- ORIGINAL ARTICLE -

Artificial Intelligence Applied in Legal Information: A Systematic Mapping Study

Inteligencia Artificial aplicada en Información Jurídica: Mapeo Sistemático de la Literatura

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Abstract

Advanced technologies, particularly Artificial Intelligence (AI), are transforming how legal professionals handle civil law relationships and daily processes. Legal Information Retrieval (LIR), a significant field within AI, focuses on efficiently identifying and analyzing legal norms and documents relevant to users' specific information needs. This systematic mapping study identifies and synthesizes primary approaches, trends, and advancements in applying AI to LIR. By reviewing recent research, it provides an overview of employed strategies, AI techniques, and emerging areas of focus. Systematic search methods were applied to academic databases, selecting relevant studies published over the past fifteen years. From 3405 initially identified articles, 34 were selected for in-depth analysis after applying inclusion and exclusion criteria. The findings reveal sustained interest in AI techniques for LIR, with a clear trend toward adopting Natural Language Processing (NLP) and machine learning to enhance search relevance, precision, and automation of legal processes. This study emphasizes the potential of AI in the legal domain and highlights the need for continued research to address unique LIR challenges in a rapidly evolving technological landscape.

Keywords: artificial intelligence, civil law, legal information retrieval, automatic query expansion, text classification algorithms.

Resumen

Tecnologías avanzadas, como la Inteligencia Artificial (IA), están transformando cómo los profesionales del derecho gestionan las relaciones jurídicas y procesos cotidianos. La Recuperación de Información Jurídica (RIJ), un campo clave dentro de la IA, permitiendo identificar y analizar normas y documentos legales relevantes para las necesidades de los usuarios. Este estudio identifica y sintetiza los principales enfoques, tendencias y avances en la aplicación de la IA a la RIJ. Mediante revisión de investigaciones recientes, se ofrece un resumen de las estrategias empleadas, técnicas de IA utilizadas y áreas emergentes. Se aplicaron métodos de búsqueda sistemática en bases de datos académicas, seleccionando estudios publicados en los últimos quince años. De 3405 artículos identificados inicialmente, 34 fueron seleccionados para un análisis en profundidad tras aplicar criterios de inclusión y exclusión. Los hallazgos revelan un interés en las técnicas de IA para la RIJ, con una tendencia hacia la adopción del Procesamiento del Lenguaje Natural (PLN) y el aprendizaje automático para mejorar la relevancia y precisión de las búsquedas, así como la automatización de procesos legales. Este estudio subraya el potencial de la IA en el ámbito jurídico y resalta la necesidad de continuar investigando para abordar los desafíos únicos de la RIJ.

Palabras claves: inteligencia artificial, derecho civil, recuperación de información jurídica, expansión automática de consultas, algoritmos de clasificación de textos.

1. Introduction

In today's fast-evolving technological landscape, the intersection between artificial intelligence (AI) and the legal field has become fertile ground for innovation [1, 2]. The adoption of advanced technologies, such as AI and analytical algorithms, has drastically transformed legal activities, offering solutions to problems like inefficiency and repeatability [3, 1]. These advanced technologies are altering conventional practices for both lawyers and citizens by automating tasks, enhancing information retrieval, and enabling more explainable decision-

making processes [3, 4]. As AI facilitates the handling of redundant tasks, legal professionals can focus on more complex issues, improving efficiency and accuracy [5]. The ability of AI to provide transparency and support better decisions is particularly valuable in the legal context, where trust and explainability are paramount [4, 5, 6] .

Today, it is common for legal professionals to utilize AI through software and technological tools. From speeding up processes to assessing credit risks, AI plays a crucial role in courts, legal departments, public authorities, and everyday life [7, 8]. The need to optimize legal processes and information retrieval has driven the use of AI-based approaches [7, 8]. This includes the development of systems for automated legal knowledge extraction [9], semi-automated ontology generation for legal question answering [10], and the application of NLP (natural language processing) and ML (Machine Learning) techniques for legal text classification and judgment prediction [11, 12]. Furthermore, AI aids in managing and analyzing arguments in legal documents, enhancing the accessibility and efficiency of legal information retrieval [7, 13, 14].

Artificial Intelligence (AI) has played a key role in addressing the challenges of Legal Information Retrieval (LIR). LIR involves searching and analyzing relevant documents to meet users' information needs, yet it faces difficulties due to the complexity and variability of the legal language and vast amount of available information sources [10, 15] or processing long legal documents [16] AI techniques such as machine learning [5, 11], natural language processing [4], ontologies [10], and named entity recognition have been leveraged to tackle these issues. However, these approaches must also overcome challenges such as data scarcity [17] and the need for explainable AI models [4] to ensure trustworthiness and effectiveness.

This article presents a systematic mapping of the literature, focusing on AI techniques such as machine learning (ML), natural language processing (NLP), and ontologies, and their applications in addressing key challenges in Legal Information Retrieval (LIR), including managing complex legal language, enhancing knowledge extraction, and improving the accuracy and explainability of legal information retrieval.

Through an exhaustive and critical review of the literature, this study seeks to understand emerging strategies and AI techniques in this field, identify gaps in current research, and highlight areas where AI has been successful. These findings will contribute to the theoretical and practical development of LIR, providing guidance for future research and promoting improvements in the efficiency and effectiveness of LIR systems, ultimately enhancing the impact of AI in the legal domain and beyond.

The search for information and query expansion is addressed through entity-based models [8] and prior knowledge. Other studies ([2, 15, 18]) have highlighted the need to standardize judicial processes and the lack of relevance in legal information retrieval systems. This systematic mapping aims to understand the current landscape and future trends at the intersection of AI and legal information retrieval, providing a solid foundation for research and development in this field

This work utilizes a systematic mapping method based on the Brereton et al. [19] methodology, which includes research questions, followed by the description of the search and article selection process. The results highlight key findings and emerging trends in the field. Finally, the conclusions provide reflections on these findings. The rest of the article is structured as follows. Section 2 presents the research questions. Section 3 describes the review methods used. Section 4 details the search process. Section 5 shows a synthesis of the extracted data. Finally, Section 6 discusses the conclusions.

2. Research questions

One of the most important aspects of a systematic mapping is the research questions, which guide a critical analysis as proposed by [19]. These questions were developed to identify the underlying motivations of the reviewed studies, the AI techniques employed, and the problems or barriers faced by researchers. The following table summarizes the key research questions and their respective motivations, providing a framework for the subsequent synthesis and discussion of the results obtained.

Table 1. Guiding questions for the mapping

RESEARCH QUESTIONS	MOTIVATION
Q1. What are the main motivations for the article?	M1. Determine what are the main uses and applications that are sought to be obtained from the research.
Q2. What AI techniques were applied?	M2. Detect what are the methods and tools for information retrieval and categorization of legal texts.
Q3. What are the main problems, barriers and setbacks reported?	M3. Determine which and what common impediments the researchers encountered in carrying out their research.

