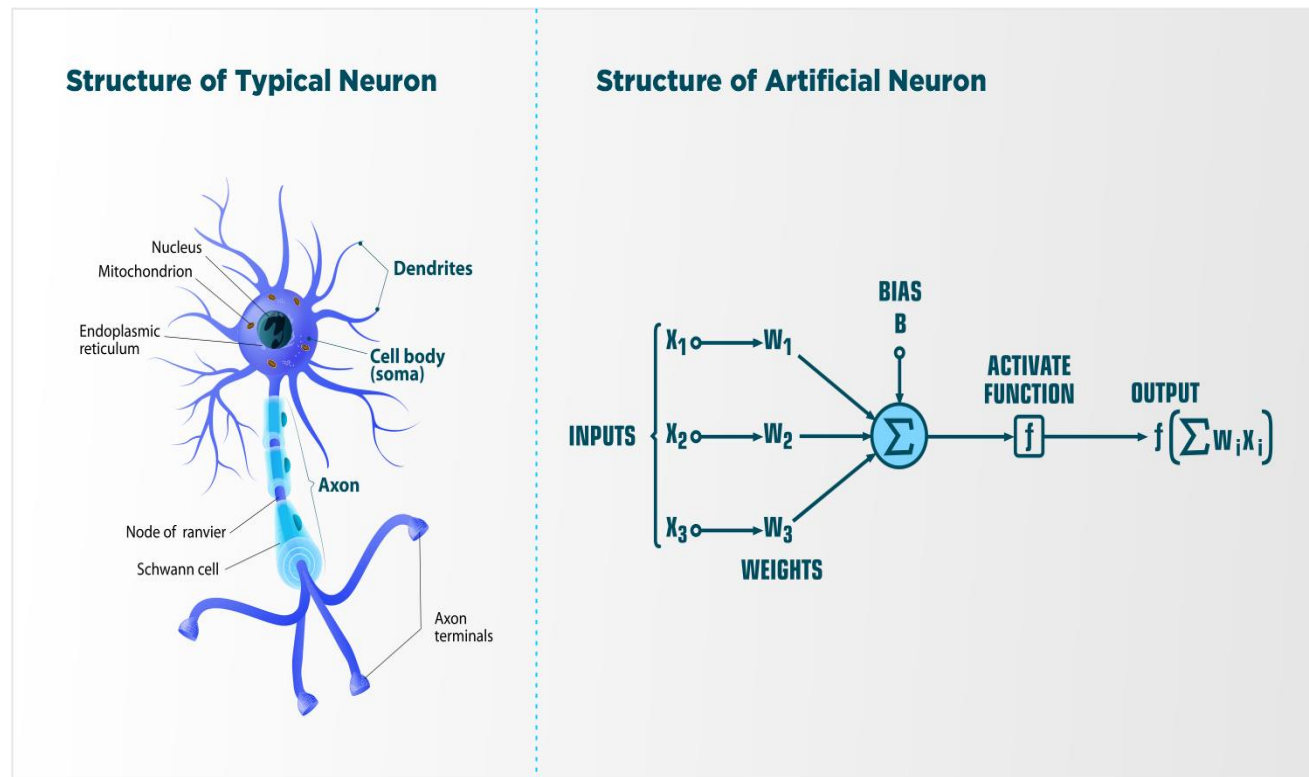
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- **Deep learning** is a crucial technology behind driverless cars and enables the machine analysis of large amounts of complex data — for example, recognizing the faces of people who appear in an image or video.



