

# ML

## LECTURE-1

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# Definition of machine learning

- ❖ Arthur Samuel, an early American leader in the field of computer gaming and artificial intelligence, coined the term “Machine Learning” in 1959 while at IBM.
- ❖ He defined machine learning as “the field of study that gives computers the ability to learn without being explicitly programmed.”
- ❖ However, there is **no universally accepted definition for machine learning**. Different authors define the term differently. We give below two more definitions.
- ❖ 1. Machine learning is programming computers to optimize a performance criterion using example data or past experience. We have a model defined up to some parameters, and learning is the execution of a computer program to optimize the parameters of the model using the training data or past experience. The model may be predictive to make predictions in the future, or descriptive to gain knowledge from data, or both.
- ❖ 2. The field of study known as machine learning is concerned with the question of how to construct computer programs that automatically improve with experience.

# Definition of learning

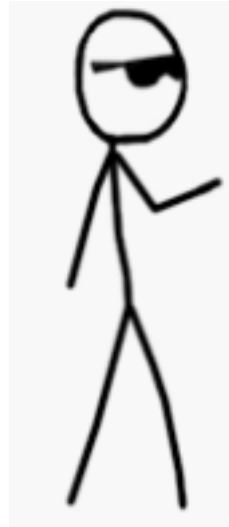
- ❖ A computer program is said to learn from experience  $E$  with respect to some class of tasks  $T$  and performance measure  $P$ , if its performance at tasks  $T$ , as measured by  $P$ , improves with experience  $E$ .
- ❖ Examples
  - ❖ i) **Handwriting recognition learning problem**
    - ❖ Task  $T$ : Recognising and classifying handwritten words within images
    - ❖ Performance  $P$ : Percent of words correctly classified
    - ❖ Training experience  $E$ : A dataset of handwritten words with given classifications
  - ❖ ii) **A robot driving learning problem**
    - ❖ Task  $T$ : Driving on highways using vision sensors
    - ❖ Performance measure  $P$ : Average distance traveled before an error
    - ❖ Training experience  $E$ : A sequence of images and steering commands recorded while observing a human driver
- ❖ A computer program which learns from experience is called a machine learning program or simply a learning program. Such a program is sometimes also referred to as a learner.



Human can learn from past experience  
and make decision of its own

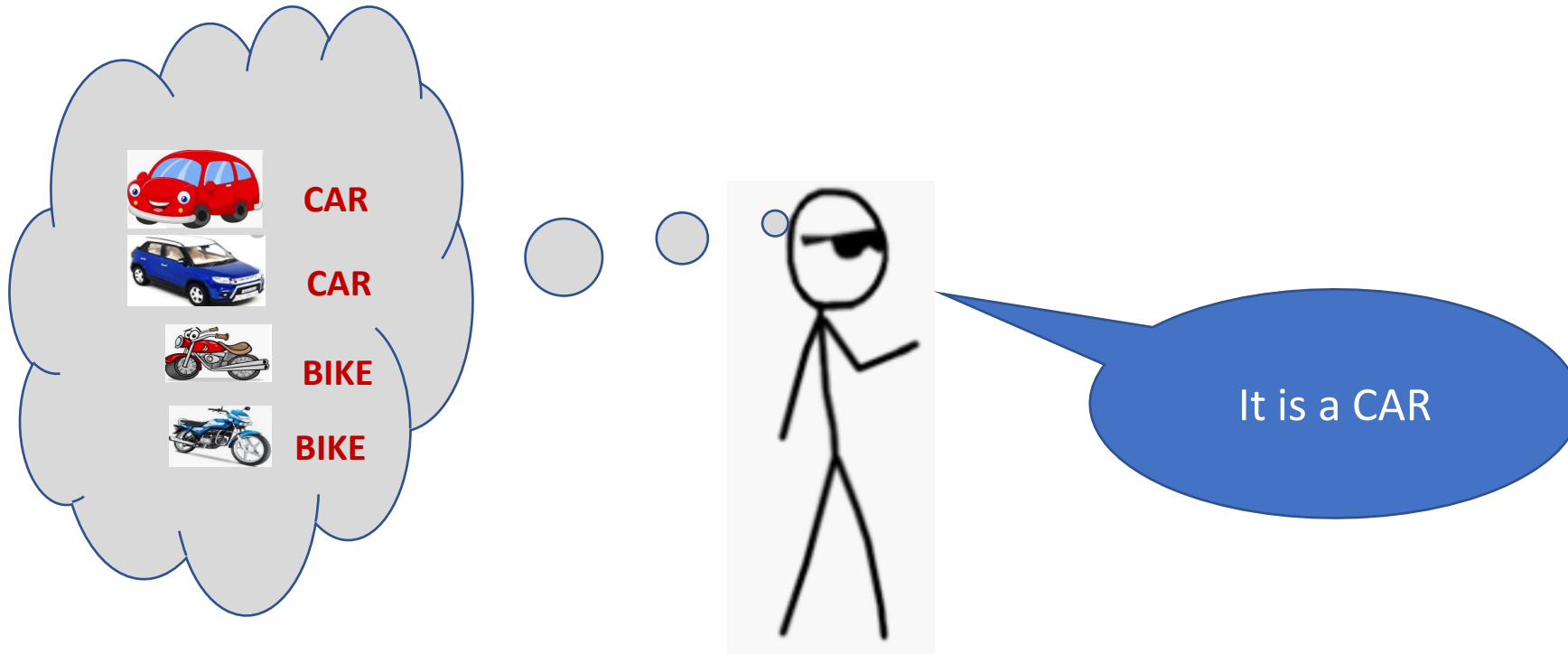


**What is this object?**





What is this object?



# Let us ask the same question to him

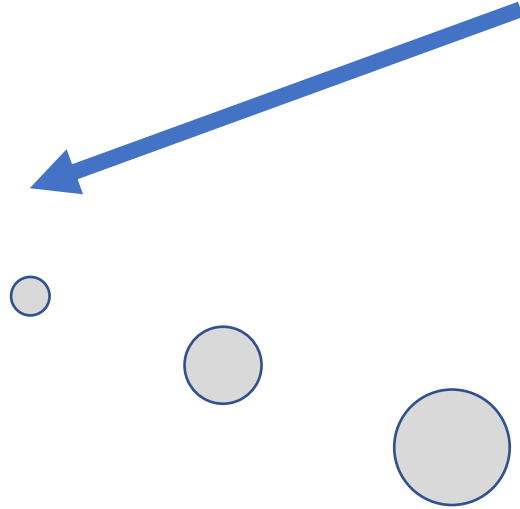
What is this object?



# Let us ask the same question to him



What is this object?



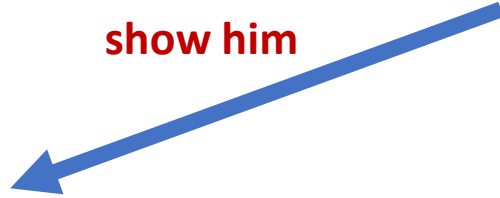


[ But, he is a human being. He can observe and learn ]

# Let us make him learn



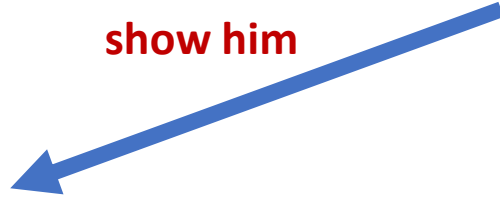
show him



# Let us make him learn



show him



CAR



CAR



BIKE



BIKE

# Let us ask the same question now

What is this object?



