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Scaling Up: Analyzing Classification Outcomes in Large Korean Legal Document Datasets

SUMMARY

This paper proposes an integrated approach that combines artificial intelligence models for automatic classification and prediction of Korean legal judgments. Given the complexity of the Korean legal system and the diversity of its legal issues, this study utilizes a transformer-based model to classify and predict legal judgment documents. By leveraging these models, this study addresses the challenges posed by the intricate legal language and diverse topics within Korean legal documents, significantly improving the efficiency and accuracy of classification tasks. The proposed approach enhances the automation and reliability of legal document predictions, demonstrating exceptional performance in managing the complexities of legal language. Specifically, the models facilitate a deeper understanding of the context of Korean legal judgments, thereby increasing the reliability of prediction outcomes. Moreover, this study introduces a novel integrated framework that significantly enhances the performance of automated legal document processing and prediction systems. This framework supports legal consultations, document management, and automated judgment systems, representing a significant advancement in the application of artificial intelligence in the legal domain.

Keywords: Legal Case Classification, Legal Analysis, Transformer Model, Legal Text Processing.

1. INTRODUCTION

In modern society, legal issues frequently arise in daily life, and resolving them effectively requires precise legal knowledge and expert assistance. However, it is difficult for the public to acquire and utilize such knowledge (Katz, 2013). Legal professionals also spend considerable effort searching for relevant or irrelevant

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information in their judgments to support their arguments (Al-Kofahi et al., 2001). To address these challenges, innovative legal services incorporating artificial intelligence (AI) have been developed (Van Opijnen & Santos, 2017).

Recent advancements in AI technology, particularly in natural language processing (NLP), have enabled us to understand the complex structure of legal documents and support judgment prediction and legal decision-making. These technologies play a crucial role in analyzing vast amounts of legal documents and data quickly and accurately and predicting the outcomes of judgments. However, for these technologies to function effectively, they must be tailored to reflect the specific characteristics of the legal system.

This study proposes an integrated framework that combines classification approaches reflecting the unique aspects of the Korean legal system. Specifically, we utilized models based on transformer architectures, such as Bidirectional Encoder Representations from Transformers (BERT) and generative pre-trained transformers (GPT), to perform case classification. This approach effectively processes the intricate linguistic features of legal documents, enhancing the accuracy of judgment predictions.

Finally, this study proposes an AI-based approach aimed at automating legal document processing and prediction, considering the unique characteristics of the Korean legal system. By integrating classification and retrieval approaches, this study attempts to automate the process of predicting legal judgments in Korea. Classification focuses on automatically categorizing legal documents into specific categories to improve predictability and helps quickly and accurately find critical information within legal documents, providing the data necessary for legal decision-making.

We aim to develop an automated judgment prediction system that reflects the complex characteristics of the Korean legal system, thereby supporting legal professionals in making more efficient and accurate decisions.

2. RELATED WORK

Early legal information analysis efforts relied primarily on knowledge engineering approaches based on AI and case-based reasoning. However, these methods faced challenges such as scalability and high costs, eventually rendering them unsustainable in the long term (Maxwell & Schafer, 2008). This realization led to a significant shift towards alternative methodologies, particularly those employing NLP techniques, which have since transformed the field by automating text analysis and improving the accuracy of legal text tasks.

Subsequent advancements in this area leveraged machine learning techniques, such as support vector machines (SVMs) and term frequency-inverse document frequency (TF-IDF), to process text data for legal tasks (Prastyo et al., 2020).

Simultaneously, there have been significant developments in document embedding strategies, particularly those aimed at creating dedicated vector spaces for the legal domain. These approaches utilized innovative algorithms, such as PageRank graphs combined with TF-IDF, to train neural network models efficiently, thereby improving the effectiveness of legal text tasks (Sugathadasa et al., 2019). Legal-specific embeddings such as LegalBERT have outperformed general NLP models by capturing the unique linguistic features of legal languages, thereby enhancing classification and prediction tasks (Chalkidis et al., 2020).