Q4. What datasets and evaluation metrics were used in the studies?	M4. Understand the data sources and performance measures employed to validate the proposed AI techniques for Legal Information.
Q5. What are the key contributions and future directions identified by the studies?	M5. Determine the novelty and potential impact of the research, as well as the areas needing further investigation.

3. Review Methods

This section follows a protocol which was used for search and selection of articles following three basic steps: selecting databases for the search (detailed in the "Sources" section), defining a search string in the "Definition of Terms" section, and using inclusion and exclusion criteria for filtering the articles (explained in the "Inclusion and Exclusion Criteria" section).

3.1. Sources

To obtain the articles for this systematic literature review, electronic sources related to Information Retrieval, knowledge ontologies, and artificial intelligence in legal systems were used. The sources consulted were: IEEE, ACM, ResearchGate, Science Direct, ArXiv, Springer, and Sedici (Table 2).

Table 2. Libraries used

Sources
IEEE Xplore Digital Library
ACM Digital Library
ResearchGate
Science Direct
ArXiv
Springer
Sedici

3.2. Definition of Terms

Based on Brereton et al. [19], terms were defined in both English and Spanish, along with their acronyms, to generate search strings that cover the key concepts of the research. These terms were selected based on the research questions and the main concepts of the study to ensure comprehensive coverage of relevant topics. Subsequently, search strings were created using four elements: Artificial Intelligence (AI), Natural Language Processing (NLP), Information Retrieval (IR), Machine Learning (ML), and Legal. This selection allows for identifying relevant studies related to the application of advanced technologies in the legal domain and information retrieval. Table 3 summarizes the search strings.

Table 3. Research strings

Search string #	Search String Value
1	(“legal” AND ((“AI” or “Artificial intelligence” OR "Machine Learning" OR "ML")) OR (“Inteligencia artificial”)) AND ((“Information Recovery”) OR (“Recuperación de la information”))
2	(“legal” AND ((“AI” or “Artificial intelligence” OR "Machine Learning" OR "ML")) OR “Inteligencia artificial”) AND ((("NLP" OR "natural language processing" OR "Named Entity Recognition" OR "NER" OR "Text Summarization" OR "Text Classification" OR "Argument Mining" OR "Automatic Query Expansion" OR "AQE")) OR (("PLN" OR "procesamiento del lenguaje natural")))
3	“Legal” AND (“Information Recovery” OR “Recuperación de la informacion”) AND (“Legal” AND ("NLP" OR "natural language processing") OR (“PLN” or “procesamiento del lenguaje natural”))

3.3. Inclusion and exclusion criteria

To filter the articles from the databases, selection rules were applied iteratively. Relevant articles were chosen for this research and analyzed in detail in the following sections with additional filters. The inclusion and exclusion criteria for selecting the articles are detailed in Tables 4 and 5, respectively.

4. Search for papers

Following the protocol described by Brereton et al. [19] a review protocol was implemented to search selected databases, yielding a total of 3405 articles. The inclusion and exclusion criteria were applied in two stages. In the first stage, titles, abstracts, and keywords were examined, reducing the number to 587 articles. In the second stage, a thorough review of the full texts was conducted to ensure that the studies met the established criteria and answered the research questions. As a result of this process, 34 final articles were selected for this systematic mapping.

Table 4 Inclusion Criteria

Inclusion criteria #	*Definition*
IC 1	Accurate digital libraries: We evaluated the quality, quantity and reliability of the published studies from seven digital libraries. We analyzed IEEE Digital Library, ACM Digital Library Science Direct, Springer, arXiv, Sedici, and ResearchGate
IC 2	Consistency of the study: It was validated that the studies were related to the field of computer science. To do this, the field of study and the title of the articles were identified.
IC 3	Full-text studies: All the studies identified in the Digital Libraries were reviewed, validating the completeness of the information. In this way, only full studies were included.

IC 4	The publication is in English or Spanish
IC 5	Articles within the 2010-2024 interval

Table 5 Exclusion Criteria

Exclusion criteria #	***Definition***
EC 1	Duplicate studies: Duplicate studies from different Digital Libraries were eliminated. The purpose of this exclusion criterion is to reduce the volume of unnecessary information.
EC 2	Studies based only on a particular opinion: Studies that only mention a particular opinion were excluded. The purpose of this exclusion criterion is to have studies based on validated scientific hypotheses.
EC 3	Studies that do not mention the criteria used for the application of Information Retrieval or Artificial Intelligence or Natural Language Processing. Consideration should be given to whether it is within the scope of law.
EC 4	Unclear or ambiguous studies: Studies that did not clarify their contributions or did not clarify their relationship with the field of Law or Advocacy were discarded.

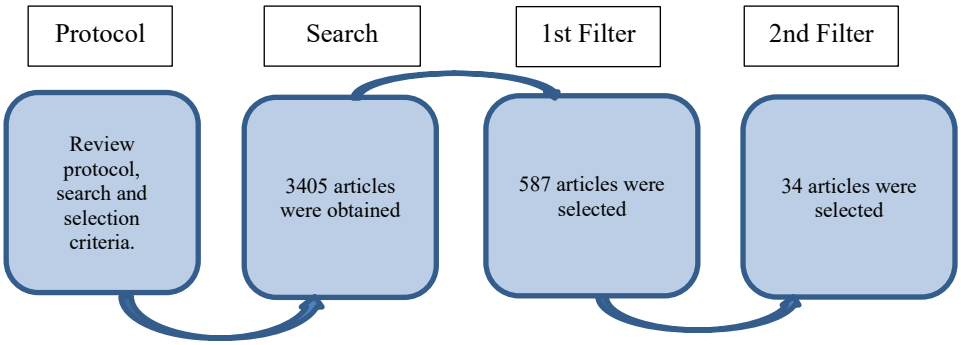

Fig 1 Review Protocol.

5. Synthesis of Extracted Data

The search and selection of works provided a set of studies representing trends within the research topic for the specified period. Below are the results obtained for each of the research questions:

Q1. What are the main motivations for the article?

Artificial Intelligence (AI) offers opportunities and challenges in the judicial domain. Some motivations for investigating AI in the legal field include:

- Improving search effectiveness Automatic Query Expansion (AQE) is important to improve search effectiveness because the user's original query is augmented by new features with a similar meaning [20]. Moreover, a model based on ontologies and semantic distances is designed and implemented to improve the user's consultation and obtain relevant sentences[21]. Also, a legal information retrieval system with entity query expansion by relevance feedback seeks to improve the precision of results when searching for relevant jurisprudence [8].
- Aiding legal professionals: The goal of some systems is to provide reasoning support to a legal question answering tool that determines entailment between a pair of texts [10]. Moreover, a knowledge-based AI service platform focuses on assisting companies in researching and successfully addressing compliance issues in a multilingual and multi-jurisdictional scenario [22].
- Enhancing legal processes: NLP techniques are used for textual classification, with the purpose of categorizing the descriptions of the services provided by the Public Prosecutor's Office in one of the areas of law covered by the institution, which automates the process of assigning petitions to their respective areas of law [12]. Because of AI tools, the reduction of time in the search and analysis of the information is coadjuvant, which improves the study and analysis of the legal bodies [23].

