

VIRTUAL ARGUMENTS

On the Design of Argument Assistants
for Lawyers and Other Arguers

Series Editors

Aernout H.J. Schmidt, *Editor-in-Chief*
Center for eLaw@Leiden, Leiden University

Berry J. Bonenkamp, *Managing Editor*
NWO/ITeR, The Hague

Philip E. van Tongeren, *Publishing Editor*
T·M·C·ASSER PRESS, The Hague

For other titles in the Series see p. 162

INFORMATION TECHNOLOGY & LAW SERIES ⑥

VIRTUAL ARGUMENTS

On the Design of Argument Assistants
for Lawyers and Other Arguers

Bart Verheij

*Assistant Professor, Artificial Intelligence Department
University of Groningen*

T•M•C•ASSER PRESS

The Hague

The *Information Technology & Law Series* is published
for ITeR by T·M·C·ASSER PRESS
P.O. Box 16163, 2500 BD The Hague, The Netherlands
<www.asserpress.nl>

T·M·C·ASSER PRESS English language books are distributed exclusively by:

Cambridge University Press, The Edinburgh Building, Shaftesbury Road,
Cambridge CB2 2RU, UK,

or

for customers in the USA, Canada and Mexico:
Cambridge University Press, 40 West 20th Street, New York, NY 10011-4211, USA

<www.cambridge.org>

The *Information Technology & Law Series* is an initiative of ITeR, the National Programme for Information Technology and Law, which is a research programme set up by the Dutch government and the Netherlands Organisation for Scientific Research (NWO) in The Hague. Since 1995 ITeR has published all of its research results in its own book series. In 2002 ITeR launched the present internationally orientated and English language *Information Technology & Law Series*. This series deals with the implications of information technology for legal systems and institutions. It is not restricted to publishing ITeR's research results. Hence, authors are invited and encouraged to submit their manuscripts for inclusion. Manuscripts and related correspondence can be sent to the Series' Editorial Office, which will also gladly provide more information concerning editorial standards and procedures.

Editorial Office

NWO / ITeR
P.O. Box 93461
2509 AL The Hague, The Netherlands
Tel. +31(0)70-3440950; Fax +31(0)70-3832841
E-mail: <iter@nwo.nl>
Web site: <www.nwo.nl/iter>

Single copies or Standing Order

The books in the *Information Technology & Law Series* can either be purchased as single copies or through a standing order. For ordering information see the information on top of this page or visit the publisher's web site at <www.asserpress.nl/cata/itlaw6/fra.htm>.

ISBN 90-6704-190-4
ISSN 1570-2782

All rights reserved.
© 2005, ITeR, The Hague, and the author

No part of the material protected by this copyright notice may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system, without written permission from the copyright owner.

Cover and lay-out: Oasis Productions, Nieuwerkerk a/d IJssel, The Netherlands
Printing and binding: Koninklijke Wöhrmann BV, Zutphen, The Netherlands

PREFACE

This book provides an overview of research into the design of argumentation software. The focus is on defeasible argumentation as it occurs in the law. This book reports on interdisciplinary research, and I hope that not only researchers in the field of artificial intelligence and law, but also legal theorists, argumentation theorists and interested lawyers will be able to find their way through the material.

The research was funded by ITeR, the National Programme for Law and Information Technology (project numbers 014-37-112 and 014-38-708) and was carried out at the Faculty of Law of the Universiteit Maastricht. I would like to thank Jaap Hage and Bram Roth for their comments on a draft of this text. Earlier versions of much of the material in this book have been presented elsewhere, mostly in workshops and conferences (see the references in the text). An abridged and adapted version of the text, entitled ‘Artificial argument assistants for defeasible argumentation’, has been published in *Artificial Intelligence*, in a special issue on artificial intelligence and law (Verheij 2003b).

