

# Modern Methods for Machine Learning Algorithms: An Analysis of Supervised Learning Strategies for Data Categorization

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## ABSTRACT

Artificial intelligence (AI) techniques such as machine learning (ML) enable a system to learn without explicit programming. The primary goal of the ML technique is to make computers capable of learning without human intervention. In terms of the supervised ML techniques, logistic regression is primarily employed to analyze information and prediction. Human input and output are essential for supervised algorithms, and they also need to provide feedback regarding the training process's prediction accuracy. In most ML decision-making tasks, we need to build a model that not only correctly interprets and collects the necessary input, but also, in the instance of controlled learning, generates reliable output predictions. In AI, the most widely used classification system is LR. The capacity to implement the method to fresh samples instead of describing patterns in the existing dataset sets it apart from independent learning. In contrast to supervised learning (SL) methods, which necessitate a training phase, unsupervised learning approaches do not. Nonetheless, SL techniques are less complicated than unsupervised techniques. The SL techniques that are frequently applied in the process of classifying data are reviewed in this study. The objective, approach, positive effects, along limitations of the methods are investigated. Finally, the target market is given an overview of supervised AI methods for data classification.

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## 1. INTRODUCTION

ML is a subset of AI technology that allows a system to learn things on its own without the need for explicit programming. It focuses mostly on creating computer programs that can retrieve data and let it learn on its own. To make superior choices, this process begins with inspecting the information while looking for trends. Enabling automated learning without human involvement is the primary objective. While consciousness is not required to acquire knowledge, it does identify patterns seen in the data. By doing this, AI algorithms remove the requirement for human intervention in the data collection process [1]. However, it was discovered that ML methods were highly challenging in a variety of settings. In the field of statistics known as statistical learning theory, testing and statistical analysis of the ML of learning are done. Predictive simulation, data extraction, and neural networks all work basically in a similar way.

The software actions are modified by each of these stages upon discovering trends in the data. Several studies have been conducted to suggest adverts to individuals according to the things they have purchased online [2]. The understanding of the intelligence of individuals is the source of these acquired

behaviors. This section provides an overview of AI using a thorough ML model. Data is all that is needed for ML to succeed. ML is recognized for the various ways it operates. Controlled, uncontrolled, and demonstrated are the terms used to describe these methods.

Only data is used for these, as it is the fundamental component [3]. Finding the correlation between the variables that are dependent and independent is one of the goals of Supervised. The input properties are known as independent variables, while the intended characteristics are known to be linked variables. Work done without supervision is counter to a controlled strategy. The requirement for accurately defining the course material, implementing techniques that will guarantee success, offering the tools and resources necessary to make it happen, and fostering an environment that cultivates understanding, control over it, and the advancement of human potential gave rise to classroom instruction.

A multitude of strategies, including instance-based, logic-based, stochastic, and others, have been developed by researchers to address such difficulties. That's why the main portion of this section will go over a few popular methods for supervised learning and how they work in terms of learning speed, accuracy, complexity, and overfitting risk factors [4]. Figure 1 show evaluating the outcomes is crucial to determining the model's robustness, we will talk about assessment metrics like accuracy and precision as well as the primary issues we ran into when trying to teach our model. Finally, the broad fields that utilize SML techniques, such as image processing and text media, will be examined. The method provides the most recent data and uses the marked datasets to obtain regression to predict continuous-valued results. An SML algorithm should be chosen after considering the information's variability, accuracy, a surplus, and regularity.

