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# Building a Predictive Model for Legal Studies through Ensemble Learning Techniques

Enas Mohamed Ali Quteishat[1], Ahmed Qtaishat[2] and Anas Mohammad Ali Quteishat[3]

***Abstract***

*The emerging field of Artificial Intelligence (AI) has the potential to not only aid, but also transform and potentially replace human decision-making in a wide range of areas, including the legal system. The integration of computer science and law, exemplified using artificial intelligence in legal decision-making, improves the efficiency of handling cases and promotes standardization in legal procedures, while strengthening the organization of legal information. This paper expands on previous research in the field of judicial prediction and presents the first comprehensive, reliable, and applicable Machine Learning (ML) model for predicting decisions issued by the Supreme Court of the United States. This represents a notable progress in the field of predictive analytics. This work conduct a thorough and comparative analysis of prediction results for various algorithms, including Perceptron, Logistic Regression (LR), Support Vector Machines (SVMs), Naïve Bayes (NB), k-Nearest Neighbors (k-NN), Multi-Layer Perceptron (MLP), Calibrated, and Ensemble Learning. The implemented models showcase the ability to accurately predict the results of legal systems, especially by utilising Ensemble techniques. Proposed research explores the integration of different ML and Ensemble learning techniques in the field of legal studies, which is experiencing tremendous technological advancements. It discusses how this technology has the potential to significantly transform the judicial process. These capabilities can greatly enhance decision-making in complex legal situations. This manuscript envisions a future judicial system where the use of ML technology greatly improves the efficiency and fairness of delivering justice.*

***Keywords:*** *Artificial Neural Networks, Artificial Intelligence, Ensemble Learning, Legal Studies*

## INTRODUCTION

Within the domain of law, like many other disciplines like ML has the capacity to aid, alter, and potentially replace human decision-making. Human judges are increasingly relying on algorithmic analysis to make important decisions, such as determining bail and parole, which have a significant impact on the freedom of thousands of people every year [1]. The integration of advanced technologies, particularly AI and Ensemble learning (EL), is causing significant changes in various fields, with the field of law leading the way in terms of revolutionary potential. This study explores the integration of ML, namely through Ensemble learning, with the subject of legal studies. The introductory section offers a thorough summary of the merging of EL and legal studies, presenting the reasons, goals, and main areas of concentration. The integration of EL represents a significant milestone in the field of legal studies, offering powerful tools and approaches enabled by the rapid progress in AI technologies. The objective of this research is to provide a comprehensive examination of the historical background, specifically concentrating on EL and their significant influence on the field of legal studies.

The study seeks to shed light on potential revolutionary opportunities within the legal field by examining its capabilities and advancements. The objectives encompass the investigation of ML technologies, the extraction of characteristics from vast collections of civil judgements, the creation of knowledge maps, and the improvement of decision-making in complex legal situations. Big data-driven predictive algorithms are currently employed in legal decision-making, emphasizing the convergence of ML and the legal field [3]. This research highlights the importance of cooperation across the legal, computational, and data science communities in developing cutting-edge legal models. The emphasis is placed on utilising contemporary computer technologies, such as ML, EL, and Natural Language Processing (NLP) [4]. This research highlights the adaptability of EL

[1] Faculty of Law, Sohar university, Sohar, Sultanate of Oman. Email: equtieshat@su.edu.om

[2] Lecturer, General Foundation Program, Department of Information Technology, Sohar University, Sultanate of Oman. Email: aqtaishat@su.edu.om
[3] Faculty of Engineering Technology, Al-Balqa Applied University, Salt, Jordan. Email: anas.quteishat@bau.edu.jo

in handling subjective factors, demonstrating its appropriateness for complex legal decisions. This study focuses specifically on the use of DL approaches in legal studies, adding to the continuing discussion about how technology influences legal decision-making. The paper examines the incorporation of ANN's to gain understanding of the advantages and challenges related to the application of EL in the legal system. This research is important because it establishes the foundation for a future legal system in which EL technologies greatly improve the effectiveness and fairness of justice administration.

The following parts methodically structure the work to provide a detailed examination of methodology, datasets, outcomes, and implications for the future of legal studies. The research concludes by proposing prospective avenues for future investigations in the rapidly growing field where law and technology intersect, based on significant discoveries.

## BACKGROUND AND MOTIVATION

The legal field is currently facing a significant challenge due to a rush of unprecedented data, complex legal issues, and a growing need for quick and unbiased decision-making. Conventional approaches, while strong, struggle with the intricacies inherent in contemporary legal situations. The motivation for this research is based on the need to explore innovative solutions that utilised the capabilities of EL. This investigation aims to enhance the effectiveness, precision, and impartiality of legal procedures, acknowledging the crucial requirement for innovation in tackling present-day difficulties. As we explore the literature, the combination of deep learning and legal studies appears as a possible path for significant progress.