Therefore, the main uses and applications pursued include question answering, document

summarization, semantic search, and improved access to justice [23, 10].

Q2. What AI techniques were applied?

Several AI techniques have been applied for information retrieval and categorization of legal texts, with the goal of enhancing legal intelligence and streamlining various tasks.
For instance, Machine Learning (ML) techniques are applied for multi-label classification of judgements, which can be useful when legal practitioners search jurisprudence [5]. Also, Machine learning is used to classify legal texts in an explainable manner, analyzing features and decision paths to provide understandable information to end-users [4]. Furthermore, Machine learning algorithms and deep learning are applied to predict the court rulings [24].

The application of natural language processing (NLP) and machine learning to predict court outcomes in Turkey's higher courts, using techniques such as named entity extraction and linear regression [24]. The article [25] highlights data mining, ontology construction, and AI integration with databases to improve decision support systems, using strategies such as web crawler design and automatic ontology generation. In [26], NLP, semantic analysis, ontology development, and machine learning are used to classify legal texts. Data preprocessing, feature extraction, and machine learning algorithms were applied to extract and classify judicial data using methods such as lexical analysis and cross-validation [27]. Supervised machine learning and NLP techniques categorized risk levels in legal documents by transforming text into numerical representations and evaluating the models' effectiveness using specific metrics [28]. SVM and Random Forest algorithms were employed to identify argumentative elements, build arguments, and structure premises and conclusions, following a sequential three-module approach [7].

Another technique, Deep Learning approaches, such as those based on Transformer models like BERT and Longformer, have demonstrated robustness over traditional methods for legal documents [1]. Deep learning has widened the area of applications in NLP especially, in the field of legal intelligence [17].
In another branch for AI techniques, Semantic analysis involves techniques like Latent Semantic Indexing (LSI), which replaces observed features of documents with a new set of uncorrelated features. Additionally, semantic parsing of questions based on roles is utilized [20] .

Next, Automatic Query Expansion (AQE) is used to expand the original query with terms that best capture the user intent.
All these AI techniques show the variety of approaches to addressing challenges related to legal text analysis, decision-making, contributing in this way to various applications, including legal question answering, document summarization, semantic search, and improved access to justice.

Q3. What are the main reported problems, barriers, and setbacks?

Efforts to incorporate AI Techniques into the legal field have encountered several notable problems and challenges. In [5], the importance of explainability in machine learning within the legal context is highlighted, considering ethical, trust, and accountability implications. The article [25] mentions issues such as data quality and availability, and the need to integrate AI with databases to achieve precise semantic interpretation and automatic ontology generation. On the other hand, [27] highlights common barriers such as the lack of knowledge in its application, the risk of bias, security and data privacy concerns, model interpretation, and resistance to change. Ethical challenges and the potential to exacerbate existing inequalities are also mentioned. The article [28] points out the lack of standardized data for training models and the complexity of legal language. In the same path, [29] highlights that small dataset pose a problem in practical research, especially in NLP. The limited size of training data can affect the performance of machine learning models. Even more, the generalization of the framework across different jurisdictions with varying regulations is also highlighted as a difficulty. In the case of [7], the complexity of identifying boundaries and argumentative components in legal texts is emphasized, along with their interconnection, which can affect precision.

Article [20] mentioned that term mismatch problem, where indexers and users do not use the same words, affects retrieval effectiveness. Synonyms and polysemy compound this issue. Additionally, improper query expansion can alter the focus of a search topic, hurting precision. Additional terms correlated with single query terms may match unrelated concepts. On top of that, all AQE (Adaptative Query Expansion) techniques rely on several parameters. Retrieval performance is usually markedly dependent on the parameter setting hence the execution of expanded query may become too slow.

Even more, language ambiguity is a significant obstacle, particularly with one-to-many associations where a term's relationship to the query as a whole may not be accurately reflected [20]. Confusing fact

descriptions and similar law articles can lead to misjudgments [11] .
In another hand, [10] mentioned that techniques may lack the legal knowledge and reasoning required to determine entailment in bar examination questions. Additionally, [10] showed up that extracting all required facts for reasoning can be problematic, with open domain information extraction tools sometimes failing to capture necessary details.
Furthermore, the usage of legal jargon is an interference to obtaining rigorous results in legal IR applications, as well as, recognition of legislative modifications is intricate due to the absence of a standard encoding for the codification of amendments or repeals [14].
These studies collectively expose a series of common challenges, such as interpretability, data quality, legal language complexity, and ethical concerns, which must be addressed to ensure the effective and ethical implementation of AI in the legal domain. Consequently, these impediments highlight the necessity for ongoing research to tackle these issues, enhance the robustness and applicability of AI tools, and guarantee more precise and equitable results within the legal domain.

Q4. What datasets and evaluation metrics were used in the studies?

In order to evaluate the effectiveness of each AI Technic utilized, there were some decisions involved such us, determine which asset will be used to evaluate the proposed AI Technique and then, be able to measure efficiency.
For instance, [1] uses a dataset with 768 **articles** from the Civil Code. To accomplish this, employs an F2 **score** as the primary evaluation metric, along with precision and recall. The system achieved a state-of-the-art **F2 score** of **76.87%**. In a similar way, [12] article uses a dataset containing **17,740 documents** from 18 different fields of law, obtained from petitions registered in the PRO-MP system between 2016 and 2019. Additionally, [8] employs a set of court documents to populate the knowledge base, with sources of information from the SAIJ (Sistema Argentino de Información Jurídica).

In [7], it is utilized **Case-Law issued by the European Court of Human Rights (ECHR)** annotated by Mochales-Palau and Moens which employed the **F-measure** to evaluate the performance of the Random Forest (RF) algorithm.
Another article such us [10], uses Models legal knowledge from **US bar examination preparatory materials**, including bar exam curriculum, course material, and legal textbooks which allow to evaluate valuates the semi-automatic ontology generation tool, measuring the number of **classes**, **subclasses**, **instances**, **object properties**, **and axioms** generated both manually and automatically.
The author Carpineto in [20], used the standard test collections called **Trec** to evaluate retrieval effectiveness. The metrics such us as **average precision** to compare AQE methods, often in conjunction with baselines and true relevance feedback and also, mentions other evaluation methods.
Additionally, [9] employed a real dataset of **180,000** court decisions of the State of Illinois taken from the Caselaw Access Project (CAP) which assesses terminology and bootstrapping effectiveness, focusing on the terms discovered by the proposed framework.