In the realm of legal document classification and prediction, research has aimed to reflect the legal specificities of various countries, including China, the United States, Italy, and the European Union. For instance, Lawformer was developed to classify Chinese legal documents, utilizing an attention mechanism to effectively capture linguistic structures, particularly in tasks such as the China AI and Law Challenge (Qin et al., 2022). These approaches underscore the importance of tailored models that reflect the nuances of national legal systems.

In addition to applying language models to legal documents, efforts have been made to transform and develop these documents into specialized datasets. In the European Union, the EURLEX legal dataset has been extended to a recently published multi-EURLEX dataset. This new dataset explores zero-shot cross-lingual transfers in legal topic classification by including multiple languages and reflecting various national legal structures, thereby addressing the limitations of the original EURLEX dataset (European Union, 2022; Song et al., 2022). These developments are crucial in enhancing the cross-border applicability of legal AI models.

In addition to advancing existing datasets, efforts have been made to create new datasets tailored to specific legal frameworks. For example, a dataset reflecting the hierarchical structure of Italian law was introduced to improve content navigation in legal document classification tasks (Benedetto et al., 2023). The study validated the effectiveness of utilizing language models for legal document classification, highlighting the potential of AI in navigating complex legal hierarchies. Similarly, in the United States, a judgment-based dataset was developed to facilitate automated legal text classification using methods such as random forest and deep learning, thereby demonstrating the effectiveness of domain-specific features (Chen et al., 2022).

3. BACKGROUND ON THE SOUTH KOREAN LEGAL SYSTEM AND DATASET

To analyze and predict legal outcomes in the context of South Korean law effectively, it is essential to understand the unique structure of the South Korean legal system and the characteristics of the dataset used in this study. This section lays an overview of these elements and provides the necessary foundation for the following methodologies and experiments.

3.1. The Structure of the South Korean Legal System

The South Korean legal system is unique in that it incorporates elements from both civil and common law traditions (Kim, 2008). Consequently, judicial precedents often establish standards for legal judgments that are not explicitly defined by the law itself, and these precedents play a critical role in the interpretation and application of the law (Kim & Kim, 2020). Consequently, South Korean court rulings typically include reference precedents, relevant legal provisions, previous rulings, and points of law, which serve as implicit standards for legal decision-making, although they may not be explicitly stated in legal documents (Hwang et al., 2022).

3.2. Dataset Overview and Focus

The dataset constructed for this study was specifically designed to focus on legal issues addressed in appellate court decisions, with the goal of gaining a deeper understanding of the essence of legal judgments. While lower court rulings primarily focus on determining the facts of a case, appellate courts, particularly the Supreme Court, center their attention on legal matters (Civil Procedure Act, Article 432; Criminal Procedure Act, Article 383). Therefore, this dataset is structured to concentrate on the legal problems and issues addressed in appellate decisions, providing legal professionals with clear guidance for interpreting and resolving complex legal matters.

Moreover, this dataset encompasses a broad range of legal fields, including administrative, patent, and tax laws, which are not covered by the existing LBOX OPEN dataset. It primarily comprises appellate court rulings rather than lower court decisions (Open Law, 2022). This approach reflects the intricate structure and unique characteristics of South Korean legal judgments and is expected to make significant contributions to legal AI research and applications.

The dataset used in this study comprises 87,160 Korean legal judgments. These judgments cover a wide array of legal issues and cases, with each document detailing the case background, legal issues, and judgment outcomes (Open Law, 2022).

Additionally, the dataset includes critical legal elements such as relevant statutes, case types, and primary reasons for judgments, ensuring that essential information can be effectively extracted and analyzed from the rulings (Open Law, 2022).

4. MODEL DESCRIPTION

In this study, experiments were conducted to predict the dismissal of legal judgments using transformer models. The primary models utilized include the LCUBE model, based on the transformer architecture with GPT, and the BERT and RoBERTa models, both based on BERT. These models were evaluated for their effectiveness in accurately classifying legal judgments based on the textual data from court rulings. Figure 1 shows the overall progress of the experiments using advanced transformer-based models.