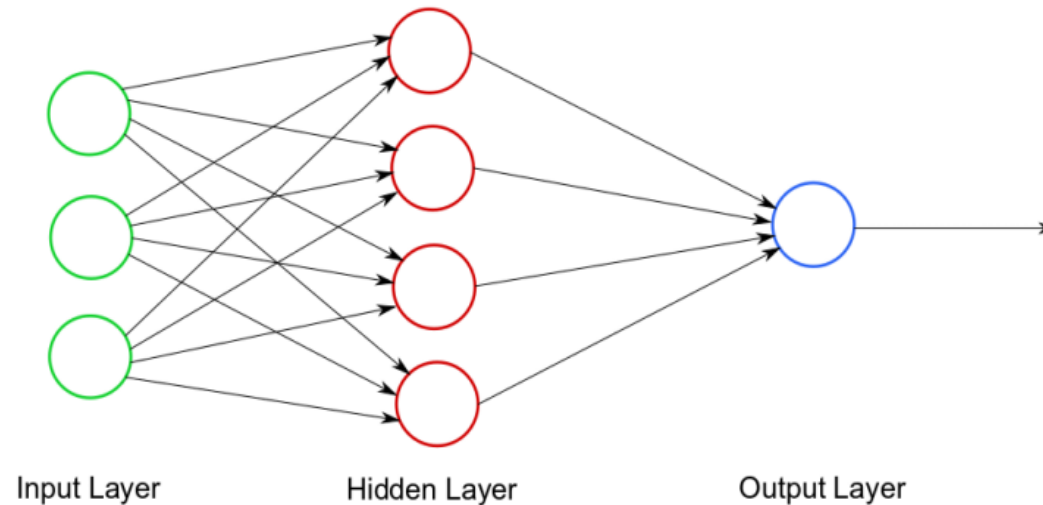
Neural networks:

- Neural networks are inspired by biological neurons in the human brain and are composed of layers of connected nodes called “neurons” that contain mathematical functions to process incoming data and predict an output value.

