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Legal Court Case Classification and Prediction Using ML

Ms. Saloni Bhatt[1], Prof. Kiran Patel [2]
[1]*Dept of Computer Engineering &* [2] *Information Technology, KITRC, Kalol, Gujarat, India*

Abstract: ***The increasing availability of digital legal documents has made it essential to develop intelligent systems that can efficiently process and analyze large volumes of legal text. This study proposes a machine learning-based framework for classifying legal documents and predicting case outcomes by combining both traditional algorithms and advanced deep learning techniques. Specifically, Logistic Regression and Random Forest are used as baseline models, while BERT (Bidirectional Encoder Representations from Transformers) is employed to capture deeper contextual relationships within the text.***
The models are evaluated on a legal dataset after applying standard preprocessing techniques. The findings indicate that although traditional models provide reasonable performance, the BERT-based approach significantly enhances accuracy and understanding of complex legal language. The proposed system achieved an overall accuracy of 91%, along with improved precision and recall in predicting case outcomes. This approach has the potential to support legal professionals by reducing manual effort and enabling faster, data-driven decision-making.
Keywords: Legal NLP, Machine Learning, BERT, Case Outcome Prediction, Text Classification

I. INTRODUCTION

The increasing digitization of legal documents, including case records, judgments, and contracts, has significantly expanded the volume of textual data within the legal domain. Managing and analyzing such large-scale data manually is both time-consuming and inefficient, creating a strong need for automated and intelligent solutions. Recent advancements in machine learning and Natural Language Processing (NLP) have enabled the development of systems capable of extracting meaningful insights from legal text and supporting decision-making processes [1].

Legal decision-making is inherently complex, as it involves interpreting case facts, applying relevant laws, and considering precedents. Traditional approaches rely heavily on human expertise, which can introduce delays and subjective variations. Machine learning techniques provide a data-driven alternative by identifying patterns in historical legal data and assisting in tasks such as document classification and case outcome prediction [2]. These approaches have demonstrated promising results in improving efficiency and consistency in legal analytics.

Several studies have explored the application of machine learning models such as Logistic Regression, Support Vector Machines, and Random Forest for legal text classification and prediction tasks [11]. While these models offer reasonable performance and interpretability, they often struggle to capture the contextual and semantic complexity of legal language. In contrast, transformer-based models such as BERT have shown significant improvements by leveraging deep contextual representations of text, making them highly effective for legal NLP applications [3].

Recent research also highlights the importance of integrating structured knowledge and domain-specific features to enhance prediction accuracy. Approaches such as graph-based models and precedent-aware systems have demonstrated improved reliability in legal judgment prediction tasks [2], [15]. However, challenges such as limited domain-specific datasets, high computational requirements, and lack of interpretability still persist in real-world applications [1].

This study aims to develop a machine learning-based framework for legal document classification and case outcome prediction using Logistic Regression, Random Forest, and BERT. The objective is to compare the performance of traditional and deep learning models and identify the most effective approach for handling legal text. By leveraging both structured and unstructured data, the proposed system seeks to improve prediction accuracy and reduce manual workload.

Ultimately, this research contributes to the field of legal informatics by demonstrating the practical application of machine learning in legal analytics. The proposed approach has the potential to support legal professionals in making faster, more consistent, and data-driven decisions, while also providing a scalable solution for future advancements in intelligent legal systems.

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II. LITERATURE REVIEW

Recent advancements in Natural Language Processing (NLP) have significantly impacted legal informatics, particularly in tasks such as document classification and judgment prediction. A study by Siino et al. highlights the growing use of large language models (LLMs) in legal applications, while also emphasizing challenges such as limited datasets, interpretability, and computational cost [1].

Several approaches have been proposed for improving legal outcome prediction. Zhao et al. introduced a graph-based method that integrates legal facts and law articles, improving prediction accuracy but requiring structured data [2]. Similarly, Valvoda et al. incorporated legal precedents into predictive models, enhancing reliability but increasing computational complexity [15].

Traditional machine learning models such as Logistic Regression, Random Forest, and Support Vector Machines have been widely used for legal text classification. Park and Chai demonstrated their effectiveness in predicting outcomes, although these models often struggle with contextual understanding [11]. These methods provide a strong baseline but are limited in handling complex legal language.

Deep learning models, particularly transformer-based architectures like BERT, have shown superior performance in recent studies. Gardazi et al. highlighted BERT's ability to capture contextual and semantic relationships, making it highly effective for NLP tasks [3]. Other studies have also confirmed that deep neural networks improve classification accuracy in legal documents, although they require large datasets and are less interpretable [4].

