

Supporting Discretionary Decision-Making with Information Technology: A Case Study in the Criminal Sentencing Jurisdiction

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A NUMBER OF INCREASINGLY SOPHISTICATED technologies are now being used to support complex decision-making in a range of contexts. This paper reports on a project undertaken to provide decision support in discretionary legal domains by referring to a recently created model that involves the interplay and weighting of relevant rule-based and discretionary factors used in a decision-making process. The case study used in the modelling process is the Criminal Jurisdiction of the Victorian Magistrate's Court (Australia), where the handing down of an appropriate custodial or non-custodial sentence requires the consideration of many factors. Tools and techniques used to capture relevant expert knowledge and to display it both as a paper model and as an online prototype application are discussed. Models of sentencing decision-making with rule-based and discretionary elements are presented and analyzed. This paper concludes by discussing the benefits and disadvantages of such technology and considers some potential appropriate uses of the model and web-based prototype application.

UN NOMBRE DE TECHNOLOGIES de pointe de plus en plus raffinées aident maintenant à la prise de décisions complexes dans une grande diversité de contextes. Cet article fait le compte rendu d'un projet mis en œuvre pour aider à la prise de décision dans des domaines juridiques discrétionnaires et décrit un modèle récent qui prend en ligne de compte l'interaction et le mérite des facteurs fondés sur les règles de droit et des facteurs de nature discrétionnaire qui sont pertinents dans la procédure de la prise de décision. Cette étude de cas utilise la procédure de modélisation de juridiction pénale de la Cour de magistrat victorienne (Australie), où l'ordonnance d'une peine carcérale ou non carcérale appropriée exige l'examen de plusieurs facteurs. L'article commente les outils et les techniques utilisés pour faire un survol du savoir expert pertinent et exposer ce savoir à la fois sous forme d'un imprimé et d'un prototype d'application électronique. Des modèles de décisions prises en matière pénale à partir d'éléments de nature réglementaire et de nature discrétionnaire sont présentés et analysés. En conclusion, l'article évalue les avantages et les désavantages de cette forme de technologie et explore certaines utilisations possibles appropriées du modèle et du prototype d'application diffusé sur le Web.

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1. INTRODUCTION

DECISION-MAKING IN THE LEGAL DOMAIN is often a complex task that involves gathering large amounts of information, analyzing issues, legislation and precedents, as well as evaluating feasible options. This paper explores the use of artificial intelligence techniques to provide decision support by making reference to a collaborative project that took place in Victoria, Australia in 2002 and 2003. The project involved exploring, modelling and building a decision-support prototype for the sentencing decisions made by magistrates in the Victorian Magistrates, (criminal) jurisdiction.

One of the central and perennial questions of sentencing law and scholarship is how lawmakers should strike an appropriate balance between consistency and individualization in punishment. In some jurisdictions, including many states in the United States and Australia, legislatures have increasingly moved towards mandatory sentencing regimes, which attempt to maximize consistency by minimizing judicial discretion—and hence individualization. In other jurisdictions, such as Victoria, Australia where this project is based, legislatures continue to grant judges considerable discretion in sentencing. In these jurisdictions, legislators have arguably favoured individualization over consistency.

Even in these jurisdictions, however, it is desirable that like cases be treated alike. From a retributivist perspective, a certain measure of consistency is necessary to ensure that offenders are punished in at least rough proportion to their culpability and thereby maintain public confidence in the integrity of the criminal-justice process. From an economic/utilitarian perspective, consistency enhances certainty of punishment, which, in turn, increases lawmakers' ability to pursue optimal levels of deterrence. We believe that the technology-based solutions we propose in this paper can help to maximize consistency of process in bounded discretion-sentencing regimes.¹

1. This paragraph is paraphrased from comments made by the original (and anonymous) reviewers of this article.

The paper commences with a discussion of sentencing in the Victorian Magistrates court. We then conduct an analysis of some of the difficulties in using artificial intelligence techniques in discretionary legal domains and review some previously published material on automated sentencing systems. We next describe the methods and techniques that were used in the Victorian sentencing project and present a selection of the models developed. The paper next discusses potential uses of these models and considers possible extensions to this work. The paper concludes with an assessment of the benefits and limitations of the project and its potential contribution to furthering an understanding of artificial intelligence decision support in discretionary legal domains.

1.1. *Sentencing in the Victorian Magistrates' (criminal) jurisdiction*

The *Sentencing Act 1991* of Victoria² generally governs the sentencing guidelines and penalties available in Victorian Magistrates' Courts for people found guilty of offences by Victorian Courts; the exception is the Children's Court, which has its own sentences.³ The 1991 Act was changed in important respects by the *Sentencing (Amendment) Act 1999*, which includes the new sentencing option of a deferral of the sentence and changes to the Victim Impact Statement procedures.

Section 5(1) of the 1991 Act sets out the purposes of sentencing, which are as follows: just punishment; deterrence of the defendant and of others from committing similar offences; the establishment of conditions for the rehabilitation of the defendant; denunciation of the defendant's conduct; and the protection of the community from the defendant.⁴ Section 5(2) requires magistrates making sentencing orders to give regard to: the maximum penalty for the offence; current sentencing practices; the nature and gravity of the offence; the defendant's culpability and degree of responsibility for the offence; whether the defendant has pleaded guilty and at what stage such a plea was indicated; the defendant's previous character; and the presence of aggravating or mitigating factors.⁵

Amendments to the 1991 Act require magistrates making sentencing orders to take into account the personal circumstances of the victim and also any injury, loss or damage resulting from the offence.⁶ Courts are also directed not to impose a more severe penalty if a less severe penalty can achieve the sentencing purpose.⁷ For example, the Court should consider imposing an intensive correction order before imprisonment and a community-based order before an intensive correction order.⁸

Sentencing orders can be grouped as follows: (a) imprisonment; (b) intensive correction order; (c) suspended sentence; (d) community-based order; (e) youth-training-centre order; (f) fine; (g) conviction; (h) adjournment or dis-

2. *Sentencing Act 1991* (Vic.) (amended to October 2004), <http://www.austlii.edu.au/au/legis/vic/consol_act/sa1991121/>.