Groningen, September 2004

Bart VERHEIJ

TABLE OF CONTENTS

Preface		V
One	Introduction	1
1.1	Argument Assistants	4
1.2	Defeasible Argumentation in the Field of Law	5
1.3	Theory Construction and the Application of Law to Cases	7
1.4	From Automated Reasoning to Argument Assistance: the Artificial Intelligence Perspective	10
1.5	Experimental Argument Assistants: ARGUE! and the ARGUMED Family	12
1.6	Related Research	14
1.7	An Example: A Case of Grievous Bodily Harm	15
Two	The First Prototype: ARGUE!	17
2.1	Argumentation Theory	19
2.2	The Grievous Bodily Harm Example	22
2.3	Program Design	25
Three	Improved Naturalness: ARGUMED 2.0	29
3.1	Argumentation Theory	31
3.1.1	Reasons, conclusions, exceptions	31
3.1.2	Warrants	33
3.1.3	Justification	36
3.2	The Grievous Bodily Harm Example	42
3.3	Program Design	44
3.3.1	Moves	44
3.3.2	Views	47
3.3.3	Algorithms	48
3.4	User Evaluation	50
Four	A Logical Extension: ARGUMED 3.0 based on DEFLOG	53
4.1	Argumentation Theory	55
4.1.1	The structure of dialectical arguments	55
4.1.2	Evaluating dialectical arguments	58

4.1.3	When can argumentation end?	61
4.1.4	DEFLOG: a theory of prima facie justified assumptions	63
4.2	The Grievous Bodily Harm Example	67
4.3	Program Design	70
4.4	User Evaluation	75
Five	A Comparison of Argument Assistants and Mediators	77
5.1	Belvedere	79
5.2	Convince Me	81
5.3	KIE's SenseMaker	83
5.4	Reason!Able	84
5.5	Room 5	88
5.6	Zeno and Hermes	89
5.7	Overview and Comparison	91
Six	Theories of Defeasible Argumentation	95
6.1	Toulmin's Argument Scheme	98
6.1.1	Arguing with pros and cons	99
6.1.2	Arguing with warrants	100
6.1.3	Argument evaluation	101
6.1.4	Theory construction	102
6.2	Reiter's Logic for Default Reasoning	102
6.2.1	Arguing with pros and cons	102
6.2.2	Arguing with warrants	103
6.2.3	Argument evaluation	103
6.2.4	Theory construction	104
6.3	Pollock's Rebutting and Undercutting Defeaters	104
6.3.1	Arguing with pros and cons	105
6.3.2	Arguing with warrants	106
6.3.3	Argument evaluation	107
6.3.4	Theory construction	108
6.4	Vreeswijk's Abstract Argumentation Systems	110
6.4.1	Arguing with pros and cons	111
6.4.2	Arguing with warrants	111
6.4.3	Argument evaluation	111
6.4.4	Theory construction	112
6.5	Prakken and Sartor's Winning Strategies	113
6.5.1	Arguing with pros and cons	113
6.5.2	Arguing with warrants	114

6.5.3	Argument evaluation	114
6.5.4	Theory construction	115
6.6	Dung's Admissible Sets of Arguments	115
6.6.1	Arguing with pros and cons	115
6.6.2	Arguing with warrants	115
6.6.3	Argument evaluation	116
6.6.4	Theory construction	116
6.7	CUMULA's Generalized Defeaters	117
6.7.1	Arguing with pros and cons	117
6.7.2	Arguing with warrants	117
6.7.3	Argument evaluation	118
6.7.4	Theory construction	118
6.8	Reason-Based Logic	118
6.8.1	Arguing with pros and cons	119
6.8.2	Arguing with warrants	119
6.8.3	Argument evaluation	119
6.8.4	Theory construction	119
6.9	ARGUE!, ARGUMED 2.0 and ARGUMED 3.0	120
6.9.1	Arguing with pros and cons	120
6.9.2	Arguing with warrants	121
6.9.3	Argument evaluation	121
6.9.4	Theory construction	122
Seven	Argument Assistants: Conclusions and Prospects	123
7.1	Overview of ARGUE!, ARGUMED 2.0 and ARGUMED 3.0	126
7.2	Contributions and Conclusions	127
7.3	Future Research and Prospects	128
Appendix A	The test protocol of ARGUMED 2.0 (translated excerpt)	131
Appendix B	Spin-off: the dialectical logic DEFLOG	135
B.1	Dialectically Justifying Arguments	135
B.2	The Existence and Multiplicity of Extensions	137
B.3	Dung's Argumentation Frameworks and Admissibility	140
Literature		145
Web addresses		155
Index		157

