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Dilemma and Unlocking: Application Mechanism and Path Optimization of Judicial Intelligence Discretion System

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Abstract. Driven by the rapid development of artificial intelligence technology and the surge in judicial efficiency, judicial intelligence discretion system has been widely used in China, which has achieved remarkable results in improving judicial efficiency and promoting the concept of fairness and justice of "similar cases and similar judgments." However, the system currently faces multiple dilemmas such as insufficient data quality, algorithm bias, algorithm black box, etc., which seriously restricts its two-way integration with justice and its effectiveness. In this regard, path optimization should be achieved from three dimensions: judicial standard, technical assistance and judge-led, so as to promote the two-way integration of digital technology and justice,and provide dual support of theory and practice for the process of judicial intelligence.

Keywords: judicial intelligence discretion system, algorithm, technology-assisted, judge-led

1. Introduction

Judicial intelligent discretion system refers to an intelligent system that uses artificial intelligence, big data, natural language processing and other technologies to assist judicial personnel to make scientific decisions in sentencing suggestions, case adjudication and other links. Its core purpose is to improve judicial efficiency and unify adjudication standards through technical means, but it cannot replace the final discretion of judicial personnel. With the aid of judicial intelligence discretion system, judicial efficiency and judicial resources are significantly optimized. However, due to technical limitations and other factors, the actual effect of judicial intelligence discretion system is limited. Therefore, we should speed up the two-way integration of artificial intelligence and digital technology, and truly realize the intelligent discretion system to assist justice.

2. Application mechanism of judicial intelligence discretion system

Judicial intelligence system tries to simulate human thinking to achieve logical reasoning, and a large number of judicial databases are also its significant advantages. Therefore, the application mechanism of judicial intelligent discretion system can be divided into three levels: multi-source data integration, algorithm model construction and logical reasoning.

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2.1. Integration of multi-source data

Multi-source data integration, as the cornerstone of judicial intelligent discretion system, makes the messy judgment information appear clearly through structured processing. Specifically, its construction process needs to be elaborated from the following three levels:

First, expand the dimensions of data sources. Judicial data integration not only involves basic information of cases, but also covers multiple information layers such as legal provisions, guiding cases, historical judgment documents and even social public opinions. Taking the procuratorial organ of Hainan Province as an example, it constructs a high-quality knowledge base covering legal norms and case experience by integrating Internet public data and internal procuratorial data, which significantly improves the effectiveness of model training.

Second, drive standard transformations of data structures. With natural language processing (NLP) and OCR, unstructured raw files are transformed into elemental data that can be quantified and analyzed [1].A typical example is the "206 system" of the Shanghai court, which automatically captures the core information of the case and generates standardized documents, which not only greatly improves the availability of data, but also enables the legal provisions and judicial experience to be type-reorganized, and finally forms a rule system that can be analyzed by machines.

Third, build a dynamic governance mechanism for data quality. In order to avoid information distortion in the process of integration, it is necessary to establish a "three-review mechanism" to achieve accurate filtering: firstly, the algorithm initially screens out invalid information, then verifies the logic rationality through business verification, and finally corrects the knowledge deviation by experts. At the same time, the judicial big data platform continuously guarantees the timeliness vitality of the knowledge base through the real-time update of the case base and judicial interpretation.

2.2. Algorithmic modeling

To construct the algorithm model of judicial intelligent discretion system is essentially to seek a balance between the rigid constraints of legal rules and the flexible needs of discretion scenarios. This complex task is not a simple technical stack, but relies on a scientifically designed system:

First, the underlying architecture focuses on precise analysis of legal rules. At this stage, it is necessary to transform the core elements such as the subject of behavior, the nature of behavior and the legal consequences in the legal provisions into a structured language that can be recognized by machines, and the essence is to construct the "digital code" of judgment [2]. For example, text classification technology provides a solid normative basis for discretionary decision-making by automatically encoding legal provisions.

Second, the middle-level mechanism focuses on the dynamic adaptation of discretionary scenarios. The algorithm needs to deeply integrate case facts, evidence chain logic, social influence and other situational elements, and at the same time absorb judge experience to form an "artificial-intelligent" collaborative decision-making model. With the help of machine learning technology, the system can identify abnormal feature points in the judgment of similar cases and realize situational accurate response- [3] for example, Hebei procuratorial big data platform has passedthe "discretionary elastic space" verified by 60,000 criminal governance data.

Third, the top-level fusion realizes the organic unity of rules and scenes. At this level, the system needs to synthesize the outputs of the first two stages to generate discretionary conclusions that are both in line with the spirit of the law and adapt to the complexity of the case.

