Workshop on Preliminary Exploration on Artificial Intelligence (Junior Secondary Level)

20 July 2021

Programme Rundown

1. Introduction to Machine Learning Algorithms
2. Exploration on programming AI applications with models and datasets
   - Use Python to develop AI applications in Junior secondary level

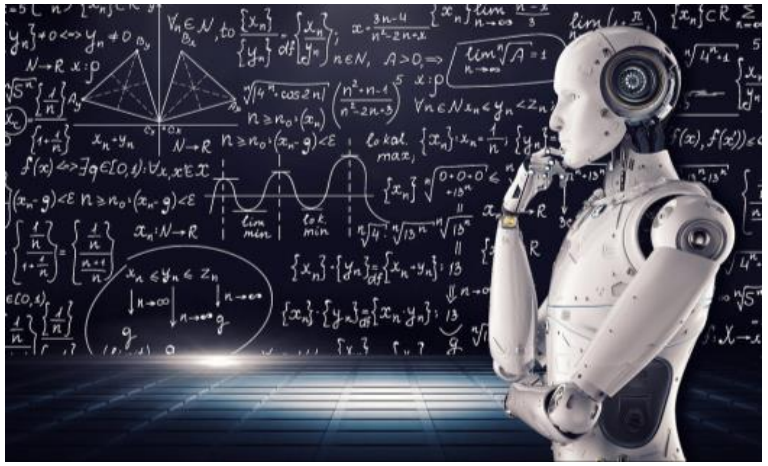
Resources

- https://bit.ly/36Kqq1p

Introduction to Artificial Intelligence

What is Artificial Intelligence?

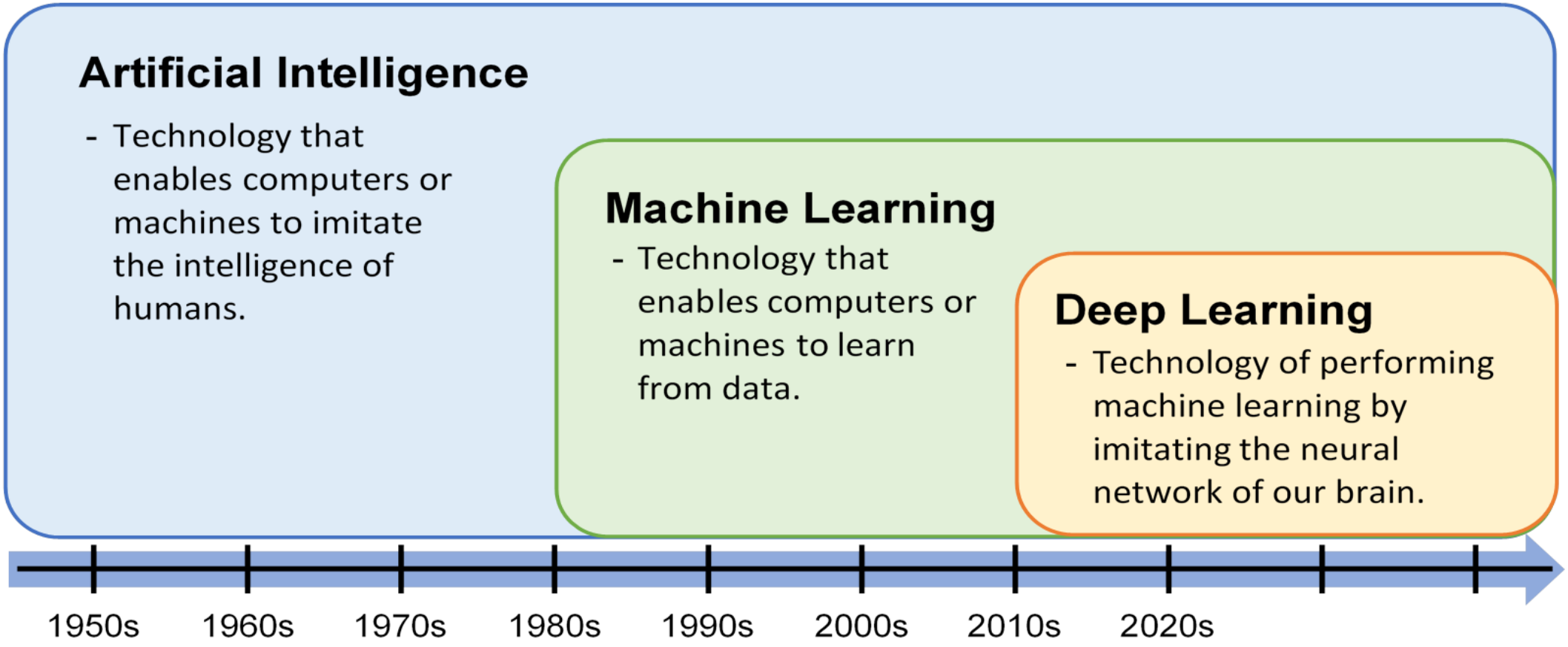
- **Artificial Intelligence (AI)** is a technology that aims to develop computers or machines with the intelligence demonstrated by human.
- This includes enabling computers or machines to imitate human's perception, learning, decision-making and problem-solving capabilities.



Artificial Intelligence in Our Daily Lives

- Face Recognition
- Object Detection
- Speech Recognition
- Handwriting Recognition
- Chatbot
- Text Translation
- etc.