Chapter 1
Introduction

Chapter 1

Introduction

Computers can be used to support tasks that involve argumentation. Computer programs that can support argumentative tasks are called *argument assistants*. Just as word-processing software assists the process of writing, e.g., by making it easy to move text from one place to another and by providing automatic spelling checks, argument assistance software assists with argumentative tasks. Argument assistants can, for instance, help with the organization, visualization and evaluation of arguments.

In this book, no attempt is made to cover all aspects of argumentation. The focus in this book is on *defeasible argumentation*, especially as it occurs in the law. In defeasible argumentation, it may occur that a conclusion that is at first sight justified by an argument, is later withdrawn, for instance because there are new reasons against the conclusion. Since in legal argumentation defeasibility is omnipresent and often crucial, the law is chosen as the domain of application.

More specifically, the focus is on the following four aspects of argumentation: arguing with pros and cons, arguing with warrants, argument evaluation, and theory construction. These aspects of argumentation are all common in the domain of law. The argument assistants discussed in this book provide assistance with these four aspects of argumentation.

After a general introduction to argument assistants (section 1.1), the defeasibility of argumentation in the field of law is discussed (section 1.2). This leads to a view of the application of the law to concrete cases in terms of theory construction (section 1.3). An important question is then how information technology, and especially artificial intelligence research, can deal with argumentation. The question is addressed in section 1.4, where argument assistance is distinguished from automated reasoning. In section 1.5, the experimental argument assistants presented in this book are introduced: ARGUE! and the systems in the ARGUMED family. In section 1.6, pointers are given to related research. The chapter concludes with a legal case that is used as an example throughout the book (section 1.7).

1.1 ARGUMENT ASSISTANTS

Argument assistants are computer programs that assist users with argumentative tasks. Argumentative tasks occur in many kinds of situations. For instance, people draft argumentative texts, try to justify points of view, take part in debates between opponents or in opinion forming discussions, they must make decisions, and try to choose rationally between several options.

A domain in which argumentation plays a dominant role is the law. The following observations exemplify the mentioned argumentative tasks in a legal setting:

- Lawyers routinely *produce argumentative texts*, such as court pleadings.
- A legal opinion is worth as much as the *justification* that is given to support it.
- In the courtroom, *debate between opponents* has been institutionalized.
- *Opinion formation* concerning matters of law is an important task of legal research.
- Judges are authoritative *decision makers*.
- Lawyers must try to *choose rationally* between different courses of action, for instance when giving advice to a client or determining whether or not to prosecute a suspect.

All these situations involve argumentation. There are issues to be settled, and for that purpose arguments are produced. These arguments are based on assumptions and contain reasons for and against the issues involved.

In these terms, argument assistance software can for instance help with argumentative tasks by

- keeping track of the issues that are raised and the assumptions that are made,
- keeping track of the reasons that have been adduced for and against a conclusion,
- keeping track of the issues that have been settled or remain open,
- providing means to organize the statements made,
- providing tools for argument evaluation,

- providing argument templates, and
- checking constraints that must be obeyed.

The research presented in this book originated in the interdisciplinary field of artificial intelligence and law. The law is of course a fruitful source of examples of argumentation. Moreover, many – if not all – of the most difficult questions with respect to argumentation occur within the law in a real-life context. As a result, many examples in the book will be taken from the legal domain. The general reader will however discover that most of what is said is relevant in a context which is wider than the law.

1.2 DEFEASIBLE ARGUMENTATION IN THE FIELD OF LAW

Argumentation is a vast topic. As a result, the software described in this book was developed with a restricted perspective on argumentation in mind. The selection of focal points has been made with an eye on legal reasoning. Especially, defeasibility of argumentation lies at the heart of the research in this book.

In all argumentation software to be discussed in this book, the argumentation involves statements that are not only supported by arguments for them, but they are also attacked by arguments against. In short, the focus is on *arguing with pros and cons*.