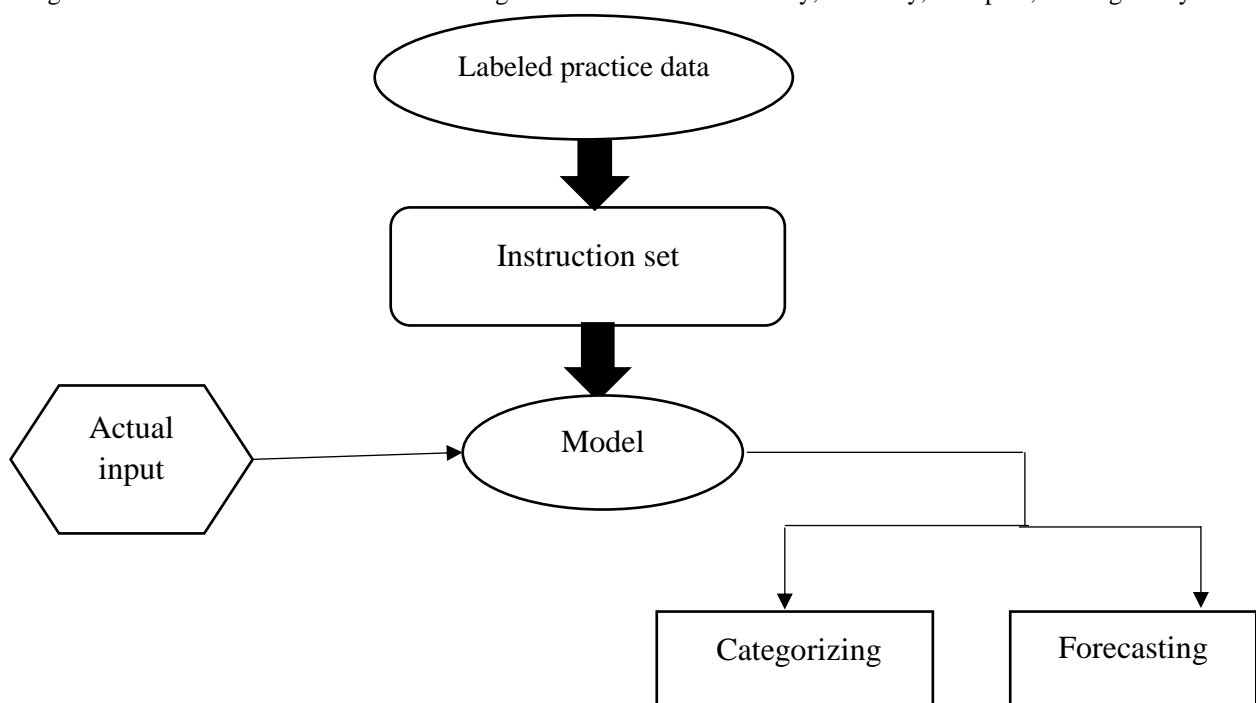


Figure 1. Block diagram of supervised machine learning

The information being supplied is linked to the desired result during training in monitoring, and the system gains knowledge from a set of labeled data. Subsequently, the computer can predict the outcome of newly supplied data [5]. Common issues for supervised learning include verification, and analytical regression, including determining the object. The primary goal of controlled ML is to create a succinct model of the classification label distribution concerning forecasting features. The test cases where the outcomes of the predictor characteristics are known but the quantity of the category identified is indeterminate are then given class labels by the resultant classifier. We hope that this work will enable investigators to steer in new directions and equal the efficiency and impact of controlled ML methods.

To foresee occurrences, SML approaches make use of the information that has been acquired from both past and current data with the use of labels. With this method, ML develops a function that is inferred to predict the output values during the dataset training process. With a proper training procedure, the technology may output outcomes based on input data. The ML algorithm looks for flaws and modifies the predictive model based on findings by comparing the produced results with the observed and predicted results. A function that converts inputs into desired outputs is produced by the different algorithms. The classification

issue is a typical way to formulate a supervised learning task: the learner must look at multiple input-output instances of the operation to train a function that maps a vector into a single of multiple categories.

The remaining portion of the study's paper, which is provided in Section 2, will follow this format. SDN architecture is illustrated in Section 3. In Section 4, we discuss in detail how education through performance evaluation measures is used to achieve machine representation. Section 5 wraps up the topic and lays out future directions.

## 2. RELATED WORKS

A significant amount of data must be investigated for ML. It must give accurate findings to identify lucrative opportunities or risky situations, and more time must be allotted for appropriate training. Processing vast amounts of material successfully is made possible by the combination of AI and ML. SML procedures are the most widely utilized and well-liked of the several types of AI methods available [6]. The focus of this study is mostly on supervised learning approaches. The present work reviews the current literature on SML models. The methods, objectives, benefits, and drawbacks of each strategy are examined. Ultimately, a comparative analysis is conducted between the studied methodologies.

The environment is set up to maximize success with the least amount of work, and there are resources and opportunities for a suitable assessment of the work produced by young people. Additionally, learning becomes somewhat enjoyable as a result, and students' attention is more intensely engaged [7]. The quality of programmed teaching is further enhanced by the fact that it considers factors such as teacher grade, diagnostic test results, student intelligence, knowledge, and reading proficiency. Information is typically provided together with a problem statement for the student to solve in supervised teaching. The student then provides his solution, performs the operation to view the programmer's solution, compares it, makes any necessary modifications or completions, receives a grade, and is given directions for additional work.

There are numerous professional paths that we might pursue when concentrating on the topic of ML [8]. A variety of methods, including supervised learning, are used in other forms of learning to characterize entire learning categories. Shadow learning research will be our main focus. Controlled learning and independent learning are the two categories of superficial learning. However, machine learning can be done in several ways. The technique uses a data set that includes both inputs and outputs to create an equation for this learning. Through text-based examples, the algorithms are shown. The inputs and results that are wanted are already known. The input set and the associated appropriate outcomes are obtained by the method in this study. To determine the results, the technique analyzes real outcomes with the proper results.

Incorporating anticipation data, SML aims to enhance target category algorithms. Moreover, another class is used for deploying classifications to examine knowledge in situations where the amounts of the forecast characteristics are known but the significance of the target group is not. The categories in which the source information belongs are indicated by the descriptions used in the segmentation [9]. This part examines the classification of SL algorithms. We carry on looking into the components of the machine learning process. Using the categories for supervised ML. An exceptional collection of data has occasionally led to advances in ML methods.

