LEGAL EXPERT SYSTEMS AS SIMULATION TOOLS

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ABSTRACT

In the paper the utilisation of legal expert systems for simulation is presented. Law in a general form prescribes the frame of possible behaviour of players in the domain regulated by it. A law can be considered as a set of rules forming a knowledge base and problems arising in the domain of its application should be answered based on it. In the last six years we developed a method to transform rules of law as it is published in statute-books into working expert systems. On the other hand simulation is the use of models to predict behaviour of existing or planned real system. If we consider the law as a model of the reality it is regulating, the corresponding expert system could be considered as the implemented version of this model on computers. Now by the use of these expert systems we can perform simulation. This simulation means the examination of the possible behaviour of the players which in some cases can be quantified by the use of statistical data. The method presented is particularly useful when one is framing new laws and wants to see the possible effects of the different proposed versions. Our method is mainly applicable for tax law, social security law, Finances Act or similar laws.

1 INTRODUCTION

The political, social and economic changes in the last years in Eastern-Europe and particularly in Hungary showed the necessity of framing dozens of new laws in a very short period.

One of the basic social problems in these countries is the internal uncertainty the participants of social and economical life feel due to the lack of clear regulations. Actually as in most of the Western countries the principle of "what is not prohibited is admissible" is applied instead of the former "what is not admitted is prohibited" concept. However, because of missing tradition people are indisposed towards the authorities and the government and only clear laws based on public concensus can change the situation.

What is needed is a clear and unambiguous frame in which or by the help of which the players of the economic or social life could act and could be unambiguously controlled or calling to account if it is necessary.

Legal expert systems of special types could provide such frames or tools.

2 EXPERT SYSTEMS

We assume that the readers are already familiar with the main concepts of expert systems. A possible definition of expert systems is: An expert system is an intelligent system that is able to use expert knowledge, stored in the form of inference procedures to resolve complex problems. The goal of the designer of an expert system is to somehow capture the knowledge of a human expert relative to some specific domain and code this in a computer in such a way that the knowledge of the expert is available to a less experienced user. Definotion from Sage (1991). For us the **why, how and what if** functions are determinant features of an expert system.

Nowadays to construct expert systems generally so called expert system shells are used. These expert system shells provide basic functions for the applications and support two basic type of knowledge representation: **rule based** or **frame based**.

In our work we are using a frame based expert system shell called ALLEX-PLUS which was developed by us in the last years.

2.1 Legal Expert Systems

Legal reasoning is a challenging field for the AI researchers since the beginning of 80ies. This is so because it has a tradition of examining its own reasoning process and its reasoning is stylized. See in Rissland (1988). In the Anglo-Saxon common law the doctrine of precedent is accepted in which similar cases are to be

decided similarly. This could be a good basis for researches on reasoning by analogy or case based reasoning. In other countries like Germany or Hungary the low is mainly codified which could be a good basis for researches on rule based reasoning.

The opinion of specialists is very different about the possible use of legal expert systems. It ranges from the total rejection by Leith (1986) to the optimistic view that these systems could be solutions in some extent to the the legal system crisis. See in Berman and Hafner (1989).

Meantime, several legal expert systems were constructed and used. The goal of these expert systems was to replace in some cases the human experts (lawyers) to solve legal problems as it is mentioned in Waterman, Paul and Peterson(1986), Berman and Hafner (1989), Rissland (1988).

In the present paper we deal with legal expert systems of so called **codified knowledge**. We call codified knowledge the content of some **codified** law. We are interested in this kind of knowledge because Hungarian jurisdiction, contrary to the Anglo-Saxon system, is not precedent based one as it was mentioned above.

As a consequence our legal expert systems contradict a little bit to the definition given before because their knowledge base contains not the knowledge of a group of experts but the formalised version of the law as it is published in the Official Gazette. (However we can say that this is the knowledge of the legislators but it is not fully true).

2.2 Use of Expert Systems in Legislation

The society can be controlled either by force or by laws. In this second latter case the responsibility of the legislator is high, errors could cause serious troubles in the economic or social life. In spite of this high responsibility legislators actually practically have no adequate methods and tools to model, investigate and predict the effect of their decisions.

We think that legal expert systems could be such an adequate tools in a lot of cases.

The use of a legal expert system should start at the moment of the birth of a law, that is when the first versions are worked out by the specialists. According to our experience, too the basic problem is, that the underlaying notions are not clearly defined making possible different interpretations. As a first result of using expert system based tool to develop the very first version of a proposed law is that most of ill defined notions are revealed.

In the second phase due to the used expert system technology the legislator can make the system work and check if it fulfils the planed requirements. The legislator can systematically check the different possible consequences, that is he/she can validate the system.

The third phase is the debate about the proposition. In our work we were interested in the legislation of the Parliament. where during the discussion of a proposed law hundreds of modifications were made or proposed. By the use of an adequate expert system based tool it is possible to follow and manage the modifications and check the effect of a proposition.

The next phase is the approval and publication of the law. From that moment the expert system can be used by the players of the touched domain for consulting in a general sense.

For example in the case of the social security law the corresponding expert system is able from one side to calculate the social security contributions and allowances. (For e.g. in the social insurance institute it can be used to check the correctness of pay in and paying out). On the other hand the same expert system can be used to get information **with explanation** about the allowances in given particular cases. (For e.g. in the pay-office).

In the first case an important advantage of the expert system is that in the social insurance institute the programmers have to convert the law as it appeared in the Official Gazette into executable algorithms, while the expert system itself is an already executable program. The efficiency is not a real question because it is the interactive use and the explanation facility, which in this case could be omitted, that. makes the expert system implementation slow

As a matter of fact when the new social security law was accepted on the initiative of the social insurance institute we were asked to make a proposal for such an expert system but due to the short dead-line and the limited number of experienced staff available it was finally rejected.