One natural context in which to study arguing with pros and cons, is that of dialogues in which two or more arguers exchange arguments for and against the statements made. For instance, it can be the case that in a particular dialogue two arguers have dedicated roles: one arguer tries to defend a claim by giving reasons for it, while another tries to raise doubts by providing reasons against the claim.

In the present book, argumentation is however not studied in a dialogue context. Instead, argumentation is treated as a process of finding satisfactory assumptions to settle one or more issues. In other words, argumentation is regarded as a kind of *theory construction*: the assumptions determined in the process of argumentation provide a theory to settle the issues.

For instance, a judge uses his knowledge of the law and of the world in general, the available evidence and the court proceedings in order to settle the issue as to whether a criminal suspect is innocent or guilty. It regularly

occurs that the available information contains conflicting material (for instance, contradictory witness testimonies) and does not suffice to settle the issue. As a result, the judge will have to form an acceptable theory of the case. A first selection of reasonable hypotheses can for instance provide an initial theory with respect to the suspect's innocence. By subsequent critical scrutiny and adaptation of the theory, e.g., by arguing for and against its elements and consequences, the theory is developed until it provides a satisfactory account of the case and the suspect's innocence. The theory construction view on argumentation is especially relevant when it is acknowledged that argumentation is defeasible, since in that case the status of an issue can change throughout the process.

A topic requiring special attention when considering argumentation with pros and cons is *argument evaluation*. The standard view on argument evaluation is provided by classical logic in terms of logical validity (whether in a semantic, proof-theoretic or procedural guise). For instance, an argument is regarded as valid when the truth of its conclusion follows from the truth of its premises. This standard view requires adaptation, however, since arguing with pros and cons is defeasible: a conclusion that is justified given a particular set of arguments can cease to be justified when arguments are added. This can, for instance, occur when a reason against a conclusion is introduced. When there are only reasons for punishing someone, it seems to be justified to conclude that he must be punished. However, when sufficient counter-reasons become available it may occur that it is no longer justified to draw that conclusion. It can even happen that it is justified to draw the opposite conclusion, that he must not be punished.

The result of the defeasibility of argumentation with pros and cons is that a corresponding argument evaluation function cannot be monotonic. An argument evaluation function is monotonic when adding information can only extend the set of justified conclusions and never leads to a smaller set of justified conclusions. Since evaluation in terms of standard logical validity is monotonic, the notion of argument evaluation must be revised. The defeasibility of reasoning and the corresponding nonmonotonicity of consequence relations has received a great deal of research attention since the 1980s and has turned out to be a difficult and subtle subject.

A perspective on argumentation is not complete without a discussion of *warrants*, in the way that Toulmin (1958) used the term, viz., as generic inference licences. For Toulmin, warrants are rule-like statements warrant-

ing that some reason supports its conclusion. For instance, the statement that murderers should be imprisoned for twenty years can warrant the argument that a particular suspect should be imprisoned for twenty years since he is a murderer. Dealing with warrants is especially intricate in the context of defeasible argumentation, since it is often the case that warrants have exceptions. For instance, even when in general the warrant obtains that murderers should be imprisoned for twenty years, it can occur that a specific murderer should *not* be imprisoned, e.g., when he is considered to be mentally ill.

Especially in an account of legal argumentation, warrants cannot be missed. Many of the issues in legal reasoning concern the question whether a particular warrant is justified. This occurs for instance in a debate on the interpretation of a particular statutory article. From an argumentation-theoretic point of view, such a debate concerns settling the issue of which warrant (or warrants) are backed by the article.

Summarizing, the argumentation perspective in this book consists of four points of focus:

- Arguing with pros and cons
- Theory construction
- Argument evaluation
- Arguing with warrants

All four are of central relevance for defeasible argumentation in the law.

1.3 THEORY CONSTRUCTION AND THE APPLICATION OF LAW TO CASES

Theory construction provides a view on the application of law to cases. A somewhat naïve conception of the application of the law to concrete cases is that it consists of strictly following the given rules of law that match the given case facts – a conception by which a judge is turned into a *bouche de la loi* (Figure 1.1).