Historical Development of Artificial Intelligence



- *Reference:* https://en.wikipedia.org/wiki/Timeline_of_machine_learning

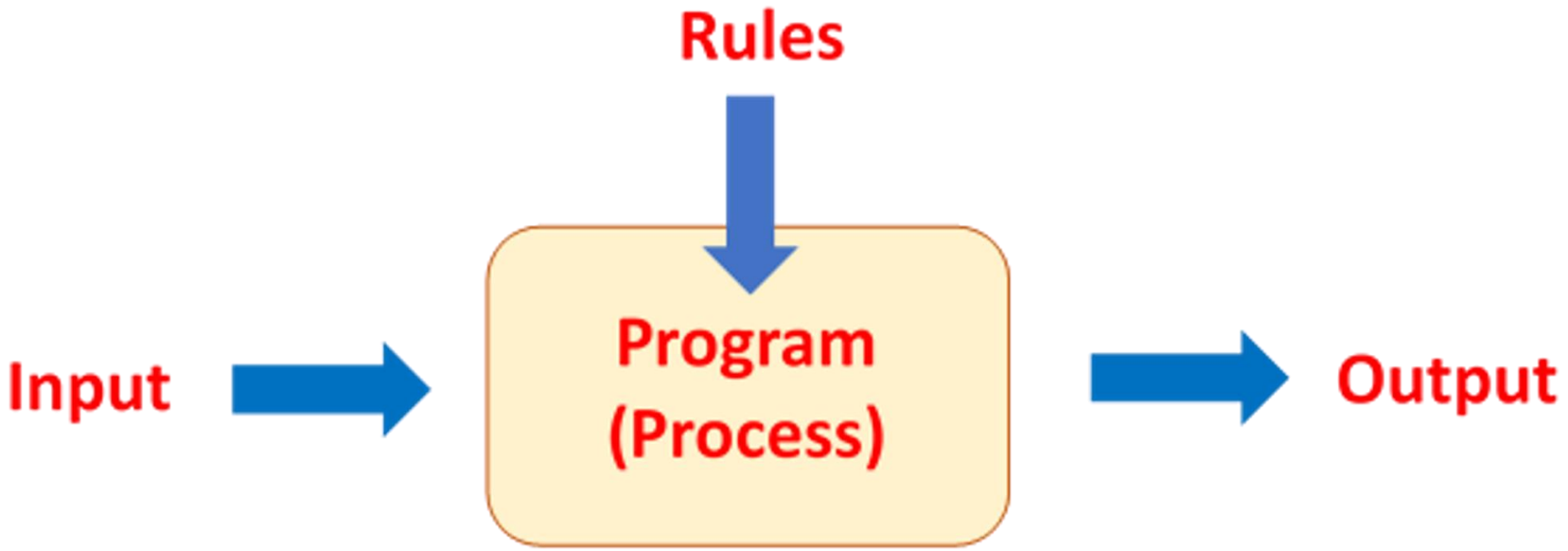
Basic Idea of Machine Learning

- **Machine Learning (ML)** is the subfield of Artificial Intelligence that aims to give machines the ability to learn without being explicitly programmed.
- We will not provide the machines with definite sets of rules, but instead, we will feed the machines with enough data (and sometimes the corresponding results) and let them learn from the data.

Basic Idea of Machine Learning

Machine Learning vs Traditional Programming

- **Traditional Programming Approach:**



Traditional Programming

Machine Learning vs Traditional Programming

- **Traditional Programming Example:**

```
chi = float(input("Chi score: "))
eng = float(input("Eng score: "))
mat = float(input("Mat score: "))
average = (chi + eng + mat)/3
print("Average score is", average)
if (chi >= 50 or eng >= 50 or mat >= 50) and (average >= 50):
    print("Promoted")
else:
    print("Repeated")
```

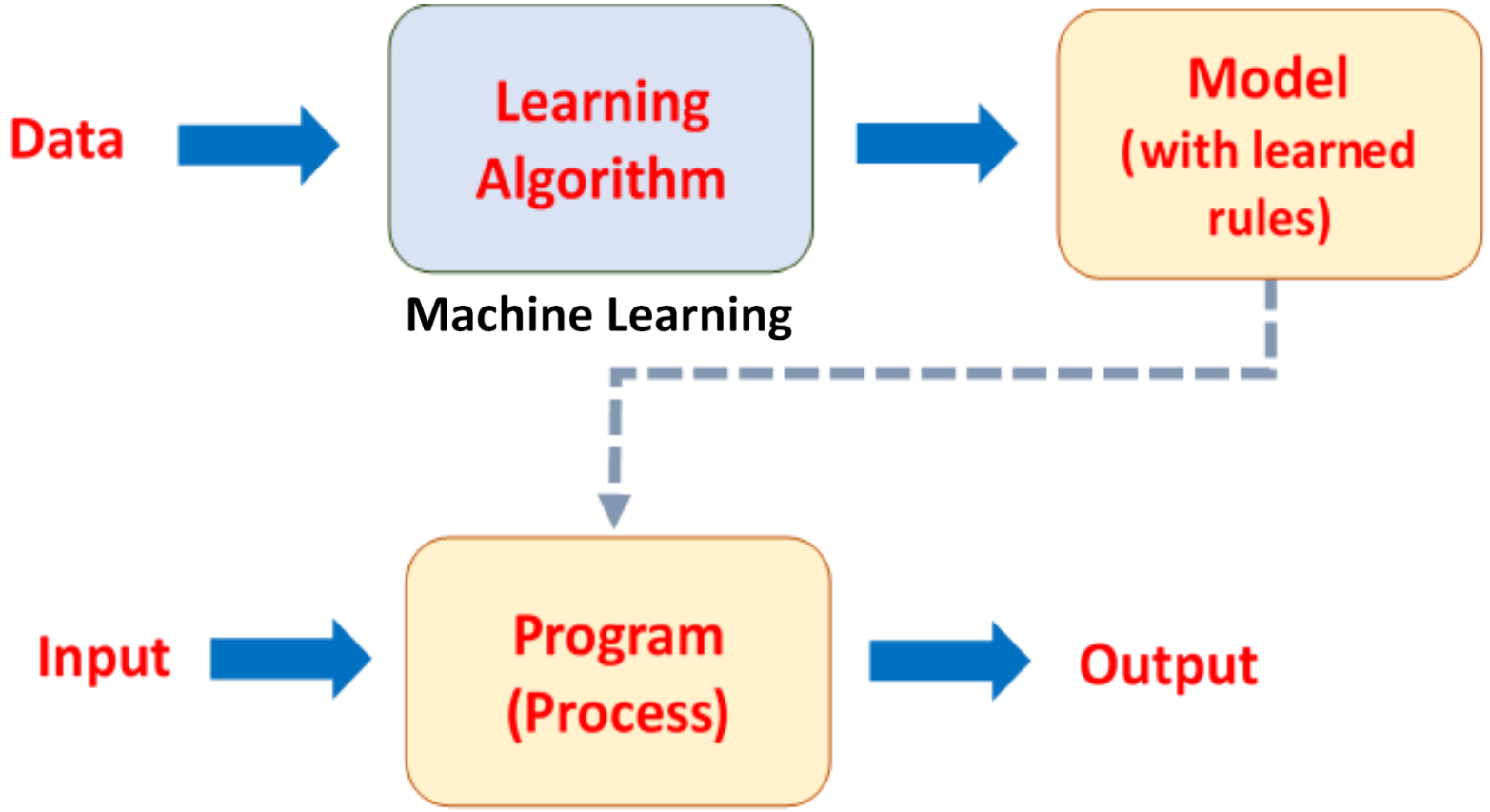
Machine Learning vs Traditional Programming