Instead of being explicitly coded, ML gives systems the capacity to learn on their own and improve with experience [10]. Whenever it is not practical to implement expressly defined techniques with outstanding execution, ML techniques are helpful. Sorting numbers is a basic operation that can be completed quickly and easily. All you need to do is provide some numbers as input, and you will receive an ordered list as the result. Here, we are aware of what to provide as input and the steps that must be taken to produce the intended result. However, some duties are difficult to understand, such as email filtering to distinguish between spam and valid communications.

It's amazing what AI has accomplished and the future that it holds. ML has many usages that we use every day [11]. ML appears to be the future of global governance. Thus, we developed the premise that ML approaches can be used to assist technology-enabled businesses conquer their current issue of spotting new assaults, or zero-day attacks. In this instance, we created an SML model that employs information gleaned from known communication to categorize unknown traffic on the network. Particularly among the most common jobs that so-called computer systems perform is overseeing categorization. As such, a great deal of methods that utilize AI are currently established.

Acquiring a machine capable of autonomous adaptation is the primary goal of the ML approach, and this goal can improve the precision of specific actions or experiences [12]. While in regression strategy, the result should continue to contain a numeric amount instead of a discrete quantity, in the classification approach, computers are expected to learn how to classify strategies of observation examples. Issues related to regression and classification are resolved using controlled neural networks. Among the most popular SL techniques include simple Bayes, random woodlands, the use of support vector machines, and linear regression. Group evaluation is the most often used autonomous learning technique.

We use controlled AI approaches to solve certain fluid movement issues related to regression. The features, robustness, computing cost, and performance of four neural network topologies are analyzed for canonical flow issues. We take into consideration the calculation of disturbances as well as force constants for fluxes over wings containing a Side move and cylinder using just a handful of contact sensors. Under consideration is the result of the instructional data's spatiotemporal complexity [13]. An accurate forecasting of stock prices model can assist managers, investors, and other decision-makers in reaching wise and practical choices. The present work reviews previous research on supervised AI models for predicting stocks.

### **3. METHODS AND MATERIALS**

#### **3.1 The Process of Selecting Features**

A significant amount of investigation has been done to find a trustworthy decision-making approach. Deciding on features is a crucial component of ML which reduces the size of information. Filtering and wrapping have been employed for feature selection. Based on their results from a variety of statistical tests that gauge a feature's significance by comparing it to a dependent or consequence variable, characteristics are chosen using the filter technique. Its wrapper technique uses the factor in question to measure an assortment of characteristics' applicability to identify a sample of characteristics. Therefore, filter techniques operate independently of ML algorithms, while wrapper approaches rely on the algorithm for ML that was used to train the model to determine which feature subset is optimal for the wrapper approach, a subset evaluator employs every feasible subset before using a system for classification to persuade classifiers based on the features of each subset.

The subset of features that the classification algorithm works best with is taken into account by the classifier. The assessor will use various search strategies, such as depth-first, to locate the segment. Electrically operated, breadth-first, by chance, or screening methods. The filter technique ranks all of the distinctive characteristics in the information set by using a ranker and an attribute evaluator together. In this case, the predicted success of the algorithm for classification is evaluated by removing one characteristic at a time, based on its lower ranks. Figure 2 shows the scores or values assigned by evaluation method and the ranking website techniques are distinct. Filtering is more appropriate for testing data mining applications since it offers numerous features, but wrapping is more suited when testing AI applications.

