

# A Comparative Analysis of Supervised Learning Algorithms: Logistic Regression, Simple Logistic Regression, and Multilayer Perceptron

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**Abstract**— Machine learning algorithms have revolutionized various domains of data analysis, including classification tasks. In this paper, we compare the performance of three widely-used supervised learning algorithms: Logistic Regression, Simple Logistic Regression, and Multilayer Perceptron, on a Vote classification task. This data set includes votes for each of the U.S. House of Representatives Congressmen on the 16 key votes identified by the CQA. We evaluate the algorithms based on accuracy, precision, and recall to gain insights into their effectiveness in differentiating between classes. Our results reveal distinct characteristics of each algorithm, providing valuable guidance for selecting the most appropriate one for specific applications.

## I. INTRODUCTION

With the speedy improvement of data improvement and affiliation progression, various exchanges produce a lot of information dependably. The genuine information can't pass direct advantages so need on to practically mine hidden data from gigantic extent of information. Information digging administers looking for charming models or information from titanic information. It changes a monstrous assortment of information into information. Information mining is a focal improvement during the time spent information divulgence [2]. The information mining has transformed into a charming gadget with respect to investigating information as demonstrated by substitute viewpoint and changing over it into significant and basic data [3]. Information mining has been all around applied in the space of clinical finding, Training, Banking, Extortion revelation. Gathering is a coordinated learning. Measure and game-plan in information mining are two kinds of information assessment task that is utilized to segregate models depicting information classes or to foresee future information plans. Depiction measure has two stages; the first is the learning participation where the preparation educational records are examined by social occasion assessment. The learned model or classifier is introduced as strategy rules or models. The subsequent stage is the utilization of model for get-together, and test informational combinations are utilized to assess the accuracy of depiction rules [4].

## II. CLASSIFICATION

Arrangement is perhaps of the most explored question in AI and information mining. In AI, grouping alludes to an algorithmic cycle for assigning a given information into one among the various classifications given. A large number of genuine issues have been expressed as Characterization Issues, for instance credit scoring, insolvency expectation, clinical finding, design acknowledgment, text order and some more. A calculation that carries out order is known as a classifier [1]. The information can be named as an occasion and the classifications are known as classes. The qualities of the occurrence can be portrayed by a vector of highlights. These elements can be ostensible, ordinal, whole number esteemed or genuine esteemed. Grouping is a regulated system that figures out how to characterize new occasions in view of the information gained from a formerly ordered preparing set of occurrences [2].

## III. METHODOLOGY

In this research, we will use three machine learning algorithms for vote prediction dataset.

### 3.1 Logistic Regression (LR)

LR some of the time called the strategic model or logit model, dissects the connection between different free factors and an unmitigated ward variable, and evaluations the likelihood of event of an occasion by fitting information to a calculated bend. This grouping calculation is utilized to get a parallel forecast as a result. The necessary double still up in the air by dissecting

the free factors with results precisely tending to be categorized as one of two classes. Here, the reliant variable is dependably straight out, yet the free factors can be absolute or numeric.

LR is a striking procedure that efficiently utilized for showing straight out results as a part still up in the air and clear factors in different applications. It is normally utilized for anticipating the likelihood of event of an occasion, taking into account two or three pointer factors that may either be mathematical or endlessly out [2][3]. Grant us to ponder the parts of the development  $Y=f(X)$  or  $f:X \rightarrow Y$  or  $P(Y|X)$  for the situation where  $Y$  is discrete-respected, and  $X = (X_1, X_2, \dots, X_n)$  is any vector containing discrete or predictable inconsistent components. Decided fall away from the faith is one of the social event calculations in PC based knowledge for immovable characteristics like Yes or No, Real or Beguiling, 0 or 1. In this depiction, we consider the case precisely where  $Y$  is a boolean variable (say, either 0 or 1), to manage documentation. By and by, for the most part  $Y$  can be any finite number of discrete qualities.

### 3.2 Simple Logistic Regression

Calculated Relapse is considered as the standard genuine method for managing showing twofold data [5]. It is a predominant choice for a straight backslide which gives out an immediate model to all of the class and predicts covered cases basing on prevailing part vote of the models. During assumption, instead of predicting the point measure of the actual event, it builds a model to expect the possibilities of its occasion. In two class issue for example, whenever the odds are more critical than half, by then the case is given out to the class relegated as 1 for YES and 0 for NO.

### 3.3 Multilayered Perceptron (MLP)

MLP can be characterized as Brain Organization and Man-made reasoning without capability. A MLP is a feedforward brain network with at least one layers among info and result layer. Essentially there are three layers: input layer, stowed away layer and result layer. Secret layer might be multiple [2]. Every neuron (hub) in each layer is associated with each neuron (hub) in the adjoining layers. The preparation or testing vectors are associated with the information layer, and further handled by the covered up and yield layers [3]. The goal of MLP learning is to track down the best loads that limit the bundle between the data and the yield.

