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A Multi-Level Architecture of a Judicial Decision Support System in Divorce Proceedings (the JUDIPRO)

This paper extends and deepens certain ideas developed in the Parenting Plan Support System (the PPSS). The JUDIPRO is a logical architecture of a decision support system designed to help the judges in deciding on acceptability of divorce in concrete situations. The main novelty of the proposal is a model of cognitive process of the judge, based on the assumptions of Epistemic Contextualism.

Contents

1   Introduction

[Rz 1] The JUDIPRO is a multi-level architecture of a decision support system designed to assist the judges in the process of sentencing in judicial proceedings. Unlike the Parenting Plan Support System [Araszkiewicz, Łopatkiewicz and Zienkiewicz 2013a, 2013b, 2014], the JUDIPRO is a model of purely judicial reasoning and not of amicable process of dispute resolution. In this connection, one of the aims of the JUDIPRO is to show how complex issues have to be resolved by the judge in case of lack of cooperation between the divorcing couple. As the level of complexity of knowledge representation and reasoning leads to a significant amount of judicial discretion, the present project might play a persuasive role and influence the divorcing couples to settle their dispute as regards its merits, because the judicial decision can be suboptimal with regard to both of the divorcing parents. More technically, the JUDIPRO may be seen as a complex BATNA (Best Alternative to Negotiated Agreement)-calculating system.

[Rz 2] Judicial proceedings are an interesting subject of legal knowledge engineering, because they encompass all important types of legal inference: rule-based, theory-based and case-based reasoning. The issues of burden of proof also play a pivotal role in this context. Therefore, an intelligent decision support system adequate for this domain has to be a hybrid one, taking into account all the above mentioned modes of knowledge representation and establishing proper relations between the respective modules.

[Rz 3] One of the most important objectives of research on intelligent legal support systems in the field of AI and Law is to attain the desired level of context-sensitivity of inferences performed by the system. In the JUDIPRO, this objective is realized in the following manner. At the first stage of the operation of the system, it generates certain output on the basis of input (concerning factual description of the case) as provided by the user. This part of functioning of the system may be compared to the functionalities of the classic Case-Based Reasoning or hybrid systems such as HYPO [Ashley 1990], CATO [Aleven 1997] CABARET [Rissland and Skalak 1991] or BankXX [Rissland, Skalak and Friedman 1996]. However, on the second stage of operation of the system, the generated output is analyzed on the epistemological level, taking into account the following question: «Can the judge be ascribed with the knowledge that P (where P stands for a proposition relevant for a certain decision in the divorce proceedings), given the context of the case C?». The key problem investigated in this connection is that the standards for ascription of knowledge that P may vary with the changing context, which is an idea drawn from the Epistemic Contextualism.

[Rz 4] The structure of the paper is as follows. In Section 2, the set of obligatory and facultative elements of a divorce judgment, as required by the Polish Family and Guardianship Code, is presented. In Section 3, the elements of the Knowledge Base and the Inference Engine of the JUDIPRO are outlined. It is shown how they interact in generation of the obligatory and facultative elements of the divorce judgment. The Section 4 is devoted to a more detailed description of the Knowledge Attribution Module which brings contextual considerations to the operation of the

system. The last section discusses the contribution and concludes.

2 The Legal Background of the Polish Divorce Proceedings

[Rz 5] The normative material providing the content of the database of the JUDIPRO system consists in the norms of the Polish law related to divorce proceedings. The two most important legal acts partially represented here are: the Polish Family and Guardianship Code (the PFGC)[1] and the Polish Code of Civil Procedure[2].

[Rz 6] According to the Polish law, the divorce procedure is a subtype of civil adversary proceedings. The plaintiff bears the burden of proof as regards the basic premises of grating of the divorce, that is, the complete and irretrievable breakdown of marital life (art. 56 § 1 PFGC).

[Rz 7] The PFGC prescribes for a rich set of elements of a divorce judgment. They can be divided into obligatory elements (which have to be present in every divorce judgment) and facultative ones (decided only upon a motion of any of the parties).