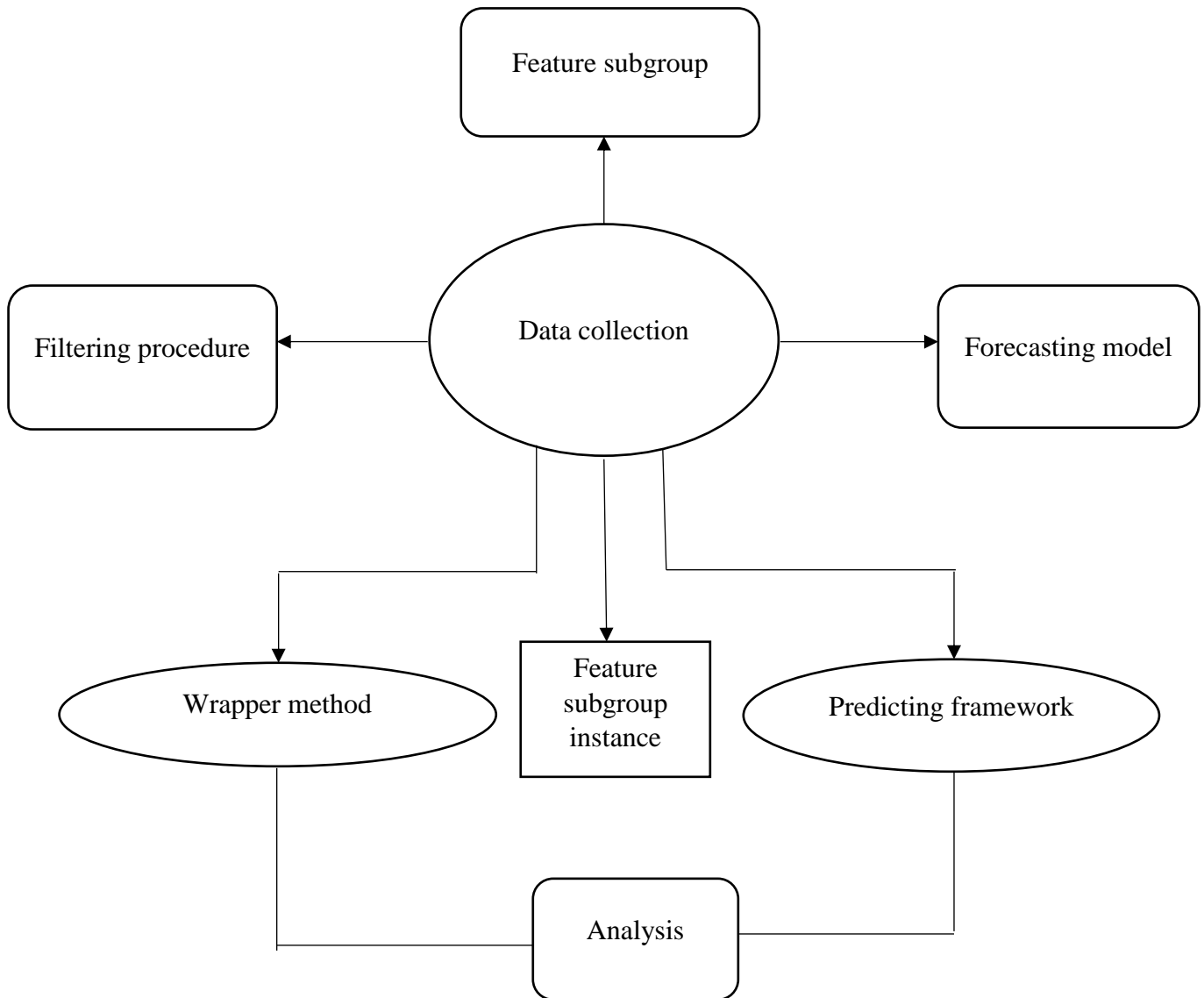


Figure 2. The Selection Phase for Features

### 3.1.1 The standards of evaluation for feature sets

The method of selecting a relevant feature from feature sets using a variety of techniques is known as an assessment criterion. There are four assessment criteria for feature selection: filter, wrapper, embedding, and hybrid. These approaches, along with their pros and cons, were covered in the subsection that followed. Separate preparation techniques in the form of filters are frequently used. Rather, elements were chosen using numerous statistical analyses to determine how well they correlated with the outcome variable. The way the parts are evaluated is independent of the sorting method.

### 3.2 Probabilistic Classification Algorithms

Mixed model approaches are employed by the classifier in question to categorize the input. It believes that each class is a component of the combination. All combination elements are general models that allow you to sample a particular element's term. Generic classifiers are the name given to this type of classifier. Common varieties of detectors with probabilities.

#### 3.2.1 Decision-making Trees

A classification algorithm stated as a hierarchical segmentation of the space for instances is represented by a decision tree. Figure 3 shows the hierarchy of choices has been made up of nodes that come together to form any spreading branch known as the "root tree," which has no entering links. There is just a single entering connection for each of the other nodes. An internal node, sometimes known as a test node, is a node with outward edges. Leaves are the remaining nodes. Each evaluation node within an option branch

separates a space for instances into at least two sub-spaces based on a particular discontinuous relationship between the input values.