3. *Ibid.*, s. 4.

4. *Ibid.*, s. 5(1).

5. *Ibid.*, s. 5(2).

6. *Ibid.*, s.5(2)(da)-(db).

7. *Ibid.*, s. (5)(3).

8. *Ibid.*, s. 5(2E), 5(4)-5(5).

charge; (i) non-conviction conditional adjournment with an undertaking or dismissal⁹; (j) a new sentence of deferral of sentence for defendants aged between 18 and 25 years¹⁰; and (k) other orders.¹¹ Imprisonment orders are to be served in full. The previous automatic remission of up to one third of the sentence was abolished in 1992. Magistrates may sentence a defendant for up to two years for a single offence¹² and five years for aggregate offences.¹³ Magistrates may impose one aggregate sentence of imprisonment for offences that are based on the same facts or are of a similar character.¹⁴ Defendants ordered to serve more than one term of imprisonment shall, unless otherwise ordered, serve such sentences concurrently.¹⁵

The *Sentencing (Victim Impact Statement) Act 1994*¹⁶ provides for magistrates to have regard in sentencing defendants for the impact of their crime on the victim. Crime victims are now allowed to make a victim-impact statement, usually by means of a statutory declaration—and on occasions by sworn evidence in court—which will contain details of their injury, loss or damage. The Court must order a pre-sentence report before imposing an intensive-correction order, a community-based order¹⁷ or a youth-training order¹⁸ and may order such a report in any other case.¹⁹ The prosecutor or defence lawyer may file a notice of intention to dispute the pre-sentence report with the Court, which allows evidence to be led and cross-examined on the report.²⁰

1.2. Sentencing and discretionary decision-making

Lovegrove states that decision-making in sentencing raises weighty and controversial matters. He claims that the prerequisites for good legal decision-making require that judgments should be:

- individualized—as numerous matters relating to the circumstances of the offence and the offender are potentially relevant to ensuring justice in the individual case;
- consistent—as like cases are treated similarly and unlike cases differently;
- coherent—as, given the premise that what is said is what is decided, it follows that, when for instance a factor is said to be important, it is in fact accorded substantial weight; and
- logical—as judgments, if they could be analyzed, would be found to conform to an underlying logic (the alternative being arbitrariness) and

9. *Ibid.*, s. 7(1).

10. *Ibid.*, s. 7(2).

11. *Ibid.*, s. 7(1).

12. *Ibid.*, s. 113C.

13. *Ibid.*, s. 113B.

14. *Ibid.*, s. 9.

15. *Ibid.*, s. 16(1).

16. Now incorporated into s. 85(2)(d) of the *Sentencing Act 1991 (Vic.)*, *ibid.*

17. *Ibid.*, s. 96(2). However, under s. 39(7) a court is not required to order a pre-sentence report for a community-based order whose only condition is a community service condition requiring 250 hours or less of work.

18. This order only applies to those who are 17 or more but under age 21 at the day of the court hearing.

19. *Supra* note 2, s. 96(1).

20. *Ibid.*, s. 18K(1).

as this is implicit in the basis of the appellate process which is set out in *House*,²¹ a High Court judgment rendered by Dixon, Evatt and McTiernan JJ.²²

Lovegrove claims that what is at issue is how the best balance between these four prerequisites is to be achieved.²³ In Australian legal circles, two options vie for prominence. One is that of judgment as an intuitive/instinctive synthesis and the other is that of judgment by way of a more-or-less conscious and explicit framework and process. The concept of measuring what is consistent decision-making is a vexed one. As we shall discuss later, legislators—particularly in North America—have introduced mandatory sentencing laws, judicial sentencing guidelines and sentencing grids in order to attain consistency of outcomes. Almost all decision-support systems for sentencing have been built with the judiciary as the intended end-users. Furthermore, almost all provide a range of possible sentences for a given offence. This project is novel in that the end-users are lawyers and the desired outcome is an argument rather than a sentence. Hence we are not concerned with considering the vexed issue of consistency of outcomes. Rather, we are concerned with the consistency of approaches to decision-making and the presentation of arguments to support decision-making.

As Zdenkowski notes, while mandatory sentencing and sentencing grids impose non-intuitive thinking upon sentencers, they are not concerned with achieving better legal decision-making, but, rather are driven by law-and-order populism.²⁴ Lovegrove comments that, until the late 1980s, academics and reform bodies tended to attack intuition, whilst the judiciary defended it.²⁵ However, as Fox & Freiberg claim, the judiciary is now more willing to accept non-intuitive decision-making.²⁶ Guideline judgments identify a pattern of case characteristics and indicate the sentence or range of sentences considered appropriate; there may also be an accompanying non-exhaustive list of potentially aggravating and mitigating factors, which, if present, may justify a sentence outside the range.²⁷ See Ashworth for example.²⁸ Guideline judgments can be compared to the “shopping-list” statutes discussed by Christie.²⁹ Stranieri and others have used knowledge discovery from database techniques to ascertain the relative weights of shopping-list factors in the domain of property distribution in Australian family law.³⁰

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21. *House v. The King* (1936), 55 C.L.R. 499, <<http://www.austlii.edu.au/au/cases/cth/HCA/1936/40.html>> (HCA) [House].
 22. Austin Lovegrove, “Intuition, Structure and Sentencing: An Evaluation of Guideline Judgments” (2002) 14:2 *Current Issues in Criminal Justice* 182 at 182.
 23. *Ibid.*
 24. George Zdenkowski, “Limiting Sentencing Discretion: Has there been a paradigm shift?” (2000) 12:1 *Current Issues in Criminal Justice* 58 at 61.
 25. *Supra* note 22 at 183.
 26. Richard G. Fox & Arie Freiberg, *Sentencing: State and Federal Law in Victoria*, 2d ed. (Melbourne, Australia: Oxford University Press, 1999) at 195-202.
 27. *Supra* note 22 at 192.
 28. Andrew Ashworth, *Sentencing and Criminal Justice*, 3d ed. (London: Butterworths, 2000).
 29. George C. Christie, “An Essay on Discretion” (1986) 35 *Duke L.J.* 747 at 776ff, <[http://eprints.law.duke.edu/archive/00000029/01/35_Duke_L_J_747_\(1986\).pdf](http://eprints.law.duke.edu/archive/00000029/01/35_Duke_L_J_747_(1986).pdf)>.
 30. Andrew Stranieri et al., “A hybrid rule—neural approach for the automation of legal reasoning in the discretionary domain of family law in Australia” (1999) 7, No. 2-3, *A.I. & L.* 153 at 156.

