Technology Choice and Practice Path Applied by Artificial Intelligence in Litigation Services

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Abstract: Under the environment of "artificial intelligence +", new changes have taken place in social demand for litigation services, and the litigation explosion calls for judicial quality and effectiveness, which is urgent to be solved by new ideas. Based on the field of "artificial intelligence + litigation services", this paper analyzes the specific logic applied by artificial intelligence in litigation service, and presents the application status in combination with typical cases to analyze the principles that should be followed in the application of artificial intelligence in litigation service in China, thus the path of application of artificial intelligence in litigation services in China can be conceived, which provides reference for the mode of "artificial intelligence + litigation services" in China, so as to promote the construction of intelligent courts and judicial intelligentization.

1. Introduction

With the development of artificial intelligence technology and its wide application in all walks of life, artificial intelligence has also started to participate in and deeply affect judicial activities. In practice, the deep combination of artificial intelligence technology and judicial practice has become an innovative path to solve many problems in current judicial practice. In recent years, the institutions in our country involved in exploring the application of artificial intelligence in law include not only the suppliers of comprehensive AI technology and solutions, such as Baidu, Ali, iFLYTEK, etc., but also the professional legal information platforms or legal information enterprises, such as Huayu software, Wusong, etc., as well as both the listed companies, such as Huayu software, Ali cloud, etc., and start-ups, such as Fagougou. In addition, the artificial intelligence technology is shown with some significant achievements in the exploration of application in judicial field, such as the emergence of litigation-guidance robot, filing a case online and other services, thus providing new ideas for the innovative development of litigation services, which means that the application of artificial intelligence can replace the work with high repetition rate or the relatively basic work to alleviate the contradiction between few people and many court cases. At the present stage, the main problems existing in relevant researches are as follows: There
is a lack of systematic summary of the application of artificial intelligence in litigation services, the combination of artificial intelligence and justice is still quite insufficient, and no feasible practice path has been proposed.

2. Method and Material

2.1. Method

There are three methods used in the research. The first is the interdisciplinary research method, which is the method that must be adopted, that is, the legal knowledge and principles are fully integrated with the knowledge of computer science and mathematics to provide technical scheme on the application of artificial intelligence in law. The second is the empirical research method. Through the empirical research and investigation, we can know about the general situation of construction of intellectual court and application of big data technology and artificial intelligence, thus focusing on the research of problems in application process. The third is the comparative research method. We should hardly study the theory and practice applied by artificial intelligence in other countries' judicature, especially the existing application and present situation in judicial practice, and draw lessons from their theories and methods of defining the content and limit of application of artificial intelligence.

2.2. Material

In present China, the awareness of law and the recognition of function of judicial dispute resolution have been gradually strengthened, resulting in the dramatic increase in the number of cases accepted by the courts (see Table 1. Data from the work report of Supreme People's court over the years.) and the continuous increase in complexity of cases with social development [1], thus the original litigation service mechanism of the people's court is more and more difficult to meet the actual needs of litigation activities. On the one hand, the demand by the increasing number of cases for high-quality litigation service does not match the actual ability of court litigation services, with the more and more prominent contradiction between few people and many cases; on the other hand, the satisfaction of litigants with the courts' litigation services still needs to be improved.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of received cases (ten thousand cases)</th>
<th>Growth ratio of number of received cases</th>
<th>Number of closed cases (ten thousand cases)</th>
<th>Growth ratio of number of closed cases</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Supreme court</td>
<td>Local courts at all levels</td>
<td>Supreme court</td>
<td>Local courts at all levels</td>
</tr>
<tr>
<td>2013</td>
<td>1.1016</td>
<td>1421.7</td>
<td>3.2%</td>
<td>7.4%</td>
</tr>
<tr>
<td>2014</td>
<td>1.2120</td>
<td>1565.1</td>
<td>1.8%</td>
<td>10.1%</td>
</tr>
<tr>
<td>2015</td>
<td>1.5985</td>
<td>1951.1</td>
<td>42.6%</td>
<td>24.7%</td>
</tr>
<tr>
<td>2016</td>
<td>2.2742</td>
<td>2303</td>
<td>42.3%</td>
<td>18%</td>
</tr>
<tr>
<td>2017</td>
<td>2.143</td>
<td>1655.8</td>
<td>-5.77%</td>
<td>-28.1%</td>
</tr>
</tbody>
</table>