[Rz 8] The list of the obligatory elements may be presented as follows:

1) the principal decision whether the marriage is dissolved by the divorce of whether the divorce is not granted;
2) the decision on fault of the parties (unless the parties, at a joint motion, agree that the court waives deciding on this case);
3) the decision on the contacts between the parents and the child after the divorce is granted,
4) the decision on the exercise of parental authority by the parents after the divorce is granted,
5) the decision on the bearing of the costs of living and educating of any of the minor children of the divorced parents,
6) the decision on the residence for as long as the divorced spouses are sharing accommodation,
7) taking into account the agreement between the spouses concerning the exercise of parental authority and the issues of contacts with children after the divorce (the parenting plan), if the parties are interested in maintaining the joint parental authority — provided that such plan is not inconsistent with the well-being of the child.

[Rz 9] There exists also a list of facultative decisions which have to be present in the divorce judgment only if any of the parties files a proper motion, such as the decision concerning financial support from of the spouses due to another one, the division of the joint estate of the spouses (typically decided in a separate proceedings), certain facultative decisions concerning the joint accommodation of the spouses etc.

[Rz 10] The issues that have or may be present in the divorce judgment may be also classified with respect to another criterion, namely, the subject who carries the burden of proof as regards presenting evidence and the burden of argumentation to obtain certain legal consequences. Although typically those burdens are placed on the plaintiff, due to the peculiarities of civil proceedings in family cases (particularly, if minor children are present), certain considerations have to be made by the court itself even in case of absence of initiative of any of the parties with regard to this issue. There are also certain issues which involve the cooperation between the court and the

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[1] Act of 25 February 1964, Journal of Laws 2012 pos. 788 consolidated text, as amended.

[2] Act of 17 November 1964, Journal of Laws 2014 pos. 1010 consolidated text, as amended.

parties to the dispute. The behavior of the subject encumbered with the burden of proof and argumentation produces different consequences with respect to the eventual content of the divorce judgment, depending on whether a given element is obligatory or facultative. In case of lack of fulfillment of these burdens with respect to the obligatory elements, the divorce judgment will contain a negative decision on these matters (unless the burden is placed on the court). In case of lack of sufficient initiative with respect to the facultative elements, the divorce judgment will not contain any decision on this matter.

[Rz 11] An example of an issue where the burden of proof is not placed only on the parties, but rather the whole factual circumstances have to be determined by the court is whether granting of the divorce will not infringe certain important values. As provided by the art. 56 § 2 of the PFGC, despite the irretrievable and complete breakdown of matrimonial life, divorce is not permitted if it would be detrimental to the well-being of the minor children of both spouses, or if there are other reasons why the decision to divorce is contrary to the principles of social coexistence. On the other hand, a typical issue where a burden of proof is put on a party to the dispute is the fault of another party.

[Rz 12] Importantly, as much of the concepts used in the relevant provisions are highly open-textured and evaluative, their actual scope is to large extent determined by the doctrinal theories and non-binding, yet practically decisive, case law. The role of the latter is especially visible with regard to the interpretation of the concept of well-being of the child. In this place, the JUDIPRO intersects largely with the PPSS model, which is devoted to the assessment of the parenting plan against the criterion of (non)realization of well-being of the child.

[Rz 13] The judicial decision-making in divorce proceedings are relative simple in case of cooperation of the parents, where no fault issues are presented and the parents agree on the majority, if not all issues related to the divorce, out of court. Although the divorce judgment is indispensable to dissolve the marriage, in case of cooperative attitude between the spouses the content of the judgment is largely prepared by them; the court is still obligated to investigate the issues concerning proper protection of the interest of children. In case of lack of cooperation between the parties, however, the content of the judgment has to be determined by the judge which involves intellectual operations of a very high degree of complexity. The JUDIPRO architecture is to provide support for this decision-making process.