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2.3. Logical reasoning

The core mission of logical reasoning mechanism of judicial intelligent discretion system is to realize the dynamic adaptation of legal norms and case facts. This process should not only deal with the rigid characteristics of legal system, but also be compatible with the complex situation of real cases, which constitutes a project of integration of technology and jurisprudence. To achieve this dynamic balance, the system must deeply integrate intelligent processing capabilities and massive data analysis capabilities: it can not only automatically retrieve the normative core in legal documents and cases, but also accurately determine the particularity of individual cases, so that abstract legal provisions can be transformed into concrete judgment basis. Human reasoning is cold and impersonal

3. Dilemmas faced by judicial intelligent discretion system

3.1. Quality and integrity of data result in inaccurate results

For example, when the threshold of larceny differs up to 1500 yuan among Beijing, Zhejiang and Guangdong, the retrieval system of similar cases falls into a dilemma: forcibly expanding the sample range will reduce the reference value due to standard conflict, while shrinking the range will lead to the reduction of valid samples. More serious is the data distortion caused by selective disclosure: [4] In some provinces, the disclosure rate of dangerous driving documents is only 62%, and desensitization eliminates the correlation between alcohol content and sentencing outcomes. This systematic cutting not only hinders the algorithm from constructing accurate sentencing model, but even distorts the similarity calculation of similar cases. Two documents involving justifiable defense may be misjudged as unrelated cases due to the difference in the expression of "excessive defense" and "inappropriate defense", resulting in the failure of the early warning mechanism for different judgments in the same case. The dilemma of data ecology is more reflected in the disintegration of technical logic due to structural defects. Semi-structured data such as court recordings and mediation transcripts lack uniform labeling standards, which makes feature extraction difficult. The core of the problem lies in that the essence of judicial decision-making is value balance, and the existing data can only present the judgment result, but can not restore the thinking track of judge's argument.

3.2. Algorithmic bias leads to unfairness in discretion

The built-in algorithm bias makes the system treat suspects differently, or creates an imbalance of power between the prosecution and the defense, shaking the foundation of judicial justice. This not only tramples on the equal rights granted by the Constitution, but also completely deviates from the core mission of protecting justice in criminal proceedings. In essence, the erosion of algorithm to equality makes it lose its legitimacy in constitutional dimension, and its fundamental conflict with criminal judicial value makes it empty its moral foundation in litigation procedure.

3.3. Algorithm black box leads to insufficient credibility

The essence of an algorithm black box is a high wall of technical complexity-people can only see the two ends of input and output, but it is difficult to penetrate its internal decision-making fog. This dilemma is rooted in the inherent opacity and unexplainability of algorithms. The barrier of technical rationality separates judicial cognition. Judges are caught in a double dilemma when faced with algorithm analysis: at the technical level, even if the developer discloses the source code, the

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judge's weak mathematical modeling ability still makes it difficult for him to understand the meaning of the code, let alone understand the generation logic of the decision tree; at the cognitive level, the nonlinear decision mode formed by the deep learning algorithm independently extracting the characteristic parameters has already broken through the interpretable boundary of the traditional rule-driven technology, and even the developer himself cannot completely reproduce the reasoning trajectory [5]. This double cognitive fault essentially deprives judges of their ability to examine.

4. An analysis of the causes of the realistic dilemma of intelligent discretion system

4.1. Limited and irregular sample of adjudicative documents

Firstly, there are significant irregularities in the samples of adjudicative documents. The primary problem lies in the fact that due to the differences in economic and social development levels among provinces and even different regions within the province, the conviction and sentencing standards are also different. For example, the standard of "relatively large amount" of theft is 2000 yuan in Beijing and 3000 yuan in Zhejiang, while in Guangdong Province, Guangzhou and Shenzhen are 2000 yuan and Jiangmen and other places are reduced to 1500 yuan. Relaxation of the search area in order to increase the sample size may lead to insufficient reference value of the sample. In addition, although China's adjudicative documents have been more common on the Internet, the phenomenon of selective disclosure still exists, which will undoubtedly interfere with the accuracy of sentencing calculation, similar case push and different judgment early warning of the same case. Moreover, the nationwide judgment documents have not yet formed a unified standard format, and the words and structures are different, which makes it difficult for the intelligent sentencing auxiliary system to accurately identify documents with the same content but different expressions, which greatly increases the difficulty of accurately retrieving similar cases, and thus hinders the realization of the fundamental goal of "the same case and the same judgment". Finally, there are problems with the accuracy of the content of adjudicative documents. Due to the needs of political, social governance or judicial management, key information related to sensitive cases is often hidden, and the contents of public documents often have obvious traces of artificial editing. This lack of information naturally makes accurate sentencing calculations, push and early warning difficult to achieve.

