

Representation of an Actual Divorce Dispute in the Parenting Plan Support System

Michał Araszkiewicz
Jagiellonian University
Kraków, Poland
michal.araszkiewicz@uj.edu.pl

Agata Łopatkiewicz
Jagiellonian University
Kraków, Poland
agata.lopatkiewicz@uj.edu.pl

Adam Zienkiewicz
University of Warmia and
Mazury
Olsztyn, Poland
adam.zienkiewicz@uwm.edu.pl

Tomasz Zurek
Maria Curie-Skłodowska
University
Lublin, Poland
zurek@kft.umcs.lublin.pl

ABSTRACT

This paper evaluates the Parenting Plan Support System, a partially implemented decision support system designed to help parents to draft an agreement concerning relations with their children after the divorce, against the background of a real-life case. The focus here is on knowledge representation issues and the functioning of the inference engine.

General Terms

Theory

Keywords

Divorce, factors, knowledge representation, inference engine, Parenting Plan Support System

1. INTRODUCTION

The present objective is to provide a partial evaluation and further development of the Parenting Plan Support System (hereafter: the PPSS)—a decision support system project to help divorcing parents to draft an agreement concerning the totality of their relations with their minor children after the divorce is granted, under Polish law. This is also a first step towards future implementation of the model. The focus of the work reported here is concrete and practical. The expressivity of the functionalities of the system is hypothetically tested on the basis of (a slight variation of) a real-life example: an actual state of affairs that gave rise to a very complicated dispute. The sole focus here is to show how the system's inferences are reactions to the entered description of the factual situation; further stages related to bargaining and tradeoffs between the parties are not discussed here, nor is the relevant literature.

The structure of the paper is as follows. In section 2, the basic features of the PPSS are briefly recalled. Section 3 presents an informal description of the case at bar, together with the legal context. Section 4 describes the relevant concrete knowledge representation structures of the system and the reactions of inference patterns to the inputs supplied by the hypothetical users. A preliminary PROLOG implementation of the inference mechanisms is also presented. Section 5 discusses the significance of this contribution, along with conclusions.

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the Owner/Author.

Copyright is held by the owner/author(s).

ICAIL '15, Jun 08-12, 2015, San Diego, CA, USA

ACM978-1-4503-3522-5/15/06.

<http://dx.doi.org/10.1145/2746090.2746119>

2. THE PARENTING PLAN SUPPORT SYSTEM (PPSS)

The PPSS is a model of a computer program designed to assist divorcing parents in drafting an agreement as to the exercise of parental custody and the scheme of visiting children after the divorce is granted. The PPSS is a fusion of a hybrid Rule-Based/Case-Based Reasoning model of argumentation with a Negotiation Decision Support System (NDSS). The structure of the PPSS has been already presented in [2, 3], and so the following presentation is quite brief, referring more broadly to novelties in the structure of the model.

The main idea of the PPSS is to enable users to create a parenting plan by answering questions to choose options from the knowledge base of the system. The choices made by either parent are compared each with the other in respect of their compatibility. The users may bargain in connection with their choices, making concessions and tradeoffs. However, the most important feature of the system is that it constantly assesses the compatibility of choices made by the users with the legal criterion of acceptability of the agreement—that is, the well-being of the child(ren). Under Polish family law, such an agreement cannot be accepted by the court unless it satisfies this highly context-sensitive criterion.

The PPSS knowledge base encompasses the following elements.

Options. The set of Options includes any propositions that may form part of the parenting plan. Options are grouped in Questions; each Question provides for a set of Options, but the assumption is that in any developed agreement, one and only one Option from each Question should be chosen.

Dimensions. The PPSS contains a library of 10 Dimensions, each related to one of the important broad issues informing the content of any parenting plan. The list of the Dimensions can be found in [3] and [4].

In the PPSS, each Dimension comprises a ten-step ordinal scale [0-9], from *least favorable* (with respect to the well-being of the child) to *most acceptable*. Differences between this and the classic account of Dimensions are discussed in [3] and below (in section 5).

Environmental Factors (EFs). This set encompasses sentences containing basic information about people involved in the dispute, as well as basic description of the case. Users of the system generate a concrete set of EFs by making choices in the Questionnaire module of the PPSS.