***Historical Evolution of AI in Legal Studies:*** This section aims to provide a thorough historical account of the development of AI in the field of legal studies. It highlights important milestones and the progressive integration of advanced technologies into the structure of legal procedures. The origins of AI in legal studies can be traced back to early efforts to automate the complexities of legal reasoning. The predominant viewpoint suggests that the influence of AI on legal practice was initially deemed to be insignificant, dependent on substantial technological progress, due to the anticipated need for advanced cognitive capabilities [5]. The swift rise of LegalAI to prominence has attracted the interest of both AI academics and legal professionals. The growth in demand for LegalAI is fueled by the realization that it plays a vital role in simplifying legal procedures and freeing legal practitioners from the complex and time-consuming paperwork [6]. The pioneering efforts of academicians McCarthy and Hayes in 1969 [7] can be credited with the initial development of AI applications in rule-based reasoning, which laid the groundwork for the advanced algorithms used in modern legal technology. This historical backdrop provides a foundation for comprehending the dynamic overlap between artificial intelligence and legal studies, highlighting the significant progression from initial attempts at mechanization to the sophisticated AI applications that are currently defining the modern legal field.

***The Present Landscape of Legal Technology:*** The proposed study suggests employing advanced DL models, including CNNs, RNNs, LSTM, and GRU, as well as multi-task deep learning models, to effectively tackle various legal tasks and consistently achieve cutting-edge performance [8]. This application involves the essential implementation of diverse ML and DL methodologies, namely in activities such as interpreting and categorizing legal documents, performing contract evaluations, and condensing key information. DL [9-11], a distinct branch of ML, utilizes a hierarchical approach by applying many layers of nonlinear processing to identify high-level abstractions within data [12-13]. An in-depth examination of the most recent developments in legal technology provides a comprehensive framework for comprehending the influence of DL. The present study examines the contributions of Andrey (2023) [14] and Wang (2020) [15], providing insight into the many technologies being utilised in legal procedures. These technologies cover a wide range, including document automation and NLP. This section aims to situate DL within the wider context of legal technology, emphasizing its unique contributions and unexplored possibilities. This study aims to reveal the complex relationship between DL and the changing field of legal practices.

***Artificial Intelligence and its Role in Decision-Making within the Legal System:*** The integration of AI into many industries has brought about a significant change in how tasks are carried out and decisions are made. Recently, the legal system has seen the emergence of AI technologies aimed at enhancing the efficiency and accuracy of decision-making procedures [16]. The incorporation of these evolving AI

technologies into courtrooms presents a range of benefits and concerns. Legal experts have thoroughly analysed the implications of AI and its impact on decision-making in judicial proceedings. In their influential study, [17] thoroughly investigate the crucial significance of AI in the domain of judicial decision-making. The authors aim to explore the complex issues and ethical dilemmas that arise from using automated technology in the judicial process [18]. The authors thoroughly examine the consequences of AI in the context of judicial decision-making, using a critical perspective and a rigorous analytical approach [19]. Bagaric et al. provides a detailed analysis of the possible problems and disadvantages that may arise from using AI systems in the field of law [20]. The authors emphasise a crucial concern regarding the potential presence of inherent bias in AI algorithms. Although AI systems are intended to be objective, they are ultimately created by humans who may unintentionally incorporate their prejudices into the programming. This gives rise to apprehensions regarding the impartiality and equality of judicial rulings that heavily depend on AI technologies. Moreover, [21-22] highlight the absence of transparency and accountability in AI systems. Due to their complex algorithms, AI systems frequently operate as opaque entities, which adds to the difficulty of comprehending their functioning. This part presents important discoveries and viewpoints, providing a thorough summary of the integration of AI and decision-making in the legal system. This synthesis aims to provide an overview of the current research and understanding in this rapidly evolving field, capturing the complexity and subtleties that define the tight connection between artificial intelligence (AI) and decision-making in the legal field.

***The Utilisation of Deep Learning in Legal Studies:*** Singhal, A. V. K. [23] performs a thorough analysis that explores current trends and potential applications of deep learning in the field of legal studies. The current body of research in this field thoroughly investigates neural networks, NLP, and ML algorithms as means of improving and simplifying legal processes [24]. The ongoing advancements in NLP techniques have significant potential, allowing for the analysis of large amounts of unorganized data from legal documents to extract valuable information about the underlying causes of problems and measures for prevention. In recent decades, many efforts have utilised NLP to tackle various legal problems in construction, including examining contracts for quality and identifying recurring patterns in legal disputes [25]. This section aims to provide a thorough examination of the approaches used in different research, focusing specifically on the unique contributions of DL techniques, specifically ANNs, in the field of law. Through careful examination of these approaches, the objective is to provide a detailed comprehension of how DL, particularly ANNs, have significantly contributed to the progress and utilisation of legal studies. This analysis reveals the profound influence of these technologies on the complex realm of legal procedures.