With development and application of artificial intelligence, it has begun to participate in and profoundly affect the judicial process. The deep integration of artificial intelligence and judicial process in practice has become the best choice to solve many practical problems in current judicial practice, and the exploration of artificial intelligence in judicial field has also made some remarkable achievements, which provides a new idea for the innovation and development of
litigation service, that is, artificial intelligence service can replace the work with high repetition rate or the relatively basic work to alleviate the court contradiction.

Litigation services are the services provided by courts for participants in litigation activities. The nature of litigation service determines that it has the characteristics of high repetition and strong standardization, which is consistent with the characteristics of the application of artificial intelligence at this stage, thus providing a prerequisite for the combination of artificial intelligence technology and litigation services. Artificial intelligence takes the lead in the comprehensive application to litigation services, which will become not only the innovative way to solve the practical problems faced by current judicial practice, but also the breakthrough and focus for the application of artificial intelligence in judicature.

3. Technical discussion on application of artificial intelligence in litigation services

3.1. Semantic-based retrieval technology of legal information

The database construction of legal instruments and other legal materials has been relatively mature, and informatization and intellectualization have carried on a systematic transformation to the legal retrieval. Now legal semantic retrieval and question answering based on natural language processing (NLP) and in-depth learning have begun to reconstruct the traditional legal retrieval technology, for example, ROSS, known as the first robotic lawyer in the world, is an IBM-based intelligent search tool for Watson system, which uses powerful NLP and machine learning technique to present lawyers with the most relevant and valuable legal answers, rather than just presenting a large number of retrieval results as traditional legal databases do, and according to user feedback, it also can enhance self-learning, with continuous optimization and upgrade of algorithm, thus the more consultation it receives, the more experienced it is, and the higher accuracy it has.

In the development of information retrieval, latent semantic analysis (LSA) as a classical shallow semantic-based method explores the relationship hidden behind the words [2], which is obtained by taking the use environment and frequency of words as reference. Simply, LSA wants to reduce the dimension of a matrix by means of singular value decomposition in linear algebra, in order to map this matrix into a new semantic space. For an existing large corpus, it is easy to get a "word-document" matrix $X$ with dimension of $t \times d$, which is a high-dimensional sparse matrix. Each row of the matrix corresponds to a word, each column corresponds to a document, and the value of each element is the word frequency or TF-IDF value of this word in this document [3]. There are two orthogonal matrices $U$ and $V$, as well as a diagonal matrix $\Sigma$. The original matrix can be conducted with singular value decomposition:

$$X = U\Sigma V^T$$  \hspace{1cm} (1)

where the diagonal element of matrix $\Sigma$ is called singular value. The truncated singular value decomposition method only calculates the first $R$ maximum singular values, so the original matrix has a low rank approximation:

$$X \approx X_r = U_r\Sigma_r V_r^T$$  \hspace{1cm} (2)

Actually, we have conducted the dimension reduction on the origin matrix through the truncated singular value decomposition. $\Sigma_r V_r^T$ is a matrix with $r \times d$ dimension, which represents all document information with $R$ features, that is, each document corresponds to a vector of $r$ dimension to represent the characteristics of document. We can sort according to the cosine
similarity between current document and other documents in the corpus, that is, a preliminary retrieval system can be constructed.

In the vector embedding method of text, experiments show that some neural network-based methods, such as Word2Vec and Doc2Vec [4, 5], have achieved good results. By learning a large amount of text data, Word2Vec represents each word in the corpus as a low-dimensional and dense semantic vector, and realizes that the vector distances obtained from semantically similar words are closer. Word2Vec has two main network structures: continuous Bag-of-Words (CBOW) and continuous Skip-Gram. The CBOW model predicts the current word by context, while Skip-Gram predicts the word in context by current word. The network structure of Skip-Gram is shown in Figure 1. Firstly we select one word in this sentence as the input, and then set a range in the context of this word to select one word as the output. Input-to-output is a linear fully connected layer, whose weight matrix can map words into a dense and low-dimensional vector. For each pair of words, we have the network structure shown in Figure 2, in which the input is the one-hot coding of the current word and the output layer is the probability vector of the predicted word obtained by the softmax classifier of model, i.e.

\[ xW_{te} = e \]  
\[ y = softmax(W_{eo}e) \]

Figure 1: Network structure of Word2Vec.