CAR



CAR



BIKE



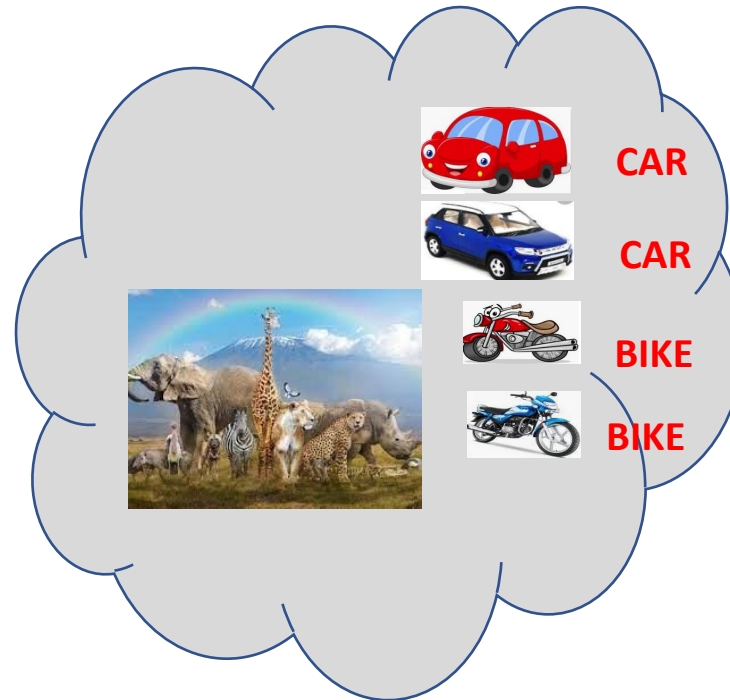
BIKE

Past experience

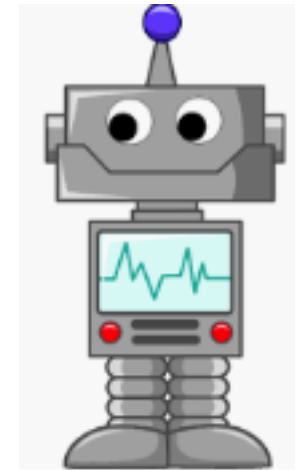
# Let us ask the same question now

CAR

What is this object?



# What about a Machine ?



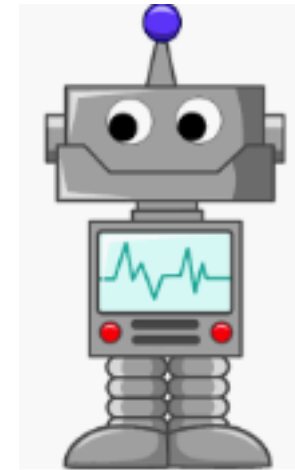
Machines follow instructions

**[ It can not take decision of its own]**

# What about a Machine ?

## We can ask a machine

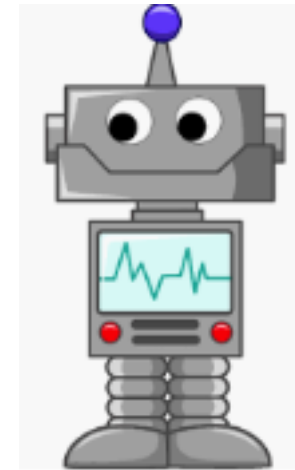
- To perform an arithmetic operations such as
  - Addition
  - Multiplication
  - Division



Machines follow instructions

# What about a Machine ?

- Comparison
- Print
- Plotting a chart



Machines follow instructions



# What is Machine Learning?

**[ We want a machine to act like a human]**

# What is Machine Learning?



**[ to identify this object.]**

# What is Machine Learning?



**Price in 2025?**

**[ predict the price in future]**

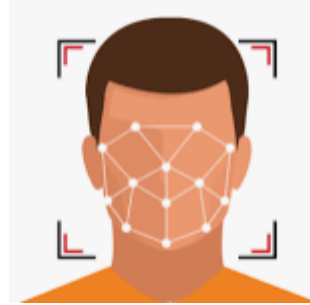
# What is Machine Learning?



I ~~made~~ **met** him yesterday

**[ Natural Language understand, and correct grammar ]**

# What is Machine Learning?



**recognize face**

**[ Recognize Faces ]**

# What is Machine Learning?



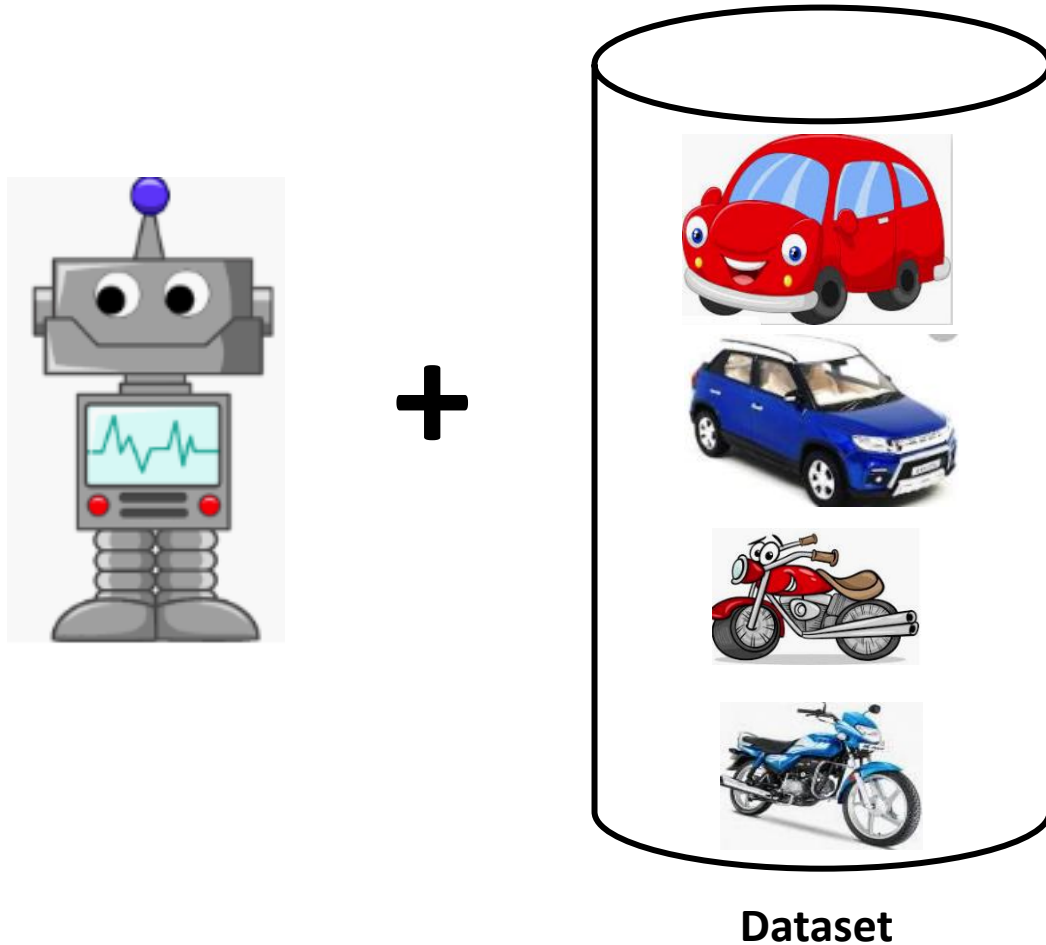
**[ What do we do?**

**Just like, what we did to human,**

**we need to provide experience  
to the machine.**

**]**

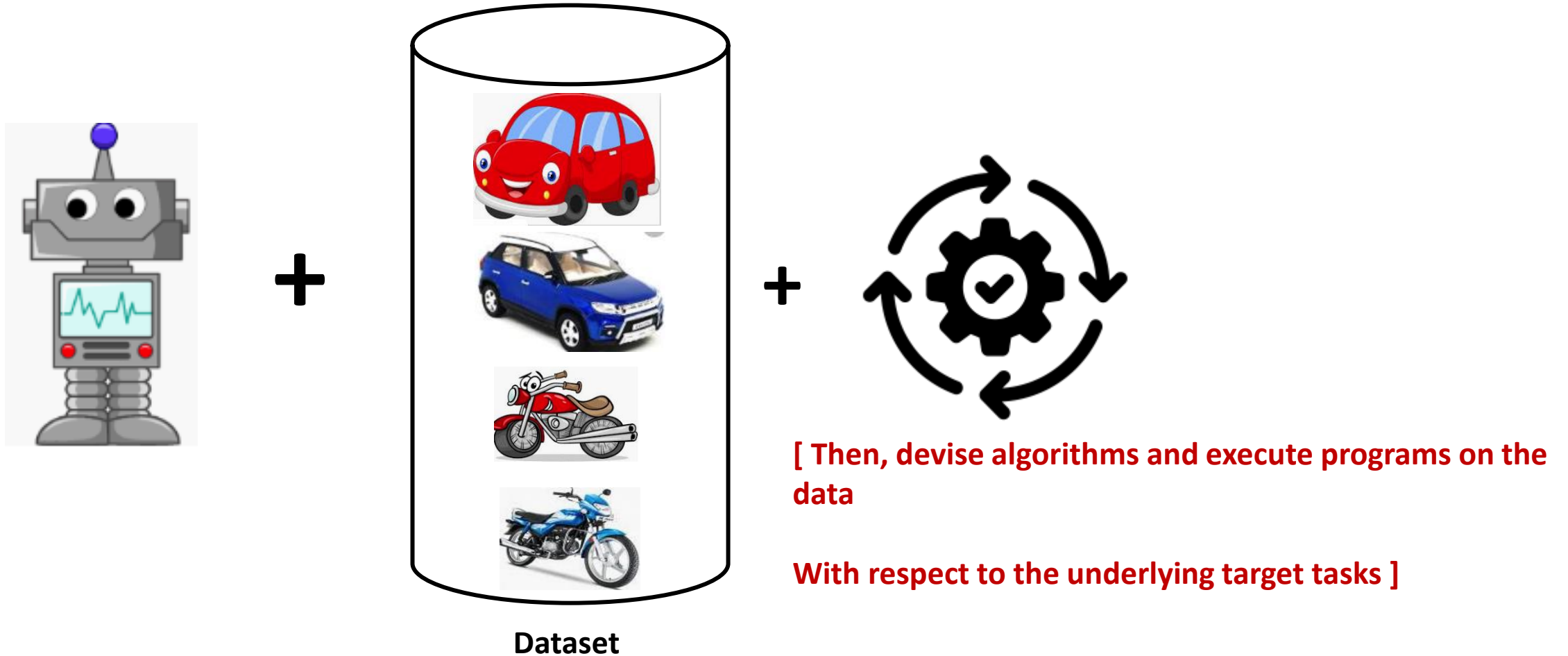
# What is Machine Learning?



