



# SNS COLLEGE OF TECHNOLOGY

Coimbatore-35

An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade  
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

## DEPARTMENT OF COMPUTER APPLICATIONS

### 23CAT702 - MACHINE LEARNING

II YEAR III SEM

#### UNIT I – FOUNDATIONS OF LEARNING

TOPIC 2 – Learning Models: Geometric models – Probabilistic models –  
Logic models

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# Recall



1. Machine Learning
2. Reading Vs Learning
3. Why Machine Learning
4. Traditional Vs Machine
5. Components of Machine Learning
6. Applications



# Learning Models

**1. Machine learning using the right features to build the right models to achieve the right tasks.**

2. The basic idea of Learning models has divided into three categories.

1. Using a Logical expression. (Logical models)
2. Using the Geometry of the instance space. (Geometric models)
3. Using Probability to classify the instance space. (Probabilistic models)

**Features : The workhorses of Machine Learning.**

**Models : The output of Machine Learning.**

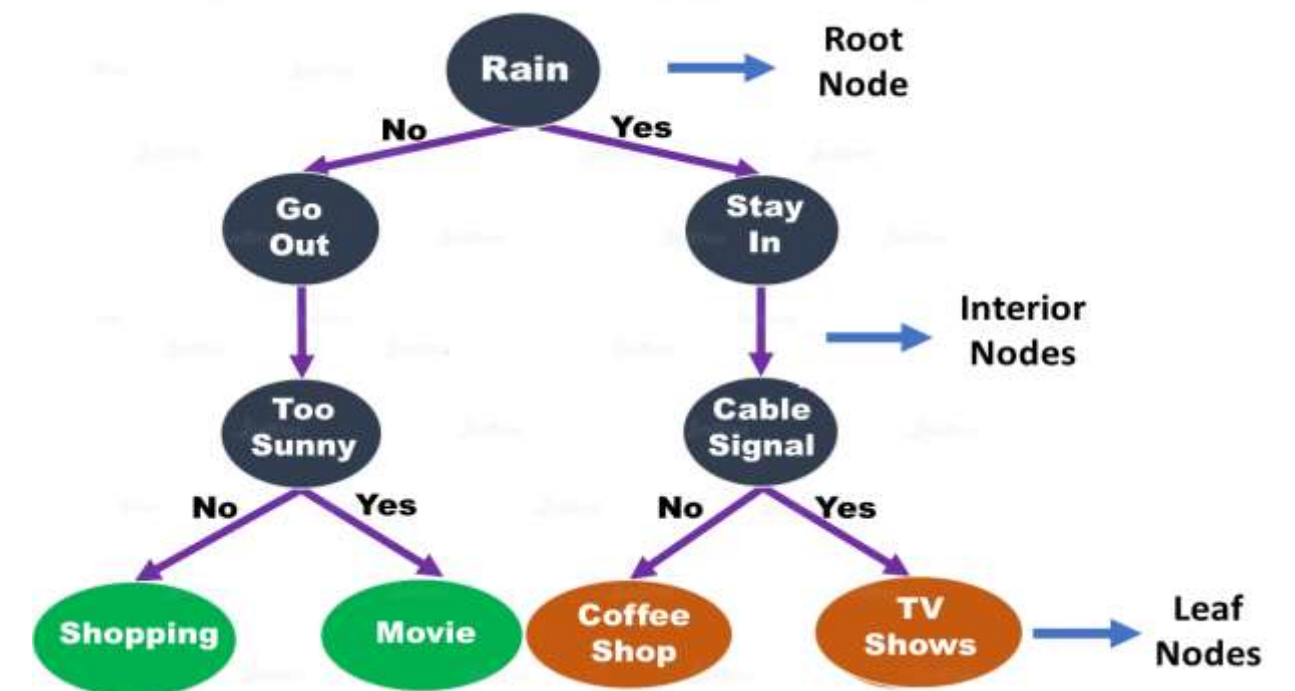
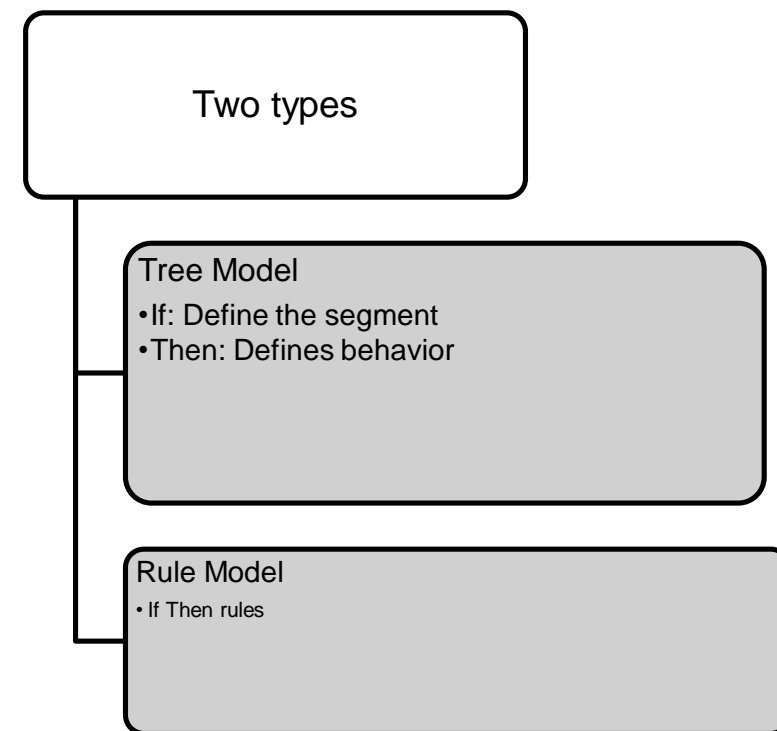
**Tasks : The problems that can be solved with Machine Learning.**