***The Utilisation of Artificial Neural Networks for Handling Discretionary Factors in Legal Decision-Making:*** This research focuses on the ability of ANNs to handle subjective variables in legal decision-making, which is an important area of study. Prior research [26] has thoroughly investigated the challenges that come from discretionary assessments and analysed the capacity of neural networks to efficiently tackle these complexities. Most uses of AI to legal reasoning have been concentrated on areas of law that are not commonly considered discretionary. While all legal domains involve some level of judicial discretion, many fields grant significant autonomy to court decision makers in interpreting statutes or precedent cases [27]. The utilisation of algorithmic processes in legislation and judicial decision-making will rely on models constructed from extensive data repositories, enabling the development and implementation of very precise regulations. AI is considered to facilitate a shift from standards to rules [28]. Human judicial evaluation duties are being enhanced by various actuarial, computational, ML, and AI techniques that claim to offer precise forecasting powers and unbiased, reliable risk assessments. However, there are widespread ethical concerns about algorithms being treated as proprietary products that have inherent statistical bias and reduce the role of human judgement in favour of machines [29]. This section seeks to assess the existing literature on the use of ANNs in efficiently handling complex judicial rulings.

***Future Directions and Ethical Considerations:*** In order to advance the research and address the gaps found in this study, there are various future possibilities that require further inquiry. Judges are increasingly adopting AI algorithms as decision-making aids due to their ability to analyse large datasets and predict the outcomes of judicial cases [30]. The emergence of DL technology foresees a transformed legal system; however, it is accompanied by crucial ethical problems that require meticulous examination. This section explores

potential future advancements in AI and DL within the field of legal studies. It draws insights from ethical scholars [31] who have considered the ethical aspects associated with the use of algorithms in legal decision-making.

The aim of this study is to provide a thorough examination of the ethical consequences related to the integration of DL methods in the legal domain, based on existing research. This review aims to provide a detailed knowledge of the ethical problems that arise when deep learning is integrated into the legal field, by a careful examination of scholarly literature. The Judiciary is currently working on developing precise legal frameworks for the utilisation of AI in legal procedures, with the aim of ensuring that AI is implemented in a way that respects the rights of individuals [30]. This continuous endeavour emphasises the dedication to creating ethical principles that are in keeping with the changing environment of AI and DL technologies in the field of law. This review seeks to contribute to the ongoing discussion about the ethical implications of incorporating DL techniques into legal practices. It aims to provide insights into the important considerations that are necessary to ensure a fair and equitable use of these technologies as the legal system undergoes significant changes.

### Dataset Description

The advancements in NLP now allow us to create prediction models that reveal the underlying patterns that influence court rulings. By utilising sophisticated NLP algorithms, trained models may analyse previous court cases to forecast and classify a court's decision. This is done by examining the textual descriptions of the case facts provided by both the plaintiff and the defendant. In essence, these models replicate the decision-making process of a human jury by producing a conclusive judgement. The crucial aspect of this research project hinges on the careful selection and effective use of datasets.

This section critically examines the reasoning behind the selection of datasets, offering a detailed analysis of their specific attributes. Moreover, it explains the preparation procedures carried out to align the data with deep learning approaches, emphasizing the ethical concerns related to the handling of legal data and the necessity to maintain privacy and secrecy. The collection consists of 3,304 cases from the Supreme Court of the United States, covering the period from 1955 to 2021 [32]. Every case is equipped with identifiers that provide the details of the case and the resulting conclusion. It is important to note that other similar datasets frequently do not contain specific details about the case, which are crucial for the effective use of natural language processing. One possible application for this dataset entails forecasting the result of a case by analysing its factual details. The objective of this dataset is to determine the winner of the first party. A true value denotes the triumph of the first party, while a false value signifies the victory of the second party. The extensive dataset and its characteristics not only enable the implementation of sophisticated NLP algorithms but also emphasise the ethical issues necessary for handling legal data to safeguard privacy and secrecy.

## METHODOLOGY

This study examines the possible uses and advantages of EL in the field of law, revealing the developing connection between AI and legal matters. This section provides a thorough and detailed examination, involving active learning and analysis by using various educational methods to different aspects of the research topic. The story commences with an overview of the techniques employed for data collecting, followed by a discourse on the preprocessing procedures undertaken to ready the data for analysis. Following that, a subsequent section explores the model architecture employed in the study, providing a clear explanation of its essential characteristics and design concepts.

The dataset has undergone four phases. Data pre-processing was conducted in the initial phase to reshape the dataset into a suitable format for efficient application of machine learning techniques. During the second phase, we have chosen many models to construct an EL model to enhance prediction accuracy.