[  
This what we called as Data  
or Training dataset

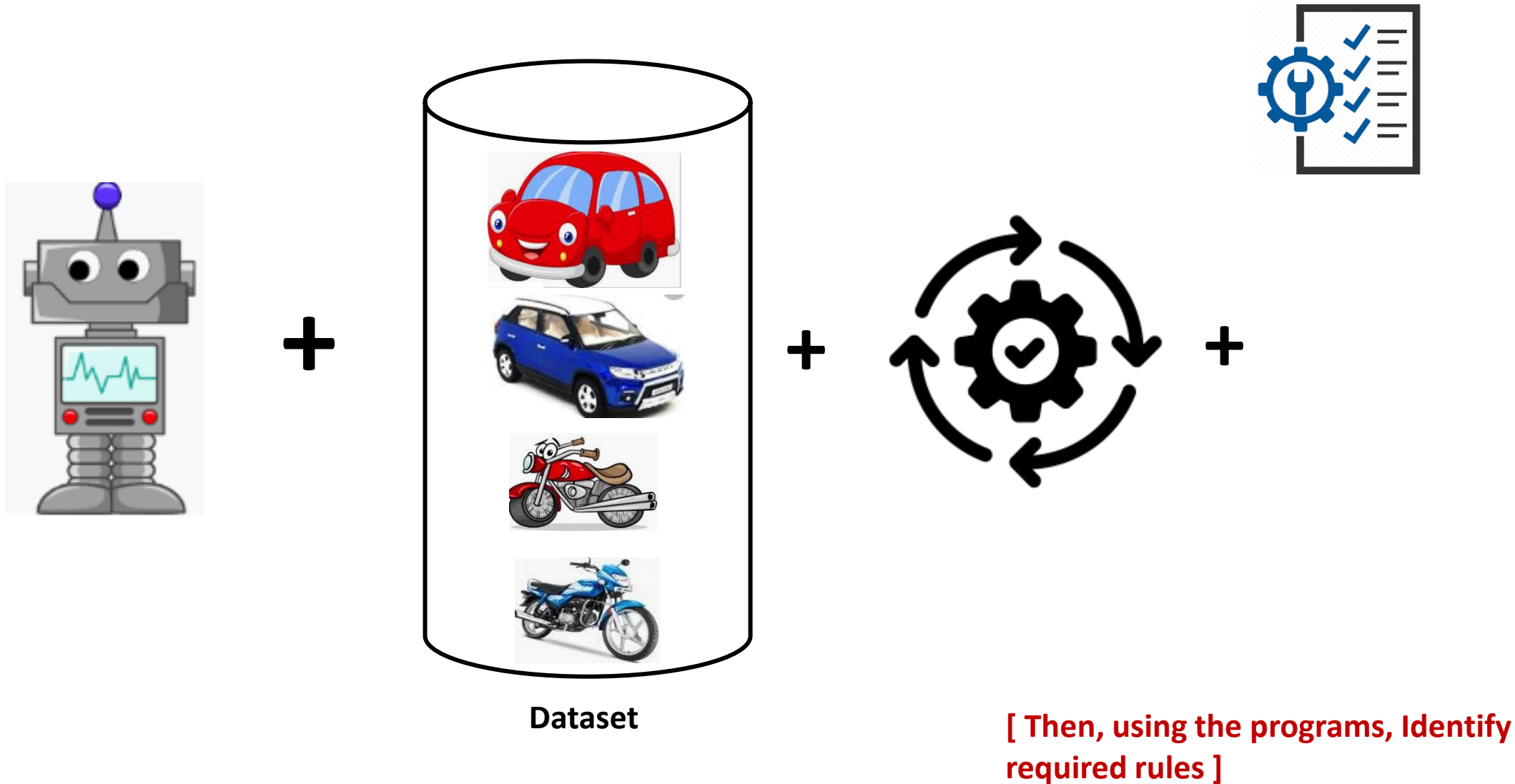
So, we first need to provide  
training dataset to the  
machine  
]