In the article [4], uses a **real annotated experimental data set**, paying particular attention to explaining the decisions, but in [17] evaluates metrics including **intrinsic** or **extrinsic measures**, **manual evaluation techniques** (readability, coherence), and automatic evaluation using ROUGE measures (ROUGE-L). The article [17] also considers **sentence similarity** by measuring the cosine similarity between sentences transformed into vector spaces.

Reviewing which what was used in the Chinese and Japanese Law, [11] employs two datasets from the **Chinese AI and Law challenge (CAIL2018)** called CAIL-small and CAIL-big, and for the article [16], uses the **CJRC dataset (Chinese Judicial Reading Comprehension)**, providing statistics on the number of case documents, average document length, and types of questions. Likewise, [30] article uses the competition data of the information extraction track of the 2021 China Legal Intelligence Technology Evaluation Competition as the data set. For the article [14] uses tests methods with the **COLIEE 2017 data set**, comprising 659 queries and 1,098 articles of the Japanese Civil Code.

In regard of predicting outcomes of Canadian appeal cases, the article [6] defines the task as a binary classification problem between 'Allow' and 'Dismiss' and this, achieves high accuracy (93.46%) and **F1-scores** (0.92) using Deep Learning (DL) models.
In a similar way as previous articles, [29] article uses the **BERT** encoder and adds an attribute extraction network to solve the problem of unbalanced distribution which achieves an accuracy of **90.35%** on small sample data with an **F1** value of **67.62.**

Therefore, diverse datasets and metrics are used, reflecting the variety and complexity of legal AI applications. These validation methods are crucial for ensuring reliability. [9, 17, 11, 8, 12, 6, 30, 31, 29,14]

Q5. What are the key contributions and future directions identified by the studies?

To recognize the potential impact and development of AI in legal information systems, this section synthesizes the key contributions of the attached studies and considers their proposed future research directions. The studies point out the innovation of their approaches, along with recognition of areas needing further investigation.

Several studies concentrate on **improving legal information retrieval systems** [1, 8]. For example, one study presents particular models to tackle the challenges posed by different languages and long legal documents [1]. Furthermore, one study details an information retrieval system with entity query expansion that uses relevance feedback, specifying that suggested terms should be semantically related to the query [8] . Another study, "Legal Content Fusion for Legal Information Retrieval," suggests legal term translation to overcome general and legal term discrepancies and to improve legal information retrieval methods [14]. Therefore, these studies contribute to making legal information retrieval systems more precise and relevant [1, 8, 14].

Other studies focus on **argument mining and legal text classification**:

- One study proposes a phased approach to automatically identify arguments in legal documents using the Argument Element Identifier (AEI), Argument Builder (AB), and Argument Structurer (AS) modules [7]. It suggests that more research should explore string kernels and other representation models, like linguistic features such as POS tags and parse trees.
- Moreover, one study focuses on classifying petitions to the Public Prosecution Service, with future work aimed at integrating a model that identifies the most relevant words to the predicted class and updating methodologies for contextualized sentence representation using language models and transformer architectures like BERT [12].
- Also, one study details an automatic analysis and explanation of Spanish legal texts using NLP techniques and ML algorithms. The study plans to extend its analysis to other languages and court systems.[4]

Several studies focus on **knowledge models, ontologies, and annotation**:

- One study emphasizes that its system does not address a range of challenging issues such as defeasible reasoning complex compound nouns, polysemy, legal named entity recognition, and implicit information in legal text. It suggests that ontology learning techniques might be used to learn further OWL (Web Ontology Language) axioms, which can be used together with SWRL rules (Legal rule acquisition and representation), and aims to develop a Legal NER (Named Entity Recognition) system to identify legal named entities [10].
- Another study [13] aims to use its NERC (Named Entity Recognition and Classification) and NEL (Named Entity Linking) to speed up the manual annotations of the judgments of the ECHR (European
- Court of Human Rights) and obtain new mentions and entities to populate their legal ontology.
- In a similar vein, one study [9] indicates that ongoing research activities aim to extend the CRIKE (CRIme Knowledge Extraction) framework with multi-label classification techniques, relying on classifiers like random forests or neural networks to detect candidate terms and using black-box model explanation tools like LIME to support legal experts in choosing relevant terms.

In addition, one study [20] focuses on **automatic query expansion** (AQE). The article identifies open issues and suggests research directions, noting that most current research efforts aim to improve the retrieval effectiveness and robustness of AQE. It also mentions that researchers are investigating integrating personal and negative relevance feedback information into the AQE framework, as well as more sophisticated forms of implicit user feedback like eye tracking.

Furthermore, another study mentions that **training and formation of human resources** through refresher and postgraduate courses in the area of study, is expected, with the consolidation of team members as researchers [2].

Finally, one study, regarding **legal judgment prediction for Canadian Appeal Cases**, notes that attention scores have the potential to be utilized as a proxy for feature extraction and that this measure will be reviewed and evaluated in their future work [6]. Also, one study expresses that the extent to which it is consistent and aligned with fairness and justice, are open problems for future research [24].

In conclusion, the studies collectively drive advancements in legal information systems through diverse contributions, while their proposed future directions highlight a commitment to refining AI-driven legal technology, expanding the scope and applicability of legal datasets, and developing more

nuanced models.

5.1. Results

Appendix 1 shows analyzed articles with the details of the answers to the research questions.
Figure 2 below shows the number of selected articles per year throughout the period considered in this systematic literature mapping. This annual distribution allows for the observation of research trends in the use of artificial intelligence in the legal domain, highlighting a growing interest and increase in study production in recent years. Peaks in certain years suggest moments of special relevance or advancements in technologies applied to law, such as natural language processing and machine learning, reflecting the ongoing drive to integrate artificial intelligence approaches into the judicial system and legal information retrieval.

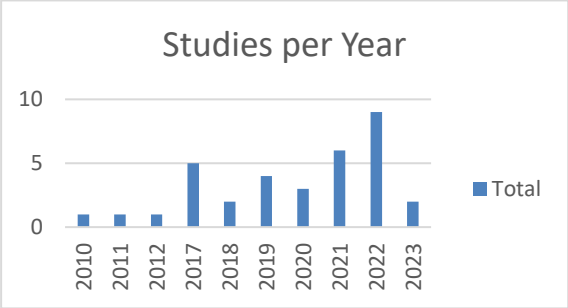

Fig 2 Number of studies per year.

Figure 3 presents the distribution of the articles selected in this systematic mapping according to the AI techniques applied. This figure catalogs the main techniques discovered in each article according to the proposed classification of authors, including Natural Language Processing (NLP), Machine Learning (ML), Deep Learning (DL), Expert Systems, and Information Retrieval (IR).
Each branch of the map expands into specific techniques within these wider groups, showing the diversity of AI approaches used in the legal domain. The visualization highlights the interconnections between techniques and provides a structured view of the predominant methodologies applied in legal.
This representation not only showcases the variety of AI techniques but also helps recognize emerging trends and areas with significant development in the intersection of artificial intelligence and law.

