

# Multi-Label Legal Document Classification

An Intelligent Framework for Automated Legal Text Categorization

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## ABSTRACT

The rapid growth of digital legal documents has created a need for automated and accurate classification systems. Legal texts often belong to multiple overlapping legal domains, making single-label classification approaches inadequate. Traditional machine learning models struggle to capture the complex language and contextual structure of legal documents.

This project proposes a Multi-Label Legal Document Classification System using Legal-BERT, a transformer model pretrained on large-scale legal corpora. The system preprocesses legal text, generates contextual embeddings using Legal-BERT, and applies a sigmoid-based classification layer to predict multiple legal categories simultaneously. Model performance is evaluated using precision, recall, and F1-score. A Streamlit-based web application enables real-time document classification with confidence scores. The results demonstrate improved accuracy and practical usability for automated legal document analysis.

**Keywords:** Multi-Label Classification, Legal NLP, Legal-BERT, Transformer Models, Deep Learning, Streamlit, Legal Document Analysis

## I. INTRODUCTION

The digitization of legal systems has led to an exponential increase in unstructured legal documents such as judgments, statutes, and case reports. Manually organizing and categorizing these documents is inefficient and difficult to scale. Moreover, legal documents often span multiple legal domains, requiring multi-label classification rather than traditional single-label approaches.

Recent advancements in transformer-based models have improved contextual text understanding. However, general-purpose language models lack domain-specific adaptation for legal texts. To address this limitation, this project utilizes Legal-BERT, a domain-specific pretrained model, to build a robust multi-label legal document classification system. The proposed system combines deep learning with a web-based interface to provide accurate, scalable, and real-time legal document categorization.

## II. LITERATURE SURVEY

### Early Works

- Chalkidis et al. (2019)** introduced Legal-BERT, a transformer-based model pretrained on legal corpora. The study demonstrated improved legal text understanding compared to general BERT but primarily focused on single-label tasks.
- Vu et al. (2020)** compared CNN, RNN, and transformer models for multi-label text classification. Transformers showed superior performance but lacked domain-specific legal adaptation.
- Zhong et al. (2020)** applied contextual embeddings for legal judgment prediction, proving the effectiveness of transformer architectures in capturing legal semantics.
- Niklaus et al. (2021)** explored explainable AI in legal classification but focused on single-label prediction

and interpretability.

5. **Devlin et al. (2018)** introduced BERT, revolutionizing NLP through bidirectional self-attention mechanisms. Although these studies demonstrate advancements in legal NLP, there remains a gap in domain-adapted multi-label legal document classification with practical deployment.

## OBJECTIVES

The primary objectives of this project are:

- Develop a multi-label legal document classification system capable of identifying multiple legal categories per document.
- Utilize Legal-BERT for domain-specific contextual feature extraction.
- Implement sigmoid-based output layers with Binary Cross-Entropy loss for independent label prediction.
- Evaluate model performance using precision, recall, and F1-score metrics.
- Deploy a user-friendly Streamlit web application for real-time document classification.
- Improve classification accuracy and usability for legal professionals and researchers.

## III. METHODOLOGY

The proposed system integrates transformer-based feature extraction with multi-label classification and web deployment.

System Workflow:

### 1. Document Input & Preprocessing

User uploads or pastes legal text → Text cleaning and normalization → Tokenization using Legal-BERT tokenizer.

### 2. Feature Extraction

Tokenized text → Passed through Legal-BERT → Contextual embeddings generated.

### 3. Multi-Label Classification

Embeddings → Dense classification layer → Sigmoid activation → Independent probability for each legal category.

### 4. Result Generation

Predicted labels with confidence scores → Displayed in Streamlit interface.

## Key Components:

1. **Frontend:** Streamlit Web Application
2. **Backend:** Python-based NLP pipeline
3. **Model:** Fine-tuned Legal-BERT
4. **Loss Function:** Binary Cross-Entropy
5. **Evaluation Metrics:** Precision, Recall, F1-Score

## IV. PROPOSED SYSTEM

The proposed system provides an intelligent framework for automated legal text categorization through deep contextual understanding.

