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TOWARDS SUSTAINABLE JUSTICE: LOOKING FOR AI-DRIVEN SOLUTIONS FOR LEGAL PRACTICE AND COURT MONITORING

This research explores the application of artificial intelligence (AI) in legal practice, focusing on AI-driven solutions for managing large datasets of court decisions and improving judicial efficiency in Ukraine. The study demonstrates the importance of AI in addressing challenges related to the overwhelming influx of unstructured legal data, which human resources alone cannot manage effectively. The project titled "Innovative Technologies for Processing Court Decisions Using Machine Learning Algorithms" applied AI methodologies to collect, label, and analyze over 300,000 court cases. Through the analysis, the research identified ways of defining patterns of inconsistency, judicial errors, and procedural anomalies, providing a foundation for further legal reforms in Ukraine. The project also highlights the potential of AI to advocate for out-of-court resolution mechanisms to ease the burden on courts. While the pilot phase was limited in scope, it demonstrated the viability of AI-assisted legal processes, setting the stage for future research. A comprehensive review of existing literature on AI applications in legal settings was conducted, revealing significant advancements but also gaps in AI's role in case law monitoring and judicial decision-making. Additionally, the research identifies AI's capacity to automate repetitive legal tasks, reduce inefficiencies, and improve access to justice in post-conflict environments like Ukraine. Continued efforts will focus on refining AI algorithms and scaling up the labeling process to improve the accuracy of legal predictions and enhance transparency, fairness, and efficiency in Ukraine's legal system, particularly in the post-war context.

Keywords: artificial intelligence, legal practice, judicial efficiency, case law monitoring, out-of-court resolution; legal reform, sustainable justice, Ukraine.

AMS 2020 classification: 62H30, 34C60.

Introduction

In the modern legal landscape, professionals face an overwhelming influx of data, ranging from legal documents and contracts to case law and regulatory frameworks. This vast amount of unstructured information poses significant challenges for timely and accurate analysis, decision-making, and efficient management of legal operations. Human resources alone are insufficient to effectively process and utilize this massive volume of data. As a result, the integration of artificial intelligence (AI) into legal practice has become increasingly relevant. AI offers solutions that can improve the efficiency of legal processes, enhance transparency, and broaden access to justice, simplifying a wide range of legal services. The importance of research on how to use AI in legal practice lies in its potential to discover AI-driven methodologies for addressing these challenges, particularly in jurisdictions like Ukraine, where legal consistency and access to justice remain critical concerns.

One of the major challenges faced by the legal sector, both in Ukraine and globally, is the inefficiency in handling the large amounts of unstructured legal data. These include court decisions, contracts, and regulations that require timely and accurate processing. Current methods, which rely heavily on human resources, are no longer sufficient to manage these tasks efficiently, leading to delays, inconsistencies, and limited access to justice. This research addresses the problem of how AI can be applied to legal practice to manage large datasets more effectively. AI has the capacity to automate time-consuming processes, streamline decision-making, and offer insights into patterns and trends that would otherwise remain hidden. The main problem this study seeks to address is the lack of efficient systems to process, analyze, and utilize large legal datasets in a way that enhances judicial transparency and consistency.

This research aims to generalize AI-based solutions for the analysis and management of large legal datasets, with a particular focus on court decision monitoring in Ukraine. In the post-war period, there is an urgent need for sustainable justice systems that can efficiently handle complex legal challenges, support judicial reforms, and ensure transparency in legal processes. AI-driven tools might offer crucial support in addressing these needs by automating data processing, improving consistency in judicial decisions, and ensuring timely access to justice.

This research is particularly important in Ukraine, where rebuilding the legal infrastructure requires efficient processing of legal information to restore public trust in the judiciary. The integration of AI can enhance the efficiency of legal services, reduce the risk of inconsistent rulings, and provide a framework for long-term judicial sustainability. By leveraging AI to promote fairness, transparency, and accountability, the research aims to support the development of a resilient and sustainable legal system in Ukraine, capable of meeting the challenges of the post-war period and beyond.

1. Literature review

Recent advancements in AI technology have sparked interest in its application within the legal sector. AI has been used in various aspects of legal practice, including contract review, legal research, and case management.

Studies have shown that AI can process legal documents faster than human counterparts, with greater accuracy in identifying key information and trends. Research has also explored the use of predictive analytics in legal settings, allowing legal professionals to anticipate case outcomes and assess litigation risks.