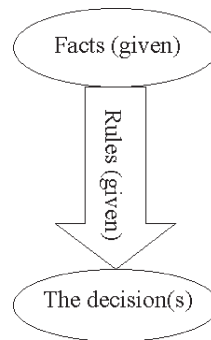


Figure 1.1: A naïve view of applying the law to a case

The main problem with this view (which has become a mock image of law application that mainly serves as a take-off point from which to move away) is that it assumes that the rules of law and the case facts are somehow readily available. Obviously, this is not the case. The available material is simply not sufficiently precise and unambiguous to allow the straightforward application of rules to facts. And even if the rules and facts were given in an adequate manner, following the rules that match the case facts can be problematic. First, following the rules may not be appropriate, e.g., when a rule is not applicable because of an exception. Second, it may be that the case is not solved at all, e.g., when no relevant result follows. Third, there may be several possibilities, perhaps ones which even conflict.

The first can occur since legal rules are generally *defeasible*. There can be exclusionary reasons or reasons against their application, for instance when applying the rule would be against its purpose.

The second is the case when there is a legal *gap*: the applicable law does not have an answer to the current case. This not only occurs on the advent of new legally relevant phenomena (such as the new legal problems as they are encountered by the rise of the internet), but also when the law only (and often deliberately) provides a partial answer, as for instance by the use of open rule conditions, such as grievous bodily harm or fairness. An adjudicator will have to fill the gap, for instance by making new rules of classification.

The third is the case when there is a legal *ambiguity*: the applicable law provides several possible answers. This can occur by accident, for instance, when there is an unforeseen and unwanted conflict of rules. In a complex,

man-made system such as the law, this is to be expected. Ambiguities also arise on purpose, however, namely when choosing between the different possibilities is left to the discretion of the adjudicator. For instance, in the Netherlands, rules of criminal law have open rule conclusions, in the sense that they merely prescribe the maximum punishment. As a result, the adjudicator can take all circumstances into account when deciding the actual punishment to be imposed.

Defeasibility is related to the dialectics that are so deeply entrenched in the law: every claim can at times be subject to discussion. Legal gaps and ambiguities are signs of the inherent openness of the legal system. Just as defeasibility, they allow for a flexible application of the law that takes all circumstances into account, and they can thus increase the system's justness.¹

In a view of applying the law to cases that is different from the naïve conception, law application is considered as a kind of dialectical theory construction (Figure 1.2; cf., also section 1.3). In such a view, applying the law to a case is a process which goes through a series of stages. During the process, a theory of the case, the applicable law and the consequences is progressively developed. The process starts with a preliminary theory with imperfections, such as insufficiently justified assumptions, tentative interpretations of legal sources, unduly applied rules, open issues and conflicting conclusions. During the process, the theory is gradually enhanced in order to diminish the imperfections. The process is guided by examining the preliminary theory, and by looking for reasons for and against it.

The argument assistants presented in the present book support the dialectical theory construction needed for the application of the law to cases.²

¹ Some may fear that defeasibility, gaps and ambiguities all too easily diminish legal security and equality. One asset of the legal system is that it tries to uphold legal security and equality by explicit specification, while leaving room for justness by remaining open.

² I first made the connection between theory construction and argument assistants in a paper on the theory of Crombag, Van Koppen and Wagenaar on anchored narratives (Verheij 2000b). The theory of anchored narratives focuses on the role of evidence in legal decision making (Crombag, Van Koppen and Wagenaar 1994, Wagenaar, Van Koppen and Crombag 1993).