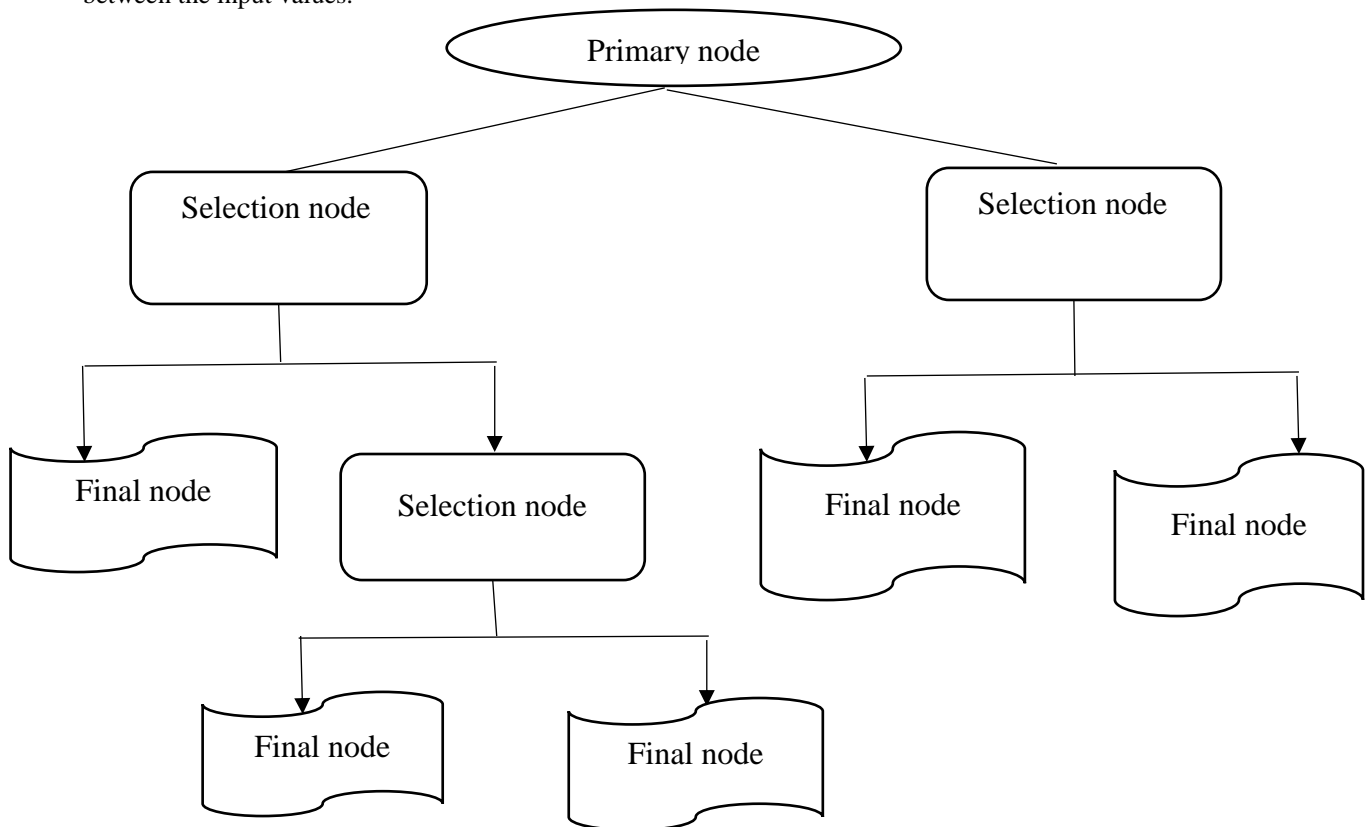


Figure 3. A representation of decision-making tree

In the most basic scenario, each test takes into account a single attribute, and the number of instances is divided based on the value of the property. When discussing numerical qualities, the term "condition" denotes an assortment. Every leaf has a class given to it that corresponds to the best target value [14]. A chance vector that represents the likelihood that the target property will have a specific number may be stored in the leaf. Using the results of tests carried out across the way, the instances are categorized by working their way down the tree from the root. Explains how to use the decision tree understandably. The qualities that each node evaluates are indicated, and the numerical values that correlate to those attributes are labeled on each of its branches.

This classifier allows the analyst to comprehend the behavioral traits of the full population of potential clients and anticipate the reaction of a subset of them. When it comes to statistical qualities, a decision tree can be statistically described as a grouping of hyperplanes that are all perpendicular to one another. Because simpler decision trees may be viewed as more complete, selection-makers tend to favor them. The model uses the amount of the attribute limit for organizing the information into an ordered split of the experimental dataset area. Until the leaf nodes have a certain number of fewer records that can be used for sorting, the information region is divided successively.

### 3.2.2 The naive Bayes method

Working based on the theorem of Bayes, it is ML-based each feature's likelihood of happening in each class is calculated, and the more probable class is returned. It operates entirely on the Bayesian theorem's statistical framework and is simple to set up. Because this requires nothing in the way of complicated repeated measurement of parameters, it may be used for enormous data sets. The simple classification methods presume that for each of the classification components, the significance of a given feature varies irrespective of the importance of any other attribute. We can determine the posterior probability.

$$P(B|C) = \frac{P(B|C) \times P(B)}{P(C)} \quad (1)$$

When accordingly, B and C stand for class and characteristics.

The likelihood of belonging to group B with all of the characteristics of category C is denoted by P (B/C). The expected value of all features, or P(C), is essentially what standardization is all about.