Lovegrove claims that recent judicial attempts to achieve greater consistency have jeopardized adequate individualization and resulted in error. These limitations arise from three interrelated sources. The first concerns what is required of a guideline sentence: a sentence as a guideline must be expressed in terms of a relatively narrow range. The second and third concern the nature of case circumstances: cases falling in the same legal category or sub-category of offence vary widely in regard to the facts of the offence and to the characteristics of the offender and, while some factors of aggravation and mitigation in the scaling of seriousness have a quantitative character, most are qualitative.³¹ Tata concurs. He states that the marked judicial ambivalence towards the institutionalization of aggregate decision-support systems seems at least in large part to be driven by a concern to be seen to perform a role that balances formal and substantive visions of justice. A decision-support system is considered most acceptable when judges regard it as flexible.³²

Freiberg states that the desirability of limiting judicial sentencing discretion has dominated sentencing discourse over the last 25 years.³³ Zdenkowski claims that, despite similar influences, the sentencing-reform developments in North America and Australia have taken different paths.³⁴ He states that for almost two decades, official sentencing inquiries have examined a rational case for structuring or guiding sentencing discretion.³⁵ Public confusion and resentment about the gap between sentences announced and sentences served, apparent disparity in the treatment of similar offences committed by similarly circumstanced offenders, and the "just-deserts" theory with its emphasis on consistency and fairness were all influential in these inquiries.

Zdenkowski notes that, apart from the introduction of "truth in sentencing" and of some other relatively minor recommendations for change,³⁶ Australian jurisdictions did not respond to the perceived concerns with the same vigour and determination as did their North American counterparts.³⁷ In many jurisdictions in North America, the reaction to unjustifiable disparity has been to embrace sentencing guidelines in various forms. However, Zdenkowski points out that in Australia, for the first time, there have been potentially serious encroachments on judicial discretion.³⁸ Recent developments include mandatory

31. *Supra* note 22 at 200.

32. Cyrus Tata, "Resolute ambivalence: Why judiciaries do not institutionalize their decision support systems" (2000) 14:3 *Int'l Rev. L. Comp. & Tech.* 297 at 306.

33. Arie Freiberg, "Sentencing Reform in Victoria: A Case Study" in Chris Clarkson & Rodney Morgan, eds., *The Politics of Sentencing Reform* (Oxford: Clarendon Press, 1995) 51 at 61.

34. *Supra* note 24 at 58.

35. *Ibid.* at 58. See e.g. Austl., Commonwealth, Australian Law Reform Commission, *Report No. 44: Sentencing*, ALRC1988 (1998), <http://www.austlii.edu.au/au/other/alrc/publications/reports/44/Report_44.txt>; Austl., New South Wales, New South Wales Law Reform Commission, *Report No. 79: Sentencing*, NSWLRC1996a (1996), <<http://www.lawlink.nsw.gov.au/lrc.nsf/pages/R79TOC>>; and Austl., New South Wales, New South Wales Law Reform Commission, *Discussion Paper 33: Sentencing*, NSWLRC1996b (1996), <<http://www.lawlink.nsw.gov.au/lrc.nsf/pages/DP33TOC>>.

36. See also Ivan Potas *et al.*, "Informing the Discretion: The Sentencing Information System of the Judicial Commission of New South Wales" (1998) 6:2 *Int'l J.L. & I.T.* 99.

37. *Supra* note 24 at 58.

38. *Supra* note 24 at 60.

sentencing laws,³⁹ judicial sentencing guidelines⁴⁰ and sentencing grids.⁴¹ Zdenkowski concludes that the community is likely to embrace the process of guideline judgments with greater confidence than a politically driven grid system because guidelines are indicative and flexibility is maintained. He claims that courts need to explain guideline decisions in an accessible way and that they need to resist the temptation to conflate consistency and severity.⁴²

1.3. Modelling discretionary decision-making

The development of computer systems that support courts in determining appropriate sentences is typically motivated by a desire to ensure efficiency and consistency of decisions. Typically, these systems organize statistical data derived from databases of prior decisions or retrieve matching cases using algorithms of varying complexity. Few systems have been developed by explicitly modelling the reasoning processes that decision-makers use when sentencing offenders.

The case study reported here involves the development of a prototype intelligent decision support system based upon a model of judicial reasoning as it applies to sentencing. The modelling exercise is made difficult in the Victorian Magistrates (criminal) jurisdiction because magistrates have a degree of discretion within the confines of relatively broadly stated statutory principles. Unlike other criminal jurisdictions in Australia, when a judge or magistrate in Victoria considers an appropriate sentence for an offender, there are few guidelines within the statutes⁴³ or the precedent cases. There are a few exceptions, such as the common law and statutory limitations. In the landmark case in the Supreme Court of Victoria of *R. v. Williscroft*, Adam and Crockett JJ. stated: "...ultimately every sentence imposed represents the sentencing judge's instinctive synthesis of all various aspects involved in the punitive process...."⁴⁴ This was confirmed by the full Victorian Supreme Court in *R. v. Young*.⁴⁵ According to that decision,