Secondly, judicial information itself has the characteristics of multi-source heterogeneity and complex structure. It comes from a wide range of sources, including judicial websites, court procuratorates bulletins, annual work reports, press conferences and various news media resources, including normative documents such as laws and regulations, as well as a large number of past case information. The information itself is difficult to extract because of its diversity of sources, strengths and structures. In addition, the information is presented in various forms, which is easy to cause data loss in the process of format conversion, which further increases the difficulty of processing.

Finally, there are significant gaps in the information on judicial cases on which the system relies. Most of the existing information is concentrated on the file itself, which makes it difficult to restore the whole picture of the case comprehensively and truly. Even experienced judges find it difficult to gain direct insight into the thinking of other judges simply by means of trial documents, let alone by machine learning. The judge's discretion process is essentially a game centering on the recognition of objective facts and legal facts, the interpretation of normative semantic connotation and the balance of interest conflicts behind laws and regulations, which contains a large number of value judgments. The adjudicative document is merely the final, literal presentation of the complex process. Just because the document does not describe the process of judgment argument clearly, its

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data characteristics are also hidden between the lines, which directly affects the reliability of legal models constructed based on such data in practical application.

4.2. Conflict between technical logic and judicial value

The algorithm bias problem of judicial intelligence discretion system is essentially the product of the conflict between technical logic and judicial value. The reason for this is the continuation of historical prejudice. Judicial data often show systematic biases in past sentences-whether it is sentencing preferences for particular crimes in particular regions or overrepresentation of particular groups in historical cases. These biases are learned by the algorithm through training data and treated as paradigms, resulting in historical injustices not only being repeated but even amplified in new cases. For example, intelligent policing models that rely on data from historically high law enforcement intensity areas are prone to misassociating factors such as community policing with individual economic conditions.

At the same time, the deep imprint left by the developer's subjective will in the algorithm cannot be ignored. Algorithm is not a pure value-neutral tool, its rules and parameters must penetrate the designer's cognitive framework. This is reflected in the weighting of indicators such as "social harmfulness" in sentencing models, which may imply developers 'underlying moral judgments about specific crime types.

4.3. Conflict between commercial interests and judicial justice

Under the mode of joint research and development between public procuratorial organs and science and technology enterprises, commercial interests may quietly reshape the direction of algorithm optimization [6]. For example, in pursuit of higher system efficiency, algorithm design may tend to simplify complex evidence review processes, prioritize standardized electronic evidence, and relatively weaken the credibility of witness testimony that requires careful evaluation.

At the subjective level, algorithm designers often deliberately hide core parameters and decision-making logic on the grounds of trade secret protection or technical security. This artificially constructed information barrier essentially constitutes the erosion of private rights to the public domain. For example, some systems encapsulate the threshold calculation rules of crime risk assessment models as trade secrets, which may imply discriminatory assumptions about specific groups. In view of the strong public nature of criminal justice, the conflict between such commercial interests and judicial justice is quite acute. When technology enterprises participate in the construction of intelligent justice as technology providers, their algorithm logic must be stripped of commercial goal orientation, otherwise,"data portrait" may be alienated into systematic deprivation of defendant's rights and interests [7]. Even if it involves exemptions such as national security, the scope of algorithm confidentiality should also be strictly limited, especially to prevent the use of black box mechanism to strengthen adverse evaluation of the accused.

5. Path optimization of judicial intelligence discretion system

The following will start from the three dimensions of "judicial standard","technical assistance" and "judge-led" to construct a complementary and dynamically balanced relationship to overcome the challenges facing the current system. Among them, judicial standard is the cornerstone, which emphasizes the unshakable core values and principles of judicial activities; technical assistance is the means to improve judicial efficiency and accuracy by using advanced technologies such as

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artificial intelligence; and judge-led is the key to ensure that technology serves judicial justice and maintains the subjectivity and judgment of judges in the process of discretion.

5.1. Clarify the basic principles of discretion

To promote judicial intelligent discretion system, we should insist on judicial standard as the foundation. This means that the application of technology must always serve judicial justice and human rights protection, and any efficiency improvement must not break through the bottom line of the rule of law. For example, in order to solve the problem of algorithm bias, it is necessary to optimize algorithm design and strengthen data governance to ensure that technical decisions conform to the spirit of law and social justice. For the judgment involving personal freedom, property rights and other important rights and interests, it is more necessary to establish a strict technical review mechanism to prevent the risk of technical abuse.