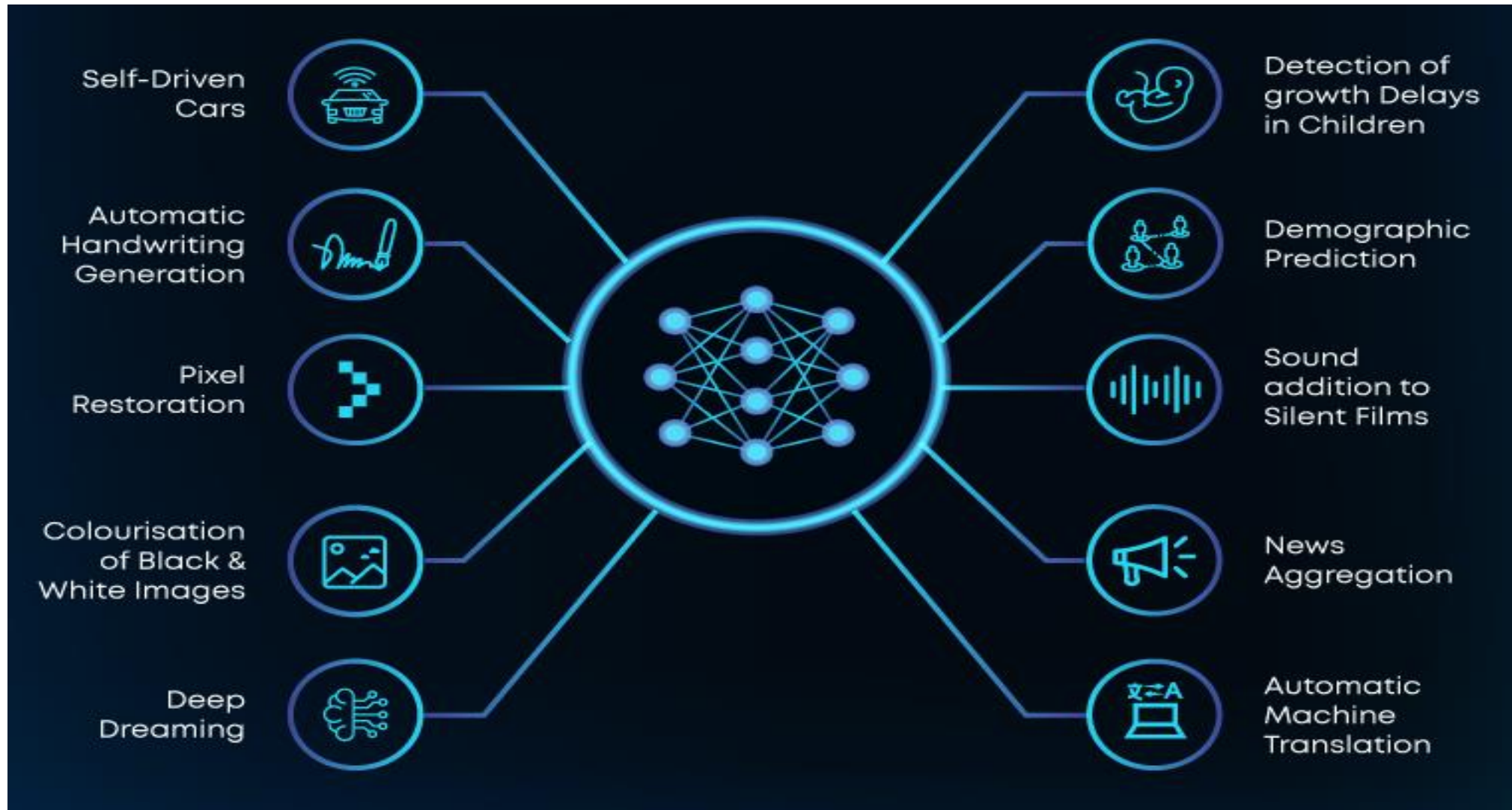


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- Artificial neural network learns by example, similarly to how humans learn from our parents, teachers, and peers.
- They consist of at least three layers: an input layer, hidden layers, and an output layer. Each layer contains nodes (also known as neurons) which have weighted inputs that compute the output.

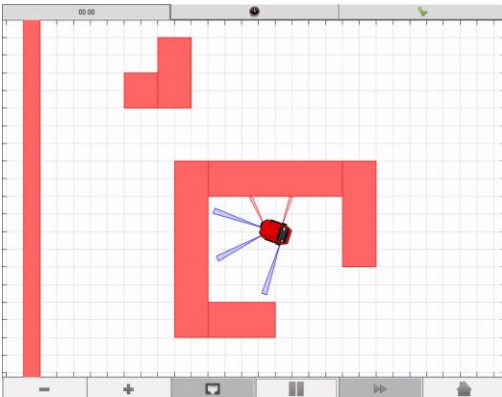
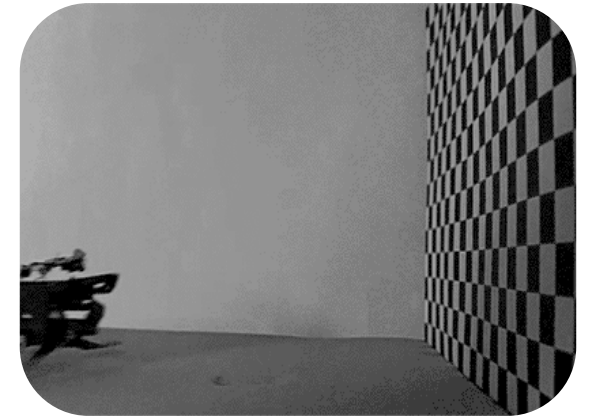
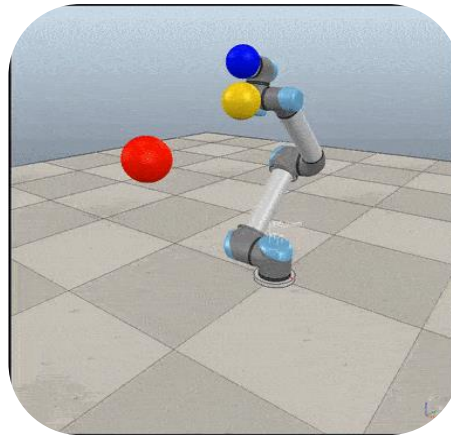