However, much of the current research focuses on commercial law and contract automation, leaving a gap in studies addressing AI's role in judicial decision-making and case law monitoring. This study seeks to fill that gap by applying AI to monitor court decisions, ensuring consistency in legal rulings, and predicting case outcomes, particularly within the Ukrainian context. Additionally, AI's ability to support sustainable justice through improved legal processes has been explored, but this research takes a step further by proposing a framework for utilizing AI to create a transparent and accessible legal system in post-conflict and transitional legal environments like Ukraine's.

The study of large datasets of court decisions has recently become a widespread trend. Researchers are increasingly seeking effective and efficient ways to use AI to extract objective information from datasets that are nearly impossible to process manually. AI and machine learning algorithms can yield a wide range of possible outcomes from data processing, and there is still no consensus on the extent and scope of their use.

Major efforts put into analysing the decisions openly available, like the European Court of Human Rights (ECtHR) or the International Court of Justice (ICJ). For example, Yildirim et al. (2023) investigates 971 non-executed pending leading cases of the ECtHR between 2012 and 2020 using machine learning techniques. This study encompasses each country party to the European Convention on Human Rights, analyzing 232 distinct factors over eight years. The research focuses on non-compliance based on pending leading cases, as these are the first to identify specific human rights infringements in respondent states.

Valvoda, Cotterell and Teufel (2023) explore the scope of legal precedents, distinguishing between positive and negative precedents, and introducing a new task of negative outcome prediction. Their study reveals an asymmetry in existing models' ability to predict positive and negative outcomes. Utilizing the ECtHR corpus, which contains thousands of instances of case law related to the European Convention on Human Rights (ECHR), they compare the performance on Articles 8 and 13 of the ECHR, noting more training data availability for negative outcomes than for positive ones.

Efforts of scholars have been devoted to predicting legal judgments using Natural Language Processing (NLP) and Artificial Intelligence (AI). Almost ten years ago, ambitious goals were set for using advances in NLP and machine learning as tools for predictive models to unveil patterns driving judicial decisions. For instance, Aletras et al. (2016) proposed models capable of predicting the ECtHR's decisions with an average accuracy of 79 %, suggesting that the formal facts of a case are the most important predictive factor.

Bellutta and Carley (2024) build on analyses of the case citation network of the ICJ, demonstrating that reverse page-rank outperforms hub and authority scores in identifying significant sources of precedent. Their processed ICJ data includes a decision-by-decision citation network with 114 decisions and 713 citations, and a judge-by-decision vote network involving 161 judges, 114 decisions, and 1641 votes.

Studies using case laws from the ECtHR and ICJ are popular among scholars examining the interaction between AI and case law, although national case law might yield more practically important results. For example, Bertalan and Ruiz (2024) aimed to predict specific judicial characteristics such as the judicial outcome, class, and particular case decisions, specifically focusing on Brazilian courts. Data was extracted from official Brazilian electronic legal systems, comprising two datasets of cases of second-degree murder and active corruption.

A study by Zhao, Gao and Guo (2023) demonstrates the use of a graph neural network-based Legal Judgment Prediction (LJP) method that utilizes a multi-graph fusion mechanism to fully and accurately integrate law article information for prediction purposes.

These outcomes could be particularly useful for civil cases, aiding in the further automation of legal services and providing a higher and more accessible level of rights protection. Delgado, Barocas and Levy (2022) reveal how an interactive simulation methodology enabled computer scientists and lawyers to collaborate as co-designers, bridging the gap between computational research and real-world, high-stakes litigation practice. This approach specifically facilitated the automation of attorney document review for civil litigation matters.

Vaudaux et al. (2023) conducted a case study on judicial decision prediction using a small dataset from the French Courts of Appeal, comprising approximately 1000 decisions about the habitual place of residency for children of divorced parents. The task was to predict, based on the facts and reasons outlined in the documents, whether the court rules that children should live with their mother or their father. The results demonstrate the importance of careful dataset construction in legal NLP tasks. By excluding 'spoilers'—information that might prematurely reveal the final decision—this study highlights a significant caveat in automatically constructing legal NLP datasets. The findings underscore the necessity of manually curating data to ensure that predictive models are genuinely challenged by the facts and reasoning, rather than inadvertently learning from hints scattered throughout the document.