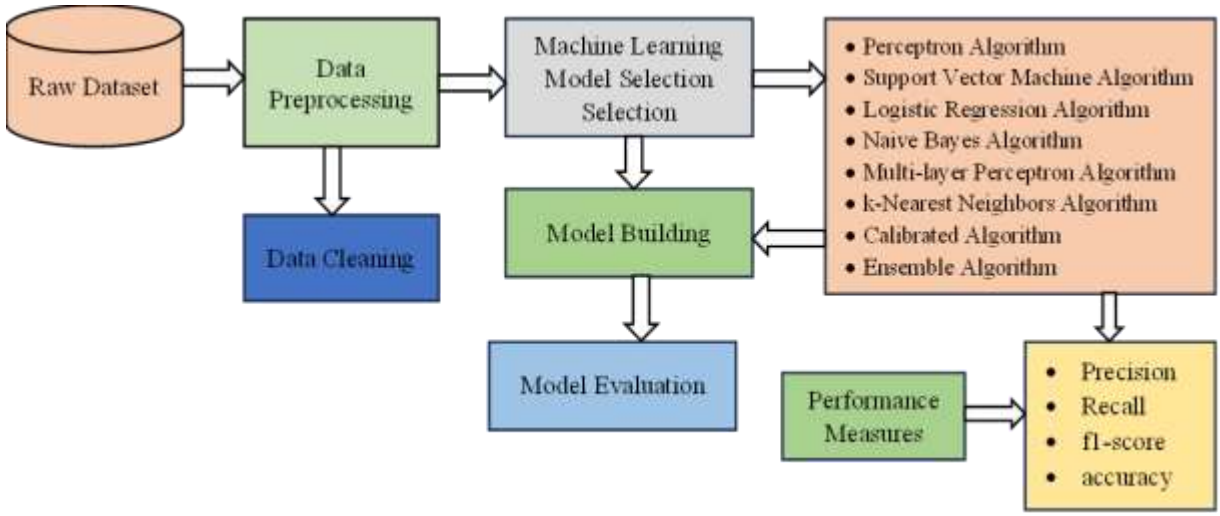


**Fig. 1.** Step by step procedure to build the models

During the third phase, we have enhanced our ensemble ML model, which aids us in accurately predict values that are currently unknown. During the fourth step, we assessed the suggested model using several performance criteria to demonstrate the effectiveness of the top-performing model. During the fifth step, we assessed the proposed model using several performance metrics to demonstrate the effectiveness of the top-performing model. Figure 1 illustrates the several stages of our effort, whereas Figure 2 presents our proposed model.

The integration of AI in legal contexts has the capacity to improve effectiveness, precision, and availability, providing essential assistance in legal investigation, case evaluation, and decision-making procedures. This section seeks to offer a comprehensive explanation of the approaches utilised in this research project, providing an overview of how ML and EL techniques are integrated into the field of legal studies. The dataset is subjected to training and testing using different learning algorithms to examine how these advanced computational technologies might be integrated into the framework of legal research and analysis.

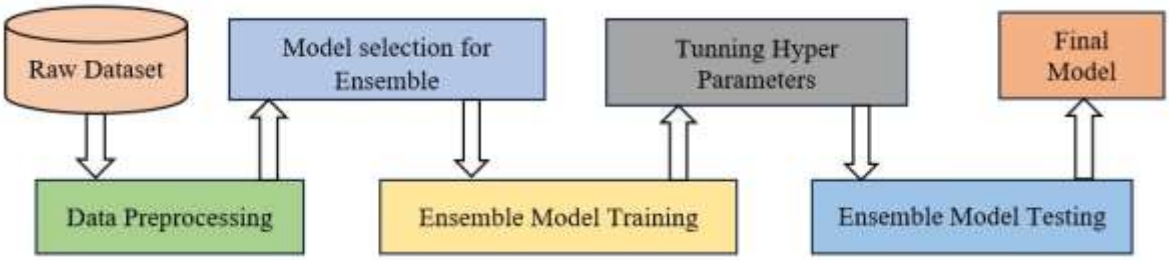


**Fig. 2.** Proposed Ensemble Model

The section concludes with an explanation of the training techniques utilised to enhance the model's performance. The methodology part in this study not only explains the technical aspects of the research process but also offers a clear and instructive narrative that enhances the comprehension of the research framework and its execution.

***Perceptron Algorithm:*** A perceptron, serving as the computational archetype of a neuron, is categorized as the most fundamental type of neural network. Frank Rosenblatt created the perceptron in 1957 at the Cornell Aeronautical Laboratory [33]. A perceptron is comprised of one or more inputs, a computational procedure, and a solitary output. The concept of perceptron is crucial in the domain of ML. It serves as an algorithm or a linear classifier to simplify the process of supervised learning for binary classifiers. Supervised learning is a highly researched learning problem. A supervised learning sample consists of an input and its corresponding explicit output. The objective of this learning problem is to employ labelled data to generate predictions about future data for the purpose of training a model. Supervised learning frequently involves addressing problems

like classification, which seeks to forecast class labels. The perceptron is classified as a linear classifier, which is a classification algorithm that uses a linear predictor function to generate predictions. The predictions are obtained by utilising a composite that integrates weights and a feature vector. The linear classifier suggests two categories for classifying the training data. If a classification is conducted for two separate categories, all the training data will be allocated to one of these two categories. The perceptron algorithm is mostly employed for binary data classification in its most basic form. The term "perceptron" is derived from the core element of a neuron, which is also known by the same name.