Figure 2: Network structure of Word2Vec pairwise words.
While our target is the first weight matrix $W_{ie}$ of model, that is, the vector embedding matrix of word. The vector representation of document can be obtained by conducting the average or weighted average on all the word vectors of one document. The biggest difference between Doc2Vec and Word2Vec is that Doc2Vec can embed a document directly into a dense and low-dimensional vector. Architecturally, compared to Word2Vec, Doc2Vec is added with an input representing the document identity, which represents the document's subject information.

Retrieval ranking is achieved by finding cosine similarity for different document embedding vectors, while it can also pre-cluster the documents in the existing corpus and classify the retrieved input documents, thus retrieving the corresponding target.

### 3.2 Intelligent case-diversion technique

In recent years, the number of cases accepted and settled by the Supreme People's Court and local people's courts at all levels has increased dramatically, and the classification of cases is not detailed enough, while there are many kinds of cases tried by the same judge, which leads to long trial time and low trial efficiency. At the same time, the litigants question the professional level of judges, thus it can be seen that the intelligent diversion technique for cases is urgently needed. However, data classification in the field of machine learning has become a more mature technology, and for clear questions, and the comprehensive and abundant data, good results can often be achieved. There are many classification methods in machine learning, such as logistic regression, support vector machine, k-nearest neighbour, naive Bayesian and neural network. Different methods can be used to compare the results for different problems, so as to select a more suitable method [6]. The following is an example of a simple binary logistic regression, which introduces the application thought in the diversion of cases.

Suppose that for a case, we need to use the characteristic information of the case to divide it into more complex cases and more simple cases, hereinafter referred to as "complex" and "simple". If a case has $n$ characteristic information, they are respectively noted as $s_1, s_2, \cdots s_n$, and the diversion result of cases is recorded as $y$, with a value of 0 or 1, respectively representing "complex" and "simple". Logistic regression conducts modeling on the probability that $y$ belongs to a certain class, instead of conducting direct modeling on the response variable $y$. If $p(y = 1 | x_1, x_2, \cdots, x_n) \equiv p(y)$ is conducted with modeling, the logistic function is used to ensure that the output is normalized to $(0, 1)$:

$$p(y) = \frac{e^{\hat{\beta}_0 + \hat{\beta}_1 s_1 + \cdots + \hat{\beta}_n s_n}}{1 + e^{\hat{\beta}_0 + \hat{\beta}_1 s_1 + \cdots + \hat{\beta}_n s_n}} \tag{5}$$

sort out the above formula to obtain:

$$\log \left( \frac{p(y)}{1 - p(y)} \right) = \hat{\beta}_0 + \hat{\beta}_1 x_1 + \cdots + \hat{\beta}_n x_n \tag{6}$$

The left side of Equation (6) is called the logarithmic occurrence ratio, so the logistic regression can be regarded as a special form of linear regression model under the transformation of logarithmic occurrence ratio, and the parameters can be estimated by using the maximum likelihood method for solving the linear regression model. When we get the estimated values of all $n + 1$ parameters, $\hat{\beta}_0, \hat{\beta}_1, \cdots, \hat{\beta}_n$, for the new case, the corresponding probability can be calculated by inputting its $n$ case characteristics, thus conducting the prediction. For example, if $p(y = 1 | x_1, x_2, \cdots, x_n) > 0.5$ of one case is greater than 0.5, we can predict this case as a simple case. In addition, if you want to be
more cautious about predicting whether a case is simple, the model can choose a higher threshold, like \( p(y = 1|x_1, x_2, \ldots, x_n) > 0.8 \)

For more refined types of diversion, we can consider some methods which can realize multi-classification by themselves, such as linear discriminant analysis, naive Bayesian, k-nearest neighbour and neural network. However, in actual use scenarios, the choice and quantification of case characteristics will largely determine the accuracy of model, so it is worth considering which features of a case should be selected and how to quantify them.