# What is Machine Learning?

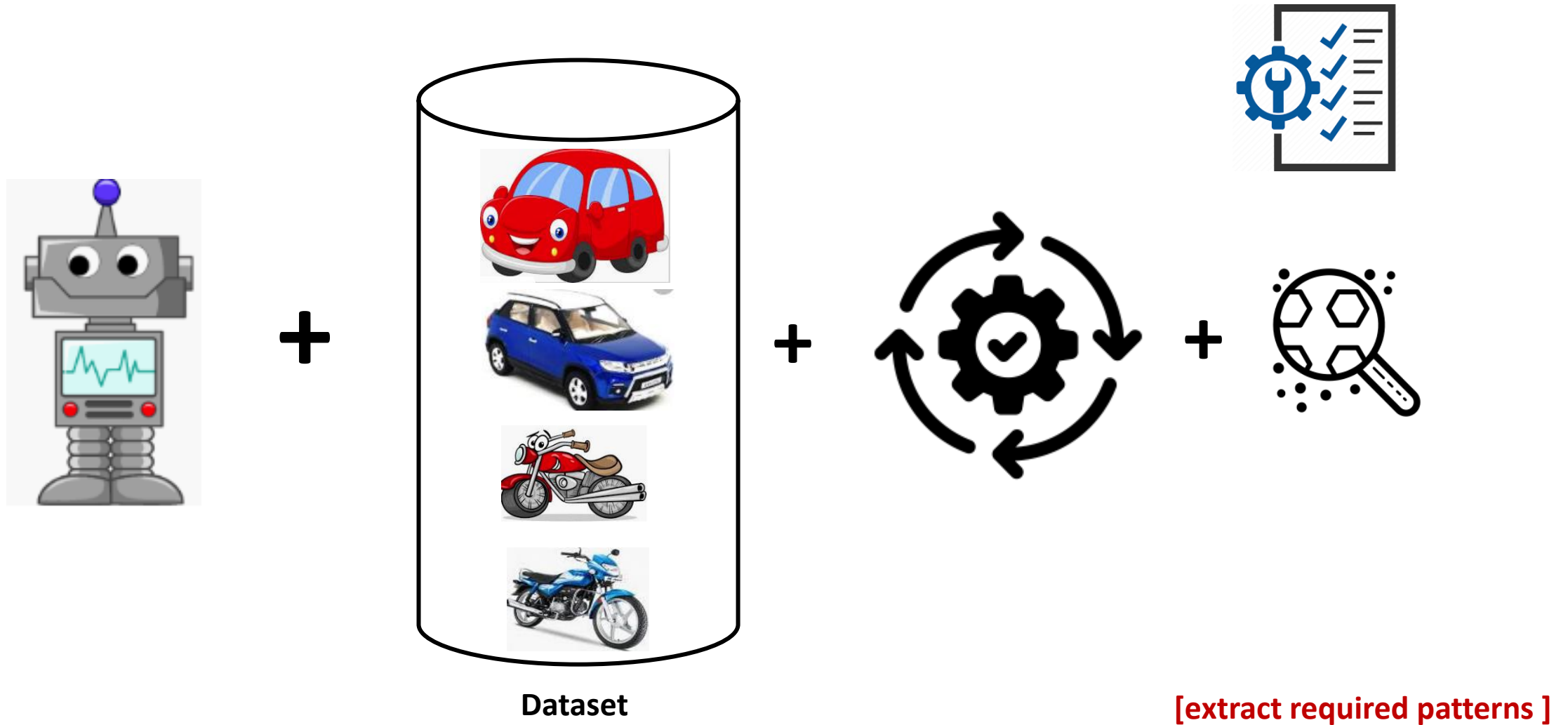




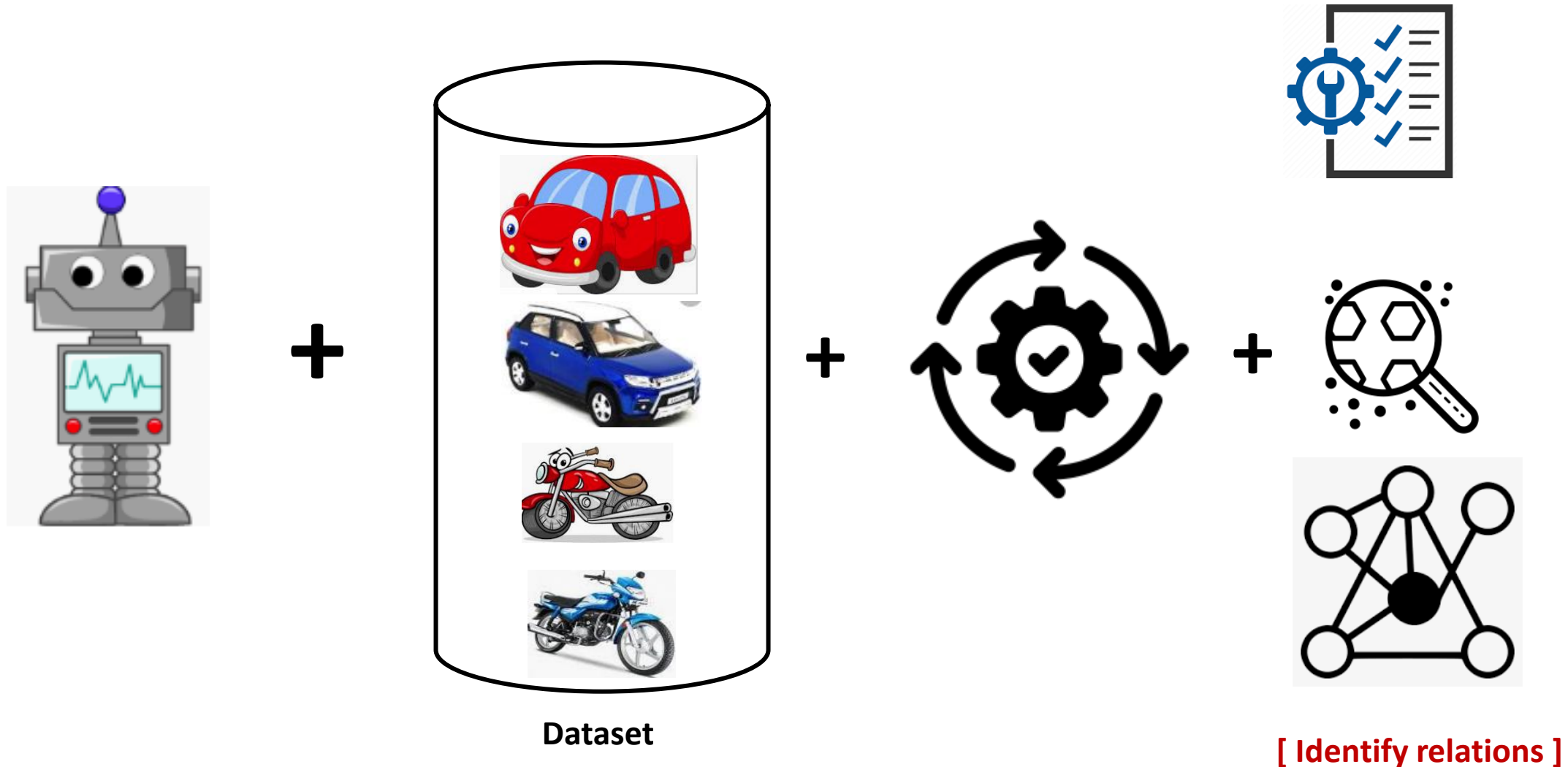
# What is Machine Learning?



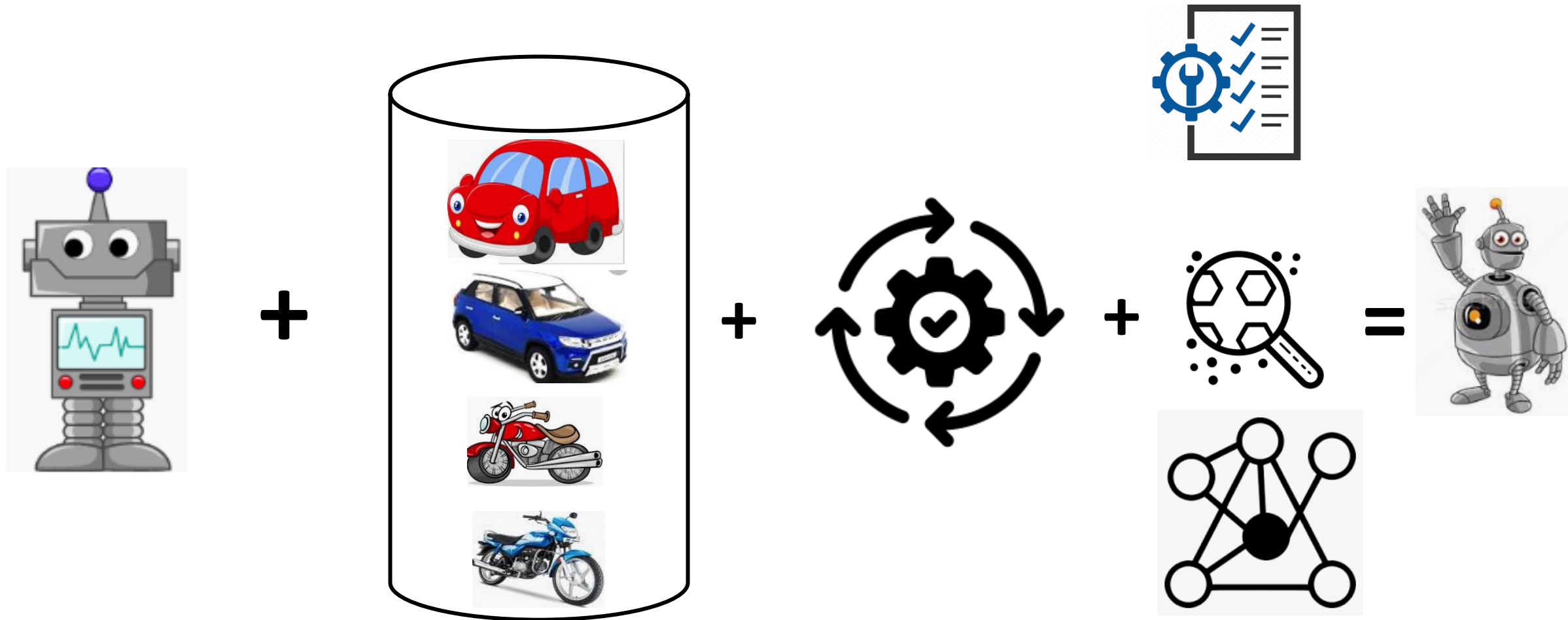
# What is Machine Learning?