Legal Factors (LFs). This is the set of more abstract descriptions of the case, derived from rulings of the judiciary of the Polish Supreme Court and the Appellate Courts.

Defeasible Rules (DRs). Here we adopt a generalized account of DRs, modified with respect to the earlier view presented in [2] and [3]. Let $DR(D_i)$ be a set of Defeasible Rules assigned to a

Dimension i . A rule belongs to this set if and only if it has the following form:

$$\Omega \Rightarrow [0 \leq n \leq 9](D_i)$$

where:

- Ω is a finite conjunctive formula encompassing elements taken from the set of Options, EFs, and LF, such that the set of Options includes at least one element (the sets of EFs and LF are possibly empty), and
- $[0 \leq n \leq 9](D_i)$ is the valuation of the antecedent of the DR in question with regard to one of the Dimensions of the PPSS.

In other words, DRs are valuation functions that adopt conjunctions of Options, EFs, and LF as their input and generate the value taken from the ten-step ordinal scale as their output.

Structured Cases (SCs). The set of SCs is a novel component of the PPSS knowledge base and will therefore be described in more detail.

An SC is a tuple $(O_C, EF_C, LF_C, DR_C, ORD_C)$, where:

- O_C is a set of Options actually deliberated upon, although not necessarily eventually agreed, in case C
- EF_C is a set of EFs present in case C
- LF_C is a set of LF present in case C
- DR_C is a set of Defeasible Rules adopting formulas that combine certain elements of O_C , EF_C , and LF_C as its antecedents
- ORD_C is an ordering relation defined over the set DR_C

If $R_x, R_y \in ORD_C$, then if $R_x < R_y$, then R_y is said to be preferred over R_x . If a valuation V is yielded by an undefeated DR, this valuation is referred to as adequate valuation. Note that the set of adequate valuations can include more than one valuation because the ordering relation does not have to be complete.

The purpose of the case-relative ordering of DRs is to foster the context-sensitiveness of the system. In the overall context of a given case, certain combinations of options and factors are considered sufficient conditions for adoption of certain valuations with respect to certain Dimensions.

Structured Cases are developed manually by human annotators.

3. INFORMAL DESCRIPTION OF THE CASE

The case chosen here for modelling is a slightly simplified version of the dispute that gave rise to the judgment of the District Court in Sieradz of 9 October 2013, I Ca 352/13.

Consider, then, a married couple with three minor children. In the course of divorce proceedings, the spouses are in conflict. The husband is a manipulative personality; in particular, he has involved the children in bargaining with his wife. Nevertheless, the parents are interested in drafting a parenting plan, as they do not want the court to authoritatively determine future arrangements concerning parental custody. As the parents begin to negotiate, it becomes clear that the three following issues are in dispute between them.

First, the father would like to adopt the *alternate custody* model, with the children residing alternately at the residence of either parent for two weeks at a time. The mother is not completely

against this proposal, but she would prefer to adopt the *single main custodian* model, in that she would like to be the children's main custodian, with visitation rights assigned to the father.

The second disputable issue is relevant only if the model of alternate custody is chosen. The father's preference for this model is that the parent exercising custody need not consult with the other parent during that time about decisions concerning the children, excepting serious issues such as health, choice of school, additional educational activities, and travelling abroad. The mother's preference is that all decisions other than the most uncontroversial, everyday issues should be consultative.

A third point of disagreement is a meta-problem, concerning implementation of the agreement. In the mother's opinion, if the alternate custody option is chosen, the agreement should be strictly implemented, with no additional meetings to be arranged. If granted main custody of the children, on the other hand, she would be keen to adopt a more elastic realization of the parenting plan. The father's disposition is the reverse.

Recall that the PPSS performs, *inter alia*, two main functions. The first of these is to provide support for divorcing parents in drafting a consistent and more or less complete parenting plan. However, another of the system's functions is to provide for assessment of the proposed plan in general and, in particular, the conformity of the Options with the criterion of the child(ren)'s wellbeing as understood by the Polish judiciary. This is one source of added value in the PPSS: its ability to provide the user with relatively precise information concerning the conformity of choices made with the crucial legal criterion as mentioned.