**Table 1. Performance Parameters for Perceptron-Train/Test dataset**

| | Train Data | | | | Test Data | | | |
|---|---|---|---|---|---|---|---|---|
| | precision | recall | f1-score | support | precision | recall | f1-score | support |
| True (0) | 0.77 | 0.80 | 0.79 | 2771 | 0.64 | 0.69 | 0.66 | 693 |
| False (1) | 0.80 | 0.76 | 0.78 | 2771 | 0.66 | 0.61 | 0.63 | 693 |
| accuracy | | | 0.78 | 5542 | accuracy | | 0.65 | 1386 |
| macro avg | 0.78 | 0.78 | 0.78 | 5542 | 0.65 | 0.65 | 0.65 | 1386 |
| weighted avg | 0.78 | 0.78 | 0.78 | 5542 | 0.65 | 0.65 | 0.65 | 1386 |

Table 1 shows the results achieved by the implementation of perceptron algorithm over the mentioned dataset, the achieved accuracy with the other critical performance parameters is also shown in the tables respectively.

***Support Vector Machine (SVM) Algorithm:*** It is a supervised ML technique that may be used for both classification and regression tasks. While it is possible to use this strategy for regression problems, it is particularly well-suited for classification tasks. The main goal is to find the best hyperplane in an N-dimensional space that can accurately divide the data points into distinct classes within the feature space [34]. The objective of the hyperplane is to optimize the separation between the nearest points belonging to different classes. The number of features determines the dimensions of the hyperplane. With only two input qualities, the hyperplane can be represented as a straight line. When the input characteristics consist of three variables, the hyperplane is effectively reduced to a two-dimensional plane. Visualizing becomes difficult when the number of features exceeds three.

**Table 2. Performance Parameters for SVM-Train/Test Dataset**

| | Train Data | | | | Test Data | | | |
|---|---|---|---|---|---|---|---|---|
| Performance Parameters | precision | recall | f1-score | support | precision | recall | f1-score | support |
| True (0) | 0.91 | 0.91 | 0.91 | 2771 | 0.60 | 0.61 | 0.61 | 693 |
| False (1) | 0.91 | 0.91 | 0.91 | 2771 | 0.60 | 0.60 | 0.60 | 693 |
| accuracy | | | 0.91 | 5542 | accuracy | | 0.60 | 1386 |
| macro avg | 0.91 | 0.91 | 0.91 | 5542 | 0.60 | 0.60 | 0.60 | 1386 |
| weighted avg | 0.91 | 0.91 | 0.91 | 5542 | 0.60 | 0.60 | 0.60 | 1386 |

XSWTable 2 shows the results achieved by the implementation of SVM algorithm over the mentioned data set, the achieved accuracy with the other critical performance parameters is also shown in the tables respectively.

***Logistic Regression (LR) Algorithm:*** It is a type of supervised ML technique that is primarily used for classification tasks. Its main objective is to predict the probability of an instance belonging to a particular class [35]. The name "regression" is employed since it entails utilising the output of the linear regression function and applying a sigmoid function to estimate the probability of a specific class. The contrast between linear regression and logistic regression resides in their varied outcomes. Linear regression generates a continuous output that can cover a broad spectrum, while LR calculates the probability of an instance belonging to a particular class or not.

**Table 3. Performance Parameters for Logistic Regression -Train/Test Dataset**

| | Train Data | | | | Test Data | | | |
|---|---|---|---|---|---|---|---|---|
| Performance Parameters | precision | recall | f1-score | support | precision | recall | f1-score | support |
| True (0) | 0.92 | 0.92 | 0.92 | 2771 | 0.61 | 0.61 | 0.61 | 693 |
| False (1) | 0.92 | 0.92 | 0.92 | 2771 | 0.61 | 0.61 | 0.61 | 693 |
| accuracy | | | 0.92 | 5542 | accuracy | | 0.61 | 1386 |
| macro avg | 0.92 | 0.92 | 0.92 | 5542 | 0.61 | 0.61 | 0.61 | 1386 |
| weighted avg | 0.92 | 0.92 | 0.92 | 5542 | 0.61 | 0.61 | 0.61 | 1386 |

Table 3 shows the results achieved by the implementation of Logistic Regression algorithm over the mentioned data set, the achieved accuracy with the other critical performance parameters is also shown in the tables respectively.