- **Traditional Programming Example:**

```
if (it has feathers):
    if (it can swim) and (its claws are webbed)
        and (its beak is flat):
        print("It should be a duck.")
    elif (it cannot fly) and (its claws are not webbed)
        and (its beak is sharp):
        print("It should be a chicken.")
    else:
        print("It should other bird.")
else:
   print("It is not a bird.")
```

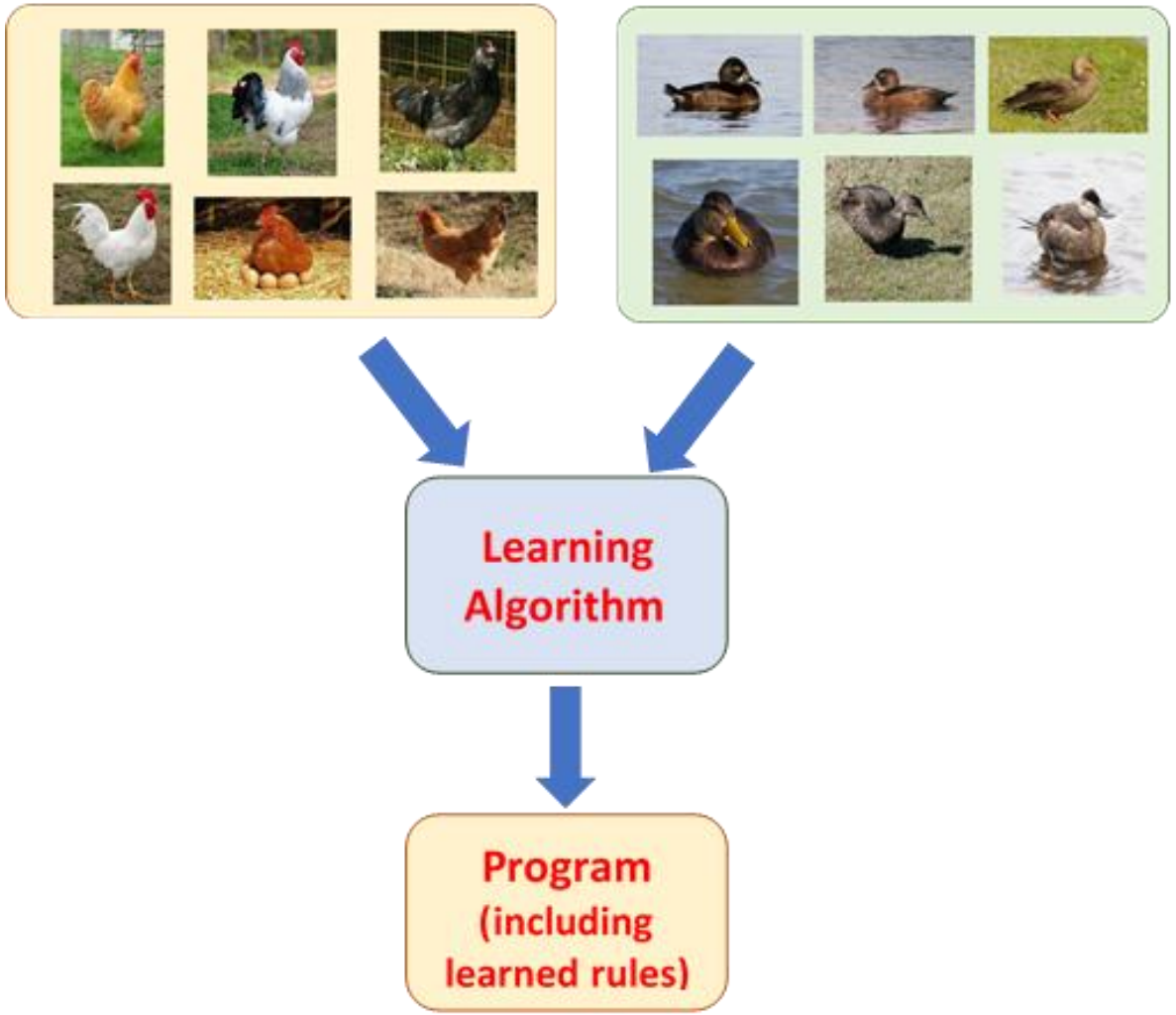
Machine Learning vs Traditional Programming

- **Machine Learning (ML) Approach:**



Machine Learning vs Traditional Programming

- **Machine Learning (ML) Example:**



Machine Learning Algorithms

Machine Learning Algorithms

- KNN, ANN, CNN, RNN ?

Machine Learning Algorithms

- Three main types of machine learning algorithms:
  1. Supervised Learning
  2. Unsupervised Learning
  3. Reinforcement Learning

Supervised Learning

- Provide the machine with training data have known labels or results.
- Problems to be solved:
  - **Classification**: To find out what category an item belongs to.
  - **Prediction (Regression)**: To predict a numerical value of an item.