# Logical Model



1. **Logical models** use a logical expression to divide the instance space into segments and hence construct grouping models.
2. A **logical expression** is an expression that returns a Boolean value, i.e., a True or False outcome.
3. Once the data is grouped using a logical expression, the data is divided into homogeneous groupings for the problem we are trying to solve.
4. For example, for a classification problem, all the instances in the group belong to one class.





# Logical models and Concept learning

## Concept Learning:

The inferring of a Boolean-valued function from training examples of its input and output.

Concept learning is also an example of **Inductive Learning**. Inductive learning, also known as **discovery learning**, is a process where the learner discovers rules by observing examples.

SI No.	Breathing difficulty	Cough	Fever	Covid
1	Yes	Yes	Yes	Positive
2	Yes	Yes	No	Positive
3	Yes	No	Yes	Negative
4	No	Yes	Yes	Negative
5	No	No	Yes	Negative
6	No	No	No	Negative





# Geometric models

1. Define similarity by considering the geometry of the instance space.
2. In Geometric models, features could be described as **points in two dimensions (x- and y-axis) or a three-dimensional space (x, y, and z).**
3. In geometric models, there are two ways we could impose similarity.
  1. **Linear Model:** Lines or planes to segment (classify) the instance space.
  2. **Distance-Based Model:** Distance to represent similarity. In this case, if two points are close together, they have similar values for features and thus can be classed as similar.