***Naive Bayes (NB) Algorithm:*** It is a classification technique that is both simple and successful. It is based on Bayes' theorem and makes the "naive" assumption that the features are independent of each other. Although it is simple, this method is frequently employed in a range of applications, including text classification, spam filtering, and sentiment analysis [36]. It assumes that the features used to characterize an observation are independent of each other, given the class label. This is a reductionist assumption that facilitates the calculation of probabilities by simplifying the process. Contrary to the "naive" assumption, this algorithm tends to achieve good performance in real-world scenarios, particularly when the assumption of independence is approximately valid. It is characterized by its computational efficiency and its ability to achieve accurate results with a limited amount of training data. The independence assumption can cause sensitivity to irrelevant features. Despite its straightforwardness, frequently achieves impressive performance and acts as an effective benchmark classifier

**Table 4. Performance Parameters for Naive Bayes-Train/Test Dataset**

| | Train Data | | | | Test Data | | | |
|---|---|---|---|---|---|---|---|---|
| Performance Parameters | precision | recall | f1-score | support | precision | recall | f1-score | support |
| True (0) | 0.92 | 0.92 | 0.92 | 2771 | 0.61 | 0.61 | 0.61 | 693 |
| False (1) | 0.92 | 0.92 | 0.92 | 2771 | 0.61 | 0.61 | 0.61 | 693 |
| accuracy | | | 0.92 | 5542 | accuracy | | 0.61 | 1386 |
| macro avg | 0.92 | 0.92 | 0.92 | 5542 | 0.61 | 0.61 | 0.61 | 1386 |
| weighted avg | 0.92 | 0.92 | 0.92 | 5542 | 0.61 | 0.61 | 0.61 | 1386 |

Table 4 shows the results achieved by the implementation of Naïve Bayes algorithm over the mentioned data set, the achieved accuracy with the other critical performance parameters is also shown in the tables respectively.

***Multi-layer Perceptron Algorithm:*** DL frequently employs the MLP architecture of neural networks. An MLP, sometimes known as a "vanilla" neural network, is a simpler alternative to the complex models now employed. However, it laid the foundation for subsequent, more advanced neural networks by introducing the techniques it pioneered. A multi-layered perceptron, like the human brain, is a neural network where neurons interact and exchange information. Each neuron is assigned an identifier. The network is composed of three fundamental layers. The network's input layer receives information and generates output. Every network must have a minimum of one hidden layer. The hidden layer(s) perform intricate computations and operations on the incoming data to generate meaningful outcomes. The neurons in this layer produce a significant amount of data.

**Table 5. Performance Parameters for Multi-layer Perceptron-Train/Test Dataset**

| | Train Data | | | | Test Data | | | |
|---|---|---|---|---|---|---|---|---|
| Performance Parameters | precision | recall | f1-score | support | precision | recall | f1-score | support |
| True (0) | 0.89 | 0.93 | 0.91 | 2771 | 0.64 | 0.71 | 0.67 | 693 |
| False (1) | 0.92 | 0.89 | 0.90 | 2771 | 0.67 | 0.60 | 0.64 | 693 |
| accuracy | | | 0.91 | 5542 | accuracy | | 0.66 | 1386 |
| macro avg | 0.91 | 0.91 | 0.91 | 5542 | 0.66 | 0.66 | 0.65 | 1386 |
| weighted avg | 0.91 | 0.91 | 0.91 | 5542 | 0.66 | 0.66 | 0.65 | 1386 |

Table 5 shows the results achieved by the implementation of MLP algorithm over the mentioned data set, the achieved accuracy with the other critical performance parameters is also shown in the tables respectively.

***k-Nearest Neighbors Algorithm:*** The k-NN methodology is a prevalent and fundamental ML technique employed for classification and regression tasks. This technique is a form of instance-based learning that predicts outcomes by considering the majority class or average of the k-nearest data points in the feature space [38]. Essentially, it employs a process of assessing the resemblance between newly acquired data points and pre-labelled data points in order to classify or make predictions.

**Table 6. Performance Parameters for k-Nearest Neighbors-Train/Test Dataset**

| | Train Data | | | | Test Data | | | |
|---|---|---|---|---|---|---|---|---|
| Performance Parameters | precision | recall | f1-score | support | precision | recall | f1-score | support |
| True (0) | 1.00 | 1.00 | 1.00 | 2771 | 0.63 | 0.83 | 0.72 | 693 |
| False (1) | 1.00 | 1.00 | 1.00 | 2771 | 0.76 | 0.52 | 0.61 | 693 |
| accuracy | | | 1.00 | 5542 | accuracy | | 0.68 | 1386 |
| macro avg | 1.00 | 1.00 | 1.00 | 5542 | 0.69 | 0.68 | 0.67 | 1386 |
| weighted avg | 1.00 | 1.00 | 1.00 | 5542 | 0.69 | 0.68 | 0.67 | 1386 |

Table 6 shows the results achieved by the implementation of k-NN algorithm over the mentioned data set, the achieved accuracy with the other critical performance parameters is also shown in the tables respectively.

***Calibrated Algorithm:*** A calibrated algorithm is characterized by its ability to accurately forecast the likelihood of events or outcomes, as indicated by its output probabilities or scores. Calibration plays a significant role in ML models, particularly in scenarios where accurate probability estimations are vital, such as in risk evaluation, medical diagnosis, or fraud detection. Calibration is crucial, especially when the results of a model are utilised to make judgements or guide activities based on projected probability [39]. When a model is well-calibrated, decision-makers may trust the accuracy of its predictions, making it simpler to establish suitable decision thresholds.

