Judicial Reasoning Model Based on Multi-agent System

Xiao Wan[1,a] and Pengnian Jin[2, b *]

[1,2]Zhejiang University, Hangzhou ZJ310008, CHN

[a]wanxiaozju@163.com, [b]pnj2018@163.com

Abstract. Intelligent technology is developing at an amazing speed. Since its birth, intelligence has been continuously deepening its research into the legal field from general issues in just over 40 years. Judicial expert system is a branch of the study of intelligent expert system. However, intelligent court is still short of research in simulating judge's thinking to conduct legal reasoning. Therefore, the significance of this study is to promote the intelligent system to promote judicial progress, so as to save judicial cost and improve case handling efficiency. By sorting out the theoretical basis of the expert system of judicial judgment, and dividing the cases into simple cases and difficult cases, this paper attempts to simulate the legal thinking of judges in judicial activities on this basis, and preliminarily model the reasoning mode of the expert system of judicial judgment, and then deduce the final conclusion. The research results of this paper show that it is not far-fetched to realize the substitution of the role of the hercules all-knowing omnipotent judge under devokin's pen with the help of the functional system, and finally to achieve the perfect unification of formal justice and substantive justice of the judgment result.

Keywords: Intelligent system, Judicial Adjudication, Judicial Progres, Inference Model

1. Introduction

With the rise of a new round of scientific and technological revolution, big data and artificial intelligence have exerted more and more profound influences on the transformation of human society [1]. With the continuous breakthroughs of artificial intelligence in various fields, how to fully explore the potential of artificial intelligence technology in the judicial field and integrate the development of justice into a new round of scientific and technological revolution has become a brand-new topic [2]. He fan, director of judicial reform at the supreme people's court, said that introducing artificial intelligence into the case-handling system is an important goal of current judicial reform.

The study on the organic combination of intelligent system and legal reasoning began with the publication of a Stanford law review article in 1970, which discussed the possibility of modeling legal reasoning and opened the prelude to the study of intelligent legal reasoning [3]. The article points out that in order to apply the intelligent system to legal reasoning, the first step is to successfully understand the legal concept, classify and discuss it, and make a correct judgment. Secondly, legal knowledge and clauses should be applied to practical reasoning, and reasoning methods should be set in the system of artificial intelligence. At the same time, we should also pay attention to the legal reasoning of artificial intelligence in the formal use of how to use reasonable; Finally, the above content is compiled into a computer program that can execute legal reasoning and debate [4-5].

In the 1980s, China began to study the application of intelligent system in the judicial field, which gradually attracted attention. More and more scholars started to apply artificial intelligence in the judicial legal system to help adjudication and judgment [6]. In 2012, China realized the establishment of judicial discretion model of intelligent system based on the example of mental damage compensation [7]. In general, the achievements of the intersection between the intelligent system and the judicial system in China are not rich. Although there have been some progress and minor achievements in a short time, the application of the intelligent system in the judicial field is still in the initial stage [8]. Although the combination of theory and practice has achieved initial results, there is still room for further exploration. For judicial judgment, due to the breach of the judicial referee expert system is to simulate the logic thinking of the judge, need to add more logic probability research and strengthen research in simulation reasoning, enhance the intelligence of artificial intelligence, a similar simulation judge thinking to judgment, to make the judicial referee expert system gradually perfected [9].

The research and development of intelligent system bring convenience to judicial activities, but in reality, the judicial system has flexible characteristics and many factors can affect the final judicial decision. The main difficulties in the research and development of intelligent system in the field of judicial judgment are as follows: first, the intelligent system is actually not perfect in refining cases. Second, the intelligent system is not sophisticated enough in judging technology. Finally, the gradual improvement of the model of intelligent judicial discretion system needs time and development. Compared with the previous legal methods which were studied purely from the perspective of human thinking and practice, the study on the theoretical model of the judicial expert system is helpful to improve the research methods used in the past, think about the problem from another Angle, find a new way to solve the legal problem and broaden a new vision. When lawyers encounter complicated cases or cases that are difficult to compare, the intelligent system will compare the previous cases according to its own calculation results, and carry out probability measurement in various aspects to obtain corresponding similar cases [10]. An approach similar to this intelligent approach to hypotheses clearly simplifies complex problems.