A broad statistical distribution with two values, P (m1, m2), will be examined. With the Bayes rule, we may obtain the equation without sacrificing specificity.

$$P(m1, m2) = P(m1, m2)P(m2) \quad (2)$$

Similarly, we obtain the remainder of the equations in the case when one has a different class factor, c.

$$P(m1, m2/c) = P(m1/m2, c) P(m2/c) \quad (3)$$

If two variables are added to the scenario to provide a conditional separation requirement

$$P(m/c) = \prod_{i=1}^N P(m/c) \quad (4)$$

Text categorization can be accomplished with the Naïve Bayes method. This technique performs efficiently for large amounts of data simply because it is based on elementary statistical theory. Determining each feature's likelihood is the primary goal of the Bayesian method. A representation of the Bayesian classification through a Bayesian network. An adequate vocabulary and effective apparatus to represent and handle independence assertions are required to successfully loosen this assumption. The Bayesian neural network is a popular sorting framework that is utilized in many different information extraction tasks. While learning it for proper grouping is one of the key research objectives, several practical information extraction operations additionally call for good probability prediction and ranking.

### 3.2.3 Techniques Integrating Neural Networks

These social media platforms are software systems that adopt the brain's neural network concept. It is not necessary to assemble these networks by task-specific rules; instead, these nodes are given instructions to carry out tasks by looking at examples. For example, while looking at photos, they identify cats by studying photos of photos that have been labeled as having cats or ones that don't, followed by utilizing the results to recognize cats in additional photos. Signals may be transmitted among neurons using any connection, such as synapses in the circulatory brain. An artificial neural network (ANN) gathers, processes, as well as distributes the signal to the associated neurons. Each neuron's output in an ANN application is determined by an exponential function of the total of its materials, whereas the signal to connect them (edges) is an actual integer.

A regularity that is suitable for the acquisition of the knowledge cycle is typically found in neurons and edges [15]. Adjusting the amount of mass within the link causes signal strength to increase or lessen. As soon as a combined signal passes the restriction in synapses can a message be conveyed. Floors usually refer to how neurons are arranging. Numerous adjustments are applied to the input via different levels. The symptoms go through several layers, until arriving at the last layer, which is referred to as the removal layer, about the initial section, which is referred to as the input layer. The ANN approach's primary goal was to solve issues similarly to the way human beings think. However, over time, emphasis became devoted to specific tasks, which caused it to depart from biology. Uses include websites, medicine, image and facial recognition, robot translation, and formerly categorized human services like painting.

These systems aim to mimic the function of neurons and, in turn, the brains of humans. The simulated cell in neural networks finds and assigns suitable numerical scales that, in turn, can predict some intended output by using specific input characteristics or variables. When a neural network is said to be extremely wide, it generally indicates that it contains an abundance of component interconnections throughout its invisible component. The latter were DL networks that perform best for more intricate data analysis, including picture analysis. As mentioned, nearly every piece integrating Network research uses a method known as transfer learning that allows the introduction of the proper instructional variables within an already trained Network that has been modified.

### 3.2.4 Regression Analysis Using Logistics

Identifying the connection among more than one independent variable alongside reliant data is possible using supervised AI techniques like extrapolation. The recurring results of the equation include forecasts, periodic analysis-based calculations for property and leasing expenses, and stature with maturity. For LR to function, an array of balanced elements must be extracted from the data being processed. Logging needs to be taken as well as combined monotonically, which implies that every component needs to be increased by weight after being included. LR is a discriminative classifier, whereas Bayes is a generative classifier. This is the primary distinction between the two methods.

A common trained learning approach in ML algorithms is LR. This approach uses a set of uncorrelated indicators to forecast the category factor. Therefore, the product of a LR must be an individual

or classification value, such as a positive or negative number, 0 as well as 1 as well as either positive or negative. The benefits of logistic regression include a simpler implementation process than other methods, a shorter training period, the ability to make multiple predictions—a process known as regression—and high accuracy if information is separated by lines. The link among the factors, which have to be a function of length, is shown equation 1.

$$x = \alpha_0 + \alpha_1 y_1 + \mu \quad (5)$$

LR is derived from regression analyses. The direct line's equation for mathematics is

$$x = a_0 + a_1 y_1 + a_2 y_2 + a_3 y_3 + \dots + a_n y_n \quad (6)$$

The expression in logarithm regression only considers  $x$  among zero and one.

$$\frac{x}{1-x}; 0 \text{ in light of } x = 0, \text{ as well as endless for } x = 1 \quad (7)$$

The formula is provided by

$$\log\left[\frac{x}{1-x}\right] = x = a_0 + a_1 y_1 + a_2 y_2 + a_3 y_3 + \dots + a_n y_n \quad (8)$$

Probabilistic collection, which is among the first and most basic active learning techniques, surprisingly does very well overall. One additional noteworthy discovery is that selection at random, the basic baseline to work with is not always swamped by individual situations. Multiple regression analysis methods are extended by LR to explore scenarios where the dependent variable is categorical. In real-world applications, scenarios with categorical results are not uncommon. Expectations for the variable consequence, for example, can be established when assessing a course of study.