## 3   Outline of the Knowledge Base and Inference Mechanisms of the JUDIPRO

[Rz 14] The shell of the Knowledge Base of the JUDIPRO is domain-independent, but the contents of it are retrieved from the authoritative sources concerning the Polish divorce proceedings law. The structure of the Knowledge Base is a multi-level one and it encompasses the following elements (layers):

- Rules (R), encompassing both strict and defeasible ones. The Rules in the JUDIPRO knowledge base are extracted from the PCFG and the PCCC. Importantly, the Rules are modelled in such manner that their consequents are identical to the issues forming obligatory and facultative parts of a divorce judgment. We will refer to these issues are Central Propositions (the CPs);

- Theory-Based Intermediate Concepts (TIC) which form an abstract layer of interpretation of statutory predicates. The set TIC is derived from the doctrinal sources, mainly from the commentaries to the PCFG and the leading textbooks. These concepts enable the judge to focus more sharply on particular factual patterns present in the case and to facilitate Case-Based Reasoning. The structure of doctrinal theories has been recently discussed in detail in [Araszkiewicz 2014];
- Factors (f) are stereotypical fact patterns which tend to promote or demote the solution in favor of either of the parties to the dispute. Factors in the JUDIPRO are grouped in several dimensions, that is, feature vectors which index the cases present in the Knowledge Base of the system;
- Cases (C) are judicial decisions of the Polish Supreme Court as well as Polish Appellate and District courts. In the JUDIPRO the database encompasses the cases pertaining to the divorce proceedings;
- Typical Evidence Catalogue (TEC). This part of the Knowledge is entirely domain dependent and encompasses the set of typical evidence which is present in divorce cases.

[Rz 15] The operation of the Inference Engine of the JUDIPRO is as follows. The user makes choices concerning the elements of the set TEC present in the actual case. Once this input is introduced (separately for every Central Proposition), the Inference Engine forward-chains from the entered TEC sentences through Factors, Theory Based Intermediate Concepts and Rules antecedents to the CP. This functioning of the JUDIPRO is in fact a classical operation of an expert system. The operation of the Inference Engine may be depicted on the following figure:

Fig 1. The operation of the Inference Engine of the JUDIPRO
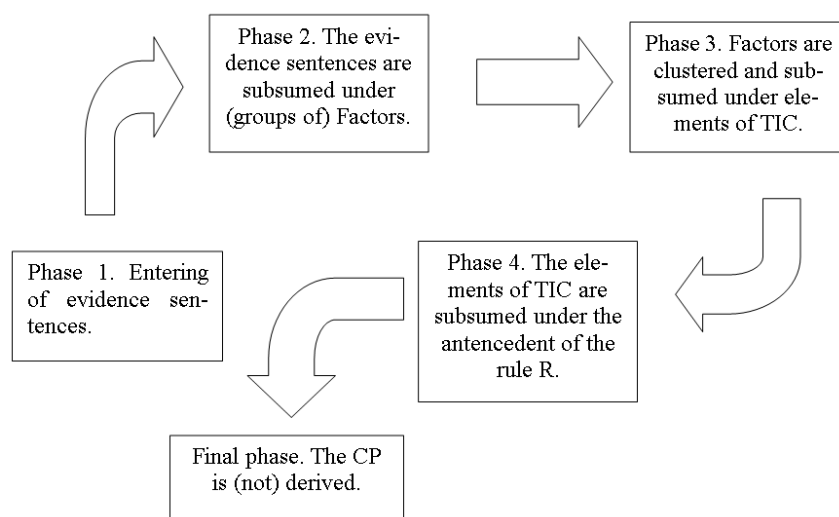
4   The Knowledge Ascription Module

[Rz 16] The main novelty of the JUDIPRO system is the Knowledge Ascription Module (KAM) presented in this Section. The function of the KAM is to enhance the level of context-sensitivity of the output generated by the JUDIPRO. The construction of any formal model of legal reasoning is troubled with the basic question: what inferences should be performed by the system itself, and

what propositions should be simply adopted by its knowledge base as an invariable part of it. The more information is assigned to the latter group, the more static and less context-sensitive is the knowledge base of the system. The recent 30 years of research on models of legal reasoning dealt in particular with the abovementioned problem and much progress has been made in the field; however, the task is still perceived as an open problem.

[Rz 17] Instead of application of neural network-based, subsymbolic representation of certain features of divorce cases (as it happened in the Split-Up system designed by Zeleznikow, Stranieri and Gawler [1996]), we have decided to account for the context-sensitivity of the output generated by the system in the manner inspired by the achievements of contemporary analytic epistemology, and more concretely, by the Epistemic Contextualism.