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39. Mandatory sentencing laws have included Western Australia's "three-strikes" legislation in 1992 (s. 401(4) of the *Criminal Code* (WA)). But see exceptions for young people in s. 189 of the *Young Offenders Act 1994*; New South Wales's mandatory life-sentence laws (*Crimes (Sentencing Procedure) Act 1999*, s. 61) and the Northern Territory's mandatory-minimum-imprisonment laws for property offenders (introduced March 1997, repealed under *Juvenile Justice Amendment Act (No. 2) 2001* for juvenile offenders and the *Sentencing Amendment Act (No. 3) 2001* for adult offenders by the new Labour government).
40. Judicial sentencing guidelines, whereby appellate courts formulate general laws for the purpose of providing guidance to trial courts, have been in operation in England for over 20 years. The promulgation of such guidelines is an incremental development from the traditional appellate role of developing common-law principles with regard to sentencing. The landmark decision of *Jurisc* (*R. v. Jurisc*, [1998] NSWSC 597, 45 N.S.W.L.R. 209, <<http://www.austlii.edu.au/cgi-bin/disp.pl/au/cases/nsw/supreme%5fct/1998/597.html?query=jurisc>>), a case involving dangerous driving causing death, was the first case in Australia in which a court issued a formal sentencing guideline judgment.
41. A sentencing grid or matrix usually involves a two-dimensional graph whose axes reflect "offence seriousness" and "prior criminal record." The penalty level is usually determined by reference to the sentencing range to be found in the cell of the grid/matrix that corresponds to the offender's offence and his or her prior record. Over 20 out of 50 US jurisdictions have embraced sentencing grids. In October 1998, the Western Australian government introduced legislation authorizing a sentencing matrix system modelled on that in place in Oregon (the *Sentence Administration Bill 1998* (WA) and the *Sentencing Legislation Amendment and Repeal Bill 1998* (WA)).
42. *Supra* note 24 at 72.
43. *Sentencing Act 1991* (Vic), *supra* note 2.
44. [1975] V.R. 292 at p. 300 (Vic SC) [*Williscroft*].
45. [1990] V.R. 951 at p. 955 (Vic SC) [*Young*].

the role in determining the just sentence entails an intuitive or “instinctive synthesis” of all the factors before the judge and should not, as the higher courts and Fox & Freiberg⁴⁶ state, “...offer any dissection of its components...”

In part because of the difficulties associated with knowledge modelling in the presence of discretion, Leith has expressed doubt about the potential for artificial intelligence to “fully represent the richness of legal knowledge in any useful way.”⁴⁷ However, the key assumption underpinning this project is that discretionary reasoning can be usefully modelled—though to do so requires a modelling technique appropriate to the task and a careful analysis of discretion.

Judicial decision-makers seek to exercise their discretion astutely both to make the optimum decision in each particular case and also to minimize the amount of conflict and the likelihood of appeals flowing from their discretion. Another objective of decision-making is to exhibit a measure of consistency rather than to appear random.⁴⁸ Discretion is closely associated with the concept of “open texture,” a term first used by Waismann to assert that empirical concepts are necessarily indeterminate.⁴⁹ It is frequently used to describe the ambiguity or vagueness in the natural-language descriptions found in legal provisions or judgments. Law is considered to be open textured in the presence of defeasible rules, vague terms or classification ambiguities.⁵⁰

Discretion is a power or right conferred upon decision-makers to act according to the dictates of their own judgment and conscience, uncontrolled by the judgment or conscience of others.⁵¹ According to Dworkin, discretionary reasoning arises when a decision-maker is free to select one from a number of plausible outcomes.⁵² As there is no concept of “one correct answer,” it is possible and sometimes probable for two decision-makers to arrive at different decisions based on the same facts. This is a result of reliance upon factors described as induction and intuition as well as the capacity to assess the social impact of decisions.

Some legal contexts afford decision-makers a greater degree of discretion than others. Legal domains underpinned by so-called “shopping-list” statutes, providing a list of relevant factors but no guidance as to their relative importance,⁵³ afford the decision-maker a high degree of discretion. Christie⁵⁴ specifically identifies such factors as domains of law requiring the decision-maker to exercise a kind of “Dworkinian” weak discretion, observing that the exercise of

46. *Supra* note 26 at 195.

47. Philip Leith, “The Judge and the Computer: How Best ‘Decision Support?’” (1998) 6:(2-4) A.I. & L. 289 at 289.

48. Uri Schild, Andrew Stranieri & John Zeleznikow, “Techniques for Reasoning in Discretionary Legal Domains” in M. Hamza, ed., *Proceedings of the IASTED International Conference on Law and Technology, LawTech 1999* (California: ACTA Press, 1999) 51 at 59–61.

49. Friedrich Waismann, *Verifiability: Logic and Language* (Cambridge: Blackwell, 1951).

50. Henry Prakken, *Logical Tools for Modelling Legal Argument: A Study in Defeasible Reasoning in Law* (Dordrecht, Netherlands: Kluwer Academic Press, 1997).

51. *Black’s Law Dictionary*, 8th ed., s.v. “discretion”.

52. Ronald Dworkin, *Taking Rights Seriously*, 2d ed. (London: Duckworth, 1997) at 31–39, 68–71, 159–161.

53. Andrew Stranieri & John Zeleznikow, “A re-examination of the concepts of open texture and stare decisis for data mining in discretionary domains” in *Proceedings of Eleventh International Conference on Legal Knowledge Based Systems 1999* (Groningen, Netherlands: Kronijklijke Vermand, 1999) 101 at 104.

54. George C. Christie, “An Essay on Discretion” (1986) *Duke L.J.* 747 at 767ff.

the discretion inevitably involves power relationships within a political system.⁵⁵

Zeleznikow groups the degree of discretion in legal domains into four categories. These categories are useful in identifying the types of approaches that are appropriate for modelling reasoning in a domain:⁵⁶

- *No discretion.* In these domains there is no room for interpretation. Jurisdictions with mandatory sentencing exemplify this group. Tightly defined sentencing guidelines can be modelled as a set of IF-THEN rules.⁵⁷
- *Narrow discretion.* These domains have clear norms expressed in legislation, cases or legal opinions. However, judges may deviate from these norms and exercise some minimum discretion. These domains can usually be modelled using case-based reasoning.⁵⁸
- *Bounded discretion.* Although these domains do not have explicit norms, the factors that judges must take into account are specified in legislation or cases. "Shopping-list" statutes typify this group. Considerable judicial discretion is involved and modelling with IF-THEN rules is difficult. "Knowledge Discovery from Databases" techniques can be gainfully used to model such domains.⁵⁹ An example of such a domain is the distribution of marital property following divorce in Australia.⁶⁰
- *Unfettered discretion.* These domains also have no norms and the factors that the judges should base their decisions upon are also not specified. They are unsuitable for knowledge modelling. Examples of such domains include the granting of refugee status and the welfare of children in Australian Family Law.⁶¹