Supervised Learning

Training data with labels

Training Phase

Supervised Machine Learning

Predictive Model

Testing Phase

Data for testing model without labels

Predictive Model

Chicken

Correct label predicted by model

Supervised Learning

- Learning algorithm:
  - Support Vector Machines
  - linear regression
  - logistic regression
  - naive Bayes
  - linear discriminant analysis
  - decision trees
  - k-nearest neighbor algorithm (KNN)
  - Neural Networks (Multilayer perceptron)

Unsupervised Learning

- Provide the machine with training data that are neither classified nor labeled
- Problems to be solved:
  - **Clustering:** To put similar items together.
  - **Association:** To find out meaningful relationships between items.

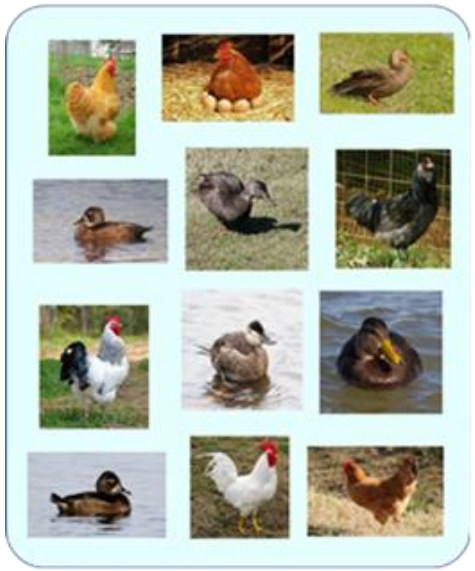
Unsupervised Learning