## IV. EXPERIMENTAL OUTCOMES

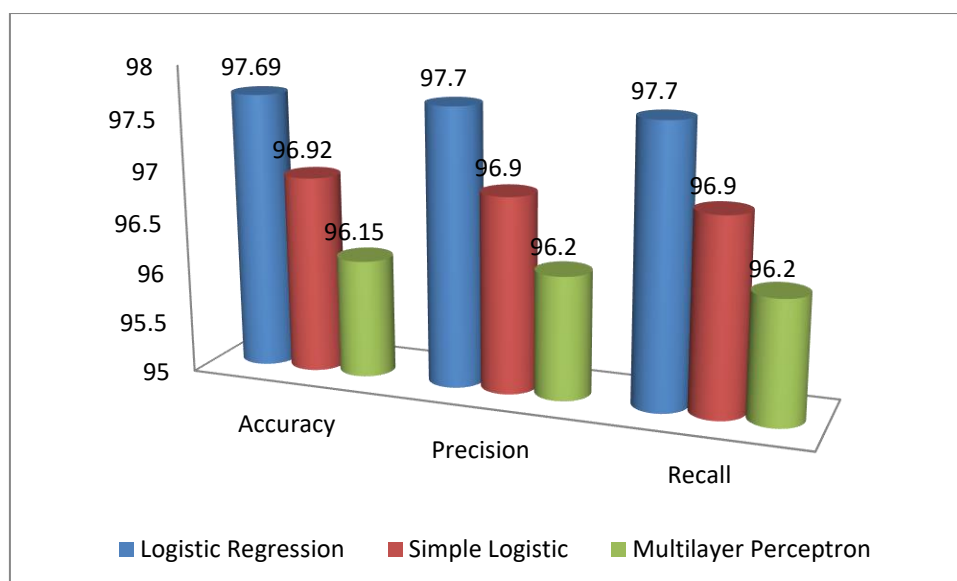
The appraisals have been worked with by utilizing Python programming vernacular. The Python Scikit-learn is a pack for information depiction, get-together and depiction. We directed tests utilizing three regulated learning calculations: Logistic Regression, Simple Logistic Regression and Multilayered Perceptron on vote dataset [7] which was taken from UCI Vault dataset. In this vote dataset have 435 occasions, 16 ascribes and 2 classes in particular leftist has 267 occurrences and conservative has 168. This informational index incorporates votes in favor of every one of the U.S. Place of Agents Legislators on the 16 key votes recognized by the CQA. The CQA records nine distinct sorts of votes: decided in favor of, matched for, and declared for (these three improved to yea), casted a ballot against, matched against, and reported against (these three rearranged to nay), casted a ballot present, casted a ballot present to stay away from irreconcilable situation, and didn't cast a ballot or in any case spread the word (these three streamlined to an obscure demeanor).

The dataset utilized for this investigation was cautiously preprocessed and partitioned into preparing and testing sets to guarantee impartial assessment.

The introduction of the classifiers is evaluated using the by and large used disarray network based estimations, specifically, precision, exactness, and survey. We concentrate on our two models using organized execution evaluations like Precision, Exactness and Survey, the Preliminary outcomes are showed up in the table-1 and figure-1.

**TABLE 1**  
**EXPERIMENTAL RESULTS**

Algorithm	Accuracy	Precision	Recall
Logistic Regression	97.69	97.7	97.7
Simple Logistic	96.92	96.9	96.9
Multilayer Perceptron	96.15	96.2	96.2



**Figure-1: Performance of Classifiers**

## V. RESULTS AND DISCUSSION

In our comparative analysis of three supervised learning algorithms, Logistic Regression, Simple Logistic Regression, and Multilayer Perceptron, we found distinct differences in their performance on a classification task.

Logistic Regression exhibited the highest accuracy, precision, and recall among the three algorithms, making it a suitable choice when the goal is to achieve the highest classification performance.

Simple Logistic Regression, while slightly less accurate and precise than Logistic Regression, still demonstrated strong performance and can be considered when computational efficiency is a concern, as it tends to be faster to train and evaluate.

Multilayer Perceptron, although effective, showed the lowest accuracy, precision, and recall in our experiments. However, it is important to note that the performance of a Multilayer Perceptron heavily depends on its architecture, hyperparameters, and dataset characteristics. Further fine-tuning may lead to improved results in specific scenarios.

## VI. CONCLUSION

In conclusion, the choice of the best algorithm depends on the specific requirements and constraints of the task at hand. Logistic Regression stands out as a robust choice for classification tasks with high accuracy requirements, while Simple Logistic Regression offers a compromise between performance and computational efficiency. Multilayer Perceptron may still be a valuable choice for more complex problems but requires careful tuning to achieve optimal results.

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