4. FORMAL MODELLING AND IMPLEMENTATION

4.1 Introductory Remarks

This section describes reactions of the PPSS to inputs provided by the users with regard to the three disputed issues outlined above. Only three Questions will be considered here (referred to as Q(1), Q(2) and Q(3)), although in practice the PPSS would be dealing with many more Questions as they arise in the following presentation.

Taking into account the scope and objectives of this paper, we present only the input entered by one of the parties to the dispute (the Mother). In general, we will refer to the Mother as M and to the Father as F.

4.2 Environmental Factors

As indicated, one of the first steps for users of the PPSS is to create an initial factual description of the case, to include basic information about the parties (and their children), and other simple factual information that may influence the system's valuation of certain Options.

Information introduced by the user forms a set of Environmental Factors (EFs). In the present case, the relevant EFs introduced by the Mother are as follows:

ef1: F(InvolvesChildrenInBargaining)

ef2: F(BreachedAgreement)

ef3: M(TreatsChildrenEqually)

ef4: F, M (NoCooperation).

These EFs follow from answers to questions in the Questionnaire; those questions are themselves based on simple elements of

factual descriptions of cases stored in the PPSS database. Of course, there is a possibility that a user will choose those answers favoring an anticipated valuation preferred by that user, but that is a potential danger in any legal decision support system. Here, we assume that the input entered by M is sincere (while noting that ef1 is favorable to F). Let us recall that the PPSS suggests to the user that any of the choices made in the Questionnaire should be capable of being backed by some evidence.

There are no Legal Factors in this case because the submitted information is too narrow to render any of them applicable. This again enables simplification of the example as discussed.

4.3 The Issues: Questions and Options

As indicated above, both parties agreed when commencing work on the parenting plan that parental authority would be vested in both of them. However, a dispute arose between them as to the temporal exercise of custody (in the range of the first Dimension of the PPSS: Contacts between parents and the child). Given the scope of relevant possibilities under Polish law, the structure of the relevant Question is as follows:

Q(1): Choose an Option concerning temporal issues relating to custody of the child. Choose a feasible Option that, in your opinion, benefits the child to the greatest extent.

O1. Alternate custody (AltCus)

Explanation: The child will alternately reside for a fixed amount of time with one parent and then with the other parent.

O2. Single custody (SinCus)

Explanation: The child will reside with one parent only. In such cases, the rights of the other parent will have to be accommodated with particular care in the parenting plan.

Let us assume that, despite her discouraging experience with her husband, the Mother decides to choose O1: Alternate Custody.

In such a situation, the system directs the user to Question 2, which is logically related to Option 1 in that the user is asked to answer it only if Option 1 is chosen in response to Question 1.

Q(2): Choose an Option concerning the mode of parental decision-making under alternate custody:

O3. Autonomous decision of a given parent, excepting certain important issues (AutDec)

Explanation. The parent with whom the child temporarily resides is entitled to make any legal decision concerning the child, excluding a number of important issues to be decided by both parents.

O4. Joint deciding (JointDec)

Explanation. The parent with whom the child temporarily resides is to consult generally with the other parent about all decisions concerning the child.

As the Mother is reluctant to entrust all but the most important decision-making to the Father while the child resides with him, she chooses O4.

The Mother is also asked to answer the following Question:

Q(3). Choose an Option for possible modification of the adopted scheme of contact with the child in the course of implementation of the parenting plan.

O5. Restrictive realization (Strict)

Explanation. Contact between parents and children should be exercised in strict accordance with the parenting plan.

O6. Elastic realization (Elast)

Explanation. There will be scope for ad hoc contact arrangements beyond the scheme provided for in the parenting plan.

O7. Restrictive realization with a possibility of facultative meetings (StrictMod)

Explanation. The parenting plan should be implemented strictly, but the parent with whom the child resides should agree to additional meetings with the other parent for any important reason.

Let us assume that the Mother chooses O5.

The conjunction of Options chosen by the Mother is therefore as follows:

(AltCus, JointDec, Strict)

The PPSS browses through the set of its Defeasible Rules in order to establish what valuation is to be assigned to this conjunction of options for the Dimension representing the category "Contacts between parents and child". To reiterate, the valuation scale for any Dimension in the system is: Unsatisfactory (0), Sufficient (1–3), Good (4–6), Excellent (7–9).