5.2. Improving the quantity and quality of data

First of all, we should strengthen the construction of data standardization, ensure the consistency of document content in expression and format, and reduce the retrieval deviation caused by expression differences by formulating unified writing norms for adjudicative documents. At the same time, promote the unification of cross-regional sentencing standards, narrow regional differences, and provide a broader and referenced sample base for case retrieval.

Secondly, it is necessary to improve the mechanism of data disclosure and sharing, break the isolated island of information, and realize the national interconnection of judicial data. This not only requires courts at all levels to upload adjudicative documents comprehensively and indiscriminately, but also retains enough relevant elements of sentencing when desensitizing sensitive information to ensure the practicality and integrity of data. In addition, judicial organs are encouraged to cooperate with third parties such as universities and research institutions to use external resources to deeply mine and verify data and improve data quality.

In addition, multi-modal data processing technology is introduced. Aiming at the problem that semi-structured and unstructured data are difficult to extract, advanced technologies such as natural language processing, image recognition and speech recognition are adopted to transform multi-source heterogeneous data such as court recordings and mediation records into structured information that can be analyzed, enrich the content of knowledge base and improve the judgment accuracy.

Finally, a dynamic updating and feedback mechanism is established to ensure the timeliness and accuracy of the knowledge base by monitoring new situations and new problems in judicial practice in real time and adjusting data model and algorithm parameters in time. At the same time, judges are encouraged to feedback data deviations and algorithm defects during use, forming a virtuous cycle of "data feedback-model correction-result optimization".

5.3. Prevention and correction of algorithm bias

As an important factor affecting judicial justice, algorithm bias should be corrected and prevented from three aspects: technology, ethics and system. First of all, at the technical level, the algorithm design should be optimized to ensure that the algorithm logic not only reflects the rigidity of legal rules, but also considers the flexibility of discretionary scenarios. By introducing fairness

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constraints, such as difference impact assessment (DIA), potential bias patterns are actively identified and corrected during algorithm training to ensure fairness of decision results.

Secondly, strengthen ethical review and supervision, establish a review team composed of legal experts, ethics scholars, technicians, etc. to conduct ethical evaluation on the whole process of algorithm development, deployment and operation, so as to ensure that algorithm decision-making conforms to social morality and the spirit of rule of law. At the same time, open algorithm logic and key parameters, increase transparency, accept social supervision, and reduce the distrust caused by "black box operation".

Finally, perfect the system guarantee, clarify the legal responsibility and accountability mechanism of algorithm bias, and investigate the legal responsibility of relevant responsible persons according to law for judicial injustice cases caused by algorithm bias. At the same time, an algorithm impact assessment system shall be established to evaluate the newly launched algorithm system in advance to prevent bias risk and ensure the legitimacy of technology application.

5.4. Breaking the algorithm black box problem

The black box problem of algorithm seriously restricts the credibility and acceptability of judicial intelligent discretion system, so promoting the transparency of algorithm becomes the key to solve this dilemma. First of all, it is necessary to establish an algorithm interpretability enhancement mechanism, encourage R & D institutions to adopt algorithm models with strong interpretability, such as decision trees, linear regression, etc., instead of "black box" models such as deep learning, so that the algorithm decision-making process can be traced and understood. At the same time, develop algorithm interpretation tools to help judges and other non-technical personnel understand algorithm logic and enhance the credibility of discretion.

Secondly, the algorithm audit and verification system shall be implemented. An independent third-party organization shall conduct regular audit on the algorithm system to evaluate the rationality and fairness of its decision logic, data input and output results. Audit results should be open to the public and subject to public supervision to ensure the transparency and legitimacy of algorithm decisions.

Furthermore, strengthen the independent judgment ability of judges on the output of algorithms, improve the technical literacy and data analysis ability of judges through training and education, so that they can identify potential deviations in algorithm decisions, and carry out manual intervention and correction when necessary. At the same time, judges are encouraged to record the algorithm application process and decision-making basis in detail in the judgment documents, so as to increase the transparency and persuasiveness of discretion.

6. Conclusion

In the future, while continuously optimizing algorithm logic and improving data quality and integrity, it is necessary to strengthen judges 'independent judgment ability on technical output to ensure that technical decisions conform to the spirit of law and social justice. In addition, strict review mechanisms should be established to prevent technological abuse, especially in decision-making involving vital interests such as personal freedom and property rights. Only in this way can we give full play to the advantages of judicial intelligent discretion system and promote the double promotion of judicial justice and efficiency.

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