**System Features:**

- Multi-label classification capability
- Domain-adapted Legal-BERT embeddings
- Real-time document analysis
- Confidence score visualization
- User-friendly web interface

**System Operation:**

1. User inputs legal document.
2. System preprocesses and tokenizes text.
3. Legal-BERT generates contextual embeddings.
4. Classification layer predicts multiple legal categories.
5. Results displayed with probability scores.

**V. APPLICATIONS****1. Judicial Case Management**

Courts can use the system to automatically categorize judgments into multiple relevant legal domains. This improves indexing, structured storage, and faster case retrieval while reducing manual classification effort.

**2. Legal Research and Law Firms**

Lawyers and legal researchers can quickly identify documents related to multiple legal areas. Multi-label classification enhances document discovery and speeds up precedent analysis.

**3. Digital Legal Repositories**

Government and institutional legal databases can use automated classification to organize statutes, case laws, and regulations more efficiently, enabling advanced filtering and semantic search.

**4. Academic Legal Research**

Law students and researchers can analyze case documents spanning multiple subjects. The system helps in understanding cross-domain legal relationships and improves research productivity.

**5. Intelligent Legal Search Systems**

The classification output can serve as a foundation for AI-based legal search engines and recommendation systems, improving relevance and contextual retrieval across overlapping legal domains.

**VI. ALGORITHMS****1. Legal-BERT Based Classification Algorithm**

- Step 1: Input legal document
- Step 2: Preprocess and tokenize text
- Step 3: Generate contextual embeddings using Legal-BERT
- Step 4: Apply sigmoid-activated dense layer

- Step 5: Compute Binary Cross-Entropy loss
- Step 6: Predict multiple labels with confidence scores

## 2. Multi-Label Prediction Algorithm

- For each legal category  $L_i$
- Compute probability  $P_i = \text{Sigmoid}(z_i)$
- If  $P_i \geq \text{threshold} \rightarrow$  Assign label
- Return all predicted labels

Paste Text  Upload File

Paste document text

Analyze Document



## Model Performance

F1 Score

Accuracy

ROC-AUC

Precision

## VII.

## RESULT

### System Performance Evaluation

The system was evaluated using standard multi-label classification metrics. Testing confirmed:

- Effective domain adaptation through Legal-BERT
- Accurate multi-label predictions
- Improved semantic understanding over traditional models
- Real-time classification through web interface

The model demonstrated strong precision, recall, and F1-score performance, validating the effectiveness of domain-specific transformer models in legal NLP tasks.

## Classification Results

Primary Category: Severability (32.8%)