In specialized legal applications, NLP techniques have been used for tasks such as contract analysis and regulatory compliance. Battu demonstrated the use of Legal-BERT for financial regulations, while Dikmen et al. applied machine learning for contract risk analysis [6], [13]. These studies highlight the practical utility of NLP but also indicate challenges in generalizing across domains.

Overall, existing research shows that while traditional models provide baseline performance, transformer-based models offer significant improvements in accuracy and contextual understanding. However, issues such as data availability, interpretability, and computational requirements remain key challenges. This study addresses these gaps by comparing traditional and advanced models to develop an efficient system for legal document classification and case outcome prediction.

TABLE I A COMPILATION OF RESEARCH PAPERS

Ref	Title	Author(s)	Publication & Year	Methodology	Limitations	Future Scope	Justifications
[1].	Exploring LLMs Applications in Law: A Literature Review on Current Legal NLP Approaches	Marco Siino, Mariana Falco, Daniele Croce, Paolo Rosso	IEEE, 2025	Systematic review of legal NLP studies (2017–2023) focusing on LLM tasks (classification, prediction, contracts).	Lack of domain datasets, interpretability issues, high compute, fairness/bias concerns.	Build large multilingual datasets, enhance interpretability, expand adoption.	Justified as it maps LLM's transformative role in law with critical barriers.
[2]	Legal Judgment Prediction via Heterogeneous Graphs and Knowledge of Law Articles	Qihui Zhao, Tianhan Gao, Song Zhou, Dapeng Li, Yingyou Wen	MDPI, 2022	Heterogeneous Graph Neural Network linking facts, charges, law articles.	Limited to Chinese datasets, needs quality structured knowledge, high compute.	Extend to multilingual, precedent retrieval, document classification.	Justified as it combines structured knowledge with ML for reliable predictions.

[3]	BERT Applications in Natural Language Processing: A Review	Nadia Mushtaq Gardazi, Ali Daud, Muhammad Kamran Malik, Amal Bukhari, Tariq Alsahfi, Bader Alshemaimri	Springer, 2025	Review of BERT applications in NLP tasks.	Needs large datasets, black-box nature, domain-specific data scarce, limited doc length.	Handle long texts, improve explainability, fairness, expand specialized BERTs.	Justified as it shows BERT & variants (Legal-BERT) outperform traditional models.
[4]	Polish Court Ruling Classification Using Deep Neural Networks	Łukasz Kostrzewa, Robert Nowak	MDPI, 2022	CNNs, RNNs, transformers for Polish rulings.	Restricted to Poland, needs large annotated data, black-box, only classification.	Expand datasets, multilingual applications, outcome prediction.	Justified as it automates legal classification with strong accuracy gains.
[5]	Masked Prediction & Interdependence Network of the Law (Japanese Judgments)	Ryoma Kondo, Takahiro Yoshida, Ryohei Hisano	Springer, 2022	Masked prediction (BERT-style) to reveal law connections.	Limited to Japan, struggles with complex reasoning, data reliance.	Extend to other jurisdictions, outcome prediction, improve explainability.	Justified as it treats law as a network to reveal deeper legal connections.
[6]	Automated Interpretation of Financial Regulations Using NLP	Geol Gladson Battu	IJSRA, 2025	Legal-BERT, FinBERT, Longformer for compliance analysis.	Lacks datasets, black-box issues, little real-world testing, compute heavy.	Apply beyond finance, improve explainability, integrate compliance systems.	Justified as it eases compliance by automating regulation analysis.
[7]	LLaMA-UTP: Knowledge-Guided Expert Mixture for Analyzing Tax Positions	Yutong Tan, Bi Wu, Jialei Cao, Bingying Jiang	IEEE, 2025	Expert mixture model with LLaMA + domain knowledge.	Focus on tax law only, curated knowledge needed, high compute, partial black-box.	Expand to other domains, fairness checks, validate in real workflows.	Justified as it improves accuracy & interpretability for tax legal AI.
[8]	AgentsBench: Multi-Agent LLM Simulation for Legal Judgment Prediction	C. Jiang, X. Yang	Systems, 2025	Multi-agent LLM simulating judge deliberations.	China-specific, high resource demand, scalability concerns.	Apply to jury systems & global courts, enrich judge profiles, external knowledge.	Justified as it models judicial deliberation realistically.
[9]	Building a Production-Ready Multi-Label Classifier with Digital-Twin-	G. M. Csányi, R. Vági, D. Nagy, I. Üveges, J. P. Vadász, A.	Applied Sciences, 2025	Multi-label classification decomposed into 100+ binary tasks, deployed as digital twin.	Limited to classification, compute heavy, lacks outcome prediction.	Integrate transformers, extend to outcome prediction, add	Justified as it delivers production-ready legal classification