However, the initial valuation assigned to the chosen conjunction of Options is influenced by the set of EFs applicable to the case. The PPSS browses through the cases stored in its database and retrieves a case that matches the set of EFs introduced by the user. This in turn leads to the generation of a set of Defeasible Rules with potential application to the case.

4.4 Defeasible Rules and Ordering

Recall [2] that the Options in the PPSS may be associated with the Incompatibility relation. If the Options stand in such relation, they cannot be antecedents of the same rule. The set INC for the contemplated case may be presented as follows:

INC: (O1, O2); (O3, O4); (O5, O6); (O5, O7); (O6, O7); (O2, O4); (O2, O3).

The structure of the set of Defeasible Rules of general relevance to the present case encompasses 30 rules. For the sake of concision, selected rules are presented here (dictated by their role in further analysis).

r1: AltCus \wedge AutDec \wedge Strict \Rightarrow S[3]

r2: SinCus \wedge Strict \Rightarrow S[3]

r3: AltCus \wedge AutDec \wedge Strict \wedge ef2 \Rightarrow U[0]

r4: AltCus \wedge AutDec \wedge Strict \wedge ef1 \Rightarrow U[0]

r5: AltCus \wedge AutDec \wedge Strict \wedge ef4 \Rightarrow U[0]

r6: SinCus \wedge Strict \wedge ef3 \wedge ef4 \Rightarrow E[7]

(...)

r12: SinCus \wedge Elast \wedge ef3 \wedge ef4 \Rightarrow G[4]

(...)

r18: SinCus \wedge StrictMod \wedge ef3 \wedge ef4 \Rightarrow G[6]

r19: AltCus \wedge JointDec \wedge Strict \Rightarrow S[2]

r20: AltCus \wedge JointDec \wedge Strict \wedge ef2 \Rightarrow U[0]

r21: AltCus \wedge JointDec \wedge Strict \wedge ef1 \Rightarrow U[0]

r22: AltCus \wedge JointDec \wedge Strict \wedge ef4 \Rightarrow U[0]

Given the choices of Options made by M, the relevant rules to be taken into consideration are r20–r22. The PPSS matches the set of Options and EFs with the Structured Case stored in the knowledge base; in this context it is the case decided by the District Court in Sieradz I Ca 352/13.¹ As a result, it retrieves the following ORD_C set, encompassing, *inter alia*, the following ordering relations:

r22>r19

r22>r20

r21>r19

r20>r19

Note that each of the rules applicable to the choices made by M are valued as Unacceptable (0) with regard to the relevant Dimension. In consequence, the ordering of these rules stemming from the Structured Case is redundant in this context. Ultimately, the valuation stemming from the presence of EF ef4 (F. M(NoCooperation)) is decisive. The program therefore informs the user of the unacceptability of the chosen set of Options, given the submitted set of Environmental Factors.

For this reason, it is suggested that the user choose option O2 in response to Question 1. Let us assume that M does so and, additionally, that she chooses O6 in response to Question 3 (Question 2 is not asked by the system). In this situation, the PPSS notifies her that, according to its knowledge base, her choice of Options is acceptable (see r12), although there are still better choices with respect to the wellbeing of the child (r18 and r6).

4.5 Knowledge Representation and Implementation

The model of PPSS described above identifies five kinds of clause, expressing five different elements of knowledge required for construction of the parenting plan.

EFs describe factual states of affairs. By clauses like `ef(factor)` we declare that factor to be an EF. To declare that a given EF ef1 is true, we can add the following clause to the knowledge base:

```
true(ef1).
```

Analogically, by `option(altCus)` we declare that altCus is an Option. To add an option to the parent plan, we must add the following clause to the knowledge base:

```
true(altCus).
```

Environmental factors and options are represented in a very simple way; representation of Defeasible Rules is more complicated. DRs are declared by these clauses:

```
rule(name, valuation, category, [list of conditions]).
```

where name is a rule name, valuation is the point of the scale of a given Dimension, and category is the name of a Dimension. List of conditions is a list of chosen Options with Environmental Factors in a given case. The following is an example of one of the system's rules:

```
rule(r3,0,Contacts,[altCus,autDec,strict,ef2]).
```

¹ Retrieval of cases is done on the basis of the inclusion relation; if any of the Options and EFs chosen or introduced by the user is present in the SC, it is retrieved as an on point case [see 4]. The problem of degrees of similarity between cases is not within the scope of this paper.