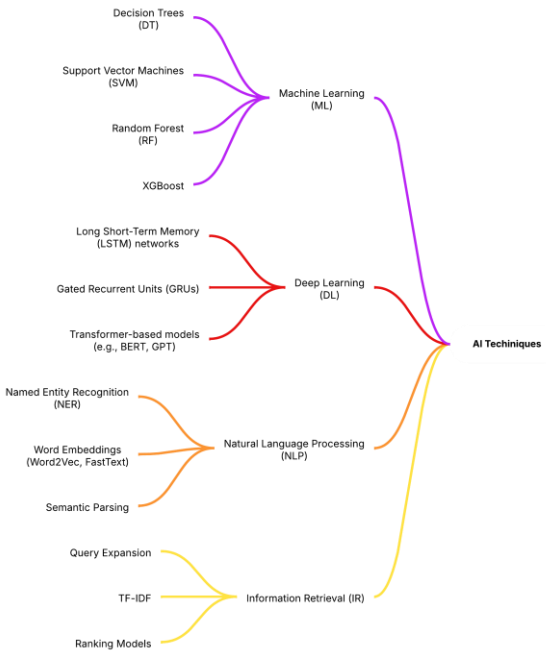

Fig 3 AI Techniques across article studies.

The following figure 4 proposes a visual representation of the AI techniques applied in the field of Legal. Based on the systematic literature review, the graphic shows up AI utilizations according to current review.
This visualization aims to provide a structured overview of the predominant AI Applications. By mapping out these applications, this study facilitates a clearer understanding of how AI is transforming the way legal professionals interact day after day.

Fig 4 AI Applications in Legal across article studies.

Within the group of works selected for these studies, author established that the articles mainly address five key categories: “Legal Information Retrieval”, “Legal Text Classification”, “Argument Mining and Legal Reasoning”, “Legal Knowledge Representation and Management” and “Legal Knowledge Representation and Management”. These

categories were defined to organize and highlight the dominant approaches in current literature, addressing everything from the general application of AI in the legal system to the specific use of technologies such as information retrieval and natural language processing. In order to understand why these categories were created, here is each category with its explanation:

- Legal Information Retrieval (LIR): In this category are studies that aim to improve the accuracy and efficiency of retrieving relevant legal information from large collections of legal documents. In here involves developing and applying techniques such as **query expansion**, **semantic analysis**, and the **use of ontologies** to better match user queries with relevant documents. The motivation is to overcome the limitations of keyword-based searches and improve access to justice.
- Legal Text Classification (LTC): inside this category are studies that focus on automatically classifying legal texts into predefined categories or areas of law. The techniques used often involve **machine learning** and **natural language processing** to **analyze the content of legal documents** and **assign them to the appropriate category**. The goal is to automate tasks such as document routing, topic identification, and legal research.
- Argument Mining and Legal Reasoning (AMLR): here are find studies that aim to extract and analyze arguments from legal texts. This involves identifying argumentative components, such as premises and conclusions, and understanding the relationships between them. The techniques used often involve **machine learning** and **natural language processing** to **model legal reasoning** and **support legal decision-making**.
- Legal Knowledge Representation and Management (LKRM): involved studies that focus on representing and managing legal knowledge using formal structures such as ontologies and knowledge graphs. These structures are used to capture the relationships between legal concepts, entities, and rules, and to support tasks such as legal reasoning, question answering, and information retrieval. The goal is to **make legal knowledge more accessible** and **usable for both humans and machines**.
- Legal Text Summarization (LTS): in this category centers on summarizing legal documents using techniques like extractive or abstractive summarization. These summaries aid legal professionals in quickly understand the main points, enhancing their effectiveness.

Table 6 classifies the 34 analyzed studies within these categories, sorted by its publication year, and providing a concise description of each study's contribution.

Table 6 Initial contribution of each article

TITLE	YEAR	CITATIONS NUMBER	CATEGORY	CONTRIBUTIONS
Using Artificial Intelligence Tools in the Judicial Domain and the Evaluation of their Impact on the Prediction of Judgments	2023	19	LTC	Clarifying different forms of use and impact of AI tools in the judicial domain to develop an intelligent automatic judgment prediction system
Automatic explanation of the classification of Spanish legal judgments in jurisdiction-dependent law categories with tree estimators	2023	6	LTC	Combines NLP and ML to classify legal texts and provide explanations for the classifications
Improving legal judgment prediction through reinforced criminal element extraction	2022	58	LTC	This study focuses on improving the accuracy of predicting legal judgments by extracting criminal elements from legal texts, using techniques like reinforcement learning and neural networks
Explainable machine learning multi-label classification of Spanish legal judgements	2022	12	LTC	Uses ML for multi-label classification of legal judgments, providing visual and natural language explanations

Legal Judgment Prediction for Canadian Appeal Cases	2022	8	LTC	The study focuses on predicting the outcomes of Canadian appeal cases using NLP and ML methods, treating it as a binary classification problem
Modern Theoretical Tools for Understanding and Designing Next-Generation Information Retrieval	2022	4	LIR	Discusses advanced theoretical tools for resolving modern IR problems
Legal Information Retrieval System with Entity-Based Query Expansion: Case study in Traffic Accident Litigation	2022	3	LKRM	Builds a legal knowledge base and ontology, extending ranking to retrieve entities using similarities of types and entities
A Legal Information Retrieval System for Statute Law	2022	3	LIR	Improves legal information retrieval using Transformer-based approaches to address challenges related to language differences and long legal texts
Design and Implementation of Intelligent Reasoning Engine Based on Legal Framework Network Database	2022	1	LKRM	It is about creating a legal framework ontology through information under each framework, and improve the framework library, vocabulary library and the example sentence library
Named Entity Recognition of Chinese Legal Text Based on BERT	2022	1	LKRM	Designs a named entity recognition method for Chinese legal text based on BERT, enhancing the extraction and organization of legal information
Desarrollo de Interfaces de Programación de Aplicaciones aplicadas en Experticia, un Sistema Experto Jurídico	2022	0	LKRM	Improve the resolution of legal procedures by optimizing times and collaborating with the work of officials through a legal expert system
Lawformer: A pre-trained language model for Chinese legal long documents	2021	249	LTC	The paper introduces Lawformer, a Chinese legal pre-trained language model capable of processing long documents. It aims to enhance legal document understanding and proposes new legal judgment prediction datasets for criminal and civil cases. Lawformer is the first pre-trained language model for legal long documents
Natural language processing in law: Prediction of outcomes in the higher courts of Turkey	2021	87	LTC	Predicts case outcomes in Turkish higher courts using a deep learning model
Lynx: A knowledge-based AI service platform for content processing, enrichment and analysis for the legal domain	2021	32	LKRM	Describes a knowledge-based AI service platform using NLP and Information Retrieval (IR) services
Deep Learning Techniques for Legal Text Summarization	2021	28	LTS	Systematically compares deep learning strategies for summarizing legal texts
A knowledge-centered framework for exploration and retrieval of legal documents	2021	20	LKRM	Introduces CRIKE, a framework that uses multi-label annotation and information retrieval techniques to improve legal document exploration.
Research on Small Sample Text Classification Based on Attribute Extraction and Data Augmentation	2021	4	LTC	Improves classification results with small data using BERT for charge prediction
Legal Document Classification: An Application to Law Area Prediction of Petitions to Public Prosecution Service	2020	33	LTC	Uses NLP techniques to categorize services provided by the Public Prosecutor's Office
Inteligencia artificial aplicada al Poder judicial	2020	4	LKRM	This study focusses on the development of an IT tool to systematize and optimize judicial processes, with the intention of later applying AI techniques to improve these processes