# What is Machine Learning?



# What is Machine Learning?



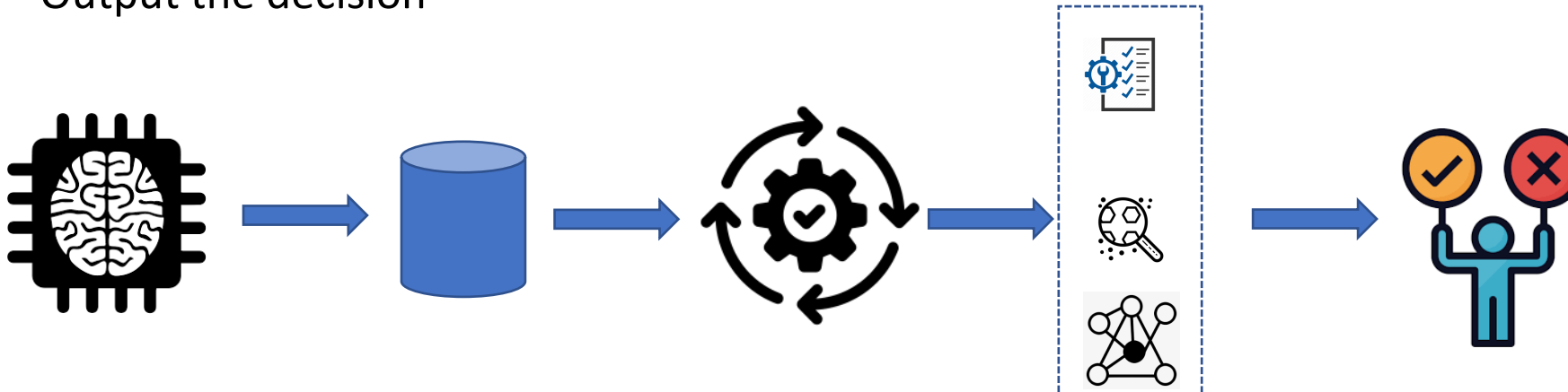
Dataset

**[ So that machine can derive inferences from the data ]**

# In summary, what is machine learning?

Given a machine learning problem

- Identify and create the appropriate dataset
- Perform computation to learn
  - Required rules, pattern and relations
- Output the decision



# Applications of machine learning

- ❖ 1. In **retail business**, machine learning is used to **study consumer behaviour**.
- ❖ 2. In **finance**, banks analyze their past data to build models to use in **credit applications, fraud detection, and the stock market**.
- ❖ 3. In **manufacturing**, learning models are used for **optimization, control, and troubleshooting**.
- ❖ 4. In **medicine**, learning programs are used for **medical diagnosis**.
- ❖ 5. In **telecommunications**, call patterns are analyzed for **network optimization and maximizing the quality of service**.

# Applications of machine learning

- ❖ 6. In **science**, large amounts of data in physics, astronomy, and biology can only be analyzed fast enough by computers. The World Wide Web is huge; it is constantly growing and searching for relevant information cannot be done manually.
- ❖ 7. In **artificial intelligence**, it is used to teach a system to learn and adapt to changes so that the system designer need not foresee and provide solutions for all possible situations.
- ❖ 8. It is used to find solutions to many problems in vision, speech recognition, and robotics.
- ❖ 9. Machine learning methods are applied in the **design of computer-controlled vehicles to steer correctly when driving on a variety of roads.**
- ❖ 10. Machine learning methods have been used to **develop programmes for playing games such as chess, backgammon and Go.**

# Types of machine learning :- (i) Supervised Learning

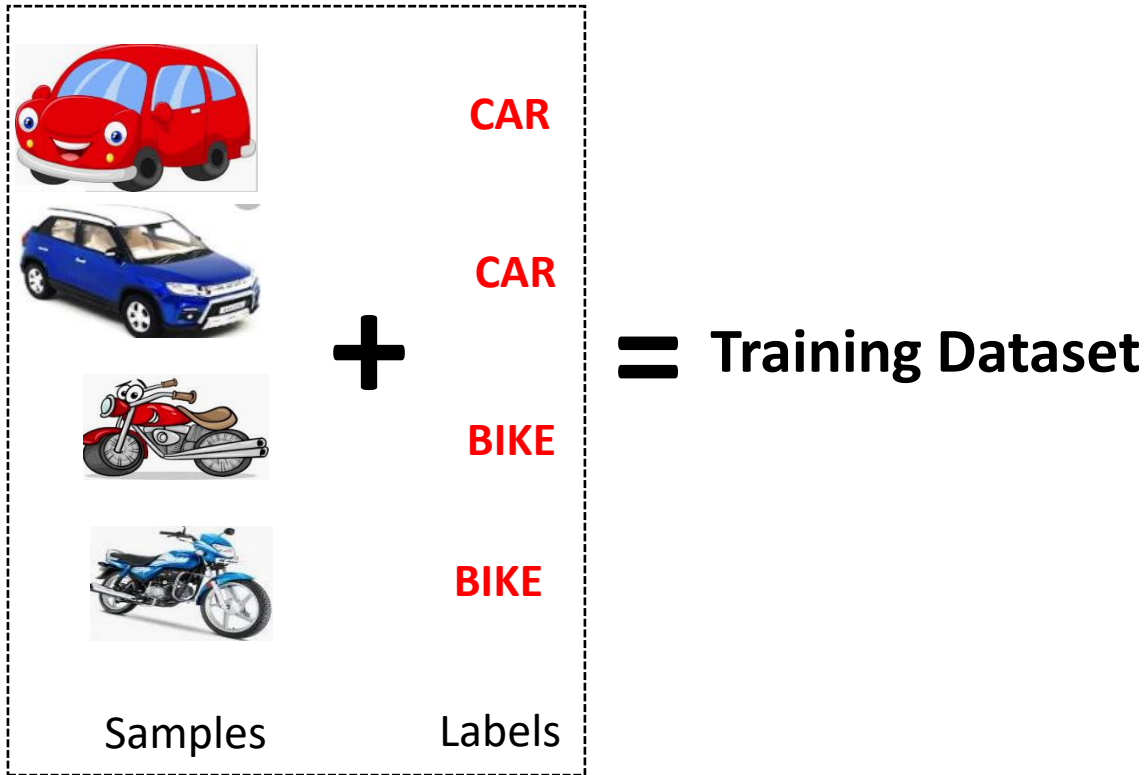
- ❖ Supervised learning is the machine learning task of learning a function that maps an input to an output based on example input-output pairs.
- ❖ In supervised learning, each example in the training set is a pair consisting of an input object (typically a vector) and an output value.
- ❖ A supervised learning algorithm analyzes the training data and produces a function, which can be used for mapping new examples.
- ❖ In the optimal case, the function will correctly determine the class labels for unseen instances. Both classification and regression problems are supervised learning problems.
- ❖ A wide range of supervised learning algorithms are available, each with its strengths and weaknesses. There is no single learning algorithm that works best on all supervised learning problems.



## (i) Supervised Learning

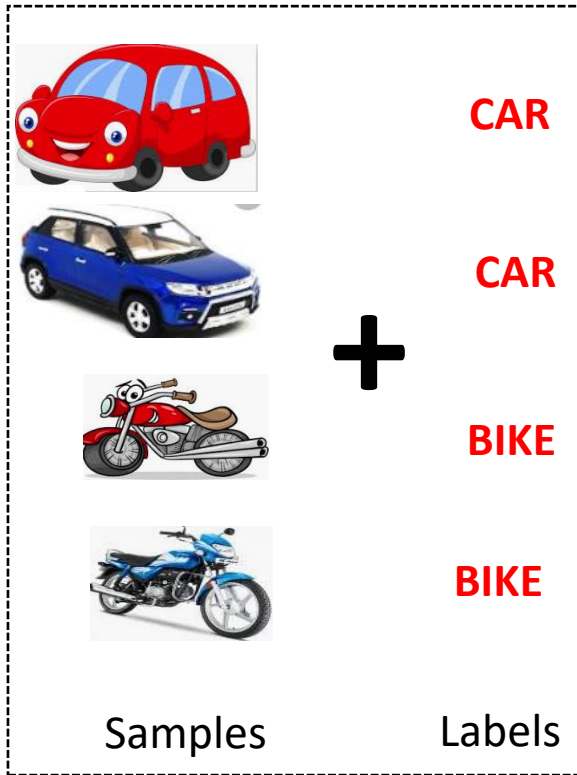
- ❖ Remarks:
- ❖ A “supervised learning” is so called because the process of an algorithm learning from the training dataset can be thought of as a teacher supervising the learning process.
- ❖ We know the correct answers (that is, the correct outputs), the algorithm iteratively makes predictions on the training data and is corrected by the teacher.
- ❖ Learning stops when the algorithm achieves an acceptable level of performance.