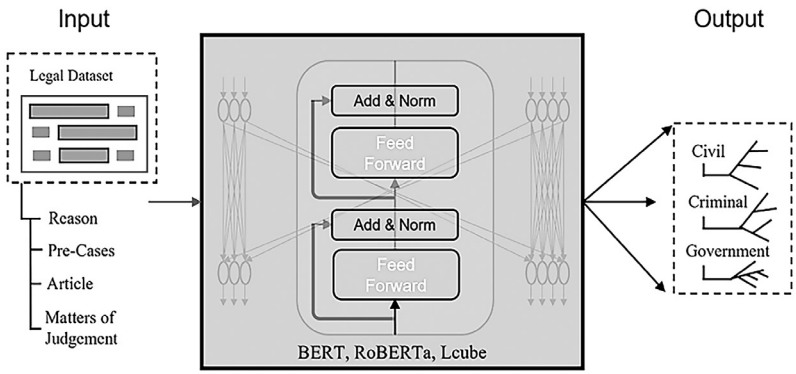

Figure 1. Overall Progress of The Models Used in Experiments.

4.1. LCUBE (GPT-based Model)

LCUBE is a model optimized for the classification of Korean legal texts built on the GPT architecture. Leveraging the powerful generative capabilities of GPT, LCUBE excels in deeply understanding and analyzing the context and meaning of texts. The model is particularly effective in handling the complex logical structures of legal texts, making it highly suitable for large-scale language models (Hwang et al., 2022).

4.2. BERT (BERT-based Model)

BERT is a BERT-based model trained on Korean Language Understanding Evaluation (KLUE) data (Devlin et al., 2019), optimized for Korean text with a strong ability to capture contextual nuances and detailed meanings in legal texts. By leveraging bidirectional encoding, KLUE-BERT effectively learns contextual information and

specific legal elements in judicial documents, making it widely applicable to text classification tasks.

4.3. RoBERTa (BERT-based Model)

The robust, optimized BERT approach (RoBERTa) is an enhanced version of BERT developed by Facebook AI, which improves performance through key training optimizations (Liu et al., 2019). It utilizes larger datasets and dynamic masking, removes the next-sentence prediction task, and employs larger batch sizes and learning rates. These modifications make RoBERTa more effective in understanding complex language patterns, consistently outperforming BERT in various NLP tasks.

5. EXPERIMENTAL RESULTS ON LEGAL CASE CLASSIFICATION

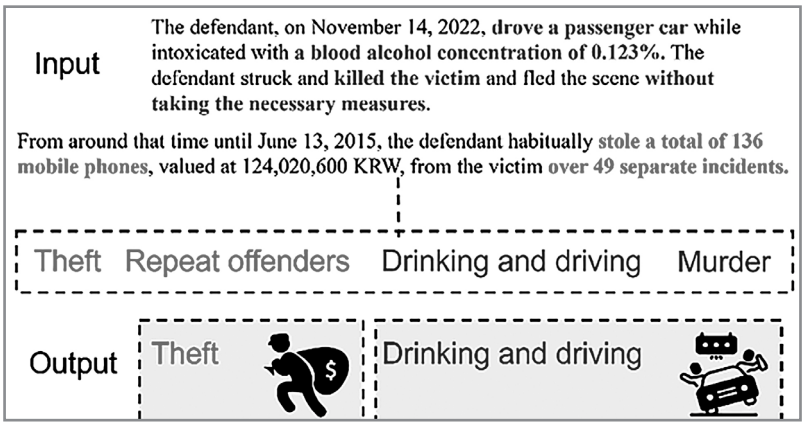

Figure 2. Example of Legal Case Classification.

In this study, legal case classification was conducted to categorize legal judgments based on key legal issues (case name). Figure 1 illustrates an example (drinking and driving, theft) of legal case classification. The primary goal of this classification is to automatically identify and group cases that share similar legal characteristics or issues, thereby enabling more efficient handling and analysis of legal documents. The classification system facilitates the legal research and decision-making process by focusing on the most critical legal issues in each case.