Much of the remainder of this paper discusses "models." But what is a model in the context of this paper? A model is not reality. It is never a depiction of the whole domain but, rather, is a subset selected to be useful for a particular purpose. Stranieri and others demonstrate that the operationalization of the con-

55. In *Taking Rights Seriously*, Ronald Dworkin presents a systematic account of discretion by proposing two basic types of discretion, which he called "strong" and "weak" discretion. Weak discretion is used to characterize situations where a decision-maker must interpret standards in his own way, whereas strong discretion characterizes those decisions where the decision-maker is not bound by any standards and is required to create his or her own standards. See *supra* note 52 at 31–34.
56. John Zeleznikow, "Building Decision Support Systems in Discretionary Legal Domains" (2000) *Int'l Rev. L. Comp. & Tech.* 341 at 344.
57. A crisp rule is of the form IF <condition(s)>, THEN <action>. An example of such a rule is if you drink and drive then you lose your licence. In Victoria, it is prohibited to drive with a blood-alcohol-level greater than .05%. Rules to indicate this are: drink(X) & drive (X) ‡ licence_loss(x), (blood_alcohol_level (X) > .05%) ‡ drink (X).
58. Case-based reasoning is the process of using previous experience to analyze or solve a new problem, of explaining why previous experiences are or are not similar to the present problem and of adapting past solutions to meet the requirements of the present problem.
59. Knowledge discovery is the non-trivial extraction of implicit, previously unknown and potentially useful information from data. See Andrew Stranieri & John Zeleznikow, *Knowledge Discovery from Legal Databases*, vol. 69, (Dordrecht, Netherlands: Springer, 2004) for a detailed discussion of how knowledge discovery from databases can be used to model discretionary reasoning in bounded domains.
60. John Zeleznikow, "The Split-up Project: Induction, Context and Knowledge Discovery in Law" (2004) 3 *Law, Probability and Risk* 147 at 157.
61. *Supra* note 56 at 344.

cept of discretion is linked to the knowledge-representation method used to model reasoning.⁶² If reasoning is modelled using rules, then discretion manifests itself as alternate sets of rules, each of which can be legitimately applied to a case leading to different outcomes. A rule-conflict strategy is required in order to automate discretionary legal reasoning using rules. This is feasible in fields of law characterized as “narrow discretion,” but becomes unfeasible in “bounded-discretion” fields because the number of possible rules in each alternate set is too large to model or automate effectively.

The modelling framework adopted for this study integrates two structures: decision trees⁶³ and argument trees.⁶⁴ Discretion is operationalized as both the selection of alternate ways to combine existing factors and the option to include or ignore new factors and is therefore appropriate for modelling reasoning in “bounded-discretion” fields such as sentencing. Figure 1 illustrates a decision tree. Nodes represent decision points and the possible outcomes of each decision are captured in arcs emerging from the node and ending in leaf nodes.

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62. Andrew Stranieri, John Yearwood & Tunde Meikle, “The Dependency of Discretion and Consistency of Knowledge Representation” (2000) 14:3 Int’l Rev. L. Comp. & Tech. 325.
 63. A decision tree is an explicit representation of all scenarios that can result from a given decision. The root of the tree represents the initial situation, whilst each path emanating from the root corresponds to one possible scenario. See for further details John Zeleznikow & Dan Hunter, *Building Intelligent Legal Information Systems: Knowledge Representation and Reasoning in Law*, Vol. 13 (Dordrecht, Netherlands: Kluwer Law and Taxation, 1994) at 260–261, 266, 268, 299.
 64. Stephen Toulmin in *The Uses of Argument* (Cambridge: Cambridge University Press, 1958) concluded that most arguments, regardless of the domain, have a structure that consists of six basic invariants: claim, data, modality, rebuttal, warrant and backing. Every argument makes a claim based on some data. Stranieri et al., *supra* note 62, developed a template for knowledge representation that varies the Toulmin structure. The template differs from the Toulmin structure in that it includes: (1) a variable-value representation of claim and data items; (2) a certainty variable associated with each variable-value rather than a modality or force associated with the entire argument; (3) reasons for the relevance of the data items in place of the warrant; (4) a list of inference procedures that can be used to infer a claim value from data values in place of the warrant; (5) reasons for the appropriateness of each inference procedure; (6) context variables; (7) the absence of the rebuttal component present in the original formulation; (8) the inclusion of a claim value reason component. Zeleznikow and Stranieri discuss the concepts of decision trees and argument trees in two related articles: See Andrew Stranieri & John Zeleznikow, “WebShell: The development of web based expert systems” in *Research and Development in Expert Systems XVIII. Proceedings of ES2001—The 21st SGES International Conference on Knowledge based Systems and Applied Artificial Intelligence* (London: Springer Verlag, 2002) 245; John Zeleznikow & Andrew Stranieri, “A framework for the construction of legal decision support systems,” *Business Information Systems BIS 2002* (Poznan, Poland: ACM, 2002).

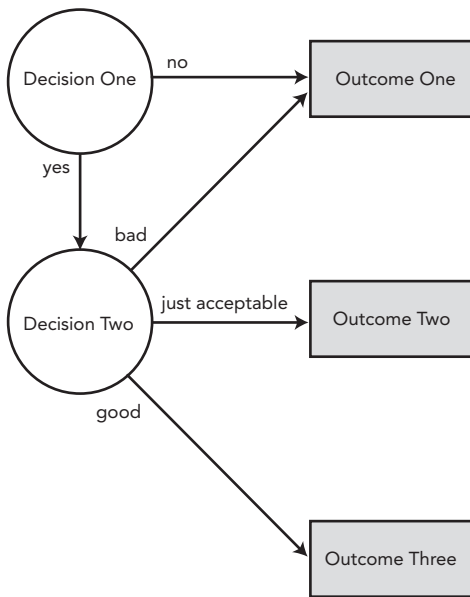


Figure 1. Rule-based procedural knowledge model

Decision one in figure 1 has two possible outcomes: "no," leading to a conclusion (outcome one), and "yes," leading to a second decision. Decision two in figure 1 has three possible outcomes: "good," "bad" and "just acceptable" with no explicit rules for deciding between them. The shadow indicates that further information about this decision is available in a second diagrammatic model. Such decisions with discretionary elements are modelled using an argumentation technique.