Actually we are working with a team of the Ministry of Environment and Regional Planning on a new Regional Development law which will be submitted to the Parliament in October this year. This is only the first and general part of the law which will be discussed, the relevant enacting clauses will be worked out later. This is the first case, that we are involved in the preparation of a law from the first phase and when we can try the possibilities of our method from the planing to the execution of a law.

In the last three years we made several demo versions of expert systems dealing with different laws like the gambling law, concession law, family doctors act etc. The first two was a complete system and the lesson

we learn from these experiences is that the demo version differs from the final one only in the number of rules. The hierarchy of notions and all the notions themselves should be already present in the demo version too.

3 LEGAL EXPERT SYSTEMS AS SIMULATION TOOLS

When speaking about legal expert systems as simulation tools we can consider two different aspects.

In the first case we look at the expert system (the knowledge base of the expert system) as a model of the codified law (in our cases).

In the second case we consider the given law as one of the controlling subsystems of a larger system called society.

As an expert system is also a running program, this expert system can be considered as a computerized and executable model of the law under consideration.

Simulation is the use of models for given purposes, mainly for validation and prediction. For what purposes the introduced legal expert system could be used as simulation model ?

3.1 Validation and Prediction

Taking the first approach the expert system could be used for the validation the proposed law. Under validation we mean the activity of checking if the law works such a way as we planed it to work. Asking a question the answer given based on the law is that what we expected ? (We already verified the expert system, that is it correctly models the law.)

In this case the purpose of the simulation (playing with a computerized model) is the **validation** of the law.

In the case of unacceptable answer we can modify the law (and the knowledge base) and continue the investigation.

The second case is more complicated. There we want to see the effect the law has on the behaviour of the players of the regulated domain or in general the possible effects of the law under consideration. The purpose of the simulation is now the **prediction**.

In this case we need statistical data about the regulated "items" for the simulation purposes.

For example if we take the section of the social security law dealing with lawyers (the most complicated section of the law) then we can calculate the allowances of the lawyers in different cases. Having appropriate statistics about the same lawyers we can predict the expected expenses of the social security institute due to

lawyers within a given period. We can make such calculations for the other players mentioned explicitly in the law too. By modifying the knowledge base and trying different alternatives we can see (predict) the different effects of these modifications. Finally we can select the best alternative (from the social security institute point of view).

This approach is much more important in the case of the Finances Act.

3.2 A Short Example

In Figure 1. we will give examples taken from the knowledge base of the social security expert system. As even this demo system contains more than a hundred rules it was not possible to take a complete part which contains a deduction chain for a given question. The examples are given only to show how paragraphs of the law are formalized in our system.

4 CONCLUSION

In the paper we demonstrated how legal expert systems can be used as simulation tools. We proposed two ways of their use for simulation. The first one is for validation of new laws the second is prediction of future effects of a law. In the case of the second way appropriate statistical data are needed.

Actually we are working on the new Regional Development law with the Ministry of Environment and Regional Development. Our method the so called NEOPOLITIS was presented to several committees of the Hungarian Parliament and it was quite well received.

However we do not claim that we can provide legal expert systems of all kinds. Our method is restricted only to some type of codified laws.

REFERENCES

Berman D. H., C. D. Hafner. 1989. The potential of artificial intelligence to help solve the crisis in our legal system. *Communications of the ACM* 8:928-938.
Cross G.R. 1986. Legal Knowledge. *Proceedings of the IEEE.* 10:1445-1450
Leith P. 1986. Fundamental errors in legal logic programming. *The Computer Journal* 6:545-551.
Rissland E., AI and legal reasoning. 1988. *AI Magazin* 3:45-55
Sage A. P. 1991. *Concise encyclopedia of information processing in systems & organizations.* Pergamon Press

Waterman D. A., Paul J., Peterson M. 1986. Expert systems for legal decision making. *Expert Systems* 3:212-226.

ALLEX-PLUS User Manual. 1992. Applied Logic Laboratory Budapest Hungary.

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IVAN FUTO is director of Applied Logic Laboratory and professor of computer sciences at the Budapest University of Economic Sciences. In 1985-1986 he was professor at the University Paul Sabatier in Toulouse, France. His research interests are focused on distributed and knowledge based simulation, AI and applications of AI. He published several papers and books and directed the development of T-PROLOG and CS-PROLOG systems.

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Rules:

Label:act15.sec1.par1.
Weight:0
if		object_of_legal_event^selected is unable_to_work
	and	*disability_allowance^objective_condition is fulfiled*
	and	disability_allowance^subjective_condition is fulfiled
	and	subject_of_legal_event^selected is insured
then		disability_allowance^lawfulness is due_to

and display(["Based on the law 15. sec.1 par.1 disability
allowance is due to the insured person"],info)

Label:r397_1b_1m_1r
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if		object_of_legal_event^selected is unable_to_work
	and	subject^selected is lawyer
	and	unable_to_work^number_of_days > 3
	and	unable_to_work^without_interrupt is yes
then		*disability_allowance^objective_condition is fulfiled*

Frames:

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Is a:
Is ancestor of:
        pregnancy
        death
        pension
        industrial_accident
        occupational_disease
        unable_to_work
        accouchement

Name: unable_to_work
Is a: object_of_legal_event
Attributes:
        number_of_days
                type = numeric
                source = [user]
                question = "Number of days you were unable to work"
                explanation = "The justified number of days you were
                                        unable to work"

Figure 1: Part of a Legal Expert System Knowledge Base