#### 4. IMPLEMENTATION AND EXPERIMENTAL RESULTS

##### 4.1 Representation of the machine using support vectors

The practice of guided learning is applied to classification as well as regression. Figure 4 shows a stochastic is a linear technique that looks at hyperplanes to contain the greatest amount of points for extrapolation within them. Throughout this research, a stochastic is implemented as whereas quadratic and bases with radial bases are employed as kernel functions. By gradually translating input channels into an enormous feature space and using the collected data of many classes on a hyperplane for analysis or categorization, support vector linear models are used to construct natural class borders. Because the following requires dealing with continuous data to identify a mechanism for mapping that can be utilized for correctly predicting data.

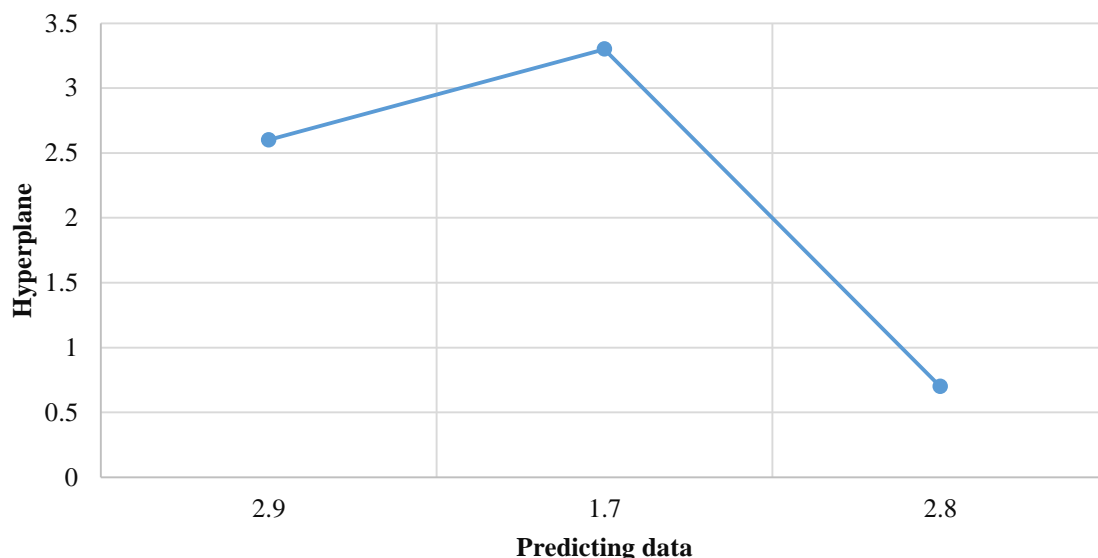


Figure 4. Algorithmic implementation utilizing support vector



Supervised neural networks are mostly used to aid in categorization; this includes identifying the plane that typically splits a collection of data into several subsets. The idea behind SVR is to add a nonlinear transformation operator that the data itself and produce understanding extremely complex, afterward carrying out LR. Since a stochastic is an SML, it requires labeled data to be trained; as a result, the data are categorized and divided into several groups. Following several training cycles, the algorithm attempts to distinguish between data. This method is frequently used to identify stolen credit cards it may also be trained to identify handwriting or categorize images. It is a popular tool for making predictions illustrating the stochastic fuzzy model's example.

Identifying correlations along with correlations connecting data is the purpose of a regression technique, which belongs to a class of classification algorithms. It depicts a mathematical interaction of a variable that is constant. To estimating a persistent target variable is the aim of logistic analysis; in contrast, classification involves recognizing identification from a finite collection. Following is a framework to supply a multiple regression with an ordered set of data factors Moreover, regression modeling is a type of controlled learning technique. In other words, we utilize data with tags to develop the model, and the model is then used for estimating labels on raw information. Figure 5 shows the graphic representation of the retreat.