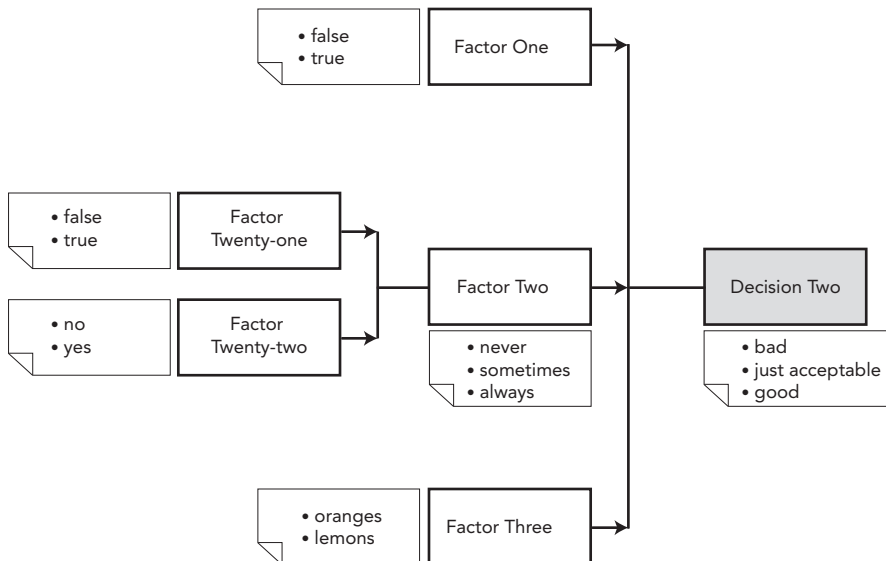


Figure 2. Argument tree

Argument trees derive from a model of structured reasoning called the Generic Actual Argument Model advanced by Stranieri and others.⁶⁵ The trees are hierarchies of relevant factors. In this study the root node or culminating factor is a decision-tree node. When discretion is present, argument trees are used to further refine the knowledge depicted as directed graph nodes; for example, "Decision Two" in figure 1 is further elaborated in figure 2.

Figure 2 illustrates an argument tree with nodes representing factors that are relevant for inferring nodes higher in the tree. For example, figure 2 shows that "Factor One," "Factor Two" and "Factor Three" are all relevant for inferring "Decision Two." However, how these three factors combine is left unspecified. Further, the value of "Factor Two" is inferred in some discretionary way from the values of "Factor Twenty-one" and "Factor Twenty-two." The values of "Factor One," "Factor Two" and "Factor Three" are used to infer whether the "Decision Two" outcome is "bad," "good" or "just acceptable." This in turn is fed back to the decision tree depicted in figure 1.

The Argument Tree provides a diagrammatic representation of the structure of reasoning. The tree can be elicited from experts in a "bounded-discretion" field of law. Once the structure is explicated a variety of methods can be used to model the way in which factors are combined to infer values at the next level. Stranieri and his colleagues trained neural networks, a machine learning technique from artificial intelligence from past cases in family law.⁶⁶ In modelling refugee law, Yearwood & Stranieri have found that at some levels of the argument tree for determining refugee law, the way in which decision-makers combine factors ought not be modelled at all because the domain varies vastly from case to case.⁶⁷

The Decision Tree and Argument based structure discussed above was used to propose an advisory system on computer copyright.⁶⁸ "ADVOKATE"⁶⁹ is a web-enabled, knowledge-based decision support application designed for use in criminal investigations, in civil litigation or as a teaching aide for investigative training. ADVOKATE provides an indicative assessment of the credibility of eyewitness testimony. It uses 23 arguments and uses the Decision Tree and Argument based structure discussed in Stranieri and others.⁷⁰

65. Andrew Stranieri, John Zeleznikow & John Yearwood, "Argumentation Structures that Integrate Dialectical and Monoletical Reasoning" (2001) 16:4 Knowledge Engineering Rev. 331.

66. John Zeleznikow, Andrew Stranieri & Mark Gawler, "Split-Up: A legal expert system which determines property division on divorce" (1996) 3 A.I. & L. 267; Stranieri et al., *supra* note 30 at 153.

67. John Yearwood & Andrew Stranieri, "The integration of retrieval, reasoning and drafting for refugee law: a third generation legal knowledge based system" in *Proceedings of Seventh International Conference on Artificial Intelligence and Law* (Oslo: ACM, 1999) 117 at 119.

68. Andrew Stranieri & John Zeleznikow, "Copyright Regulation with Argumentation Agents" (2001) 10:1 I. & Comm. T. L. 109.

69. Michael C. Bromby & Maria Jean Hall, "The Development and Rapid Evaluation of the Knowledge Model of ADVOKATE: an Advisory System to Assess the Credibility of Eyewitness Testimony" in *Proceedings of Fifteenth International Conference on Legal Knowledge Based Systems 2002* (Amsterdam: IOS Publications, 2002), <<http://www.cfsr.ed.ac.uk/publications/p16.pdf>>.

70. Stranieri et al., *supra* note 65.

1.4. Sentencing decision-support systems

Zeleznikow states that when considering decision-making as a knowledge-manufacturing process, the purpose of a decision-support system is to help the user manage knowledge.⁷¹ A decision-support system fulfils this purpose by enhancing the user's competence in representing and processing knowledge. It supplements human knowledge-management skills with computer-based means for managing knowledge. A decision-support system accepts, stores, uses, receives and presents knowledge pertinent to the decisions being made. Its capabilities are defined by the types of knowledge with which it can work, the ways in which it can represent these various types of knowledge and its capabilities for processing these representations.

Lovegrove analyzes what he calls an "offender-offence-Sentencing Information System," a computer system which retrieves statistical data based on such factors as the personality of the offender, the category of the crime and whether a weapon was used.⁷² As Schild points out, existing Sentencing Information Systems use only a small number of factors, out of which the sentencer is supposed to choose an even smaller number.⁷³ Otherwise, the database becomes too large.