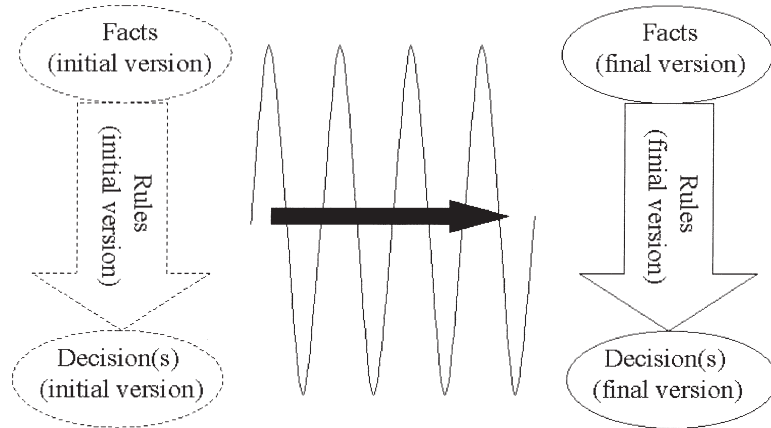


Figure 1.2: Theory construction

1.4 FROM AUTOMATED REASONING TO ARGUMENT ASSISTANCE: THE ARTIFICIAL INTELLIGENCE PERSPECTIVE

The points of focus concerning argumentation discussed above (arguing with pros and cons, arguing with warrants, argument evaluation and theory construction) concern challenging aspects of argumentation, both in theory and in practice. Is it reasonable to expect that information technology, and in particular artificial intelligence, can deal with them? It is time to address the perspective of artificial intelligence.

The idea of building intelligent machines has been around for a long time. And since the start of the computer age in the 1940s, when the first computers (such as the famous ENIAC) were built, the progress has been impressive. Automated data processing, the personal computer, the Internet and mobile computing continue to have tremendous impact. Computers can defeat chess grandmasters. Machines can recognize handwritten text. Robots can learn to walk. Knowledge-based systems can improve the work of human experts in law and in medicine.

Not all expectations have been met, though. An infamous prediction is Herbert Simon's in 1957 that 'in a visible future' the range of problems that machines and human minds can handle would become coextensive (Russell and Norvig 1995, p. 20). He did not see this future: Simon died in 2001. In

particular knowledge-intensive, underspecified tasks, such as language understanding and legal decision making, still pose extensive and difficult problems.

Considering these problems, it makes sense to combine the strengths of computers and humans. More concretely, it can be investigated how computer systems can support tasks performed by humans, instead of replacing them. In this book, this approach is taken with respect to argumentation. The design effort reported upon in this book was not aimed at the development of software that can reason autonomously and automatically, but of software that can support human reasoning. The former type of software is referred to as automated reasoning systems, the latter as argument assistance systems, or argument assistants, for short.³

Clearly, argument assistants must be distinguished from automated reasoning systems, which are more common. The latter automatically perform reasoning on the basis of the information in their 'knowledge base'. In this way, an automated reasoning system can carry out reasoning tasks for the user. Argument assistants do not (or do not primarily) reason autonomously; the goal of assistance systems is not to replace the user's reasoning, but to assist the user in his reasoning process.

The different nature of argument assistance systems and automated reasoning systems has two consequences. First, argument assistants are more reactive than active, in comparison with automated reasoning systems. Argument assistants provide a setting for performing argumentative tasks, set constraints and provide guidance. In an argument assistant, some functions can occur automatically 'in the background' instead of when a user gives a command. For instance, the evaluation of argumentative data, such as the indication which statements are currently justified, can be computed automatically, much like the spelling checks of word processing systems: after each action by the user, the argument assistance system updates previous evaluations.

Second, in the development of argument assistants, some of the difficulties of building automated reasoning systems can be avoided or become less critical. For instance, the acquisition and representation of knowledge become less of a bottleneck since such tasks can to a large extent be left to the user (or users) of an argument assistance system: using such a system

³ See also Hunter's (2001) discussion of hybrid argumentation systems.

can in fact come down to constructing a representation of the arguments that are relevant to the problem at hand. A side-effect of the mediation of the construction by the argument assistant is that the representation becomes available in a format that is – at least partially – understandable to the system. Perhaps more importantly, the responsibility for the representation remains largely on the side of the user, and can be adapted at will.

In the law, the acquisition and representation of knowledge are especially notorious because of the law's inherent complexities, such as its open and dynamic nature. As a consequence, a computer representation of a part of the law can hardly ever be complete and will easily become obsolete. By leaving a considerable part of the representational tasks to the user, these complexities are less intense for argument assistance systems than for automated reasoning systems. In fact, this is a relevant incentive to develop argument assistants in the first place (cf., also Leenes 1998).