2. Methods

2.1 Inference Model

(1) Formal reasoning

Formal inference is what bordenheimer calls analytical inference, which is not the inference that takes the substantial content of thinking as the object, but the logical inference in the aspect of concept, and the inference operation according to the corresponding rules. "Formal reasoning, as a prerequisite for judgment, must prevail in the conduct of the judgment, even if not all conditions apply to the form of formal reasoning, which must be the prerequisite before fact-finding."

Legal reasoning should be based on facts, seek truth from facts, and start analysis under the provisions of the corresponding logical basis. In carrying out legal rulings, the so-called principles must be adhered to. First, formal reasoning is more deterministic than analogical reasoning. Secondly, formal legal reasoning tends to peak in legal formalism. Finally, the application of formal reasoning can ensure the justice of the judges.

(2) Dialectical Reasoning

Dialectic means the unity or sublation of invariance and change. The so-called dialectical thinking means that A = A is no longer restricted by formal logic, and the reasoning mode is either black or white. It believes that A is both A and not A, and is the unity of opposites. The so-called dialectical thinking means that the judges' thoughts in judicial trials are shuttling back and forth in the constant and changing. In the understanding, selection and application of rules, judges often need to think repeatedly, weigh various advantages and disadvantages, and finally come to a conclusion that is not only legal but also reasonable.

The correctness of simple inference is time-limited, and usually its time-limited, as the social development, its correctness will change. The deduction and induction of formal logic and the nature of legal debate are rational. The so-called dialectical thinking means that the thoughts of judges in judicial trials shuttle back and forth in the constant and changing. In the understanding, selection and application of rules, judges often need to think repeatedly, weigh various advantages and disadvantages, and finally come to a conclusion that is not only legal but also reasonable.

2.2 Construction of Automatic Inference Model of Multi-agent System

Multi-agent automatic reasoning model is an intelligent system that can satisfy people's autonomous use of knowledge in a certain knowledge field. Therefore, it must have the following basic components: first, knowledge base, which contains the relevant basic knowledge and basic rules of the field; Secondly, the automatic inference system based on rules, which USES the knowledge in the knowledge base for specific problems, reasoning repeatedly and drawing conclusions. Third, temporary information age, which is applicable to the temporary information generated during the interaction between agents, Agem and the environment, and can help reasoning in a favorable direction.

Fourthly, the broadcasting station is used for the information transmission between the manager Agent and each task Agent. In short, the whole system operation process is the process of analyzing tasks, generating knowledge base and reasoning repeatedly. The steps of rule matching by a single Agent in the reasoning process can be represented by the following block diagram.
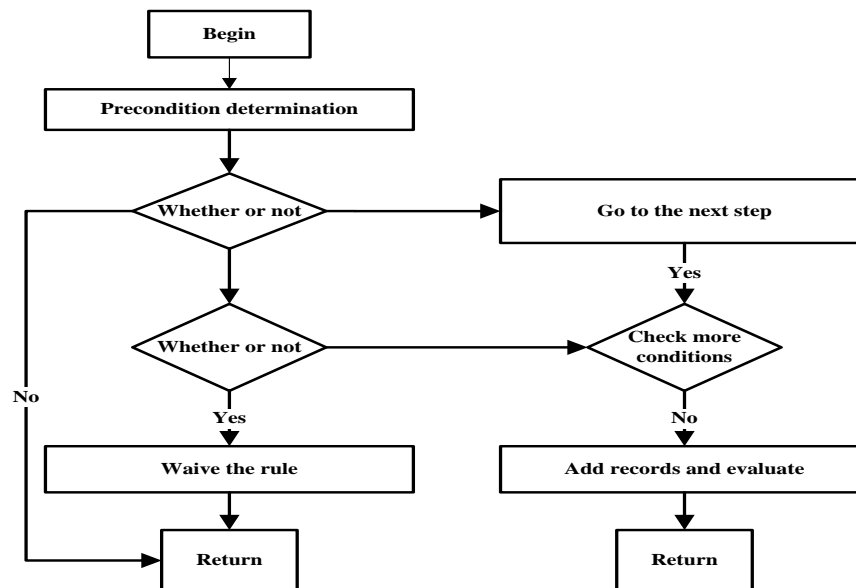
Figure 1. Framework diagram of Agent system construction

3. Experiments

The development language of the judicial system is Java language. Java is an object-oriented, secure, system-independent, lightweight multithreaded language that combines the ability to compile and interpret code. Java executable code can run on any hardware platform that has a Java interpreter or a Java enabler installed in a Web browser[1, 2].