Another study, "Building a Predictive Model for Legal Studies through Ensemble Learning Techniques" (Quteishat, E., Qtaishat, & Quteishat, A., 2024), presents the first applicable Machine Learning (ML) model for predicting decisions issued by the Supreme Court of the United States. Through a comparative analysis of prediction results for various algorithms, the proposed models showcase the ability to accurately predict the outcomes of legal cases, particularly utilizing Ensemble techniques. This research explores the integration of different ML and Ensemble learning techniques in legal studies, which are experiencing tremendous technological advancements.

In some cases, the prediction is very useful and might serve as a general prerequisite for reasonable approaches to justify out-of-court resolutions compared to court litigation. For instance, "Predicting the Outcome of Construction Change Disputes Using Machine-Learning Algorithms" (Alqaisi et al., 2024) investigates change order disputes by creating a list of legal factors on which court rulings were based in similar cases to determine the likelihood of potential outcomes for future claims. The model developed in this research may be utilized by disputing parties to evaluate and decide whether to file a claim or settle it privately, thereby resolving disputes more efficiently for construction dispute negotiations.

Another example is a study that developed a machine learning model to predict legal case outcomes, utilizing disruptive technology stored in IPFS for legal and ethical considerations. The algorithm can forecast case results, providing useful information for departments and attorneys. The model is trained on 3304 U.S. Supreme Court cases and achieves 95% accuracy, evaluated through F1-score, accuracy, precision, recall, and support metrics (Ansari, Dhillon, & Singh, 2024).

However, predicting case outcomes is very complicated due to numerous reasons. "Boosting Court Judgment Prediction and Explanation Using Legal Entities" (Benedetto et al., 2024) jointly addresses court judgment prediction and explanation by not only predicting the judgment but also providing legal experts with sentence-based explanations. The results obtained on a benchmark dataset from the Indian judicial system show the superior performance of entity-aware approaches to both tasks.

It is noteworthy that major studies related to the national case law consisting of numerous decisions in states like China, India, and Brazil are almost impossible to analyze with only human resources; as well as on international courts case law.

The results of prognosis are still insufficient, therefore more efforts might be put into analyzing specific circumstances or types of cases rather than focusing on outcomes (win-lose). National case law might be more useful for studying the potential introduction of AI tools, particularly in cases with openly available sources and interim decisions (like Ukrainian case), due to the absence of such studies yet.

The connection between the broader concept of sustainable justice and the benefits of AI-driven solutions in legal practice is clear and essential to explore, especially in light of AI's evolving capabilities in legal contexts. Sustainable justice is often defined as a system that achieves justice for current generations without compromising the ability of future generations to enjoy the benefits of a just society. This concept transcends immediate legal outcomes, aiming to create long-lasting frameworks of fairness, transparency, and efficiency that can endure over time, even as social and technological landscapes evolve (Barlow, 2013; Berardi, 2024).

AI-driven solutions can significantly contribute to this vision of sustainable justice by ensuring that legal systems remain adaptable, inclusive, and effective in the long term. The integration of AI into judicial decision-making and court monitoring can enhance transparency and efficiency, making legal processes more equitable and accessible. As Machlis (2024) argues, sustainability requires balancing short-term needs with long-term goals. By automating labor-intensive tasks such as case law analysis and decision monitoring, AI enables legal professionals to focus on high-level strategic work, improving overall decision-making and reducing the risk of inconsistencies that could compromise future justice.

The benefits of AI-driven solutions in legal practice are not just immediate; they contribute to a broader framework of sustainable justice, ensuring that legal systems remain robust and just for generations to come (Gioia Carabellese, & Della Giustina, 2023).

Furthermore, as Leonard and Kenny (2010) highlight, sustainable justice must account for the needs of diverse communities, ensuring that legal systems remain inclusive and representative. AI's ability to process vast amounts of legal data can identify patterns of inequality or bias, helping to correct systemic issues that might otherwise persist. This capability is especially critical in post-conflict societies, such as Ukraine, where rebuilding legal institutions requires a forward-looking approach to justice. AI can support the development of sustainable legal frameworks by providing real-time insights into case outcomes, procedural anomalies, and judicial inefficiencies, creating a transparent and accountable system that upholds the rights of future generations (Cordonier Segger, Szabó, & Harrington, 2021).