1.5 EXPERIMENTAL ARGUMENT ASSISTANTS: ARGUE! AND THE ARGUMED FAMILY

In the following chapters a series of computer programs for argument assistance will be discussed: ARGUE! and the ARGUMED family. All can be downloaded at www.rechten.unimaas.nl/metajuridica/verheij/aaa/.

The first argument assistant, ARGUE! (chapter 2), was inspired by my work on the logical system CUMULA that abstractly modelled defeasible argumentation (Verheij 1996a). In CUMULA, arguments (in the sense of trees of reasons and conclusions) can be defeated. The defeat of arguments results from attack by other arguments, as expressed by defeaters. A defeater indicates which set of arguments attacks which other set of arguments. CUMULA's defeaters allow the representation of several types of defeat (including defeat by parallel strengthening and by sequential weakening; Verheij 1996a). While building ARGUE!, it became apparent, however, that CUMULA (or rather: the streamlined version thereof used for ARGUE!) was not sufficiently natural for the representation of real-life argumentation. Also the on-screen drawing of argumentative data (especially of the defeaters) seemed to be too complex for the intended users. The result was a system that was mainly interesting from a research perspective, as a realization of (and a testbed for) a particular theory of defeasible argumentation. ARGUE! was first described in this way by Verheij (1998a).

After the development of the ARGUE! system, a new approach was taken, resulting in the systems of the ARGUMED family. There were two starting points. First, the argumentation theory was changed considerably. The focus was on the statements and reasons that occur in argumentation, instead of on the arguments. Second, the interface became template-based. The user could perform his argumentation by filling in forms dedicated to particular argument moves.

With respect to the argumentation theory, the focus was limited to undercutting exceptions, as distinguished by Pollock (1987, 1995): reasons that block the connection between a reason and a conclusion. Since undercutting exceptions are of established importance for legal reasoning (see, e.g., Prakken 1997, Hage 1997, Verheij 1996a), this seemed to be a natural choice. The first version of ARGUMED (ARGUMED 1.0; Verheij 1998b, not further discussed in the present book) was soon replaced by the second since it had two obvious drawbacks: undercutting exceptions were not represented graphically, and it was not possible to argue about certain relevant issues, such as whether a statement was a reason or not, or whether it was an exception or not. The former drawback was solved in ARGUMED 2.0 (chapter 3) by the use of dialectical arguments, in which support by reasons and attack by undercutting exceptions were represented simultaneously. The latter led to the introduction of step and undercutter warrants. In ARGUMED 2.0, a step warrant is a kind of conditional sentence that underlies an argument step, such as ‘If Peter has violated a property right, then he has committed a tort’. Undercutter warrants similarly underlie attack by an undercutting exception. An example of an undercutter warrant is the statement ‘The statement that there is a ground of justification for Peter’s act, is an exception to the rule that, if Peter has violated a property right, then Peter has committed a tort’. Verheij (1999a) gave the first presentation of ARGUMED 2.0.

A qualitative user evaluation of ARGUMED 2.0 involving ten test persons (see section 3.4) inspired the design of a new user interface of the system. The result was ARGUMED 3.0 (chapter 4). Its user interface is based on a mouse-sensitive argument screen, in accordance with what the test persons had expected. When the user double-clicks in the argument screen, a box appears in which a statement can be typed. The right mouse button gives access to a context-sensitive menu that allows adding support for or attack against a statement. The resulting interface is very natural and easy to use,

as was confirmed by another user evaluation (see section 4.4). Apart from the better interface, the most interesting enhancement of the new version of ARGUMED is that it uses a richer and more satisfactory argumentation theory. Whereas in ARGUMED 2.0 the only kind of attack was based on undercutting exceptions, ARGUMED 3.0 allows the attack of any statement. By considering the connecting arrows between statements (whether expressing support or attack) as conditional statements, warrants and undercutters found natural representations. Moreover, the new version of ARGUMED is logically more satisfactory: the evaluation of dialectical arguments corresponds exactly to the dialectical interpretations of *prima facie* justified assumptions in the logical system DEFLOG (see Verheij 2000a, 2003).