Lovegrove sees seven major problems in trying to use statistical information systems (SIS) as a means to achieve consistency and rationality in sentencing:⁷⁴

- *Classification*. Which factors should the SIS present to the user?
- *Selection*. Which factors should the sentencer use?
- *Ranking*. How should factors be ranked in general and for a specific case?
- *Awareness*. A sentencer may not be aware of all possible factors relevant to a given case, especially if she is inexperienced.
- *Discretionary Width*. The greater the number of extra factors and the greater the width of the distribution of sentences, the greater the likelihood of large variations.
- *Scaling*. Factors should be measured in scales, the lengths of which should be provided by the system.
- *Inconsistent Database*. How can an inconsistent database help judges to reach decisions?
- *Intercorrelations*. Factors in the database are often intercorrelated, a feature that may unwittingly be reflected in the sentencer's use of the database.
- *Multiple Offences*. How should statistics relating to multiple offences be presented? Typically, sentencing systems are statistically based, retrieving information from databases of past cases. A few systems attempt to

71. John Zeleznikow, "Using Web-based Legal Decision Support Systems to Improve Access to Justice" (2002) 11:1. & Comm. T. L. 15 at 17.

72. Austin Lovegrove, "Statistical information systems as a means to consistency and rationality in sentencing" (1999) 7:1 Int'l J. L. & I.T. 31 at 32.

73. Uri J. Schild, "Statistical Information Systems for Sentencing: The Israeli Approach" (2000) 14:3 Int'l Rev. L. Comp. & Tech. 317 at 320.

74. *Supra* note 72 at 45-51.

predict judicial decisions using rule-based or case-based techniques.

Examples of automated systems that support courts in the application of sentencing include:

- "ASSYST."⁷⁵ ASSYST is a sentencing-guideline calculator based on the *United States Sentencing Reform Act of 1984*.⁷⁶ It uses a heuristic approach to combine offence seriousness with previous conviction history to produce a guideline sentence.
- "Judge's Apprentice."⁷⁷ The Judge's Apprentice is a Knowledge Based System⁷⁸ that provides support for the sentencing of Israelis convicted of rape or robbery. "Domain experts"⁷⁹ are used to discover relevant factors. The existence of base sentences is assumed. Setting out from the base sentence, the system weighs aggravating factors (which increase the sentence) and mitigating factors (which decrease the sentence).
- "LIST."⁸⁰ LIST provides to judges statistical information retrieved from a database of criminal cases in British Columbia, Canada. A similar system has been built in New South Wales, Australia.⁸¹
- "NSW SIS."⁸² The New South Wales Sentencing Information System contains a Court of Criminal Appeal judgments component containing over 3000 full-text judgments. It includes a "sentencing-principles" database, a sentencing-statistics component and a sentencing-date calculator.⁸³
- "NOSTRA"⁸⁴ is a Sentencing Information System used in the criminal courts of the four northern provinces of the Netherlands. Tata claims that the initiative shown by judges is attributed, at least in part, to judicial concerns that, if judges themselves do not make efforts to encourage consistency in sentencing, then the powerful office of the Public Prosecutor will try to commit them to its own sentencing guidelines.⁸⁵
- "IVS."⁸⁶ IVS is an advanced retrieval system that supports judges in find-

75. Eric Simon & Gerry Gaes, "ASSYST—Computer Support for Guideline Sentencing" in *Proceedings of the Second International Conference on Artificial Intelligence and Law 1989* (New York: ACM Press, 1989).

76. *United States Sentencing Reform Act*, 28 U.S.C. § 991ff (1984).

77. Uri J. Schild, "Decisions Support for Criminal Sentencing" (1998) 6:4 A.I. & L. 151.

78. A knowledge-based system is a computer program in which domain knowledge is explicit and is contained separately from the system's other knowledge.

79. A domain expert is a person who is involved in the construction of an expert system, who has specific expertise in that domain and who advises the knowledge engineer of the knowledge which is to be placed in the expert system.

80. J. Hogarth, *Computers and the Law: Sentencing Database System User's Guide* (Vancouver: LIST Corporation, 1988).

81. Janet Chan, "A Computerized Sentencing Information System for New South Wales Courts" (1991) *Computer Law and Practice* 137.

82. *Ibid.*

83. The sentencing-date calculator is used to calculate the exact date for the commencement and ending of minimum and additional custodial terms.

84. M. Otte, "NOSTRA, een informatiesysteem voor de straftoemeting, in De computer als weegschaal van de rechter" (1998) 5 *Justitie Verkenningen WODC*, Den Haag/Arnhem, Gouda Quint 62.

85. *Supra* note 32 at 300.

86. Eduard W. Oskamp, *Computerondersteuning bij straftoemeting, de ontwikkeling van een databank* (Netherlands: Leiden University, 1998).

ing relevant precedents in five different domains, including traffic and drug offences.

- "Scottish SIS."⁸⁷ The Scottish Sentencing Information System contains mainly numerical information with over 6000 first-instance cases and all decisions of the Appeal Court (since 1993) concerning sentences.

Early work on predicting judicial decisions typically involved statistical techniques like, for example, the nearest-neighbour rule⁸⁸ and visual representation of case patterns.⁸⁹ Few legal-reasoning systems have been developed in discretionary domains, two exceptions being the application of rule-based reasoning techniques for the use of Israeli probation officers who needed to recommend sentences for young criminals⁹⁰ and an application in the discretionary domain of Family Law in Scotland.⁹¹ Edwards and others reported some inadequacies of that approach and a decade later revisited the problem of the distribution of marital assets on divorce using techniques similar to those described in this paper.⁹²

Some developers have gone beyond a simple application of rules. HaCohen-Kerner & Schild built a case-based system, the Judge's Apprentice, to provide support for the sentencing of Israeli criminals found guilty of rape or robbery.⁹³ In his book on the future of law, which was published in 1996, Richard Susskind discusses Information Technology support for the judicial process, concluding that "it is not fanciful to suppose that future automation will include sentencing databases."⁹⁴ The objective of the study described in the remainder of this paper was to explore the possibilities and the challenges of modelling and providing automated support for judicial reasoning.