Training data without labels

Training Phase

Unsupervised Machine Learning

Predictive Model



Data for testing model without labels

Testing Phase

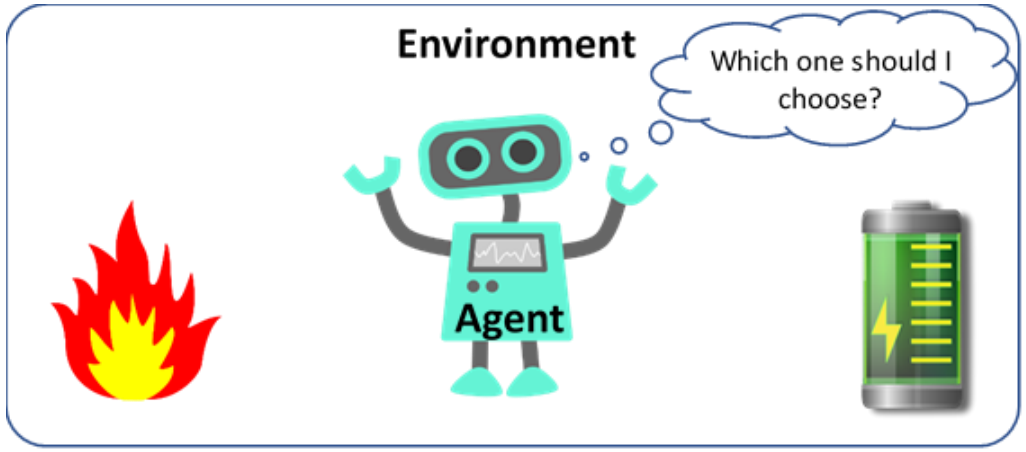
Predictive Model

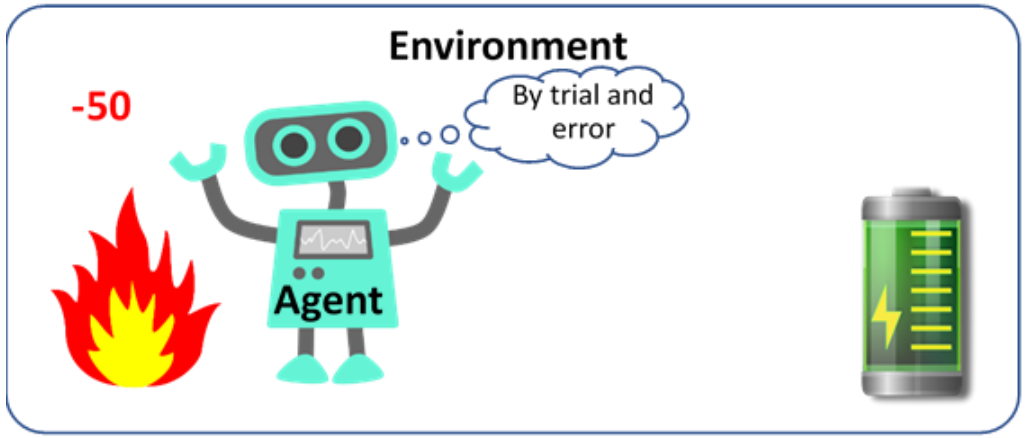
Correct dusters predicted by model

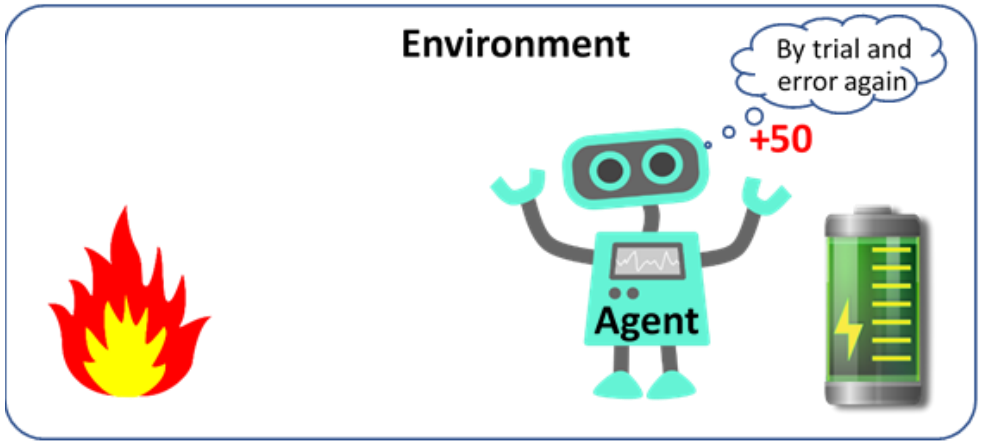
Reinforcement Learning

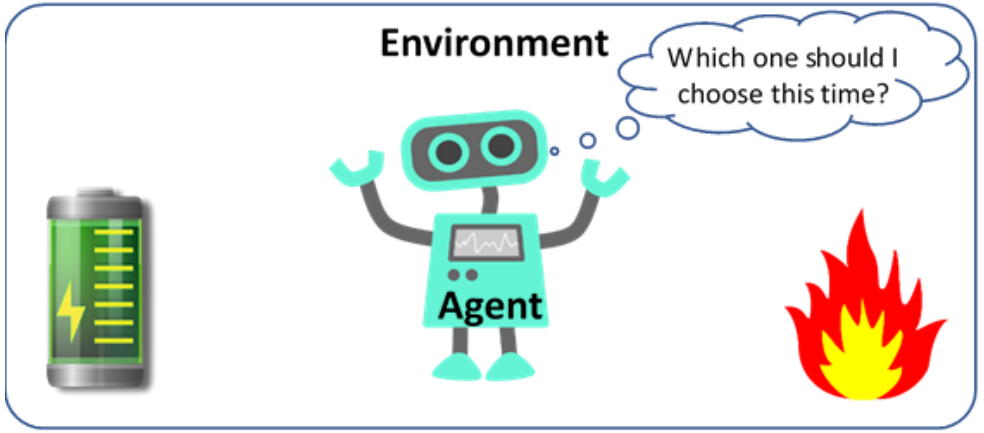
- The machine learns through rewards and punishments
- For example, AlphaZero is a program that masters the games of chess and go through reinforcement learning.

Reinforcement Learning





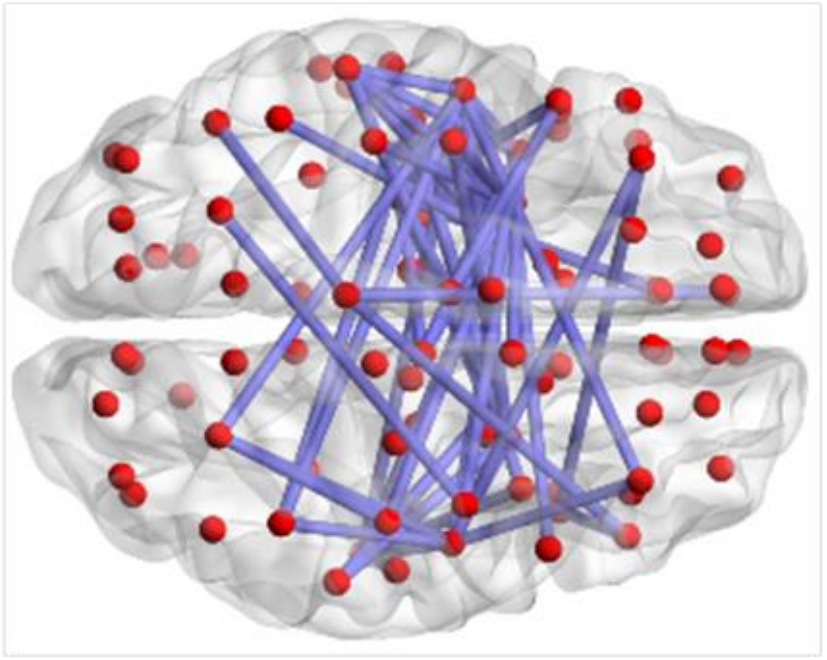




What is Neural Network?

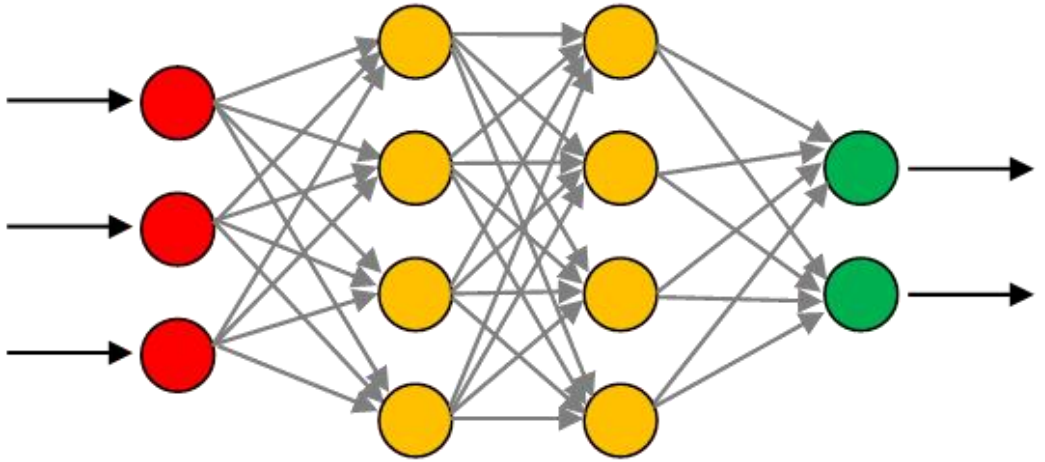
- **Artificial Neural Network (ANN)** is machine learning method that simulates the learning method of our brain.