### 3.3. Intelligent litigation consulting and counselling technology

Courts provide legal consultancy services for the public through intelligent customer-service robots, AI or entities, and the existing legal-service robots can provide multiple functions, including case litigation guidance, supply of petition template, business inquiry, and answering of litigants’ questions concerning laws and lawsuits. However, the most essential technology of constructing intelligent consultation robot is the intelligent question answering system, while the original question answering system is composed of knowledge data set written by domain experts to retrieve answers. But with the development of in-depth learning, a large-scale knowledge base automatic question answering system based on LSTM has emerged, which introduces LSTM into the process of entity extraction and question mapping of question answering system, and some achievements have been achieved. The question answering system mainly consists of three components, including question analysis, information retrieval and answer integration. The users’ questions classified by question analysis module are expressed as question type and question content according to the semantic information of text, and then the deep processing is conducted by using named entity recognition, dependency parsing and semantic disambiguation. The information retrieval module is combined with the analyzed questions and existing knowledge base to construct retrieval model and sort the candidate answer list, including Boolean model, vector space model, language model and probability model. The answer generation module calculates the confidence of candidate answers, summarizes and compresses the information of answers, and sorts out a concise and accurate answer, while the current difficulty faced by intelligent question answering is the time computational complexity brought about by accurate extraction of semantic information and in-depth learning.

### 3.4. Intelligent case prediction technique

The prediction technique based on artificial intelligence and big data has been continuously making achievements, which have made it possible for future litigation services to include case pre-judgment and pre-evaluation. Nowadays, artificial intelligence based on information network technology has been on the front lines, which also affects the current criminal law system, while intelligent sentencing prediction technique based on artificial intelligence has also attracted much attention, which uses machine method to assist judges in sentencing and case trial, thus not only reducing the workload and error rate of judges, but also preventing judicial corruption to a certain extent. For a known criminal fact, the prediction model may only care about the limited most important indicators, such as the venue, sexes and age of litigants, number of cumulative crimes, voluntary surrender and other circumstances. For the existing case database, we need to use the method of regular-expression matching to extract characteristic indicators of case and the results of case trial, such as sentencing of six-year imprisonment and a fine of RMB 30,000. These pairwise labelled data can be used to train model. Specifically, if you want to train a neural network prediction model, the coding of venue, sexes and age of litigants, voluntary surrender, recidivism and the amount of money involved in crime are taken as the input characteristics of model, noted as
\( x_1, x_2, x_3, x_4, x_5, x_6 \), while the penalty amount of case is taken as the output of model, noted as \( y \). We aim to extract characteristics from the cases in the existing case database, so as to use these pairwise labelled data to train the weight matrix parameters of each layer of neural network. For new cases, we can use the trained model to conduct interval prediction on results of case trial, and the judge can refer to the predicted result of the model in the actual penalty. Of course, the above is only a basic framework of whole prediction model, in which the characteristics of case can be adjusted and refined according to actual situation to improve the accuracy of model. In the field of machine learning, there are many kinds of prediction models, which can be compared by using different methods in practical use. In addition, regular match of laws and regulations, result of synthetical match of laws and regulations, and statistical model can be added to the model to give more valuable prediction results.

The development of the above-mentioned legal artificial intelligence technology has made the intelligent litigation service develop from simple information presentation to machine self-service, which can not only provide information instead of people, but also help people to select information and form an optimized scheme to provide more intelligent services. The rapid development of artificial intelligence technology provides a possibility for its in-depth application to litigation service.