5.1. Experimental setting

The experiments conducted in this study utilized the dataset described in Section 3.2, comprising 87,160 legal judgments. In the experiments, 80% of the dataset was used as

the training set, 10% as the validation set, and the remaining 10% as the test set. Each model was trained over 20 epochs with a batch size of ten to ensure robustness, and its performance was evaluated based on key metrics, including precision and accuracy.

Precision was chosen as the primary evaluation metric in this study because of its relevance to legal judgment predictions, where the focus is on the accuracy of positive predictions. In legal contexts, false positives (incorrectly predicting a judgment as relevant) can be particularly significant, making precision a critical measure of performance.

5.2. Comparison results

Table 1 summarizes the performance of each model. The experimental results showed that the transformer-based LCUBE and BERT-based models outperformed the traditional models overall, particularly in understanding contextual meanings. The LCUBE model demonstrates outstanding predictive performance in handling the complexity of legal texts.

Table 1. Classification Performance of Different Models on Dataset.

Model	Accuracy	Precision
Lcube	0.3888	0.6751
Klue/Bert	0.3911	0.8244
Klue/RoBERTa	0.3896	0.7999

The BERT model also demonstrated strong performance in understanding context and detailed information, which is consistent with its BERT-based architecture, and achieved high accuracy in processing the complex structures of legal texts.

These experimental results reflect the challenges in classifying legal judgment data and the effectiveness of text classification. The LCUBE and BERT models have proven to be highly effective tools for the automatic classification of Korean legal texts. The performance of each model varied depending on the characteristics of the data and the complexity of the classification task, with the transformer- and GPT-based models particularly excelling in legal text classification.

Furthermore, as shown in Table 2, the models are capable of effectively categorizing cases based on specific categories. They excel in classifying cases related to core legal issues, such as those involving Article 23 of the Labor Standards Act, which pertains to wrongful dismissal and wage-related disputes. This demonstrates the models' ability to not only handle complex legal texts but also accurately identify and classify key legal issues, making them a valuable tool for legal practitioners.

Table 2. Example of Classification Results Related to Article 23 of the Labor Standards Act.

Title	Category	Contents
2007Du20157	Revocation of Personnel Order	If an employer unlawfully dismisses an employee or engages in other unfair labor practices, the employee may file a petition for remedy with the Labor Relations...
2015Du776	Cancellation of Unfair Suspension Relief	The lower court, after considering the adopted evidence, recognized the facts as stated in the judgment. It found that the plaintiff bank, in agreement with the labor union, aimed to strengthen organizational competitiveness and improve the seniority-based, high-age, and high-cost personnel...
2015Du38917	Cancellation of Unfair Reduction and Relief for Unfair Labor Acts	On July 14, 2011, the plaintiff unlawfully entered his previous workplace on his day off, accessed his work computer, and deleted the File in this Case, thereby intentionally destroying evidence of information leakage and obstructing the company's legitimate audit operations (hereinafter referred to as the "Second Disciplinary Reason"...

6. DISCUSSION

We evaluated LCUBE, KLUE/BERT, and KLUE/RoBERTa to classify Korean legal documents and observed significant performance differences. The LCUBE model had a lower precision (0.6751) than those of KLUE/BERT (0.8244) and KLUE/RoBERTa (0.7999). To understand these results, we analyzed the judgments predicted by each model.

The simpler vocabulary-based approach of LCUBE likely fails to capture the complex language and context of legal documents. In contrast, the transformer-based KLUE/BERT and KLUE/RoBERTa models handle contextual nuances more effectively, leading to higher performance. Our analysis showed that LCUBE is prone to misclassification because it does not recognize subtle differences in legal terms.

These findings highlight the importance of models that can effectively process the complexity of legal language. Future studies should focus on enhancing model capabilities and expanding datasets to better represent the features of legal documents.

6.1. Model Performance Comparison

The experiments demonstrated that the KLUE/BERT and KLUE/RoBERTa models significantly outperformed the GPT-based LCUBE model in classifying Korean legal documents. The key performance metrics, including accuracy, precision, recall,

and F1-score, were consistently higher for the BERT-based models, indicating their superior ability in handling complex legal texts and diverse legal categories.