Applications of DL



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- **DL in Robotics:** Obstacle Avoidance in Robotics, Task Planning in Robotics, Navigation in Robotics



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- Super- resolution of underwater Images using DL



(a) Original image

(b) CLAHE

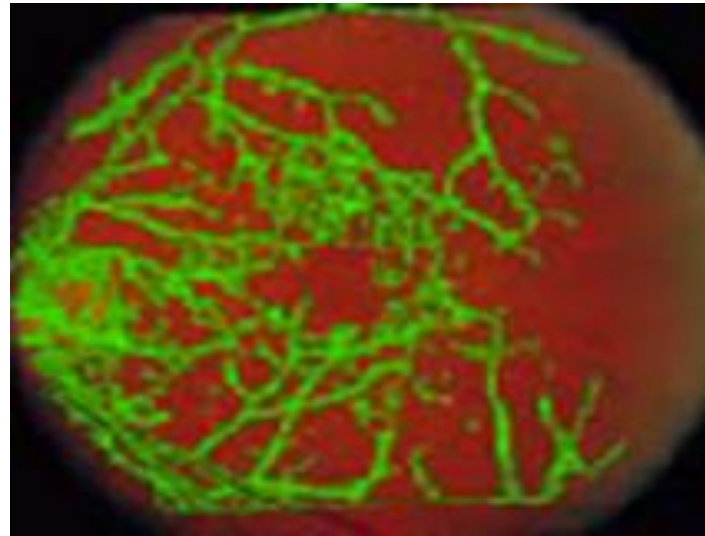
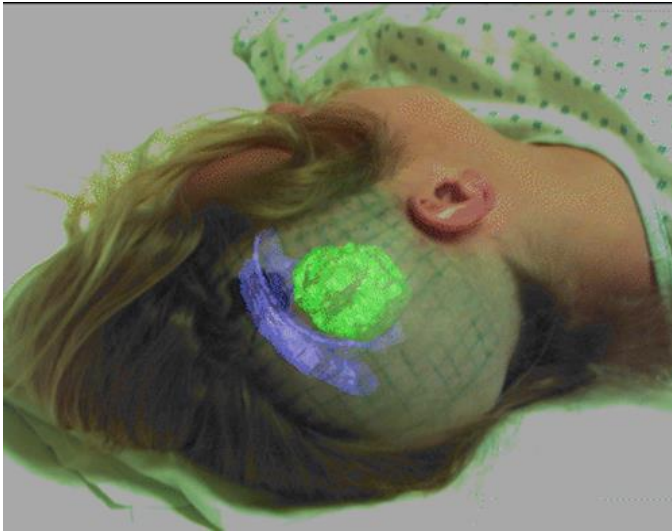
(c) DCP

(d) MSRRCR

(e) Our method

Applications of DL in Healthcare

- Image guided surgery
- Cancer prediction
- Robotic Surgery



Applications of DL in Communication

- The deep learning played a crucial role in channel estimation, signal detection, and modulation recognition etc.