## Linear models-Use case

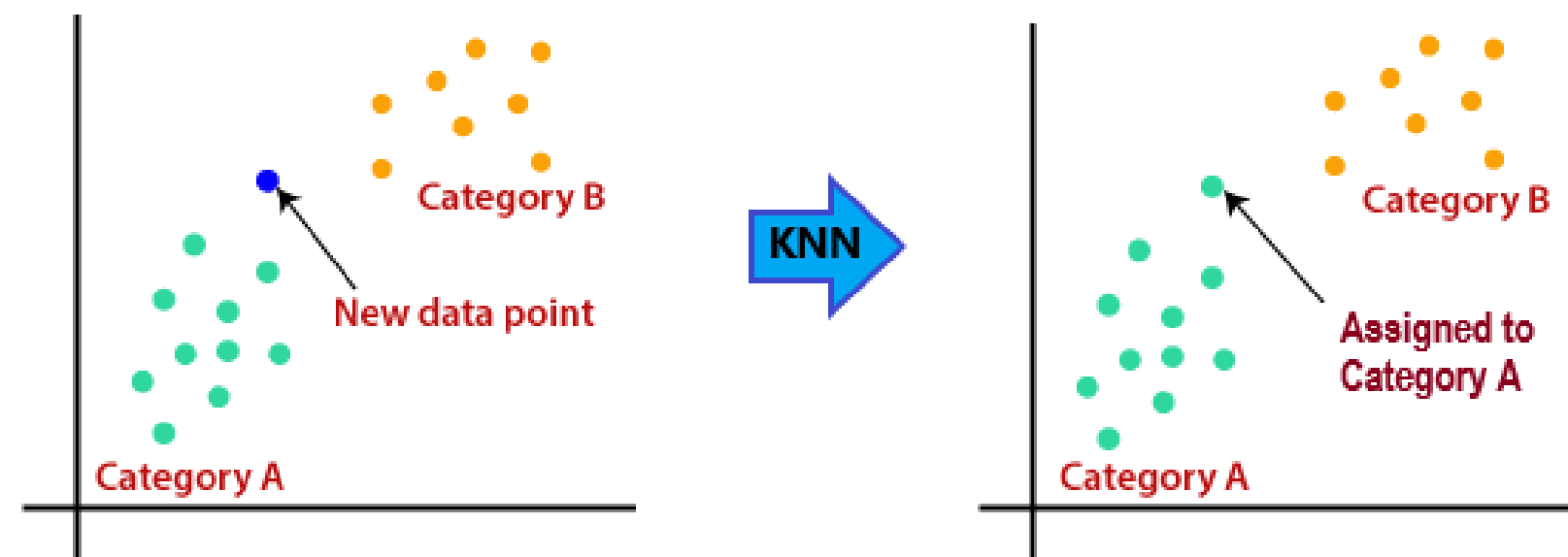
1. A linear model is one that represents the relationship between two quantities and where the degree of the equation is 1.
2. The linear model equation is  $y=mx+b$
3. where  $y$  represents the output value,  $m$  represents the slope or rate of change,  $x$  represents the input value, and  $b$  represents the constant or the starting amount.
4. \$15 per hour, how much money, and number of hours the linear model would be  $y=15x+0$
5. where  $y$  is the amount of money earned, 15 is the rate they make per hour,  $x$  is the amount of hours worked, and 0 is their starting pay (which in this case does not exist). **For example.,**

- a) Hours spent studying Vs. Marks scored by students
- b) Amount of rainfall Vs. Agricultural yield
- c) Electricity usage Vs. Electricity bill
- d) Suicide rates Vs. Number of stressful people



## Distance based models

1. Distance based models are based on the geometry of data. As the name implies, distance-based models work on the concept of distance.
2. In the context of Machine learning, the concept of distance is not based on merely the physical distance between two points. Instead, we could think of the distance between two points considering the mode of transport between two points.
3. The distance metrics commonly used are Euclidean, Minkowski, Manhattan, and Mahalanobis.







## Probabilistic models

1. Use the idea of probability to classify new entities.
2. Probabilistic models see features and target variables as random variables.
3. The process of modelling represents and manipulates the level of uncertainty with respect to these variables.
4. There are two types of probabilistic models:
  1. Predictive: Predictive probability models use the idea of a conditional probability distribution  $P(Y|X)$  from which  $Y$  can be predicted from  $X$ .
  2. Generative models: Estimate the joint distribution  $P(Y, X)$ .

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$



# Some broad categories of models



## **Geometric models**

K-nearest neighbors,  
linear regression,  
support vector machine,  
logistic regression, .....

## **Probabilistic models**

Naïve Bayes

Gaussian process regression  
conditional random field, ...

## **Logical models**

Decision tree,  
Random forest, ...



## References



Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, —Learning from Data, AML Book Publishers, 2012.

P. Flach, —Machine Learning: The art and science of algorithms that make sense of data, Cambridge University Press, 2012.

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