The above clause represents rule r3 from the set described above.

The predicate `more(rule1, rule2)` represents orders between Defeasible Rules (rule1 prevails over rule2).

The inference process has three main steps, the first of which is to check which rules have satisfied conditions. This can be done by execution of these clauses:

```
satisfy(Rule, Category, Out):- rule(Rule,Out,
Category, Conditions), satisfied(Conditions).
satisfied([]).
satisfied([Head|Tail]):- true(Head),
satisfied(Tail).
```

This construction of inferences enables the use of rules with arbitrarily long list of conditions.

The second step is to identify which of the Defeasible Rules are defeated by stronger ones. This can be done by execution of this clause:

```
notvalid(Rule):-satisfy(Rule,Category,_),
satisfy(Rule2,Category,_), more(Rule2,Rule).
```

It is important to notice that a given rule can be defeated by a rule with satisfied conditions and which is devoted to estimate the same category only.

The third and final step of the inference process is valuation of the chosen options, which can be done by calling the clause:

```
valuation(Category, Out):-
satisfy(Rule,Category, Out), not
notvalid(Rule).
```

Implementation of the PPSS inference engine is very simple, but it delivers correct results and properly reflects the reasoning presented informally above.

The system was evaluated for the case as described in section 4.3. All required knowledge was added to the program, and combinations of various possible options were tested. Eventually, the system indicated that the best plan was to entrust the Mother with single custody with restrictive realization of contact with the Father (valuation: Excellent(7)). Similar results (valuation: Good(6)), were achieved by entrusting the Mother with single custody with restrictive realization of contact and the possibility of facultative meetings with the Father. Other plans yielded worse results.

5. DISCUSSION AND CONCLUSIONS

A detailed discussion of the PPSS project in the context of the relevant literature can be found in [3]. The present contribution deals solely with the representation of a case by means of CATO-style factors [1] and sets of Defeasible Rules, relating these to values of Dimensions.

The concept of dimensions was part of the HYPO system [5], which was also widely discussed in [6] and [8]. Although knowledge representation in the PPSS system was inspired in part by HYPO, it is important to point out some important differences between both conceptions. First, HYPO dimensions are mainly tools for the comparison of cases; in our approach, dimensions are tools for estimating realization of the wellbeing of a child.

In contrast to the HYPO-style dimensions (which were pro-plaintiff or pro-defendant), the main aim of the PPSS system is not to lead any party to victory, or even to identify the winner of a trial, but to promote the wellbeing of children. In PPSS, there is only one direction because all Dimensions are pro-children.

HYPO-style dimensions may have a binary character (extreme *pro* or *con*) or they may include a wider range of positions. All 10 Dimensions of the PPSS system have a wider range of 10 possible values.

In the HYPO system, the factor represents a generalized factual state of affairs and may represent a particular point in a dimension's range. Since Dimensions in PPSS represent evaluations of various aspects of a child's well-being, the conjunction of Environmental Factors and Options has a particular influence on the Dimension. It is important to note that Environmental Factors need not be unequivocal in character. Their influence on the estimation of any Dimension may depend on the conjunction with other Environmental Factors and Options. Similarly, one Option may exert a positive influence on the Dimension, while in conjunction with a second one its influence is much worse.