Brain Neural Network



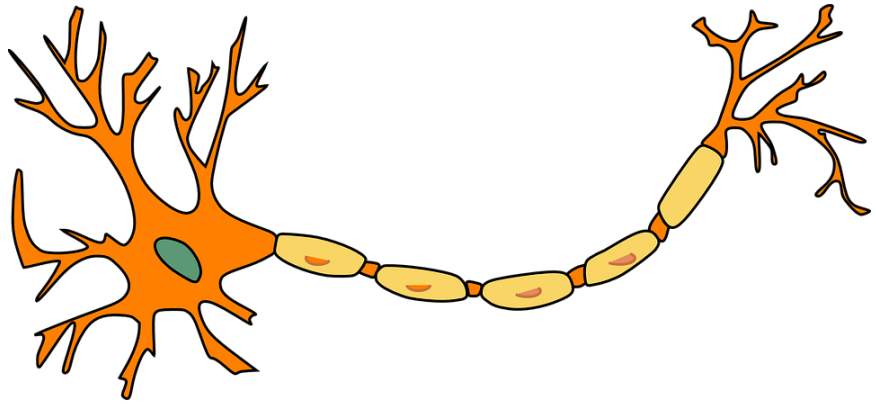
Neurons

Artificial Neural Network

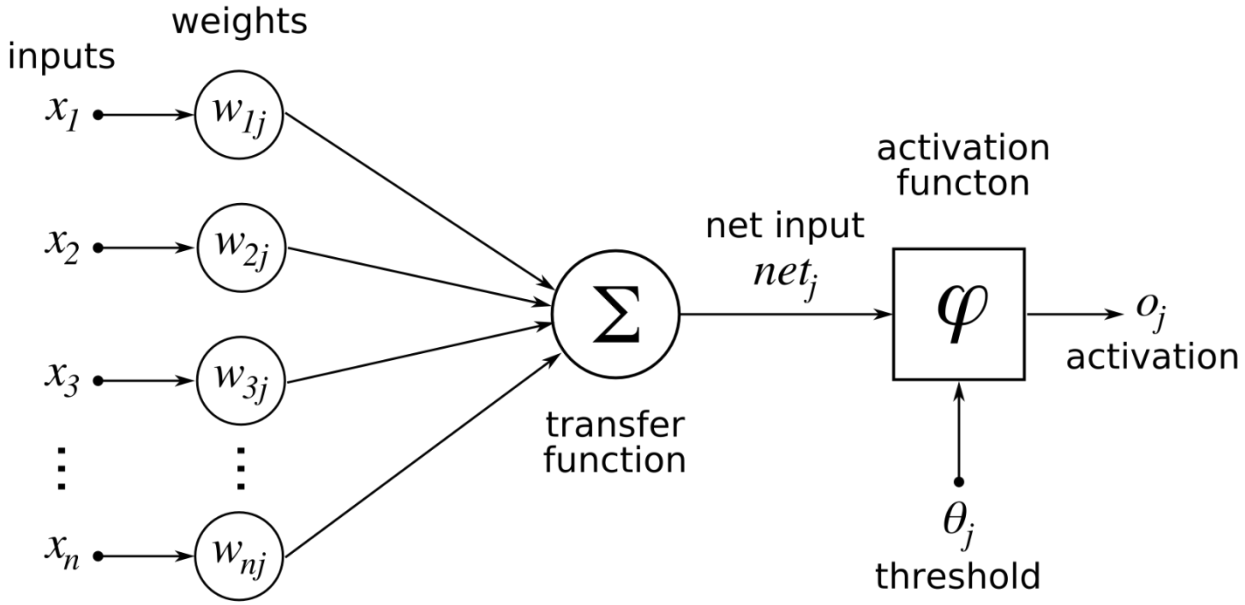


Artificial Neurons

What is Neural Network?