	Distiller	Megyeri, T. Orosz				explainability.	tools.
[10]	Legal Judgment Prediction: Predicting Damages in Car Accident Cases	D. Hsieh, L. Chen, T. Sun	Applied Sciences, 2021	KNN, CART, Random Forest on Taiwanese fatal car accident data.	Narrow scope, only structured data, ignores reasoning text.	Apply to diverse domains, adopt BERT, integrate explainability.	Justified as it reveals judicial factors in discretionary damages.
[11]	AI Model for Predicting Legal Judgments in Privacy Cases	M. Park, S. Chai	Applied Sciences, 2021	Used ML classifiers (RF, SVM, LDA, CART, NNET) + text analysis on privacy invasion cases.	Limited to privacy cases, dataset small, excludes deep learning, limited explainability.	Expand to varied domains, integrate BERT, add unstructured texts.	Justified as it improves prediction accuracy in privacy cases.
[12]	Efficient English Text Classification using ML	Xiaoyu Luo	Alexandria Eng. J., 2021	Compared ML models (SVM, NB, Decision Trees, NN) with preprocessing.	Small dataset (1033 docs), general text only, ignores deep learning, lacks legal focus.	Apply to legal corpora, explore transformers, support multi-label classification.	Justified as it establishes ML efficiency for baseline classification tasks.
[13]	Automated Construction Contract Analysis using NLP & ML	I. Dikmen, G. Eken, H. Erol, M. T. Birgonul	Computers in Industry, 2025	Classified contract clauses by risk, obligation, rights; identified parties via ML.	Limited to construction contracts, ignores broader documents, context loss.	Extend to judgments, outcome prediction, integrate transformers.	Justified as it automates contract risk assessment effectively.
[14]	Intelligent English Text Classification with Improved KNN	Q. Xu	Systems & Soft Computing, 2025	Enhanced KNN with K-means clustering + CMD for big data.	Domain-limited (libraries), ignores legal language, only classification.	Apply to legal texts, combine with prediction tasks, integrate transformers.	Justified as it optimizes classic ML methods for big data.
[15]	Modeling Negative Precedents in Legal Case Outcome Prediction	J. Valvoda, L. Polák, Z. Kaliszyk, R. Řehůřek	ACL, 2023	Modeled negative precedents to improve outcome prediction.	Computationally intensive, limited multilingual reach.	Extend across legal systems, integrate with LLMs, cross-lingual support.	Justified as it introduces precedent-aware models in law.

III. RESEARCH GAP

Despite significant progress in applying machine learning and NLP to the legal domain, several limitations remain. Many existing studies rely on traditional machine learning models that provide acceptable baseline performance but fail to capture the contextual and semantic complexity of legal language. This results in reduced accuracy when dealing with intricate legal texts and nuanced case details.

Although transformer-based models such as BERT have demonstrated improved performance, their adoption is still limited due to challenges such as high computational requirements, lack of domain-specific datasets, and limited interpretability. Most existing works also focus either on document classification or outcome prediction independently, rather than integrating both tasks into a unified system. Furthermore, several approaches depend heavily on structured or domain-specific data, which restricts their applicability across different legal systems and real-world scenarios. There is also a lack of comparative analysis between traditional and advanced models under a common framework, making it difficult to evaluate their relative effectiveness. Therefore, there is a need for a scalable and efficient system that combines both traditional machine learning and deep learning techniques to perform legal document classification and case outcome prediction within a single framework. This research aims to address these gaps by developing a comparative and integrated approach that improves accuracy, reduces manual effort, and enhances practical applicability in legal decision-making.

IV. PROPOSED FRAMEWORK

The proposed framework aims to develop an integrated system for legal document classification and case outcome prediction using both traditional machine learning and advanced deep learning techniques. The system is designed as a structured pipeline that processes raw legal text and generates accurate predictions through multiple stages.