6.2. Precision and Efficiency

The KLUE/BERT and KLUE/RoBERTa models not only improved the accuracy of legal document classification but also enhanced the overall efficiency of the processing pipelines. These models are more effective in capturing complex legal languages and contexts, resulting in more reliable classification outcomes. Accurate classification improves the speed and quality of legal document processing and is particularly important for providing precise information in complex cases. The experimental results showed that the accuracy of the LCUBE, KLUE/BERT and KLUE/RoBERTa models was relatively low, with values of 0.3888, 0.3911, and 0.3896, respectively.

6.3. In-depth analysis

Figure 3 illustrates the performance of the LCUBE model, highlighting a broad distribution of errors across various legal documents. This widespread error distribution indicates that the LCUBE model struggles to consistently capture the subtleties of legal language, resulting in frequent misclassifications across diverse legal contexts. While the GPT-based LCUBE model leverages its generative capabilities, it demonstrates limitations in effectively adapting to the complex syntactic and semantic structures inherent in legal texts. This underscores a critical drawback of the LCUBE model: despite its strengths as a general-purpose language model, it fails to meet the specificity required for accurate legal judgment prediction.

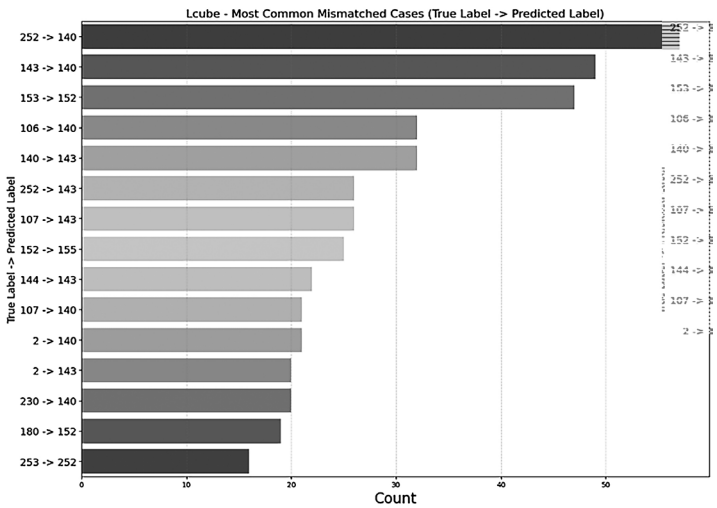

Figure 3. Error Distribution of the LCUBE Model Across Legal Document Types.

Figure 4 analyzes the performance of the KLUE/RoBERTa model, showing the frequency of errors across various types of legal documents. Notably, KLUE/RoBERTa demonstrates a distinct performance difference in accurately capturing subtle yet significant legal distinctions, such as between "cancellation of ownership transfer registration" and "ownership transfer registration." These results reveal that while the KLUE/RoBERTa model excels in understanding general legal terminology, it faces challenges in distinguishing complex and nuanced legal differences. This model's effectiveness is partly due to its optimized pretraining techniques, but it also inherits the benefits of the bidirectional encoding approach introduced by BERT, which allows it to understand context from both directions within a sentence. This bidirectional encoding is particularly valuable in legal texts, where the precise interpretation of terms depends heavily on their surrounding context. However, KLUE/RoBERTa still requires additional fine-tuning to enhance its ability to handle highly specialized legal subdomains.

Through this analysis, it becomes evident that the architectural characteristics of each model directly influence their performance in legal judgment prediction. The LCUBE model, relying on its generative capabilities, exhibits limitations without domain-specific training, whereas KLUE/RoBERTa leverages BERT's bidirectional encoding and other optimizations to show strong potential, demonstrating greater effectiveness with precise fine-tuning to tackle specialized legal tasks.