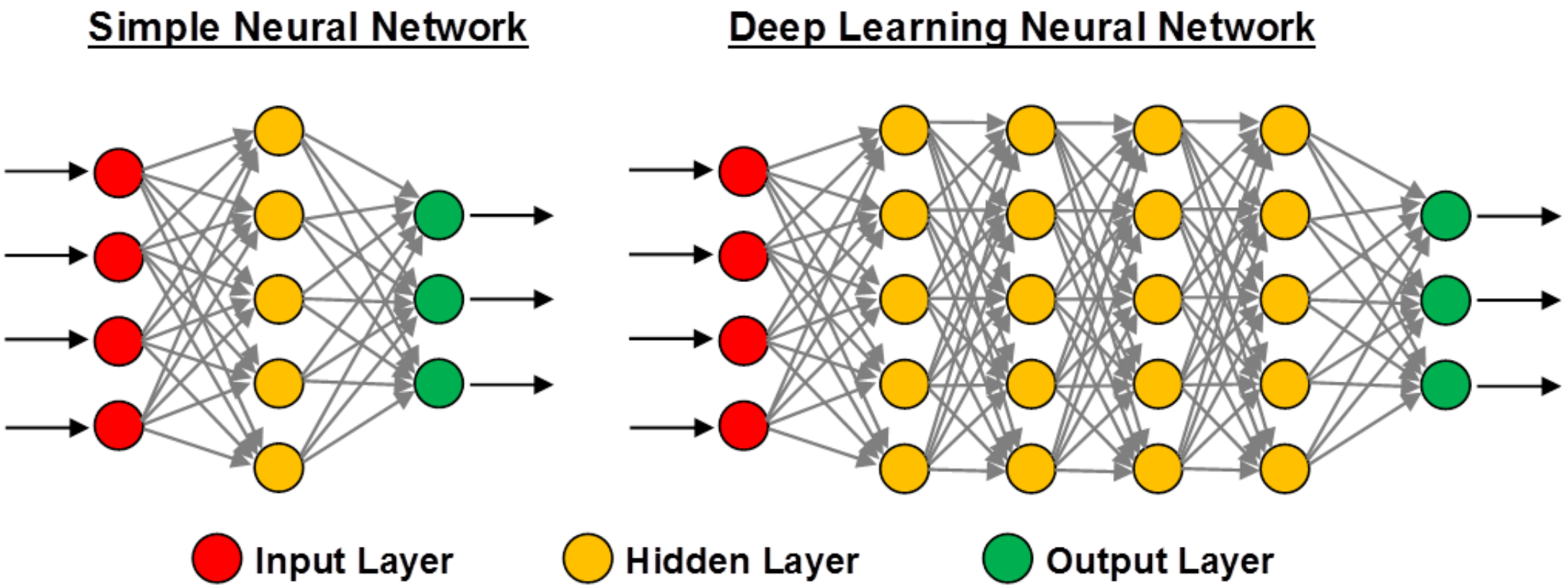
Neuron



Artificial Neuron

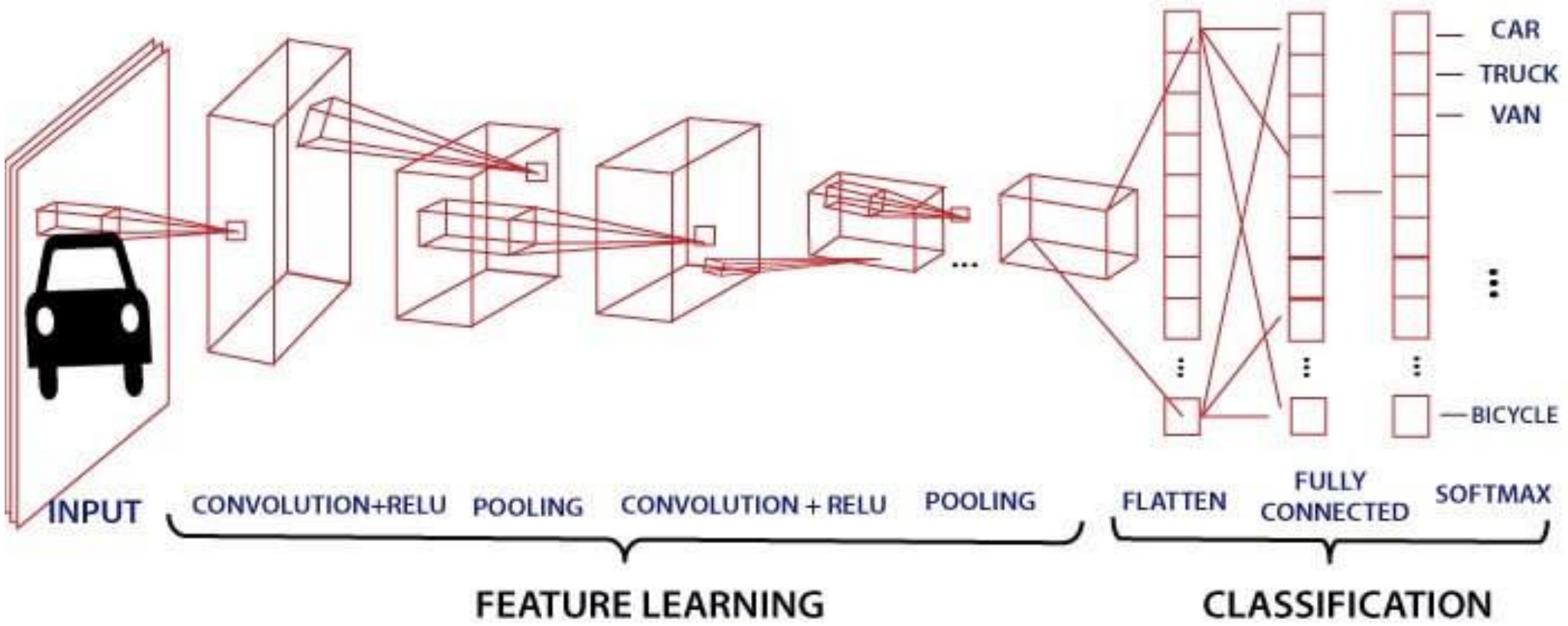
What is Deep Learning?

- **Deep learning** is ANN that uses multiple layers to progressively extract higher-level features from the input data.



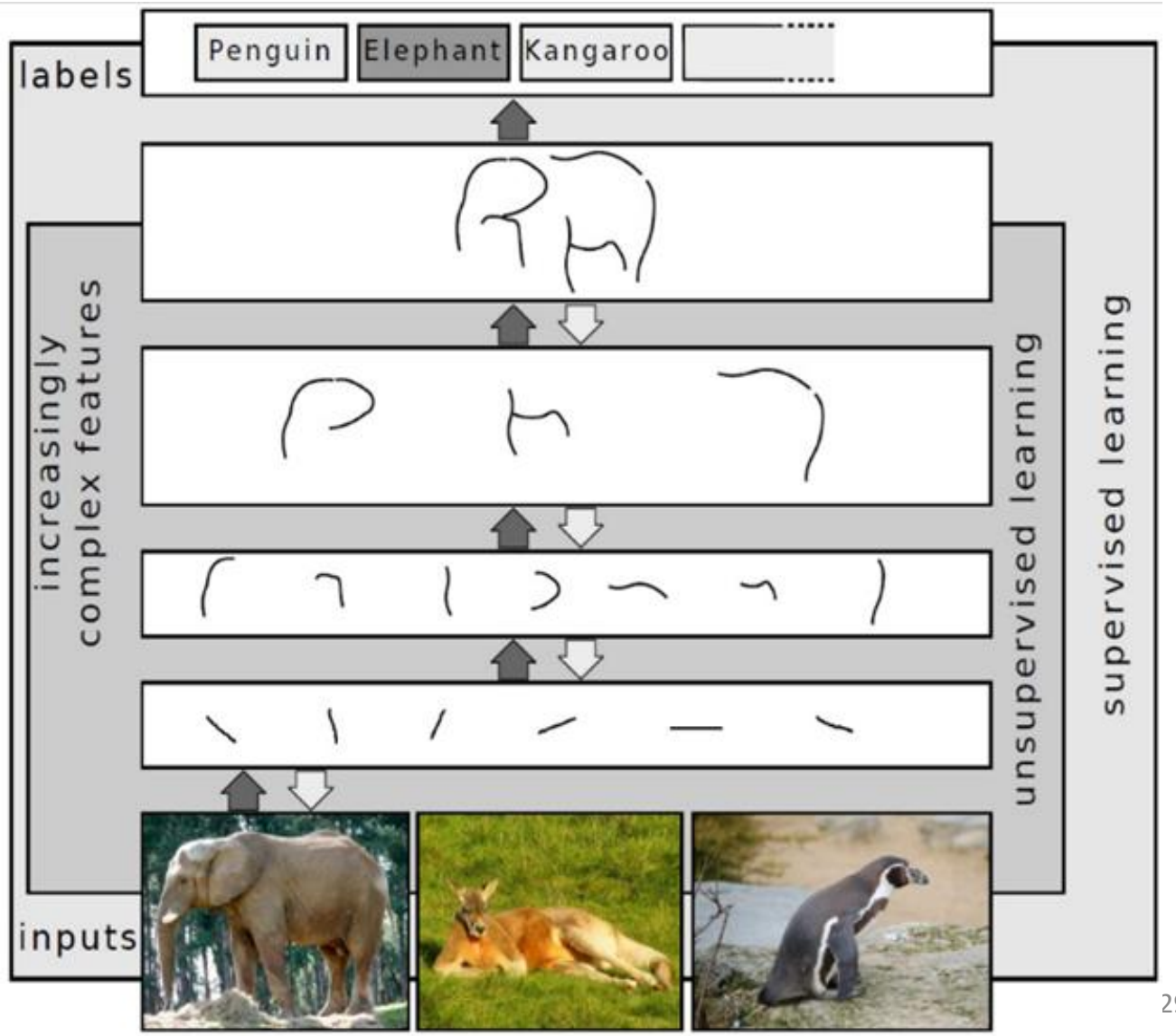
What is Deep Learning?