# What is Supervised Learning?



**[In supervised learning, we need some thing called a Labelled Training Dataset ]**

# What is Supervised Learning?



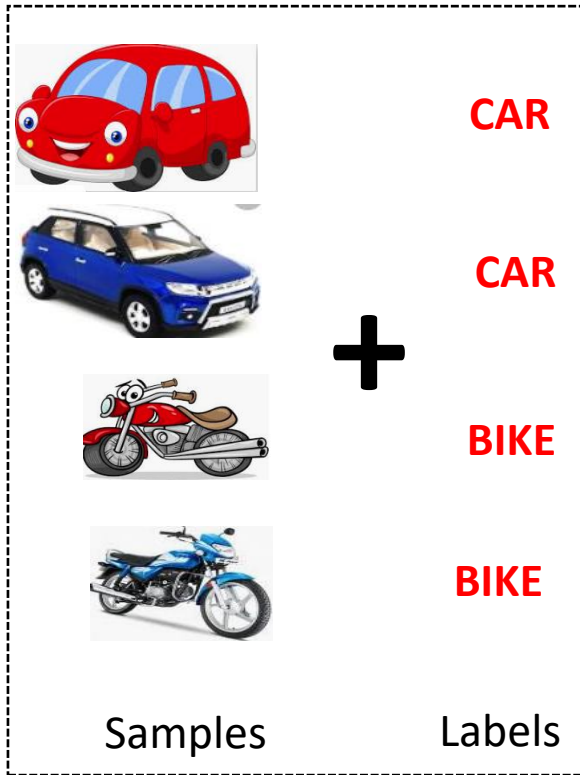
+

= Training Dataset

$f(\text{blue cylinder}, ) =$

[ Given a labelled dataset, the task is to devise a function which takes the dataset, and a new sample, and produces an output value.]

# What is Supervised Learning?



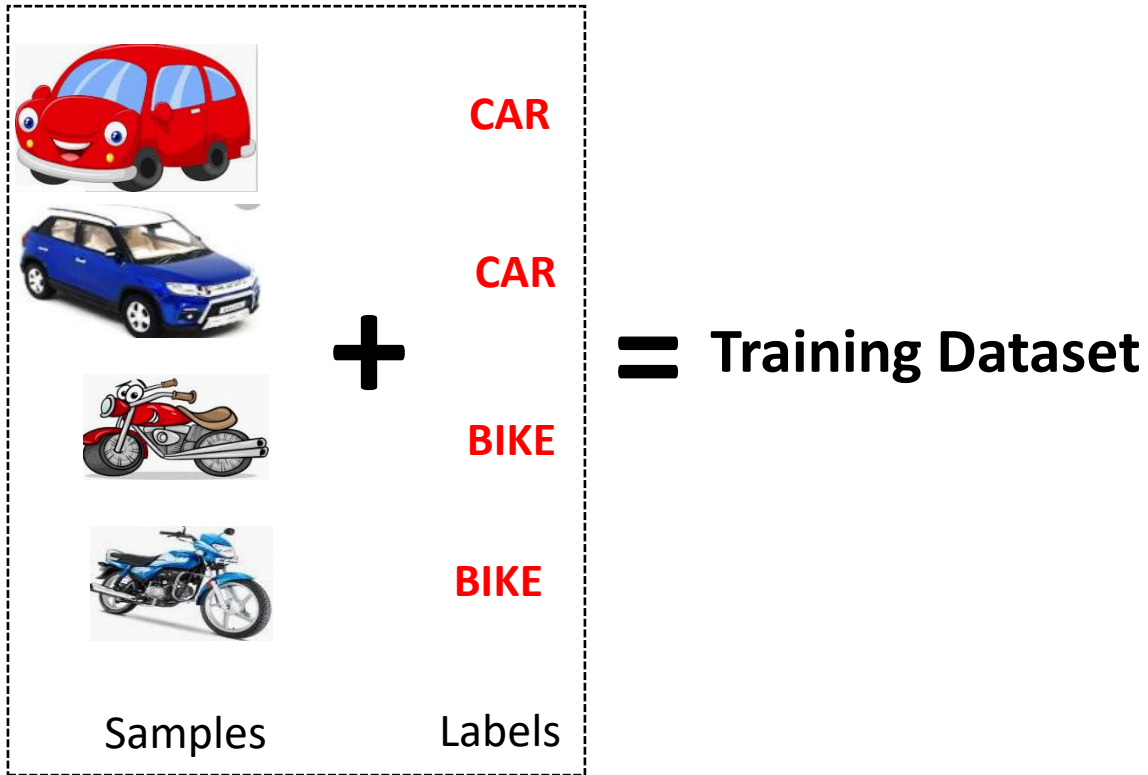
+

= Training Dataset

$$f(\text{Database}, \text{New Sample}) =$$

[ Given a labelled dataset, the task is to devise a function which takes the dataset, and a new sample, and produces an output value.]

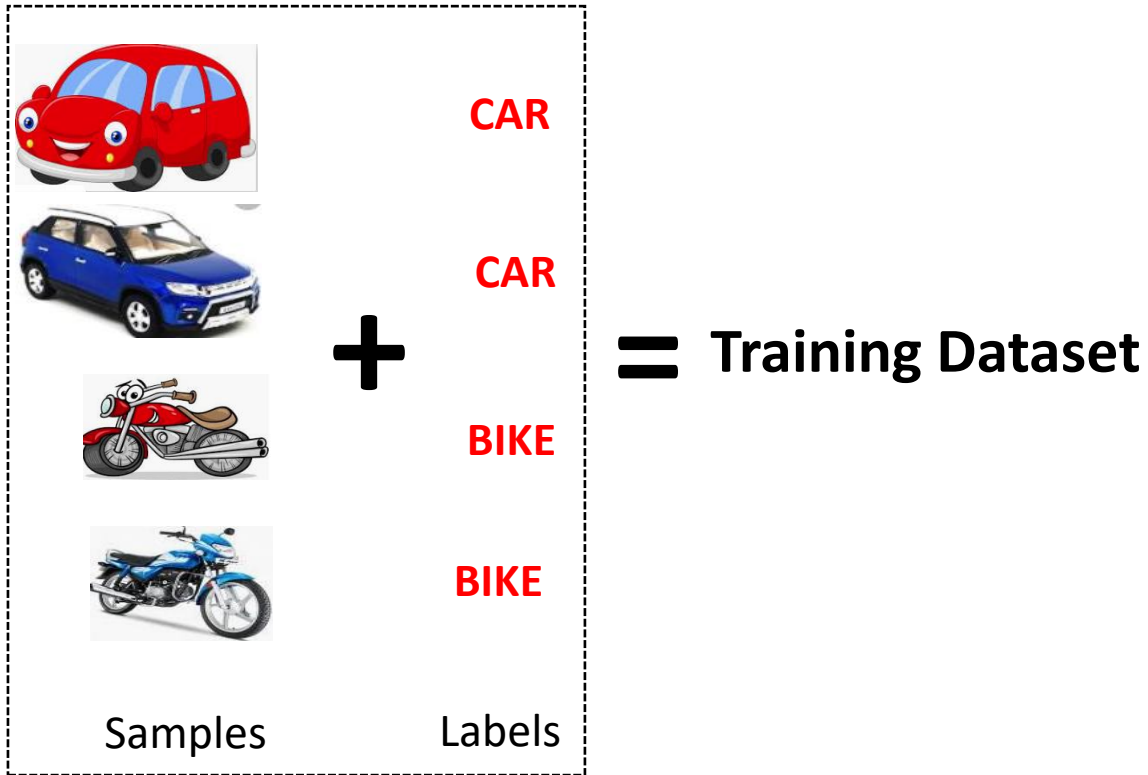
# What is Supervised Learning?



$$f(\text{Database}, \text{New Sample}) = \text{CAR}$$

[ Given a labelled dataset, the task is to devise a function which takes the dataset, and a new sample, and produces an output value.]