Moreover, the integration of AI aligns with the Sustainable Development Goals (SDGs), particularly those related to justice, peace, and strong institutions (Kaltenborn, Krajewski, & Kuhn, 2020). AI can help legal systems meet SDG targets by improving access to justice, reducing court backlogs, and fostering judicial reforms that are both efficient and equitable. This is crucial in countries like Ukraine, where restoring legal order is a key component of post-war recovery. By fostering sustainable justice, AI-driven solutions contribute not only to the current legal framework but also to the creation of a more resilient and fair system for future generations (Aamir Ali, & Ghose, 2023). AI also offers a more objective and justified approach for implementing mandatory schemes for out-of-court and pre-trial dispute resolution, and it provides sustainable options for addressing recurring procedural steps in cases with similar claims and parties.

2. About the project

The research project titled "Innovative Technologies for Processing Court Decisions Using Machine Learning Algorithms" (2023, K-I-186), was financed by the European Union's External Assistance Instrument under the Horizon 2020 Framework Programme for Research and Innovation. The project aimed to explore how AI could be applied to the judicial sector to improve the efficiency and transparency of legal processes in Ukraine. It builds on developed software for collecting datasets and labeling court decisions. The key participants in the project included a team of mathematicians led by Prof. Yuliia Mishura, which included Tetiana Ianevych and Vitaliy Golomozyi, and a team of lawyers led by Prof. Iryna Izarova, which included Prof. Yurii Prytyka and Prof. Oksana Khotynska-Nor, along with other participants from Taras Shevchenko National University of Kyiv. The results are presented in papers (Golomozyi et al., 2023a; Golomozyi et al., 2023b).

The methodology for this project was designed based on experiences and lessons learned from earlier research focused on analyzing large datasets of court decisions. During the project, unstructured data from over 300,000 court cases was collected, with approximately 2,000 of those cases being labeled. High-quality labeling was achieved for around 1,000 cases, which served as the foundation for training AI algorithms. The goal was to create a structured dataset that could be used to monitor judicial decision-making and attempt to predict case outcomes in one category of civil matters.

The general description of the Ukrainian judiciary and judicial practice can be found in (Izarova, 2023) and the evolution of case law in Ukraine is detailed in (Izarova et al., 2024). Civil cases were selected for this project due to their high volume, importance to citizens, and sensitivity, making them particularly relevant for exploring the implementation of alternative dispute resolution mechanisms.

One key challenge identified in the project was the format of court decisions available in open access. Ukraine's state register holds over 110 million non-machine-readable court documents. Developing effective tools to generalize data from this vast corpus of non-machine-readable decisions is critical. Despite the push for digitalization of justice in both the EU and Ukraine, these non-machine-readable formats remain widely used and offer unique opportunities for analysis.

The labeling process involved identifying key legal parameters, such as the parties involved, types of claims, sums of money, procedural details (e. g., whether a final decision was reached, if an appeal was made, and the type of proceedings), among other factors. The legal team under my supervision developed over 40 numerical and textual markers to label the data. These markers facilitated a comprehensive analysis of judicial processes, with a focus on anomalies such as delays, common judicial errors, and deviations from standard practices.

AI algorithms were envisioned to identify cases with unusual patterns, inconsistencies, or procedural errors. This approach could be especially beneficial in categories like bank loan cases, where case law has been inconsistent. Analyzing large volumes of cases (between 10,000 and 200,000 annually) could reveal broader trends in claimant behavior, enforcement challenges, and the need for improvements in dispute resolution mechanisms. The project aimed to use these insights to support proposals for implementing mandatory pre-trial resolutions in certain case categories, reducing the burden on courts and improving legal outcomes.

One of the primary challenges we faced was the labor-intensive nature of the labeling process. Each case took approximately three hours to label, limiting the ability to extend this process across a larger dataset. Despite this, the results

were promising. The structured data allowed us to perform statistical analyses using tools such as contingency tables, histograms, and box plots. These analyses provided valuable insights into case processing times, judicial consistency, and the identification of procedural errors.

Another significant challenge was the lack of an interface capable of generating standard statistics for selected judicial tasks. Such a tool would have enabled us to assess whether judicial errors were common in first-instance court decisions and how often these decisions were overturned on appeal or cassation. Having access to this data would have helped evaluate the overall effectiveness and consistency of the judicial system.

Although the final sample for analysis consisted of 1,221 observations (with 855 valid decisions due to data entry errors), the findings highlighted the potential of AI-assisted case law monitoring to improve judicial transparency and efficiency. This pilot project demonstrated the viability of using AI in this capacity, laying the groundwork for future efforts to process larger datasets and enhance the use of AI in legal analysis.