JADE(Java Agent Development Framework) is used as the multi-agent Development tool and application platform. JADE is a software development framework that includes two main parts, an Agent platform compatible with the FIPA specification and a Java Agent development kit. JADE's Agent development kit provides users with abstract classes and interfaces that support FIPA(Foundation for Intelligent Physical Agent) protocol. Among them, the Agent class is the base class of user Agent. Developers only need to inherit these classes and interfaces and realize ready-made methods to develop agents that realize various specific tasks. Therefore, JADE can be used to develop a FIPA compliant multi-agent system and its applications.

According to the above structure, the MAGDE system (multi-agent based on Group Discussion Environment) is realized, which can realize the visualization of emergence of proposal consensus. MAGDE adopts database, artificial intelligence and other technologies to process expert speeches through natural language word segmentation and turn them into a structured speech record, which is stored in the database.

4. Discussion

4.1 Capability Analysis of Agent Automatic Reasoning Platform

In this paper, a multi-agent automatic reasoning platform based on DFL is proposed. In order to verify the availability of this platform, combinatorial mathematics is used to demonstrate the following.

The whole system is still divided into interface Agent(IA), management Agent(MA), inference process blackboard (RB) and multi-task Agent. These agents include tongue permutation and combination Agent(A3), pigeon nest principle and inclusion and exclusion principle Agent(A2), recursive relation Agent(A1), generating function Agent(A4), P61ya

counting Agent(A5). Each Agent has relevant knowledge base, which mainly solves the counting problem in combinatorial mathematics. That is, MAS={IA, RB, (MA, K1), (A1, K1), (A2, K2), (A3, K3), (A4, K4), (A5, K5)} capabilities of agents are shown in table 1 below.

Table 1. Capability of Agent automatic inference platform

Name	K1	K2	K3	K4	K5
A1	(1,1)	(0.6,0.6)	(0.6,0.6)	(0.6,0.6)	(0.6,0.6)
A2	(0.7,0.7)	(1,1)	(0.4,0.4)	(0.4,0.4)	(0.4,0.4)
A3	(0.6,0.6)	(0.4,0.4)	(1,1)	(0.8,0.8)	(0.3,0.3)
A4	(0.6,0.6)	(0.4,0.4)	(0.8,0.8)	(1,1)	(0.3,0.3)
A5	(0.6,0.6)	(0.4,0.4)	(0.3,0.3)	(0.3,0.3)	(1,1)

In this automatic reasoning system, the threshold of evaluation function is (0.5, 0). 5). The execution process is initiated by the interface Agent, and the user can specify which method to solve the problem or choose to be determined by the system. In fact, in many cases, due to the complexity of the task, multiple negotiation and promotion of many agents are required, so the reasoning process is also more complicated[3-5].

4.2 System Performance Discussion

According to the above structure, the MAGDE system (multi-agent based on Group Discussion Environment) is realized, which can realize the visualization of emergence of proposal consensus. MAGDE adopts database, artificial intelligence and other technologies to process expert speeches through natural language word segmentation and turn them into a structured speech record, which is stored in the database. At the same time, the expert's statement will be represented by a CBG chart. With the deepening of the discussion, the record of speeches will gradually grow, and the emergence of the consensus of proposals will become more and more complex. MAGDE interface is composed of two parts: one is the discussion whiteboard, which displays speech records; the other is the graphical display of the values of viewpoint concern, viewpoint support and viewpoint consensus. The intuitive representation of MAGDE statistical data is shown in figure 2 below. The discussion interface can reflect the discussion status in real time, facilitate the host to guide the discussion venue, improve the efficiency and quality of the discussion. Combined with multi-agent technology, this paper proposes the system structure of research platform development, implements it and briefly introduces its application. With the development of multi-agent technology and theory, GDSS based on multi-agent technology will become more and more mature[5-7]. However, there is still a long way for the platform to be applied in practice, and many problems need to be further studied. It mainly includes the intelligence degree of the system, the integration of knowledge base, database, model base, method base and external information of the system, and the functions of information collection, exchange, processing and presentation based on the network need to be further strengthened. In addition, the system modeling and simulation function is not strong, and the principle of structural risk minimization ensures that the learning machine has a good generalization ability. Unlike the structural design of neural network, which relies on the designer's empirical knowledge and prior knowledge, it requires relatively few parameters to be set. Because the traditional manual parameter selection method takes time and effort, GA is introduced for SVM parameter optimization, which greatly improves the efficiency of parameter selection.
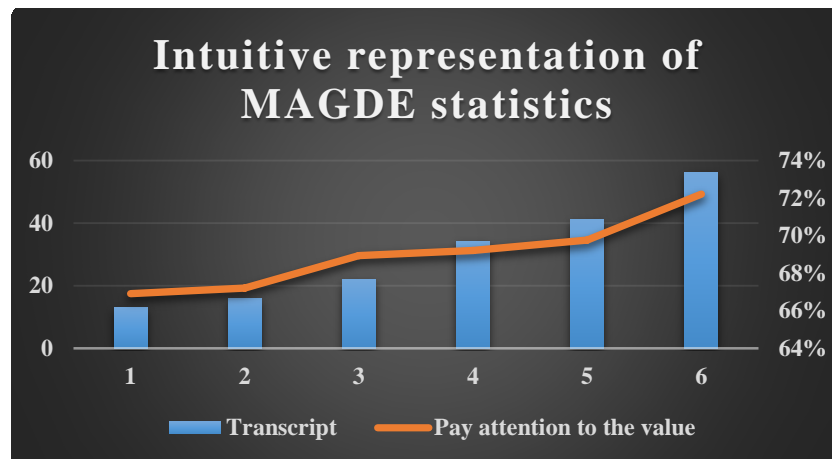
Figure 2. Visualization of MAGDE statistics