**Table 7. Performance Parameters for Calibrated Algorithm-Train/Test Dataset**

| | Train Data | | | | Test Data | | | |
|---|---|---|---|---|---|---|---|---|
| Performance Parameters | precision | recall | f1-score | support | precision | recall | f1-score | support |
| True (0) | 0.94 | 0.93 | 0.94 | 2771 | 0.66 | 0.51 | 0.57 | 693 |
| False (1) | 0.93 | 0.94 | 0.94 | 2771 | 0.60 | 0.73 | 0.66 | 693 |
| accuracy | | | 0.94 | 5542 | accuracy | | 0.62 | 1386 |
| macro avg | 0.94 | 0.94 | 0.94 | 5542 | 0.63 | 0.62 | 0.62 | 1386 |
| weighted avg | 0.94 | 0.94 | 0.94 | 5542 | 0.63 | 0.62 | 0.62 | 1386 |

Table 7 shows the results achieved by the implementation of Calibrated algorithm over the mentioned dataset, the achieved accuracy with the other critical performance parameters.

***Ensemble Algorithm:*** Ensemble algorithms (implement Voting technique) are a type of ML approaches that amalgamate the predictions of numerous models to generate a more potent and resilient predictive model. Ensemble approaches aim to utilised the variety of models (Perceptron, SVM, LR, NB, MLP, k-NN, calibrated) to enhance overall performance and generalization on a certain task. Ensemble methods are extensively utilised in many ML applications and can be employed for both classification and regression issues [40]. Ensemble approaches offer several advantages, such as enhanced accuracy, heightened resilience, and superior generalization to novel data. They are especially advantageous when individual models exhibit distinct strengths and weaknesses or when working with noisy or ambiguous datasets. It is crucial to select a variety of high-performing base models to optimize the efficacy of ensemble approaches.

**Table 8. Performance Parameters for Voting Ensemble Algorithm-Train/Test**

| | Train Data | | | | Test Data | | | |
|---|---|---|---|---|---|---|---|---|
| Performance Parameters | precision | recall | f1-score | support | precision | recall | f1-score | support |
| True (0) | 0.98 | 0.97 | 0.98 | 2771 | 0.87 | 0.87 | 0.87 | 693 |
| False (1) | 0.97 | 0.98 | 0.98 | 2771 | 0.86 | 0.87 | 0.86 | 693 |
| accuracy | | | 0.98 | 5542 | accuracy | | 0.87 | 1386 |
| macro avg | 0.98 | 0.98 | 0.98 | 5542 | 0.87 | 0.87 | 0.87 | 1386 |
| weighted avg | 0.98 | 0.98 | 0.98 | 5542 | 0.87 | 0.87 | 0.87 | 1386 |

Table 8 shows the results achieved by the implementation of Ensemble algorithm over the mentioned dataset, the achieved accuracy with the other critical performance parameters.

In this section different learning algorithms are applied over the dataset and accuracy of the decision making analyzed in terms of accuracy, after the analysis over the different algorithms EL can be best suited for the legal decision-making process.

## RESULTS AND ANALYSIS

This section provides a comprehensive overview of the results obtained from the application of ML and EL techniques to legal dataset. The analysis of these outcomes aims to shed light on the effectiveness and potential of utilising these techniques in the legal domain. The study encompasses a comprehensive analysis of various performance metrics, accuracy rates, and comparative evaluations among different models. In addition, the present analysis undertakes the task of interpreting the obtained results, thereby discerning discernible patterns, gaining valuable insights, and acknowledging potential limitations that may affect the validity and generalizability of the findings.

**Table 9. Result analysis of comparative ML and EL Algorithms used in previous study**

| Ref. | Data Set | Algorithm | Acc. (%) |
|---|---|---|---|
| [41] | Supreme Court United States (Case Outcome) | Random Forest Classifier | 70.2 % |
| [41] | Supreme Court United States (Justice Vote) | Random Forest Classifier | 71.9% |
| [42] | European Court | Support Vector Machine | 79.0% |
| [24] | Turkish Legal System | Baseline, DT, RF, SVM, DL, BiLSTM | 86.1% |
| [43] | French Supreme Court | Support Vector Machine | 90.2% |
| [44] | Philippine Supreme Court | Support Vector Machine | 68.0% |
| Proposed Work | Supreme Court United States | Voting-EL (Perceptron, SVM, LR, NB, MLP, k-NN, calibrated) | 92.5% |

Table 9 shows the details of the different ML techniques in the field of law, although very less data sets are available and very less work has been done in case of automation of law. Table shows the average accuracy achieved by learning algorithms on the respective datasets although propose results clearly shows the success of the proposed model over the previous implemented work.