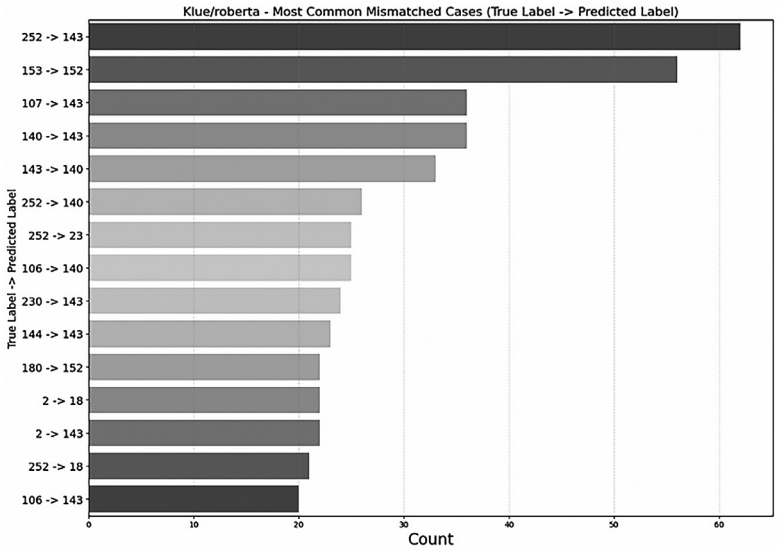

Figure 4. Error Distribution of the KLUE/RoBERTa Model Across Legal Document Types.

6.4. Error Analysis

In this study, we identified three major categories of errors in the classification of Korean legal documents.

Type 1 Misclassification Based on Incorrect Targets

The model often misclassifies cases by focusing on the main subject of the dispute rather than on the legal nature of the issue. For example, cases involving the cancellation of administrative dispositions should be categorized under administrative law; however, the model incorrectly classifies them as ownership transfer registrations or building deliveries. One instance of this is a case involving the cancellation of an administrative disposition that was incorrectly classified as an ownership transfer registration and a building delivery case (Supreme Court of Korea, 1969a; Supreme Court of Korea, 1990)

Type 2 Confusion Between Similar Topics

Another issue is that the model tends to confuse cases that involve similar topics but differ in their core legal aspects. For instance, in cases involving ownership transfer, building delivery may involve a transfer of ownership, but the underlying legal issues may be distinct. However, the model classifies them as the same type. For example, a building delivery case was incorrectly classified as an ownership transfer registration (Supreme Court of Korea, 1989). Similarly, in cases involving compensation for damages, the model misclassifies cases involving consolation money (which concerns emotional damage) as general compensation for damages (Supreme Court of Korea, 1968).

Type 3 Failure to Distinguish Subtle Legal Differences

Third, the model struggles to distinguish between subtle legal distinctions. For example, ownership transfer registration and the cancellation of ownership transfer registration are different legal actions; however, the model frequently misclassifies cases as the same. One such instance is a case involving the cancellation of an ownership transfer registration that was incorrectly classified as an ownership transfer registration (Supreme Court of Korea, 1969b).

Figure 5 summarizes various types of misclassifications made by the model.

These errors occur because the model fails to fully grasp the core legal issues in each case, relying more on surface-level content than on underlying legal relationships. To address these problems, future improvements should focus on developing algorithms that better understand legal concepts and enhance the model's ability to accurately capture key issues in legal cases.