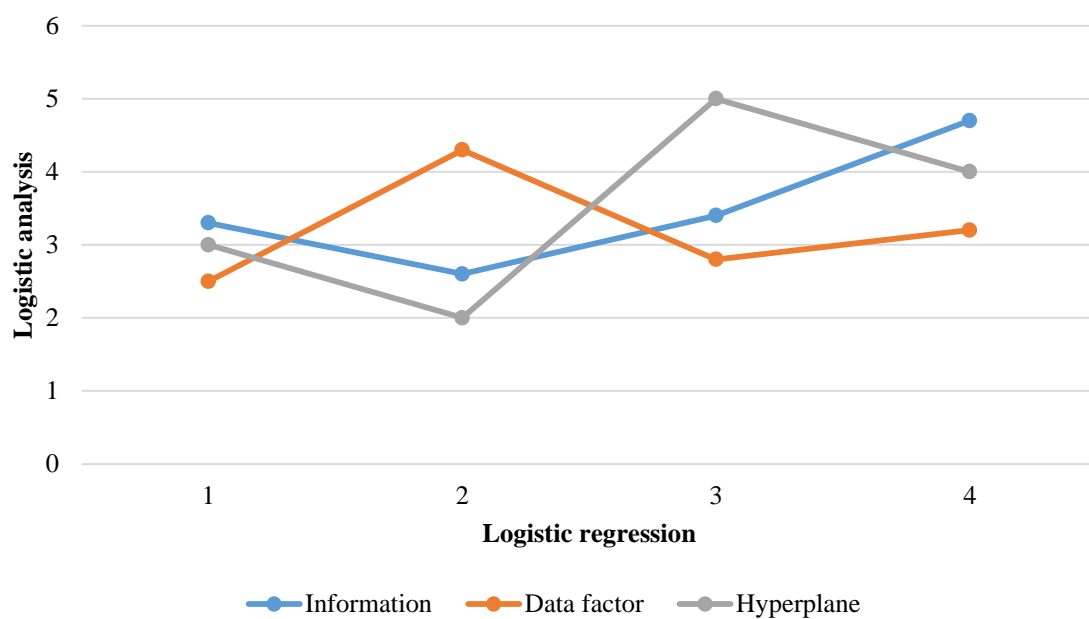


Figure 5. Graphic representation of the retreat

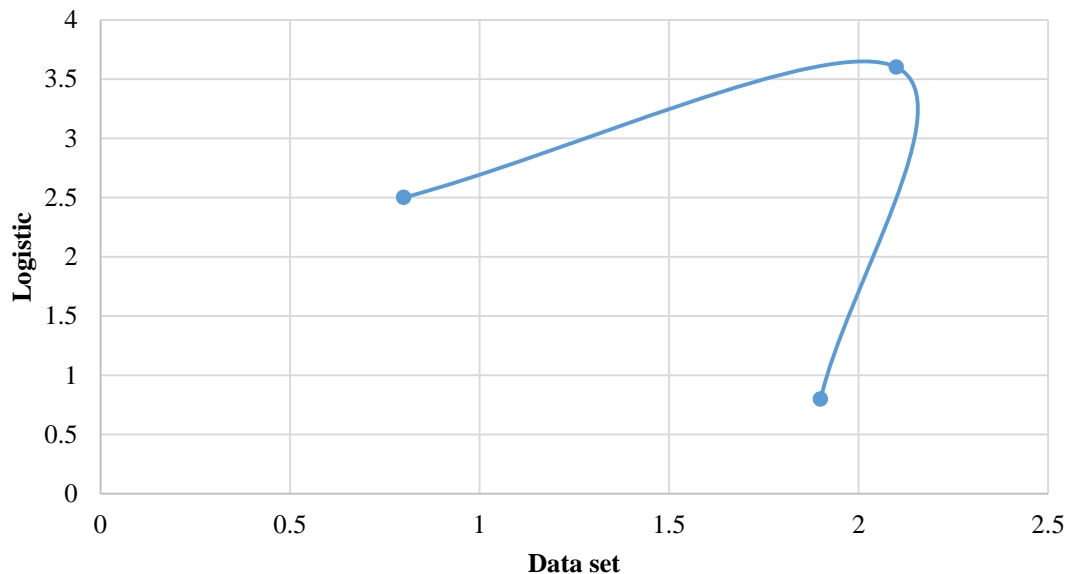


Figure 6. An illustration of the logistics component

Figure 6 depicts an illustration of the logistics component. The sigmoid function generates the numbers in the chart's assortment based on its special properties. AI will be used to identify the optimal logistic regression cost operation settings given a static dataset in order to ascertain the just for this expense function. The parameter is a method that, given the set of inputs and one specific value, calculates the logistic model's cost and slope in relation to an array that contains the  $x$  and  $y$  settings, as well as the initial values of the variables that need to be optimized. Using the final number, a selection barrier plot of the original data set will be produced.

## 5. CONCLUSION

SML techniques are being used in several fields. Discussing the advantages and disadvantages of any ML technique would be extremely challenging given the scope of this study. The assignment's structure is usually the most important determinant in approach decisions in AI. Despite of offering information indicating the ability to predict throughout the procedure of training, individuals need to provide input as well as results for supervised methods. According to the paper's discussion, among the most often used ML methodologies is supervised development. Current data annotation makes it possible to establish better parameters during model optimization, which makes the employed procedures much more effective than uncontrolled ones.

Current data annotation makes it possible to establish better parameters during model optimization, which makes the employed procedures much more effective than uncontrolled ones. An extensive collection of procedures that remain continually refined by data analysts make up the guided learning approaches. In this investigation, a few algorithms for supervision are briefly described. The ML procedure is explained in simple terms. Additionally, this study outlines the fundamental architecture of several distinct ML systems. The material also describes the primary construction underlying several different ML systems. The main framework supporting multiple ML techniques has been clarified in the content. The evolution of controlled learning techniques and their calculations evolves immediately, which withdraws from lots of room for labor and improvement among their creators.

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