5. Conclusions

Based on J2EE application technology and Agent design and development technology, this paper analyzes and discusses the application of multi-agent in judicial reasoning. This paper proposes a new integration scheme, designs a multi-agent-based formal reasoning and dialectical reasoning model, and finally makes an in-depth analysis and discussion on the function and performance of multi-agent-based judicial reasoning model[8-10]. The research of this paper shows that the agent-based reasoning model of judicial judgment cannot completely replace the judge. Judges, as the patron saint of moral bottom line and fairness and justice, cannot be completely replaced. The use of this Agent system should be limited to the trial of the primary case, if the case into the second trial and retrial procedures, the final judgment should be made by experienced professional judges according to law.

References

[1] Zhang Q, Wang J, Yang Z, et al. High-frequency feedback robust control for flocking of multi-agent system with unknown parameters[J]. Automatika – Journal for Control Measurement Electronics Computing and Communications, 2019, 60(1):28-35.

[2] Xue L, Sun C, Wunsch D C. A Game-theoretical Approach for a Finite-time Consensus of Second-order Multi-agent System[J]. International Journal of Control, Automation and Systems, 2019, 17(5):1071-1083.

[3] Leader-Following Consensus of Nonlinear Strict-Feedback Multi-agent Systems[J]. Journal of Donghua University(English Edition), 2019, 36(1):4-10.

[4] Tazi K, Abbou F M, Abdi F. Multi-agent system for microgrids: design, optimization and performance[J]. Artificial Intelligence Review, 2019, 32(28):1-60.

[5] Mosweu T L, Kenosi L. Implementation of the Court Records Management System in the delivery of justice at the Gaborone Magisterial District, Botswana[J]. Records Management Journal, 2018, 28(3):234-251.

[6] Drug Enforcement Administration, Department of Justice. Schedules of Controlled Substances: Temporary Placement of Cyclopropyl Fentanyl in Schedule I. Temporary amendment; temporary scheduling order[J]. Fed Regist, 2018, 83(3):469-472.

[7] Häyry M. Doctrines and Dimensions of Justice: Their Historical Backgrounds and Ideological Underpinnings[J]. Cambridge Quarterly of Healthcare Ethics, 2018, 27(2):29.

[8] Taylor E, Timko C, Harris A H S, et al. Receipt of pharmacotherapy for alcohol use disorder by justice-involved women in the Veterans Health Administration[J]. Addiction Science & Clinical Practice, 2019, 14(1):1.

[9] Schauer S G, Fisher A D, April M D, et al. Prehospital Administration of Antibiotic Prophylaxis for Open Combat Wounds in Afghanistan: 2013-2014.[J]. Journal of Special Operations Medicine A Peer Reviewed Journal for Sof Medical Professionals, 2018, 18(2):53-56.

[10] Ishimaru A M. Re-imagining turnaround: families and communities leading educational justice[J]. Journal of

Educational Administration, 2018, 56(5):546-561.