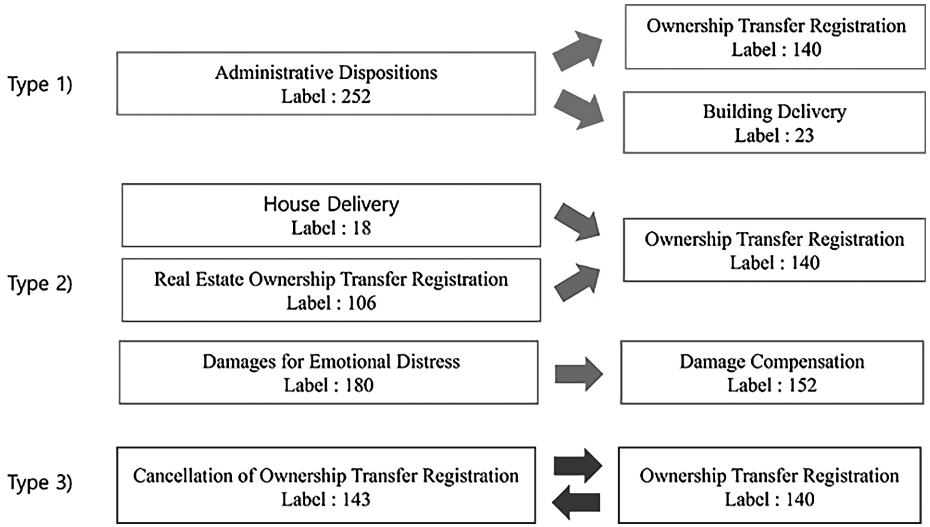

Figure 5. Illustration of Misclassification Types in Legal Document Analysis.

7. LIMITATIONS

Despite the strengths of the proposed method, several limitations were identified in the experiments. First, the models exhibit reduced precision in complex legal scenarios, particularly those involving intricate legal reasoning or specialized legal terminology. This impacts the reliability of predictions, especially in cases where an accurate interpretation of legal language is essential. Second, the models were not sufficiently fine-tuned for domain-specific legal texts, such as intellectual property law, corporate law, and international trade law. This lack of domain adaptation leads to suboptimal performance when encountering the specific legal nuances of these fields. Third, legal documents often contain archaic language, complex sentence structures, and specialized terminology, which pose significant challenges for NLP models. As a result, the models struggle to interpret and classify texts, requiring a precise understanding of legal terms. This complexity affects performance consistency across diverse legal contexts. Finally, these limitations reduce the overall effectiveness and reliability of the system, impacting its applicability in real-world legal settings.

To address these limitations, the following enhancements are suggested. First, domain-specific fine-tuning: Incorporating additional fine-tuning of legal corpora in underperforming areas, such as intellectual property and corporate law, could improve model performance in these specialized fields. Second, implementing legally specific named entity recognition, context-aware tokenization, and syntactic parsing

could better address the complexities of legal language and improve classification accuracy in intricate legal documents.

8. CONCLUSION AND FUTURE WORK

The proposed integrated framework represents a significant advancement in applying AI to legal research and practice. While this study demonstrates improvements in the efficiency and adaptability of transformer-based models, challenges such as handling complex legal language and domain-specific nuances remain. However, with ongoing developments, including adaptation to multilingual contexts, fine-tuning for specialized legal domains, and optimization for real-time responsiveness, this framework has the potential to become an indispensable tool in the legal field. Its adaptability across various legal systems worldwide holds promise for supporting more informed and efficient decision-making, contributing to the advancement of global legal practices.

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Povećanje učinkovitosti: analiza ishoda klasifikacije u velikim skupovima podataka korejskih pravnih dokumenata

SAŽETAK

Rad predstavlja integrirani pristup koji kombinira modele umjetne inteligencije u svrhu automatske klasifikacije i predviđanja korejskih pravnih presuda. S obzirom na složenost korejskog pravnog sustava i raznolikosti njegovih pravnih pitanja, ova studija koristi transformerski model za klasifikaciju i predviđanje dokumenata pravnih presuda. Koristeći ove modele, ova se studija bavi izazovima koji su nametnuti zbog kompleksnog pravnog jezika te raznolikih tema koje su dio korejskih pravnih dokumenata, značajno poboljšavajući učinkovitost i točnost zadataka klasifikacije. Predloženi pristup poboljšava automatizaciju i pouzdanost predviđanja pravnih dokumenata, pokazujući izniman učinak u upravljanju složenošću pravnog jezika. Konkretno, modeli olakšavaju dublje razumijevanje konteksta korejskih pravnih presuda, povećavajući time pouzdanost predviđanja ishoda postupaka. Štoviše, ova studija uvodi novi integrirani okvir koji značajno poboljšava učinak automatizirane obrade pravnih dokumenata i sustava predviđanja. Ovaj okvir podržava pravne konzultacije, upravljanje dokumentima i automatizirane sustave presuda, što predstavlja značajan napredak u primjeni umjetne inteligencije u pravnom području.

Ključne riječi: klasifikacija pravnih predmeta, pravna analiza, transformerski model, obrada pravnog teksta.