4. Practice path applied by artificial intelligence in litigation services

The continuous development and update of artificial intelligence will surely bring more profound changes to the judicial field, and its deep intelligentization and automation trend applied in litigation services will be more prominent. At the same time, intelligent litigation service system should also consider external expansion on the basis of its internal perfection, including interconnection with other related intelligent systems and virtual extension of real litigation service. Specifically, it includes the following aspects:
4.1. Establishment of intelligent litigation service system with more perfect function

The development trend of intelligent litigation service system mainly has the following two directions: On the one hand, it is the deep and systematic intelligentization, with the litigation service system reshaped by artificial intelligence. The functions of litigation service, such as filing a case online, online mediation, remote forensics, video authentication, online marking, remote letters and visits, electronic delivery and online applications for various items, etc., should be integrated into one, rather than staying in providing unilateral work and basic services such as case information inquiry, navigation guidance, online application and so on, while we still need to provide more intelligent services such as online mediation, electronic delivery, recommendation of a preferred solution by analogy with similar cases, endow intelligent litigation service system with more simple thinking ability, and make use of the deep learning ability of artificial intelligence and the increasingly perfect legal big data, as well as increasingly mature predictive technology, so as to intelligently help litigants to assess the litigation risk, predict the result of case trial and give recommendations for litigation strategy. On the other hand, it is the requirement of more automation, which is mainly reflected in the automatic generation of legal documents. It is a general trend that the way of legal format is changed from template to automatic generation of legal format documents, such as the format-compliant indictments automatically generated according to litigants’ case information, judgments automatically generated according to case situation and judges' opinions, etc. Perfect intelligent litigation service system will affect litigant's litigation behaviour and profoundly affect the settlement of legal disputes. It can not only help litigants to save litigation costs, but also divert cases to a certain extent to reduce the pressure of court.

4.2. Establishment of intelligent litigation service system for nationwide interconnection

This system is required to gradually unify the application process and technical standards throughout the country, so as to truly realize the real-time information sharing across the country, remote online filing, remote forensics, video authentication, video attendance of witness, etc. Moreover, it also required to have multiple presentation modes, such as entity version, Internet of things version, web version and mobile APP version, with the expansion from entity litigation to mobile terminals, so that litigants and other litigation participants throughout the country can enjoy litigation services and participate in litigation activities without leaving home, thus serving the people in all aspects and in many ways.

4.3. Realization of interconnection, seamless connection, efficient collaboration between intelligent litigation service system and other judicial intelligent systems

When providing the service of optimizing the channels of diversified dispute resolutions, the systems of relevant departments including intelligent trial system, other diversified dispute resolution system, lawyer association platform, judicial expertise and notarization institutions, the systems of relevant execution departments including industrial and commercial sectors and banking platforms, and other intelligent systems are required to realize multi-port inquiry and real-time update of case information and process, make the circulation of cases "no time lag" and improve litigation efficiency. Moreover, it also requires to realize the improvement of technical content and the update of content increments on the basis of interconnection, for example, the information sharing and docking between industrial and commercial sector, judicial expertise and notarization institutions can save the judicial resources; the execution of judgment will be docked with the system of real estate registration, financial institutions, credit reporting, asset disposal platform and
other departments, so as to achieve online "one key" start from court hearing to execution of judgment.

5. Conclusions

The Internet plus litigation services is fully implemented in the court system, with the main idea of making the service of litigation service center networked. The construction of litigation service center has greatly improved the public's satisfaction with the work of court which not only establishes a smooth channel for the public to handle affairs in court and communicate with judges, but also makes the court's pre-litigation work more standardized and efficient. A lot of work in litigation service enter is highly standardized and procedural, thus it is entirely possible to use artificial intelligence consultation system to replace the pre-litigation services such as simple case filing investigation, pre-litigation counseling and risk consultation, and the pre-litigation service will be achieved through the guidance and response of the set artificial intelligence consultation that is meticulous and in line with the reading habits and thinking mode of litigants. In litigation, artificial intelligence system can also be used to replace the collection, scanning and transmission of litigation documents, so as to liberate a large number of personnel from inefficient communication with litigation participants. On the one hand, it is a re-optimization of the allocation of human resources in the court, on the other hand, it avoids positive contradictions and conflicts by reducing direct communication.

"Development of legal big data industry from the perspective of national governance modernization" of Sichuan Soft Science Item (18RKX0516)

References


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