- **Convolutional Neural Network (CNN)** is mainly used for images recognition, images classifications, objects detections, recognition faces etc.,.



What is Deep Learning?

- Using deep learning to recognize an elephant through different layers



Deep Learning and Big Data

- In order to adopt the Deep Learning method, a large amount of high-quality data should be provided to the machine for learning. This is why "Big Data" is so important to Deep Learning.

Use Python to develop AI applications in Junior secondary level

Why Use Python?

- Python will be used in the 2024 HKDSE examination.
- Python comes with a large amount of libraries for AI and Machine Learning.

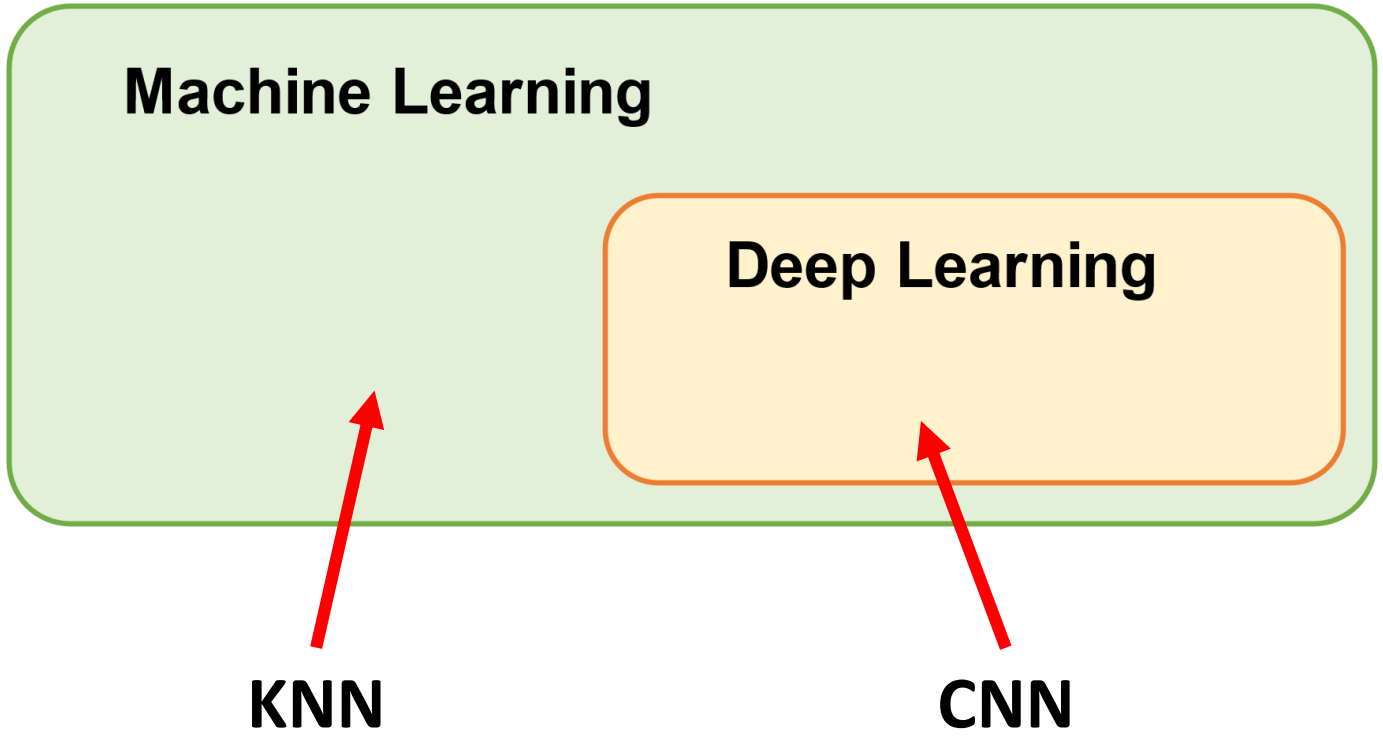
Students' Prior Knowledge

Students should have learnt the following:

- understand the basic principles and concepts of AI
- understand the technology of AI in our daily lives
- know the basic Python programming skills
  - variables, operators, list, selection, iteration, sub-program, etc.
- Reference:
  - Developing programming concepts through Python: https://www.edb.gov.hk/en/curriculum-development/kla/technology-edu/resources/computer-edu/resources.html

Using Python to develop AI applications

- Let us try KNN & CNN



Preparing the Development Environment

Practice 1

Practice 2

Q & A

~ END ~

Thank You!