# What is Supervised Learning?

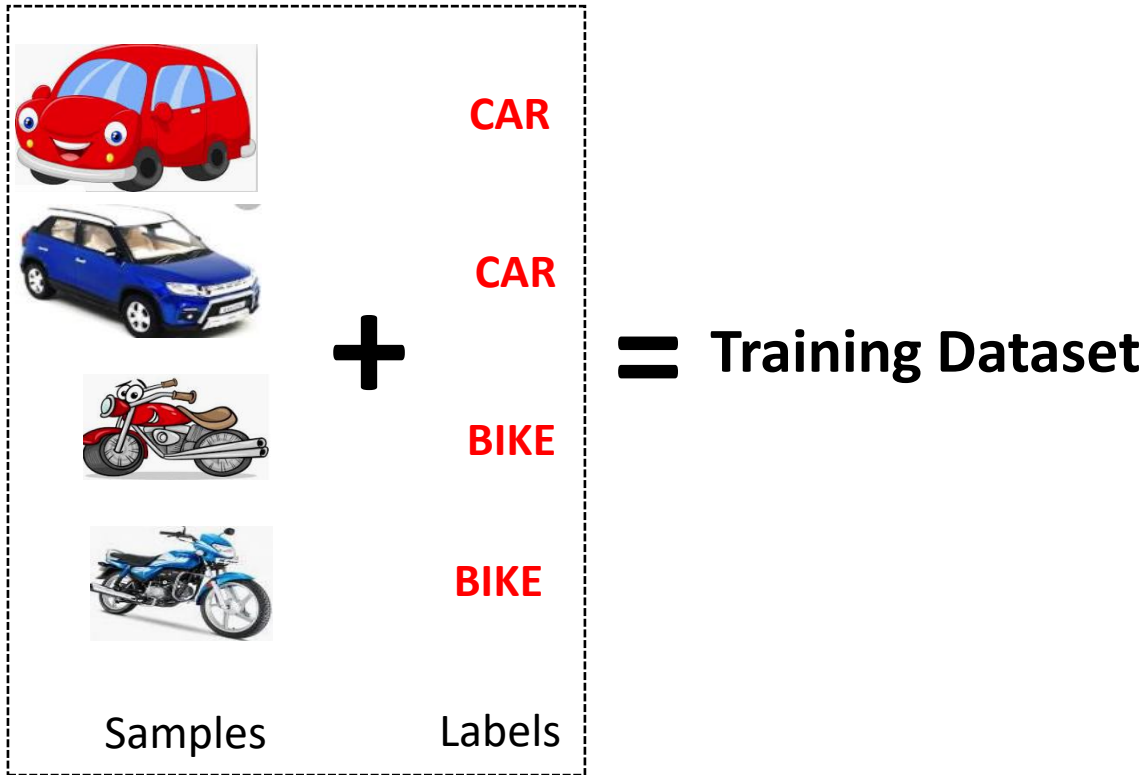


**Classification**

$$f(\text{Database}, \text{Image}) = \text{CAR}$$

**[ If the possible output values of the function are predefined and discrete/categorical, it is called Classification**

# What is Supervised Learning?

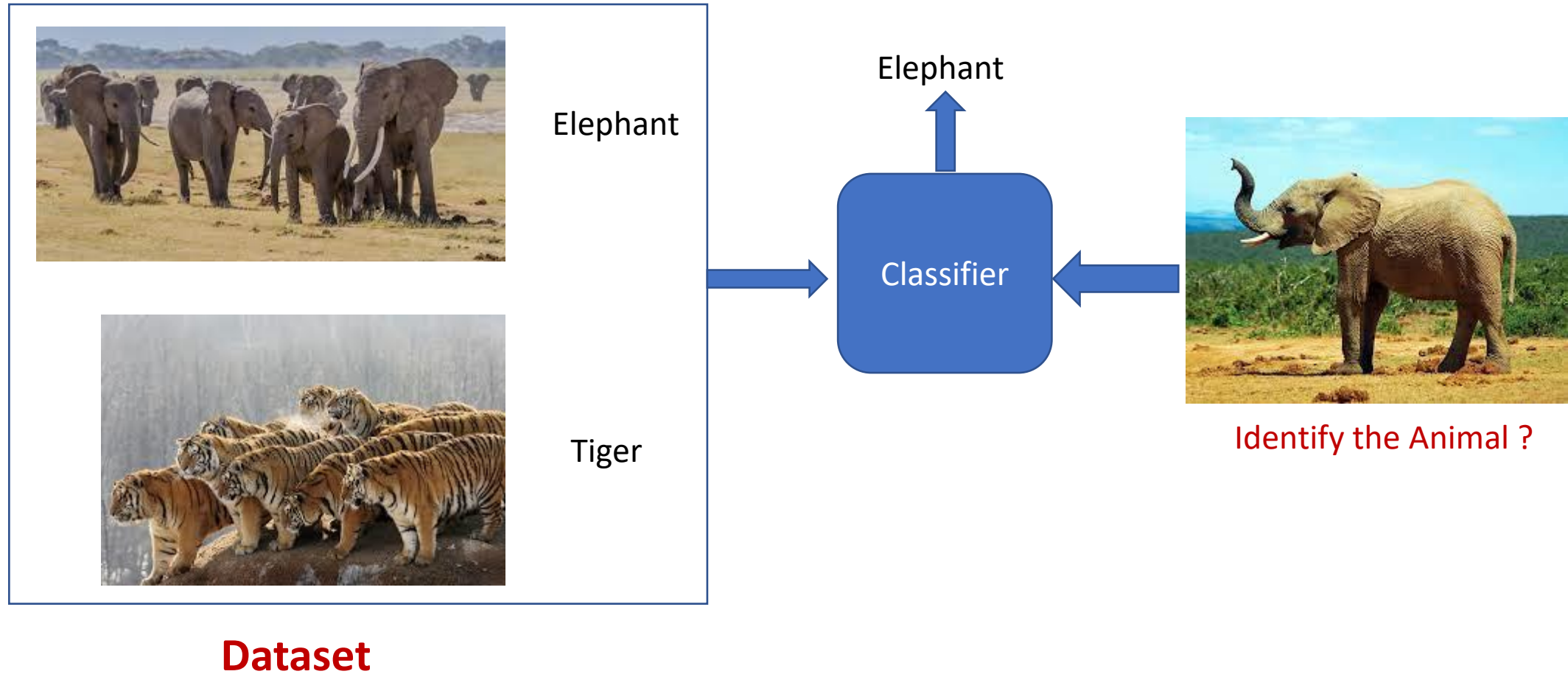


**Classification**

$$f(\text{Database}, \text{Bus Image}) = \text{CAR}$$

**[ Predefined classes means, it will produce output only from the labels defined in the dataset. For example, even if we input a bus, it will produce either CAR or BIKE ]**

# Classifier





# Regression



**Dataset**

## Regression

$$f(\text{blue cylinder}, \text{red house}) = 20500.50$$

**[ If the possible output values of the function are continuous real values, then it is called Regression**

[  
**The classification and Regression problems are supervised, because the decision depends on the characteristics of the ground truth labels or values present in the dataset, which we define as experience**  
]

## **(ii) Unsupervised Learning**

- ❖ 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, a classification or categorization is not included in the observations.
- ❖ There are no output values and so there is no estimation of functions.
- ❖ Since the examples given to the learner are unlabeled, the accuracy of the structure that is output by the algorithm cannot be evaluated.
- ❖ The most common unsupervised learning method is cluster analysis, which is used for exploratory data analysis to find hidden patterns or grouping in data.

# What is Unsupervised Learning



~~CAR~~



~~CAR~~



~~BIKE~~



~~BIKE~~

**Dataset**

**[ In the unsupervised learning, we do not need to know the labels or Ground truth values ]**

# What is Unsupervised Learning



**Dataset**



**Clustering**

**[ The task is to identify the patterns like group the similar objects together ]**

# What is Unsupervised Learning



**Dataset**

**Association Rules Mining**

**[ Association rules like ]**

# More Example Unsupervised Learning



**Dataset**

# More Example Unsupervised Learning



**Dataset**





# More Example Unsupervised Learning



**Customers who viewed this item also viewed**



### (iii) Reinforcement learning

- ❖ Reinforcement learning is the **problem of getting an agent to act in the world so as to maximize its rewards.**
- ❖ A learner (the program) is not told what actions to take as in most forms of machine learning, but instead must **discover which actions yield the most reward by trying them.**
- ❖ In the most interesting and challenging cases, **actions may affect not only the immediate reward but also the next situations and, through that, all subsequent rewards.**
- ❖ For example, **consider teaching a dog a new trick: we cannot tell it what to do, but we can reward/punish it if it does the right/wrong thing.**
- ❖ **It has to find out what it did that made it get the reward/punishment.**
- ❖ **We can use a similar method to train computers to do many tasks, such as playing backgammon or chess, scheduling jobs, and controlling robot limbs.**