Another important issue connected with Defeasible Rules and orders between them is that although there is a long tradition of ordering rules in the AI and law community, ordering in the PPSS system requires deeper discussion, mainly in relation to the root of all these orders. In our opinion, these orders follow from the relative importance of the raw facts that constitute the background of Environmental Factors. One important question arising is why in such situations we do not assume such orders between Factors. As noted earlier, the conjunction of various Factors, and of Factors with Options, may crucially change their character and influence a particular Dimension. It would seem, then, that ordering of Environmental Factors in advance is too big a simplification. In real-life cases, the influence of raw facts and options on the wellbeing of a child should not be analyzed only on the basis of past cases or without discussion of the specifics of a given case. The ordering of rules as discussed here is therefore strictly case-sensitive; it is part of a description of one Structured Case and should not be too hastily referred to other cases. However, this analogical function is less important in the PPSS than in the HYPO and CATO systems because Poland is a continental legal culture country with no principle of *stare decisis*. A probable source of additional information useful for determination of judicial decision are doctrinal theories of well-being of the child [2]. However, the concept of the well-being of the child is to a great extent immune to doctrinal elaborations due to its very high context-sensitiveness and the significant influence of value judgments.

As regards the latter context, it is considered to add the elements concerning teleological and value-based reasoning to the PPSS. There literature of the subject of balancing is vast in the research on AI and Law [7, 9, 10]. A limitation which can be seen as regards the adoption of this view in the PPSS is that this project intends to be closely based on actual wording of judicial opinions, which sometimes do not explicitly mention the relevant values and goals.

This paper presents the results of a first attempt to implement a formal model into a decision support system. The inference engine will be the core element of the system, responsible for the evaluation of plans created by the parties to the case, with the help of a mediator. The engine was created in PROLOG language and uses five kinds of clause to represent the five aspects of knowledge necessary to model a case. The engine can derive an

valuation of a declared plan, but as knowledge gathered from past cases may not be complete and unequivocal, the system may derive different valuations on the basis of various rules.

Here, the real-life case was submitted to the system's knowledge base, and the inference engine identified the best solutions. Future work will focus on two main issues: (1) nuances of formal representation of a case and its resolution, with particular regard to the problem of reasoning about environmental factors, priorities among factors, and the possibility of adding negations to a model; and (2) progressive implementation of the PPSS and testing on a set of real-life cases.

6. ACKNOWLEDGEMENTS

We are grateful to three anonymous reviewers for their insightful comments. This paper has been prepared within the research project Non-profit legal aid in Poland in the light of legal and economic analysis. Current and recommended state, financially supported by the National Science Centre; agreement no. 2012/07/B/HS4/02994.

7. REFERENCES

- [1] Aleven, V. 1997. *Teaching case-based argumentation through a model and examples*. (Unpublished doctoral dissertation). University of Pittsburgh Graduate Program in Intelligent Systems.
- [2] Araszkiewicz, M. 2014. Scientia Juris: A Missing Link in the Modelling of Statutory Reasoning. JURIX 2014. IOS Press, Amsterdam, 1 – 10.
- [3] Araszkiewicz, M., Łopatkiewicz, A. and Zienkiewicz, A. 2013a. Factor-Based Parent Plan Support System. In *Proceedings of the 14th International Conference on Artificial Intelligence and Law* (ICAIL 2013, E. Francesconi and B. Verheij Eds.). ACM, New York, 171-175.
- [4] Araszkiewicz, M., Łopatkiewicz, A. and Zienkiewicz, A. 2013b. Parent Plan Support System – Context, Functions and Knowledge Base. In *Business Information Systems Workshops, Lecture Notes in Business Information Processing* vol. 160, W. Abramowicz, Ed. Springer, Berlin, 160-171.
- [5] Ashley, K. *Modeling legal argument: Reasoning with cases and hypotheticals*. MIT Press, Cambridge, MA.
- [6] Bench-Capon, T. and Rissland, E. 2001. *Back to the Future: Dimensions Revisited*. JURIX 2001. IOS Press, Amsterdam, 41-50.
- [7] Lauritsen, M. 2015. On balance. *Artificial Intelligence and Law* 23 (1), 23-42.
- [8] Rissland, E. and Ashley, K. 2002. A note on dimensions and factors. *Artificial Intelligence and Law* 10, (1-3), 65-77.
- [9] Sartor, G. 2010. Doing justice to rights and values: teleological reasoning and proportionality. *Artificial Intelligence and Law* 18 (2), 175-215.
- [10] Zurek, T. and Araszkiewicz, M. 2013. Modeling teleological interpretation. In *Proceedings of the 14th International Conference on Artificial Intelligence and Law* (ICAIL 2013, E. Francesconi and B. Verheij Eds.). ACM, New York, 160-168.