Discussion and conclusions

The research project successfully demonstrated the potential of AI in monitoring court decisions and measuring judicial efficiency in Ukraine. By processing and analyzing vast amounts of legal data, the project uncovered the way how to manage the format of non-readable documents for further searching patterns of inconsistency and procedural anomalies, providing a solid foundation for further legal reforms. It also highlighted the potential for AI to assist legal scholars and policymakers in advocating for the implementation of out-of-court resolution mechanisms in specific categories of cases, which could help alleviate the burden on Ukraine's heavily strained court system.

While the pilot phase of the project was limited in scope, the results were promising and underscored the need for further research. Refining the AI algorithms and expanding the labeling process would enable future research to apply this methodology to a significantly larger dataset of court decisions. This could generate more comprehensive and nuanced insights into judicial practices, further supporting legal reform initiatives. Moreover, incorporating more advanced AI techniques, such as predictive analytics and machine learning, could improve the accuracy of legal predictions and enhance the effectiveness of legal decision-making.

The project has laid a critical foundation for integrating AI into Ukraine's judicial system, offering a strategic roadmap for how legal technology can improve the fairness, transparency, and efficiency of legal processes. Continued research in this area will not only deepen our understanding of AI's applications in legal contexts but will also pave the way for its broader adoption across various facets of the judicial system.

With the implementation of AI tools, Ukraine is well-positioned to strengthen its judicial system and ensure greater access to justice, particularly in the post-war context. As the country rebuilds and modernizes its legal institutions, AI will play an essential role in supporting long-term stability by fostering sustainable justice practices. The insights from this project can guide future developments, ensuring that Ukraine's judicial system evolves in a way that is both resilient and forward-thinking.

Sustainable justice is deeply intertwined with the need for legal systems that are adaptable, efficient, and transparent over time. AI offers the tools necessary to achieve these objectives by automating processes, reducing human error, and ensuring that justice is not only achieved today but is also accessible and fair in the future.

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СТАЛЕ ПРАВОСУДДЯ: У ПОШУКУ РІШЕННЯ НА ОСНОВІ ШТУЧНОГО ІНТЕЛЕКТУ ДЛЯ ЮРИДИЧНОЇ ПРАКТИКИ ТА МОНІТОРИНГУ СУДІВ

Досліджено можливість застосування штучного інтелекту (ШІ) у юридичній практиці, зосереджуючись на рішеннях на базі ШІ для керування великими наборами даних судових рішень і підвищення ефективності судочинства в Україні. Продемонстровано важливість ШІ для врегулювання проблем, пов'язаних із величезним потоком неструктурованих даних юридичного змісту, якими не можна управляти ефективно тільки за допомогою людського ресурсу. У проєкті під назвою "Інноваційні технології для обробки судових рішень з використанням алгоритмів машинного навчання" застосовували методології ШІ для збирання, маркування й аналізу понад 300 000 судових документів. Унаслідок аналізу в дослідженні було виявлено такі способи визначення неузгодженостей, судових помилок і процесуальних аномалій, що можуть лягти в основу подальших правових реформ в Україні. У проєкті також підкреслено потенціал застосування ШІ для удосконалення механізмів позасудового врегулювання спорів в Україні, щоб полегшити навантаження на національні суди. Хоча пілотний проєкт був обмеженим за обсягом і часом, усе ж він продемонстрував життєздатність моніторингу судових рішень за допомогою ШІ, заклавши основу для майбутніх досліджень. Було також проведено всебічний огляд наявної літератури про застосування ШІ в юридичній практиці, що дало змогу виявити значні досягнення науковців, а також прогалини в застосуванні ШІ для моніторингу прецедентного права й ухвалення судових рішень у світі. Крім того, у дослідженні визначено здатність ШІ автоматизувати повторювані юридичні завдання, зменшувати неефективність і поліпшувати доступ до правосуддя в постконфліктних середовищах. Постійні зусилля варто зосередити на вдосконаленні алгоритмів ШІ та розширенні пошуку й подальшого процесу маркування судових документів з тим, щоб підвищити точність правових прогнозів та прозорість, справедливість й ефективність правової системи України, особливо в післявоєнному контексті.

Ключові слова: штучний інтелект, юридична практика, судова ефективність, моніторинг судової практики, позасудове врегулювання спорів, правова реформа, стале правосуддя, Україна.

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