[Rz 18] Although there are many variants of the Epistemic Contextualism (see: [Cohen 1986], [DeRose 2009] and [Rysiew 2011] for an overview], the main features of the theory may be summarized in the following way. Let us consider knowledge attribution statements concerning third persons, having the form «S knows that p», where «S» represents an epistemic subject and «p» is a variable representing the content of a belief. According to the Epistemic Contextualism, it is the conversational context of the knowledge attributor which influences the conditions of truth of the knowledge attribution statements. Syntactically identical knowledge attribution statements may differ with respect to their truth values, given different contexts in which they are uttered.

[Rz 19] Hence, the function of the KAM is not to model the internal discovery and/or justification-related reasoning of the judge, but an assessment of a third party of the judge's decision in a concrete case. In our opinion, this perspective is very relevant from the point of view of the parties to a divorce dispute (and their professional counsels), for it enables them to deliberate whether it would be rational to appellate from (the most probable) divorce judgment.

[Rz 20] The model of operation of the KAM is as follows. Let us consider any Central Proposition (CP) generated by the Inference Engine of the JUDIPRO (for instance «there is a complete breakdown of marital life of the parties»). Such CP becomes the content of a knowledge attribution sentence of the form «the judge knows that ‹CP›». Then the system analyzes whether the truth conditions of this sentence are satisfied in the context of information available in the deliberated case. This «quotation» maneuver enables us to avoid a complicated philosophical-logical problem concerning the truth-values of legal premises and conclusions. Here, the truth value of knowledge attribution sentence is taken into account and it is generally contingent with regard to the truth value of the CP, due to the well-known phenomenon of intensionality of the operator «to know».

[Rz 21] A question arises why it is chosen to discuss the truth value of knowledge attribution sentence rather than to assess the satisfaction of a certain standard of proof (such as preponderance of evidence, often invoked in the context of civil proceedings). The operationalization of standards of proof is present in well-known formal models of practical reasoning, to mention first and foremost the Carneades system developed by Gordon and Walton [2006]. The reason for the present choice is twofold. First, unlike in common law systems, the notion of standard of proof is rarely explicitly invoked in continental legal culture to which the Polish law belongs. Second, in the Polish legal procedure the questions of proof are associated with the evidence law and therefore issues of fact, but for the determination of the soundness of judicial beliefs concerning Central Propositions legal considerations are also relevant. The use of the term «proof» in this context would be misleading.

[Rz 22] Let us now present how the truth conditions of a knowledge attribution sentence are

assessed for any CP generated by the Inference Engine of the system. For each knowledge attribution sentence the Context is a triple ‹CIV, ABS, CON› where:

- CIV is the set of rules (both defeasible and strict ones) determining the most general features of the conversational context in question, that is, the context of the Polish civil proceedings. The rules set out by JUD are present in every context that may be deliberated by the KAM. The function of the CIV set of rules is twofold. Its negative function is to rule out certain propositions that are not admissible in the course of judicial proceedings in general (such as arguments based on threat, racial discrimination etc.). The positive function of the CIV is to specify a set of necessary conditions that have to be met for any proposition to count as parts of the context for the determination of truth value of the deliberated knowledge attribution sentence;
- ABS is a four tuple: ‹R, TIC, f› where
  - R is the rule extracted from the Polish Code of Family and Guardianship which specifies the CP in question as its consequent,
  - TIC is a set of theory-based intermediate concepts, elaborated by the legal doctrine, which specify more concrete conditions of satisfaction of the rule R, and
  - f is a set of all factors extracted from the relevant judicial decisions that may influence the application of the concepts specified in the set TIC to the current factual situation.

  As a consequence, the triple ABS provides for a scheme of argument which may be used for justification of acceptance of the CP in question. The set ABS mirrors the structure of the basic knowledge base of the system. However, the KAM operates on it in a different manner than in case of operation of the Inference Engine.
- CON is a four tuple ‹EVcase, Fcase, ARG (CP, R, TIC, f), MET›, where
  - EVcase is a set of sentences encompassing the evidence presented in the course of the proceedings,
  - Fcase is a set of factors present in the case, which at least intersects with the set f present in ABS,
  - ARG (CP, R, TIC, f, *links*) is a set of arguments the conclusions of which are related by means of support or attack relation with any part of the chain provided by the argument scheme in ABS, the deliberated CP, and the inferential links between respective parts of this chain,
  - MET is a set of arguments the conclusions of which support or attack any part of any argument from the set ARG (CP, R, TIC, f, *links*) or from the set MET (this part of the context is obviously defined recursively to provide for a closure of the argumentation framework).