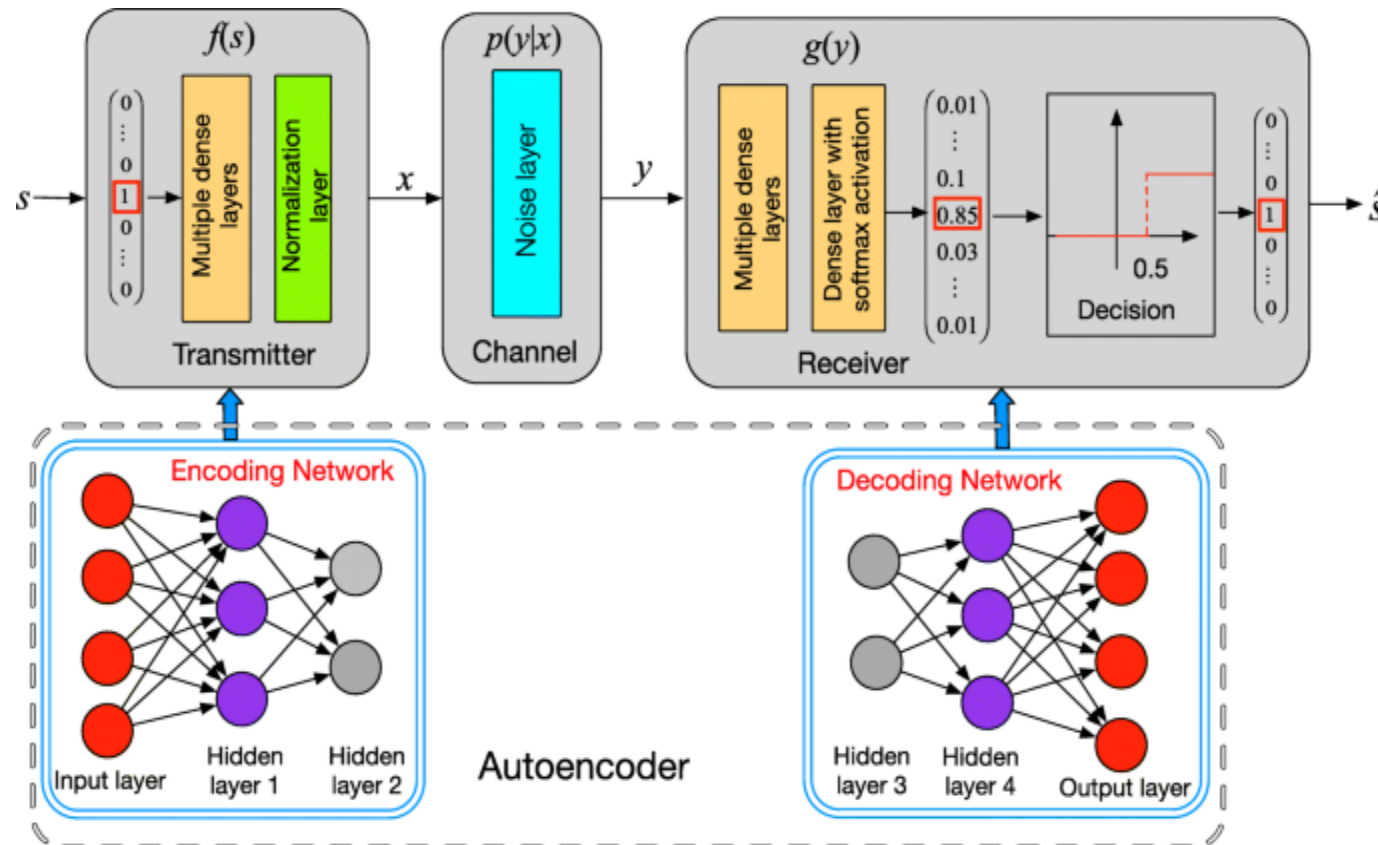
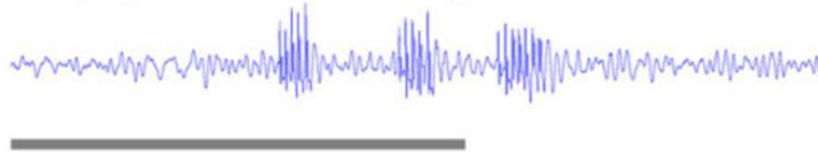


Fig: Deep learning-driven wireless communication for edge-cloud computing

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- DL in Underwater Communication

Walleye pollock, *Gadus chalcogrammus*



Arctic cod, *Boreogadus saida*



Sablefish, *Anoplopoma fimbria*



grey bar = 1 second



Thank you