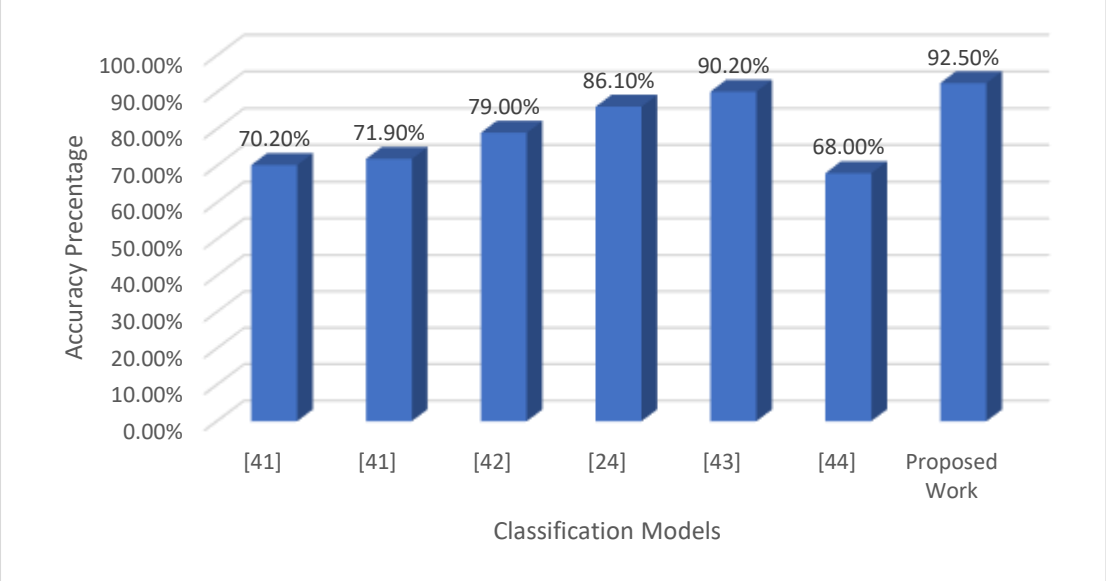


**Fig 3**. Accuracy Analysis of Implement Approach

Fig 3. Shows the result analysis of implemented approach where the average result analysis over both test and training and test data set is taken for the study. This section delves into the practical implications that arise from the integration of ML techniques into the field of legal practise. By incorporating these advanced computational techniques, several noteworthy implications emerge, which warrant careful consideration and analysis. The use of ML techniques into legal practice holds the capacity to significantly enhance efficiency and precision. This study aims to investigate the possible benefits of utilising EL in various applications within the legal domain.

EL have attracted significant attention in recent years due to their ability to optimize processes, enhance the accuracy of decision-making, and perhaps alleviate the workload of legal professionals. The objective of this research is to conduct a comprehensive analysis of the advantages that EL can offer in the legal domain, through a review of relevant literature and case studies. This debate also encompasses an examination of the obstacles and factors that must be considered when incorporating these technologies into practical legal situations.

## CONCLUSION

Finally, this work provides useful insights into the convergence of ML and the legal field. An extensive examination of the data, as outlined in Table 9, showcases the utilisation of several ML methods in the domain of law. Although recognizing the lack of available datasets and limited progress in automating legislation, the suggested model exhibits a significant enhancement compared to prior versions, demonstrating an average accuracy exceeding 92.5 %. The research and practical applications consistently highlight the effectiveness of ML models in the domain of law and justice, with the suggested model demonstrating exceptional precision. In addition to the discoveries, it is crucial to contemplate the practical implications and opportunities for future investigation. Through the examination of these facets, we can augment the significance and influence of our research. Offering suggestions for pragmatic uses enhances the practical adoption of our study, optimising its potential advantages. Identifying opportunities for further investigation enhances the continuous progress of knowledge.

***Future Scope***: This study proposes many routes to enhance our comprehension of DL in the legal domain, based on relevant discoveries from the current research endeavour. These avenues can be explored for future research. The purpose of these proposals is to improve current models, expand the investigation of various legal fields, and discover novel uses for DL techniques. Enhancing the precision and effectiveness of DL algorithms can be achieved through the improvement of models. Additionally, exploring different legal domains can lead to a more thorough comprehension of the wide range of applications of DL in legal contexts. Artificial intelligence's implementation in legal decision-making not only provides problem-solving capabilities but also improves the efficiency of resolving disputes. The integration of AI technology with the legal profession has been proven to be crucial in the modern day. Successful development in this intersection can result in the advancement of legal civilization. Nevertheless, to successfully implement AI in legal decision-making, it is crucial to confront and overcome certain obstacles. These include enhancing research in cognitive reasoning and tackling technical logic problems, especially in the areas of long-term internet and big data development. It achieves a compressed model that performs similarly to deep neural models, exceeding other prediction models that rely on word embedding. This suggests a favorable path for the future implementation of artificial intelligence in legal decision-making. The modelling technique outlined in this paper is poised to act as a strong foundation for future study in judicial prediction. The focus of this effort is to develop a comprehensive model that can endure over time and be applicable to different justices and diverse social, political, and economic situations, although other approaches may be explored for improving performance in specific instances or timeframes. This perspective, which looks ahead, establishes the foundation for further progress in incorporating deep learning techniques into the legal field.

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