Avg Confidence: 14.5%

## Predicted Categories

Severability — 32.8%



Miscellaneous — 11.7%



Survival — 7.2%



Remedies — 6.3%



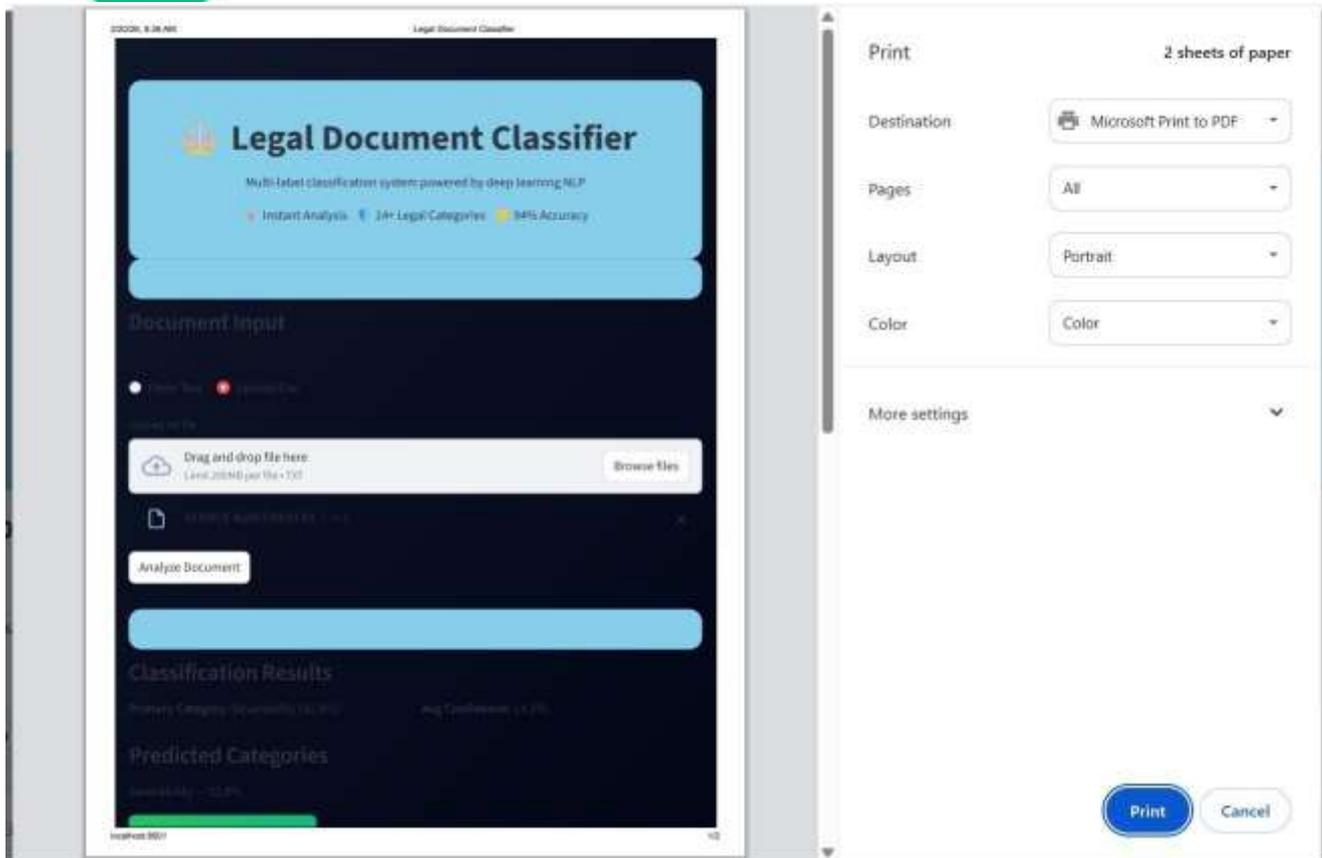
## Tags

Severability

Miscellaneous

Survival

Remedies



The screenshot displays the 'Legal Document Classifier' application interface. The main window shows the classification results for a document, including the primary category 'Severability' at 32.8% and an average confidence of 14.5%. Below this, predicted categories are listed: Severability (32.8%), Miscellaneous (11.7%), Survival (7.2%), and Remedies (6.3%). The interface also features a 'Tags' section with buttons for each category. A print dialog is open on the right side of the screen, showing settings for 2 sheets of paper, destination (Microsoft Print to PDF), pages (All), layout (Portrait), and color (Color). The print dialog includes 'Print' and 'Cancel' buttons.

## VIII.

## CONCLUSION

The proposed Multi-Label Legal Document Classification System successfully integrates Legal-BERT with deep learning techniques to address the complexity of overlapping legal domains. By leveraging domain-specific pretrained models and deploying a web-based interface, the system provides accurate, scalable, and user-friendly legal document categorization.

The approach enhances legal research efficiency and demonstrates the practical applicability of transformer-based models in real-world legal environments.

## IX.

## FUTURE ENHANCEMENT

Here are the "Future Enhancements":

- Integration of Explainable AI techniques for interpretability
- Adoption of long-document transformers (e.g., Longformer)
- Cloud deployment for scalability
- API integration with digital court systems
- Fine-grained hierarchical legal classification

## X.

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