A. Data Collection

Legal datasets consisting of case documents, judgments, and associated outcomes are collected from publicly available or structured sources. The dataset includes both textual data and relevant attributes such as case type and decision labels.

B. Data Preprocessing

The collected data is cleaned and prepared to ensure consistency and quality. This stage includes:
Removal of noise and irrelevant characters
Tokenization and normalization
Stopword removal and lemmatization
Conversion of text into numerical representations using TF-IDF and contextual embeddings

C. Feature Extraction

Two types of features are generated:
Statistical Features using TF-IDF for traditional models
Contextual Features using BERT embeddings for deep learning models
This dual approach enables comparison between conventional and context-aware representations of legal text.

D. Model Implementation

The framework incorporates multiple models for comparative analysis:
Logistic Regression for baseline classification
Random Forest for improved performance using ensemble learning
BERT (Transformer Model) for capturing deep contextual relationships
Each model is trained and tested using the same dataset to ensure fair evaluation.

E. Classification and Prediction

The trained models perform:
Legal Document Classification (e.g., case type)
Case Outcome Prediction (e.g., decision result)
Predictions are generated based on learned patterns from historical data.

F. Performance Evaluation

The models are evaluated using standard metrics:
Accuracy
Precision
Recall

F1-score
A comparative analysis is conducted to identify the most effective model.

G. Output Generation
The system provides:
Predicted case category
Predicted outcome
Performance comparison of models

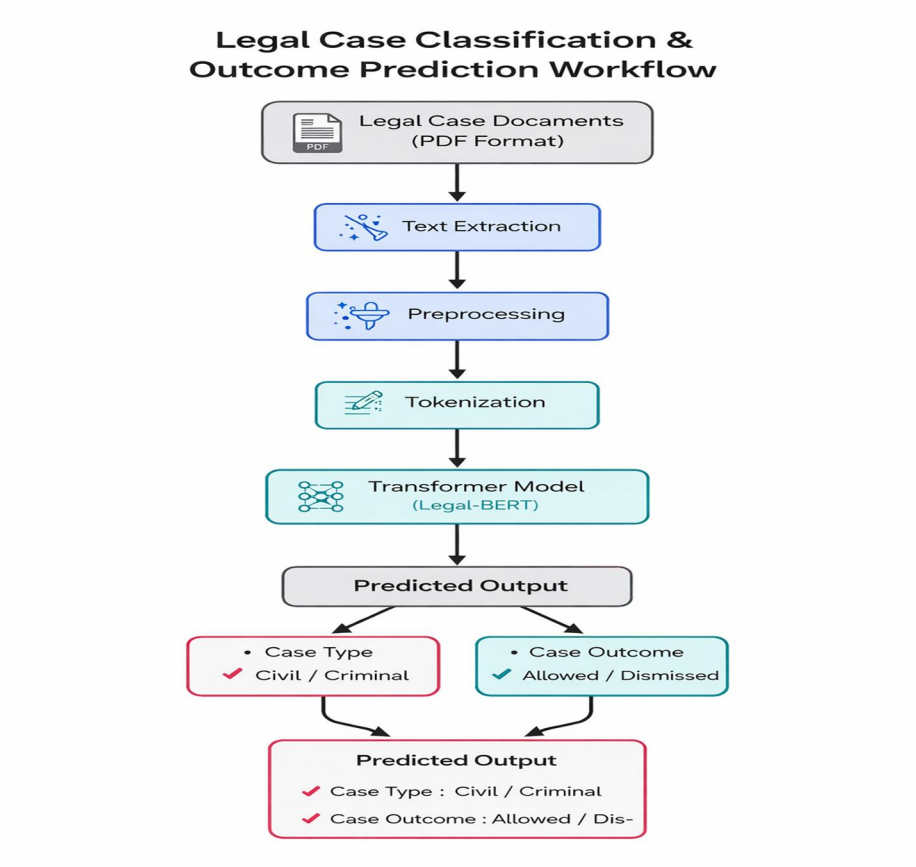


Fig. 1 Proposed Framework

V. CONCLUSIONS

This study presents a machine learning-based approach for legal document classification and case outcome prediction by integrating both traditional and advanced models. The comparative analysis demonstrates that while Logistic Regression and Random Forest provide reliable baseline performance, transformer-based models such as BERT significantly enhance accuracy by effectively capturing contextual relationships within legal text.

The proposed framework successfully combines document classification and outcome prediction into a unified system, reducing manual effort and improving analytical efficiency. The results indicate that the use of deep learning techniques leads to better precision, recall, and overall predictive performance, making the system more suitable for real-world legal applications.