[Rz 23] The structure of the Context presented above makes it possible to list certain features of the context used by the KAM to determine the truth condition of the knowledge attribution sentence for a given CP. These parameters are as follows:

P1) the degree of similarity (in the sense of inclusion) between the set f and the set Fcase,

P2) the ratio of all factors present in the set Fcase to the subset of Fcase saturated by elements of EVcase (in other words, the ratio of factors which presence in the case is backed by some evidence to the factors which lack such evidence),

P3) the number of arguments present in the set ARG (CP, R, TIC, f, *links*), both supporting and attacking any token of the argumentative chain or the inferential links between these tokens,

P4) the ratio between the supporting and demoting arguments mentioned in the point 3) above and

P5) the quality of arguments mentioned in the point 3), given the criteria stemming from the set CIV (the arguments must be actually legally relevant arguments in order to influence the calculation of the truth condition of the knowledge attribution sentence),

P6) the relevant counterparts of features mentioned in the points 3), 4) and 5) above with regard to the set MET.

[Rz 24] Now, the scheme of a truth condition for a knowledge attribution sentence having the CP as its content may be represented as follows:

[Rz 25] *Ceteris paribus*, if the value of Parameter Pn (n: 1—6) is x, then assert than the knowledge attribution sentence concerning the CP is true, otherwise state it is not true.

[Rz 26] However, the key issue is that excessing of a certain value of another parameter of the Context can change the conversational context of utterance of the knowledge attribution sentence in such way that either (1) the deliberated value of parameter will be no longer considered sufficient for claiming that the sentence in question is true or (2) the deliberated value parameter will be no longer considered necessary for drawing such conclusion.

[Rz 27] From a formal point of view, the different sets of values of parameters can be seen as analogical argumentation framework semantics (as famously introduced to the broad auditorium by Dung [1995]), generating certain extensions (sets of arguments having certain properties). In the context of the JUDIPRO an analog of argumentation framework extension is a set of CPs with assigned truth values. Note that if the values of parameters are represented by real numbers, we obtain a continuum of «semantics» which gives a system actually infinite set of possible reactions to changes of the conversational context. However, for practical purposes, such dense mode of representation is not actually needed. An important prerequisite, left for the future work is to extract a sufficiently big number of arguments from the case law, pertaining to changes of the conversational context given its structure in a given case. Introduction of such arguments to the database of the JUDIPRO would result in obtaining a very high degree of context-sensitiveness within the system.

5 Discussion and Conclusions

[Rz 28] Let us summarize the import of the present contribution. It presents an outline of a multi-level logical architecture of the JUDIPRO — a model of a judicial decision support system in divorce proceedings. The systems consists of two main parts: (1) the classical Legal Expert System part (Knowledge Base and Inference Engine) and (2) the novel Knowledge Ascription Module, inspired by the philosophical view called Epistemic Contextualism. The system's shell is domain-independent, but the content of the Knowledge Base is the corpus of the Polish law (and related jurisprudence and case law) related to the divorce proceedings. Due to its features outlined above, the JUDIPRO is able to perform the following functions:

1) determining what consequences stem from the typical evidence submitted to the case with respect to the obligatory and facultative decisions of the divorce judgment,
2) providing for a detailed argumentative chain for any Central Proposition of the divorce judgment, consisting of evidence, factors, theory-based intermediate concepts and legal rules,
3) analysis of the epistemic position of the judge deliberating the Central Propositions, taking into account the context-sensitivity of such assessment.

[Rz 29] The future work with the JUDIPRO encompasses its full-fledged implementation and testing on a large database of cases. The KAM part of the JUDIPRO offers promising perspectives of formalization by means of metalevel argumentation frameworks [Modgil and Bench-Capon 2010].

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