The main part of the book consists of descriptions of the systems and their argumentation theories (chapters 2, 3 and 4). In order to illustrate the possibilities and differences, one example is used throughout the discussion of the three systems. This example is discussed in section 1.7 below.

1.6 RELATED RESEARCH

The research reported on in this book is connected with previous work on various topics. Among the most relevant related research is that on argument assistants and argument mediators. A selection of that work is discussed in chapter 5. Also the abundance of work on defeasible argumentation has been an inspiration (see chapter 6). Other relevant topics that have been investigated in recent research are for instance the following:

- Dialogical theories of reasoning. Hage (2000) provides an insightful overview. See for instance Gordon's (1995) *Pleadings Game* and Lodder's (1998) *DiaLaw*. Both focus on the field of law.
- Computer-supported argumentation in teaching and learning. See for instance Alevén's (1997) work on CATO, related to Ashley's (1990) HYPO, Bench-Capon and Leng (1998), and – not focusing on the legal domain – Suthers et al. (1995) on *Belvedere*, Veerman (2000), Van Gelder (2001).
- Argument analysis. For instance, Reed and Walton (2001) are developing *Araucaria*, see <www.computing.dundee.ac.uk/staff/creed/

research/araucaria.html>. They build on Walton's work on argumentation schemes (Walton 1996). See also Verheij (2001b).

- Computer-supported collaborative work focusing on argumentation. See Shum's web site at <kmi.open.ac.uk/people/sbs/csca/>.
- Computer-supported and online legal mediation and dispute resolution (see, e.g., Lodder and Huygen 2001, <www.mediate.com and www.odrworkshop.org>).
- Discourse systems focusing on e-democracy and e-governance applications. See especially Gordon's web site at <www.tfgordon.de>.
- Knowledge management. Cf., e.g., Stranieri and Zeleznikow (2000).
- Case management and litigation support systems. See, e.g., <www.digital-lawyer.com/digital-lawyer/resource/caseman.html>.
- Reasoning with evidence in the law. Cf., Wagenaar, Van Koppen and Crombag (1993), Crombag, Van Koppen and Wagenaar (1994), MacCrimmon and Tillers (2002), Verheij (2000b), Prakken, Reed and Walton (2003).
- Epistemology. Cf., e.g., Pollock (1986, 1995). Especially relevant is legal epistemology. Cf., e.g., Peczenik (1989), Brouwer (1990), Ruiters (1993), Peczenik and Hage (2000), Mommers (2002).
- Legal logic. Cf., e.g., Soeteman (1989), Hage (1997), Prakken (1997), Verheij (1999b), Verheij, Hage and Van Maanen (1999), Hage (2001b).

The present book focuses on argument assistants that have been developed with a legal context in mind, and in which the argumentation is defeasible.

1.7 AN EXAMPLE: A CASE OF GRIEVOUS BODILY HARM

Consider the following fictitious case of grievous bodily harm:

'There has been a pub fight, in which someone is badly injured: according to the hospital report, the victim has several broken ribs, with complications. Someone is arrested and accused of intentionally inflicting grievous bodily harm, which is punishable by up to eight years imprisonment, according to Article 302 Dutch criminal code [*wetboek van strafrecht*]. The accused denies that he was involved in the fight. However, there are ten witnesses who claim

that the accused was involved. In one precedent (referred to as precedent 1), the victim has several broken ribs, but no complications. In that precedent, the bodily harm was not considered to be grievous, and the accused was punished for intentionally inflicting ordinary bodily harm, which is punishable with up to two years of imprisonment (Art. 300 Dutch criminal code). In another precedent (referred to as precedent 2), the victim has several broken ribs with complications. In precedent 2, the accused was punished for intentionally inflicting grievous bodily harm’.

The facts of the case can give rise to interesting argumentation concerning the accused’s punishability for inflicting grievous bodily harm. In the discussion of the three systems, it will be shown to what extent the relevant argumentation can be produced within each of them.