Design of Contract Review System in Enterprise Legal Department Based on Natural Language Processing	2020	4	LIR	The article discusses a system that offers retrieval support for legal provisions and relevant cases, using NLP to preprocess regulatory data, extract information features, and apply information retrieval algorithms to improve retrieval speed. The system selects relevant contract law cases from a large database of judgment documents and extracts keywords for legal specialists to search for reference
A Semi-automated Ontology Construction for Legal Question Answering	2019	57	LKRM	Presents a methodology for semi-automatically constructing legal ontologies from legal texts
Use of Artificial Intelligence to Analyse Risk in Legal Documents for a Better Decision Support	2019	27	LTC	Uses machine learning and NLP to review and assess risks in legal documents
Recognition of Situations Described in the Text of Legal Documents	2019	4	LTC	Using the situational approach and nuclear semantic structure to formalize situation descriptions for training sets
Modelo de Recuperación de Información Jurídica basado en ontologías y distancias semánticas	2019	0	LIR	Presents a model based on ontologies and semantic distances to improve search and retrieval of legal documents
A Machine Learning Approach to Argument Mining in Legal Documents	2018	10	AMLR	Proposes a system using machine learning to identify and structure arguments in legal texts
Mejora del acceso a Infoleg mediante técnicas de procesamiento automático del lenguaje	2018	4	LIR	Presents an approach for the Automatic Detection of Entities in legal texts, and its application to the InfoLeg corpus
On the concept of relevance in legal information retrieval	2017	155	LIR	The key contribution is a conceptual framework based on a typology of six dimensions used within general information retrieval science, tailored to the specific features of legal information
A Low-cost, High-coverage Legal Named Entity Recognizer, Classifier and Linker	2017	78	LKRM	Creates a legal Named Entity Recognizer, Classifier, and Linker to improve Information Extraction in legal texts
Modeling and Querying Greek Legislation Using Semantic Web Technologies	2017	45	LKRM	The article focuses on employing semantic web technologies for modeling and querying legislative content to make it more accessible. It discusses the adoption of web standards like XML, RDF, and SPARQL, as well as vocabularies and ontologies for legislative documents, such as Akoma Ntoso, MetaLex, and the European Legislation Identifier (ELI). The aim is to unify and link national legislation with European legislation
Legal Content Fusion for Legal Information Retrieval	2017	8	LIR	Uses TF-IDF and SVM re-ranking models, as well as Word2Vec
Question Answering of Bar Exams by Paraphrasing and Legal Text Analysis	2017	6	AMLR	Combines legal information retrieval and textual entailment to answer yes/no questions from legal bar exams
A Survey of Automatic Query Expansion in Information Retrieval	2012	1156	LIR	Provides a comprehensive overview of automatic query expansion techniques for information retrieval
Knowledge Discovery from Legal Documents Dataset using Text Mining Techniques	2011	26	LIR	Aims to group legal documents based on content using unsupervised text mining techniques
Named Entity Recognition and Resolution in Legal Text	2010	143	LKRM	Discusses named entity recognition and resolution in legal documents using various methods

6. Conclusions

This Systematic Literature Mapping aimed to identify and analyze key trends and approaches at the intersection of AI techniques and categorization in the legal field. The central objective was to analyze the current body of research, elucidating both the progressive advancements in AI techniques and the inherent challenges encountered within this evolving domain.

Through the review and analysis of a wide range of studies, it was determined that there are diverse range of studies revealed varied motivations driving research in this domain. These motivations span from analyzing the impact of AI on judicial decision-making to automating legal processes through Natural Language Processing (NLP), encompassing a broad spectrum of legal and technological challenges.

The array of AI techniques employed across these studies underscores the breath of approaches applied to legal text analysis. From unsupervised text mining and ontology construction to AI-database integration and diverse machine learning applications, a clearly multidisciplinary approach is apparent, integrating advanced techniques to address specific challenges within the legal domain.

The Systematic Literature Mapping also brought to light several recurring challenges and limitations, including the imperative for enhanced explainability in AI models, the inherent complexity of legal language (spanning the gap between AI's analytical capabilities and the nuanced interpretation of legal texts), the persistent issue of data standardization (variations in data formats, annotation inconsistencies, and limited availability of labeled legal corpora restrict the ability of AI models to generalize across diverse legal contexts), and salient ethical considerations surrounding automated legal decision-making. These challenges highlight that realizing the full potential of AI in the legal field requires not only technological advancements but also a concerted effort to address issues of transparency, linguistic complexity, data standardization, and ethical responsibility. Overcoming these obstacles is essential for development trust and ensuring that AI helps as a valuable tool for enhancing the legal system.

The analysis of study results and categorizations revealed a dynamic and rapidly evolving field, offering substantial potential for enhancing both efficiency and accuracy within the judicial system. Looking ahead, this Systematic Literature Mapping highlights several promising avenues for future investigation. It is suggested to explore more robust approaches to the interpretability of AI models in the legal field, as well as to expand research on the automation of legal ontology construction and the integration of intelligent reasoning engines. Additionally, it is recommended to investigate solutions for data standardization and address ethical and equity challenges in automated decision-making.

In summary, this systematic literature mapping has provided clarity regarding the current state of information retrieval and categorization within the legal context. By outlining key trends, AI techniques, and persistent challenges, this mapping establishes a robust foundation for future research endeavors aimed at advancing the effective and ethical integration of AI in the legal domain, therefore fostering more efficient, transparent, and equitable decision-making processes.

Authors' Contribution

JD: Conceptualization (lead); Investigation (lead); Writing – original draft (lead); Writing – review & editing (equal).
CP: Supervision (lead).
LA: Supervision (lead).
All authors reviewed the results and approved the final version of the manuscript.

Competing Interests

The authors have declared that no competing interests exist.

Declaration of Generative AI and AI-assisted Technologies in the Writing Process

The authors declare that no generative AI or AI-assisted technologies were used in the preparation of this manuscript.