# What is Reinforcement Learning

**[ It is also known as learning from trials and errors ]**

# What is Reinforcement Learning

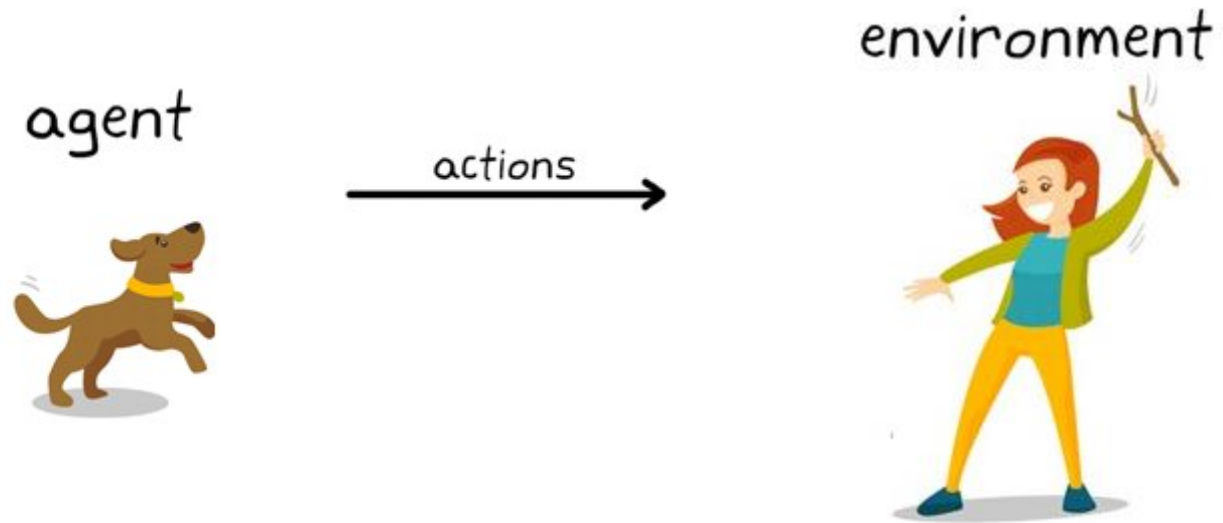
agent



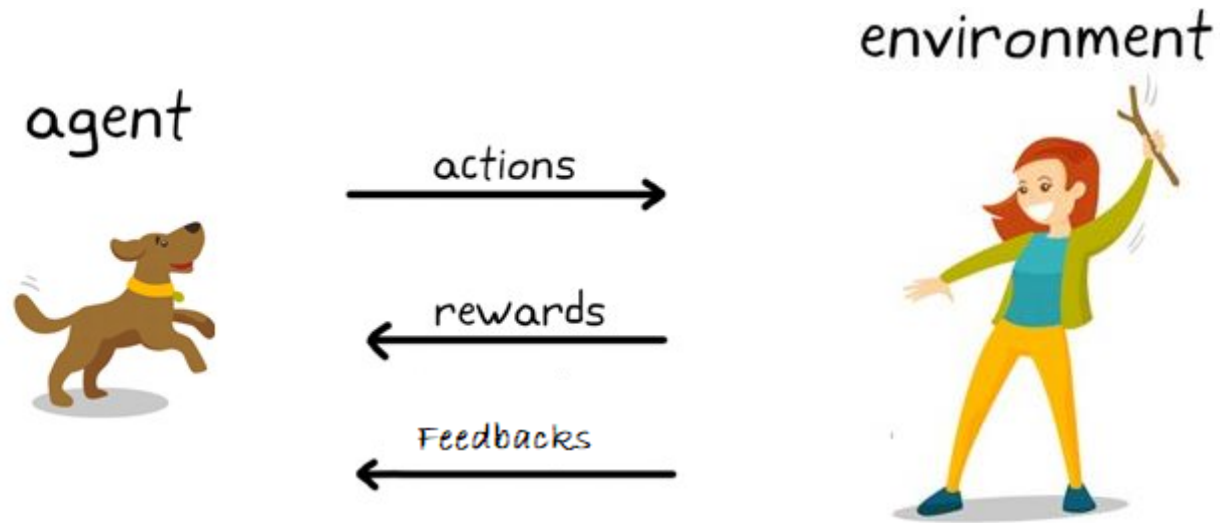
environment



# What is Reinforcement Learning



# What is Reinforcement Learning



# Another Example



Agent



Task



Environment

# Reinforcement Learning





# Reinforcement Learning



**Reward**

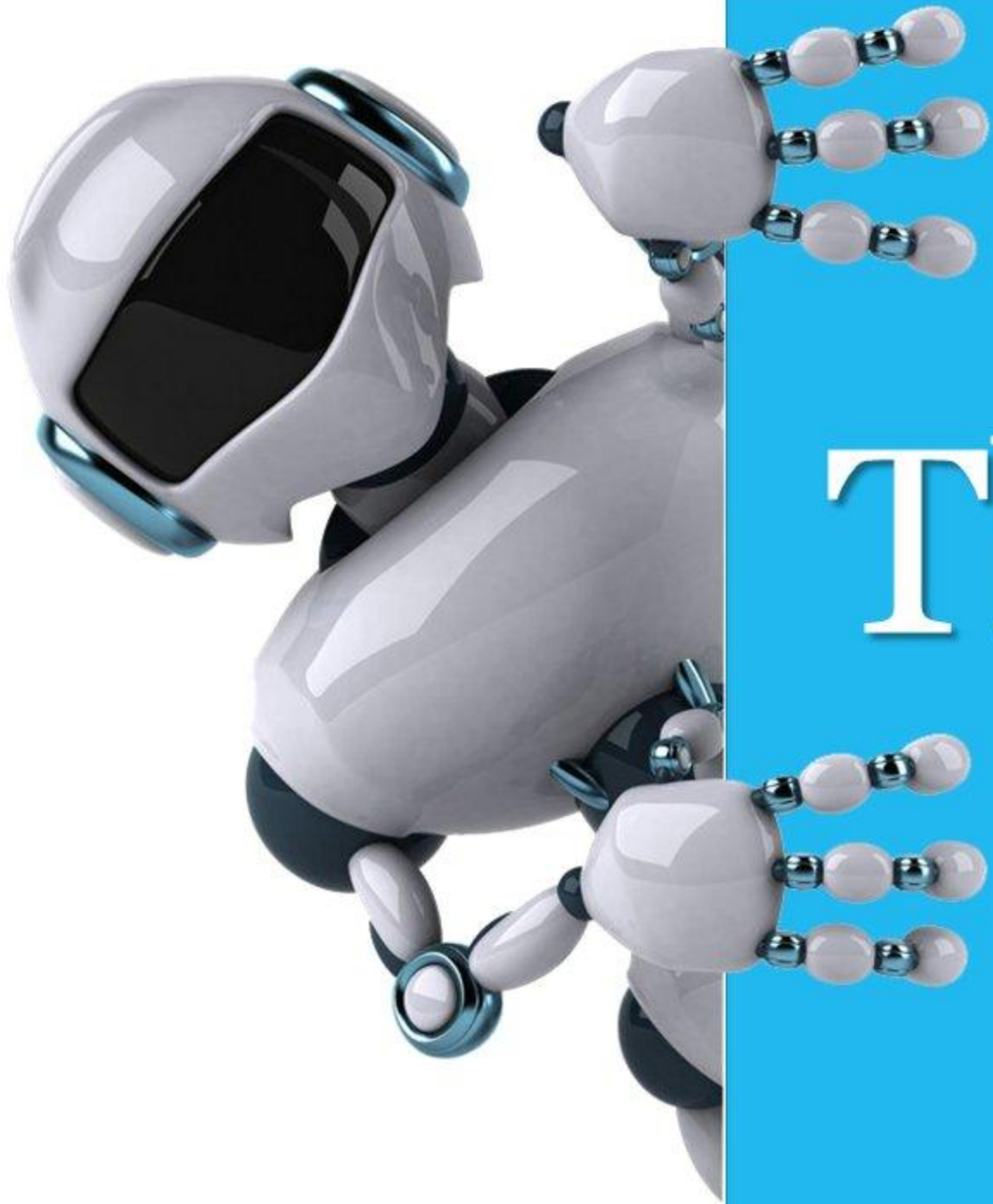
# Reinforcement Learning



**Reward**

**Baby Learn from the Trials and Errors**

**Reinforcement Learning**



Thank you