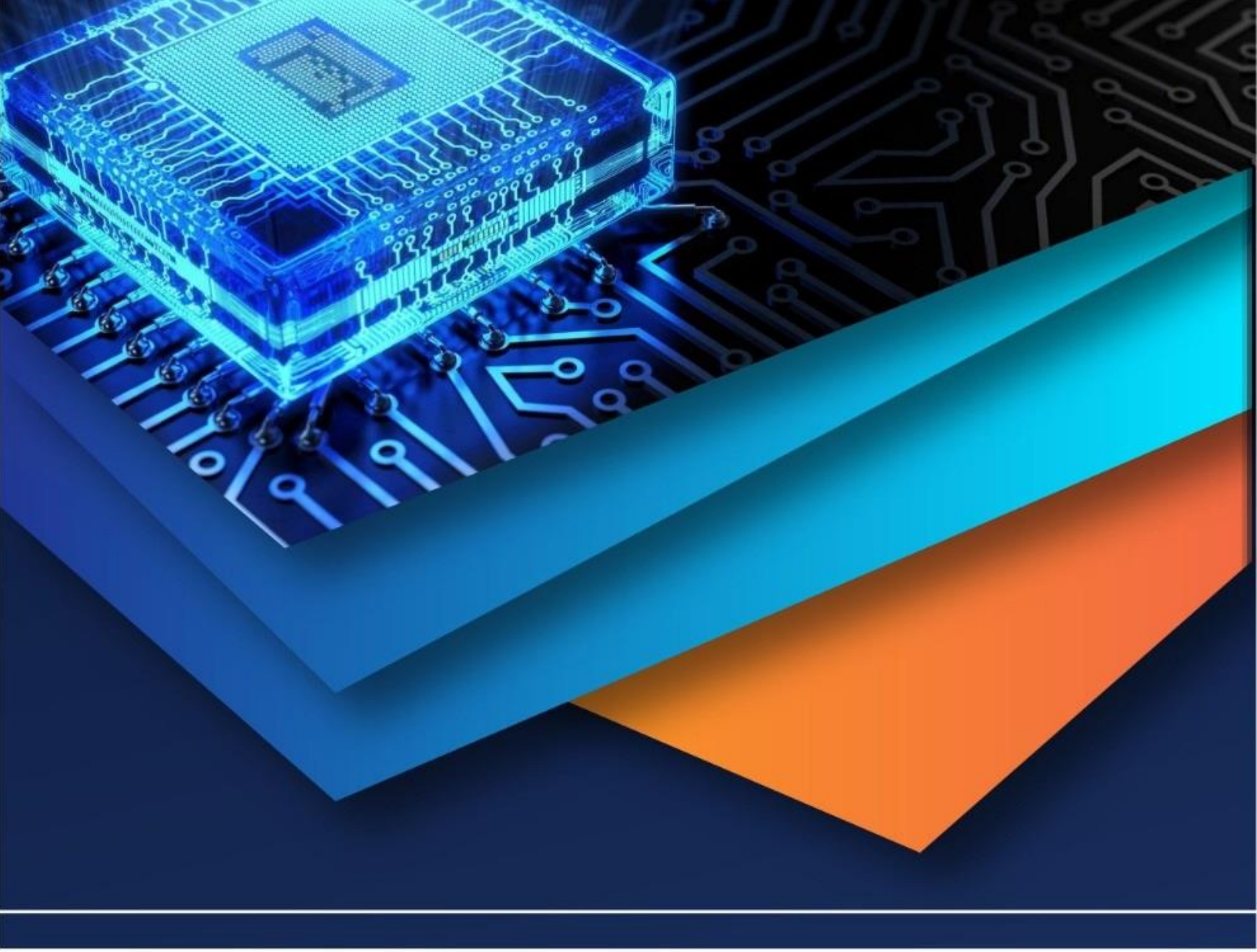
Despite these improvements, certain challenges remain, including the need for large domain-specific datasets and the computational complexity associated with advanced models. Future work can focus on optimizing model efficiency, incorporating domain-specific variants such as Legal-BERT, and expanding the system to handle multilingual legal data.

Overall, this research contributes to the field of legal informatics by demonstrating the effectiveness of machine learning in automating legal analysis and supporting data-driven decision-making. The proposed approach offers a scalable solution that can be further extended to other legal and analytical domains.

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