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7. Appendix 1

STUDY	YEAR	MAIN MOTIVATION	MAIN PRLOBLEMS, BARRIERS, AND SETBACKS?	DATASETS AND EVALUATION METRICSUSED	FUTURE DURECTIONS
Inteligencia artificial aplicada al Poder judicial [2]	2020	Generate knowledge in the analysis, design and construction of a computer tool that helps in the systematization and optimization of judicial processes.	N/A	N/A	Establish a starting point for future exploration of other AI areas to further optimize the process without compromising quality.
On the concept of relevance in legal information retrieval [15]	2017	Develop a framework for the concept of relevance in legal information retrieval and suggestions for improvements in LIR systems.	Retrieval engineering is focused too exclusively on algorithmic relevance, but it has been proven sufficiently that without domain specific adaptations every search engine will disappoint legal users	N/A	All dimensions of relevance have to be considered explicitly while designing all components of LIR systems: document pre-processing, (meta)data modelling, query building, retrieval engine and user interface
Modern Theoretical Tools for Understanding and Designing Next-Generation Information Retrieval [18]	2022	The existing theoretical tools in IR can no longer explain, guide, and justify the newly-established methodologies	Have to bet our design on black-box mechanisms that we only empirically understand.	N/A	The need for modern theoretical tools to understand and design next-generation information retrieval systems.
Knowledge Discovery from Legal Documents Dataset using Text Mining Techniques [32]	2011	Group legal documents based on their contents without external input, using unsupervised text mining techniques	N/A	N/A	N/A
A Survey of Automatic Query Expansion in Information Retrieval [20]	2012	Enhance the relative ineffectiveness of information retrieval systems is largely caused by the inaccuracy with which a query formed by a few keywords models the actual user information need	The additional terms may cause query drift, the alteration of the focus of a search topic caused by improper expansion, thus hurting precision.	TREC collections were used to evaluate the retrieval effectiveness of AQE systems	The key aspects that need to be improved are the robustness of retrieval performance, the automatic setting of parameters, the computational efficiency of executing larger queries, and the usability of an IR system implementing AQE
Modeling and Querying Greek Legislation Using Semantic Web Technologies [33]	2017	Publish legislation as open data using semantic web technologies, making Greek legislation easily accessible to the public	Recognition of legislative modifications is intricate due to a lack of standard encoding** for amendments or repeals	G3 Parser was applied to almost all gazette issues during 2006–2015 (corresponding to 2,676 legal documents) producing approximately 1,85M RDF triples	"Deploy Nomothesia in the governmental portal
A Machine Learning Approach to Argument	2018	Analyze and evaluate the natural language arguments present	Detecting the boundaries of an argument is a very challenging task mainly due to the fact that its components (premise and	"Case-Laws issued by the European Court of Human Rights (ECHR) annotated by	Further research must be done on the use of string kernel as well as other alternative

Mining in Legal Documents [7]		in legal documents.	conclusion) may be connected or related to other arguments.	Mochales-Palau and Moens .	representation models, including linguistic features such as POS tags, Parse trees and Tree Kernel.
Recognition of Situations Described in the Text of Legal Documents [26]	2019	Recognize situations described in legal documents using machine learning to establish a procedure to be performed.	N/A	N/A	N/A
Use of Artificial Intelligence to Analyse Risk in Legal Documents for a Better Decision Support [28]	2019	Assessing risk for voluminous legal documents such as request for proposal, contracts is tedious and error prone	N/A	A dataset consisting of 1,382 paragraphs for training, 151 paragraphs for validation and 75 paragraphs for test Accuracy, Precision, Recall, F-score.	AI-based system makes risk analysis of contracts fast, error free and person independent
Design of Contract Review System in Enterprise Legal Department Based on Natural Language Processing [3]	2020	Solve problems of low efficiency, high repeatability, and no fixed standard in enterprise contract review using information technology	N/A	N/A	Free legal personnel from repetitive work, improve working efficiency of the legal specialist and liberate the productivity
A knowledge-centered framework for exploration and retrieval of legal documents [9]	2021	Support legal knowledge extraction from legal documents and provide relevant suggestions to legal actors for managing new cases	Effectiveness depends on capturing the features of terminology used in legal documents and developing knowledge models where such features are properly formalized	A real dataset of 180,000 court decisions of the State of Illinois from the Caselaw Access Project (CAP) Terminology assessment and bootstrapping assessment	Extending the CRIKE framework with a pool of multi-label classification techniques
Natural language processing in law: Prediction of outcomes in the higher courts of Turkey [24]	2021	Investigate the effectiveness of machine learning models in predicting case outcomes in the legal system of Turkey.	Cases of the Courts of Appeal do not contain readily extracted features. Their documents also do not follow a strict pattern	Cases from the Turkish Constitutional Court and Civil Court of Appeal Accuracy	Training word embeddings that are suitable to legal applications is a subject that needs to be addressed on its own
Improving legal judgment prediction through reinforced criminal element extraction [11]	2022	Address ambiguous fact descriptions and misleading law articles that lead to misjudgments in Legal Judgment Prediction (LJP) tasks	Indistinguishable fact descriptions with different criminals/targets and misleading law articles with highly similar TF–IDF representations	CAIL-small and CAIL-big datasets. Development experiment results and benchmark datasets were also used	Explore evidence information extraction to provide interpretability and combine coreference resolution to enhance legal judgment prediction
Explainable machine learning multi-label classification of Spanish legal judgements [5]	2022	To apply ML for multi-label classification of judgements and provide visual and natural language descriptions for explanation purposes.	Unstructured judgements require adequate preprocessing and feature engineering, as well as NLP techniques, to take full advantage of ML algorithms	A data set annotated by legal experts. Micro precision	Classification based on eXtreme Multi-label Learning (XML) and explore language models based on transformers
Design and Implementation of Intelligent Reasoning Engine Based on Legal	2022	Design an intelligent reasoning engine based on the legal framework network database	N/A	N/A	N/A

Framework Network Database [25]		and the computational dictionary compilation project.			
Legal Information Retrieval System with Entity-Based Query Expansion: Case study in Traffic Accident Litigation [8]	2022	Improve the precision of results when searching for relevant jurisprudence for lawyers constructing a legal framework for a case.	N/A	A set of court documents used to populate the knowledge base. Quantitative experimentation	Consider legal term translation to overcome the general and legal term discrepancy and improve legal information retrieval methods using contents in the future
Using Artificial Intelligence Tools in the Judicial Domain and the Evaluation of their Impact on the Prediction of Judgments [27]	2023	Present a method of how to use AI tools, measure their impact on the judicial system, and review literature on Machine Learning methods.	Implementing AI tools in justice is still in its infancy, with a lack of knowledge regarding their use in the judicial process.	Studies mentioned used various datasets; Gonçalves and Quaresma achieved 64% performance and 79% f1 score classifying legal texts	Collecting different judgments rendered by Moroccan courts, preprocessing data, extracting features, training classifiers and evaluating the system
A Legal Information Retrieval System for Statute Law [1]	2022	Address challenges in legal queries and legal documents using specialized models for different language and long articles/queries	The application is mainly domain adaptation, without observing the characteristics of the legal articles and legal queries".	The Japanese Civil Code corpus with 768 articles. The F2 measure is used as the official evaluation measure.	Further research to observe and tackle particular characteristics of documents in the legal domain
A Low-cost, High-coverage Legal Named Entity Recognizer, Classifier and Linker [13]	2017	Improve Information Extraction in legal texts by creating a legal Named Entity Recognizer, Classifier and Linker	Few annotated legal corpora exist with annotations for entities, which constitutes an important barrier for Information Extraction from legal text	A Wikipedia corpus. Accuracy, precision, recall, and F1 score were used as evaluation metrics	N/A
A Semi-automated Ontology Construction for Legal Question Answering [10]	2019	Develop "legal ontologies and rules" for a legal question answering tool that determines entailment between background information and a question" [1].	Does not address defeasible reasoning, complex compound nouns, polysemy, legal named entity recognition, and implicit information in legal text.	Source material about criminal law and legal procedures from exam preparation material and bar exam questions. Evaluation based on the automation steps	Uncertainty/fuzzy extensions of OWL and SWRL, legal rule learning, and development of a Legal NER system; issues related to scalability.
Automatic explanation of the classification of Spanish legal judgments in jurisdiction-dependent law categories with tree estimators [4]	2023	Classify legal texts in an "explainable manner" by combining NLP and ML, making models' decisions understandable to end users	Most systems are black boxes, even when their models are interpretable, raising concerns about their trustworthiness.	An annotated data set in law categories by jurisdiction. Accuracy values.	N/A
Deep Learning Techniques for Legal Text Summarization [17]	2021	Address the complexity and length of legal texts by systematically comparing various deep learning strategies for legal text summarization.	Creating a more informative, coherent, fluent, and concise summary remains a challenge; different summarization methods need different architectural approaches	ROUGE scores, sentence similarity, blind evaluation techniques.	Use of transformers, hybrid summarization, and explainable AI to enhance readability.

Desarrollo de Interfaces de Programación de Aplicaciones aplicadas en Experticia, un Sistema Experto Jurídico [34]	2022	Improve the resolution of legal procedures by optimizing times and collaborating with the work of officials through a legal expert system	Manual and asynchronous data input from Augusta, needing validation of the obtained responses.	Data ("datos esenciales") from **Augusta**, the system used by the Judicial Branch of the Province of Buenos Aires.	Evolution of Experticia towards a predictive justice model
Lawformer: A pre-trained language model for Chinese legal long documents [16]	2021	Address the challenge of processing long legal documents by releasing Lawformer , a pre-trained language model for Chinese legal texts.	Mainstream PLMs cannot process long documents due to high computational complexity , limiting their ability to represent legal texts.	Chinese AI and Law challenge (CAIL2018) datasets, Chinese judicial reading comprehension (CJRC). Exact match score (EM) and F1 score, accuracy.	Further explore legal knowledge augmented pre-training.
Legal Content Fusion for Legal Information Retrieval [14]	2017	Address hindrances in legal IR due to complicated legal content structure and legal jargon by applying content contributions to IR processing.	When a query was expressed with common words and composed of a small number of terms, the method did not correctly retrieve the articles	COLIEE 2017 data set MAP@1, MAP@5, MAP@10, Recall@10	Legal term translation, mutatis mutandis relations, reference relations, and precedents
Legal Document Classification: An Application to Law Area Prediction of Petitions to Public Prosecution Service [12]	2020	Automate the process of assigning petitions to their respective areas of law, reducing costs and time while optimizing human resource allocation.	N/A	Descriptions of services provided by the Public Prosecutor's Office of the State of Paraná. Accuracy and F1-Score.	N/A
Legal Judgment Prediction for Canadian Appeal Cases [6]	2022	Predict judicial case outcomes automatically using NLP and ML methods on case documents, focusing on Canadian appeal courts.	Due to the vast volume of case law, it is very difficult and time-consuming for legal professionals to read, understand, and analyze all the available documents	Canadian appeal cases. Accuracy and F1-scores"	Future research on the legal system of Canada
Lynx: A knowledge-based AI service platform for content processing, enrichment and analysis for the legal domain [22]	2021	Assist companies in researching and addressing compliance issues in a multilingual and multi-jurisdictional scenario using a knowledge-based AI service platform.	The standard Akoma Ntoso is fully focused on the assumption that human experts create and maintain documents. The same is true for the guidelines of the Text Encoding Initiative (TEI).	N/A	Combining the chatbot interface with semantic search.
Mejora del acceso a Infoleg mediante técnicas de procesamiento automático del lenguaje [23]	2018	Improve access to legal documentation in InfoLeg using Artificial Intelligence to reduce time in information search and analysis.	Difficulties in linguistic characterization of entities, balancing reliability and coverage of annotations, need for more manual annotations.	InfoLeg corpus, Percentage of errors, false positives and negatives in automatic analysis using StanfordNERC.	Increase manual annotations; improve keyword-based information retrieval and related applications.
Modelo de Recuperación de Información Jurídica basado en ontologías y	2019	Improve the relevance of retrieved legal documents using ontologiesand	The increasing volume of data limits access to relevant information, making precision in search engines vital for user needs.	Model was evaluated based on precision, exhaustiveness, and F-Score.	Increase the number of sentences used; optimize the DJN; perform inferences using ontologies.

distancias semánticas [21]		semantic distances for better search results".			
Named Entity Recognition and Resolution in Legal Text [31]	2010	Recognize and resolve named entities in legal texts for improved legal text processing and information retrieval	Common names in lists may generate many false positives. Requires manual creation of lists and rules.	43,936 U.S. federal cases. Precision, Recall, and F-measure	Create text hyperlinks and indexes
Named Entity Recognition of Chinese Legal Text Based on BERT [30]	2022	Address polysemy and complex context in Chinese legal texts for accurate and efficient information extraction.	Chinese legal texts have a complicated context, are professional, and have diverse entity types, leading to poor NER performance.	Competition data of the information extraction track of the 2021 China Legal Intelligence Technology Evaluation Competition.	Improve robustness and generalization ability of the model
Question Answering of Bar Exams by Paraphrasing and Legal Text Analysis [35]	2017	Combine legal information retrieval and textual entailment for answering yes/no questions from legal bar exams	Legal bar exam queries and relevant articles are complex and varied, requiring careful determination of information for confirming textual entailment.	Training data from the COLIEE-2016 competition. Mean Average Precision (MAP), Precision, Recall, and F-score, Accuracy.	Train word2vec by larger texts and try different kernels for SVM training
Research on Small Sample Text Classification Based on Attribute Extraction and Data Augmentation [29]	2021	Address small data volume and unbalanced distribution of crime categories in crime classification tasks.	Small sample data and unbalanced distribution of crime categories.	Small sample data set. Accuracy and F1 value	Propose a text enhancement method based on back-translation technology