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2. THE VICTORIAN MAGISTRATES' SENTENCING PROJECT

THIS SECTION PRESENTS the knowledge models developed in the Victorian sentencing project. The project was conducted in two phases, a modelling phase and a program-development phase.

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87. Neil Hutton et al., "Decision Support for Sentencing in a Common Law Jurisdiction" in *Proceedings of Fifth International Conference on Artificial Intelligence and Law* (College Park, Maryland: ACM, 1995) 89.
 88. The nearest-neighbour algorithm is used in information retrieval where data that is closest to the search is retrieved. To perform this search, we need a "metric" (distance function) between the occurrence of each piece of data.
 89. E. McKaay & Pierre-N. Robillard, "Predicting judicial decisions: the nearest neighbour rule and visual representation of case patterns" (1974) *Datenverarbeitung im Recht* 302.
 90. M. Shapira, "Computerized Decision Technology in Social Service" (1990) 10 *International Journal of Sociology and Social Policy* 138.
 91. Lilian Edwards & John A.K. Huntley, "Creating a Civil Jurisdiction Adviser" (1992) 1:1 *Law, Computers and Artificial Intelligence* 5 at 21.
 92. J. Kingston, Lilian Edwards & Maria Jean J. Hall, "Prototyping a Legal Decision Support System: A Case Study" in *Proceedings of the ISLAT Third International Conference on Law and Technology 2002* (Anaheim: ACTA Press, 2002) 200.
 93. Yaakov HaCohen-Kerner & Uri J. Schild, "The Judge's Apprentice" (1999) 5 *The New Review of Applied Expert Systems* 191.
 94. Richard E. Susskind, *The Future of Law: Facing the Challenges of Information Technology* (Oxford: Oxford University Press, 1996) at 202.

2.1. Modelling reasoning in sentencing in the Victorian Magistrates' Court

Susskind makes the distinction between *academic* and *experiential* legal knowledge. Academic legal knowledge can be gleaned from the primary and secondary sources of law by research into statutes, legal texts, commentaries and judicial precedent. Experiential legal knowledge comes from personal experience acquired through day-to-day work with the law.⁹⁵ A knowledge engineer may elicit experiential knowledge from an expert or, alternatively, extract readily accessible law statements (academic knowledge) from statutes, treatises, judicial precedents and textbooks amongst other sources. For this project, legal knowledge was acquired from two major sources; the relevant statute was reviewed and a first draft of the knowledge model prepared. This model was subsequently reviewed by legal experts from Victoria Legal Aid and iteratively refined as a result of the feedback received.

The principal statute, the *Sentencing Act 1991* of Victoria, Australia,⁹⁶ has several stated purposes, the first of which is the promotion of a consistent approach to the sentencing of offenders. The Act lays out governing principles to guide the sentencing decision-maker but, in essence, the judge determines the sentence to be imposed. The judicial officer is granted wide discretionary powers to interpret and weigh the facts of the case and any other relevant factors as he sees fit in cognizance of the governing principles.

In the first phase of modelling, the knowledge engineers held discussions with a panel of domain experts regarding the nature of sentencing in the Magistrates' Court. The domain experts are listed in the acknowledgments section of this paper. They all are affiliated with Victoria Legal Aid⁹⁷ and have extensive knowledge of and practice in sentencing in the Victorian Magistrates' Court. After reading the relevant statutes, the knowledge engineers and domain experts developed the decision and argument trees as described in section 1.2 above. A system was then constructed. A future task will be the evaluation of the effectiveness of the system.

The remainder of this section presents the models developed in this phase. The top-level flow of reasoning in sentencing is depicted using a decision tree, part of which is illustrated in figure 3 and is continued in figure 4. The remaining models are argumentation trees and depict the discretionary elements of the sentencing decision. Figure 5 shows a top view of the factors involved in the discretionary decision and figures 6 to 8 provide a more detailed analysis.

95. Richard E. Susskind, *Expert Systems in Law: A Jurisprudential Inquiry* (Oxford: Oxford University Press, 1987) at 56.

96. *Supra* note 2.

97. Victoria Legal Aid, based in Victoria, Australia, is a government-funded provider of legal services for disadvantaged clients. Its goals include providing legal aid in the most effective, economic and efficient manner and pursuing innovative means of providing legal services in the community, <<http://www.legalaid.vic.gov.au>>.

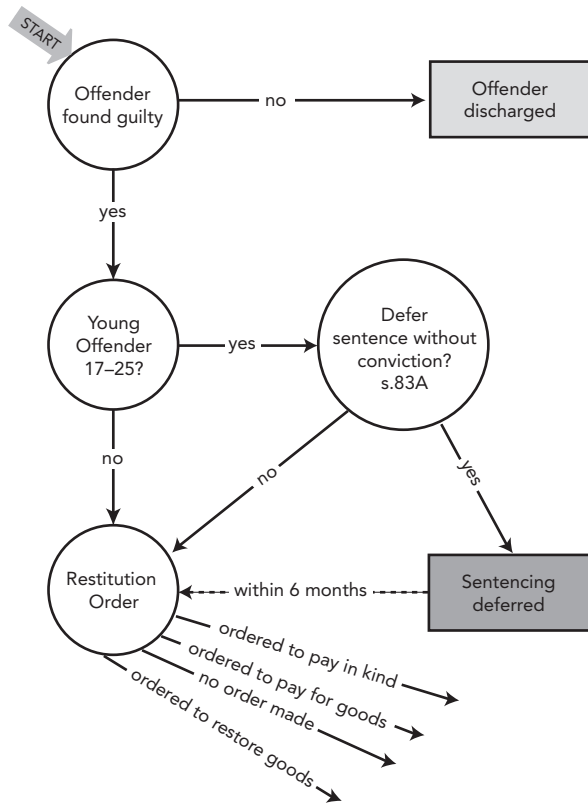


Figure 3. Part of sentencing procedural decision tree⁹⁸

98. Sections refer to the *Sentencing Act 1991 (Vic.)*, *supra* note 2.

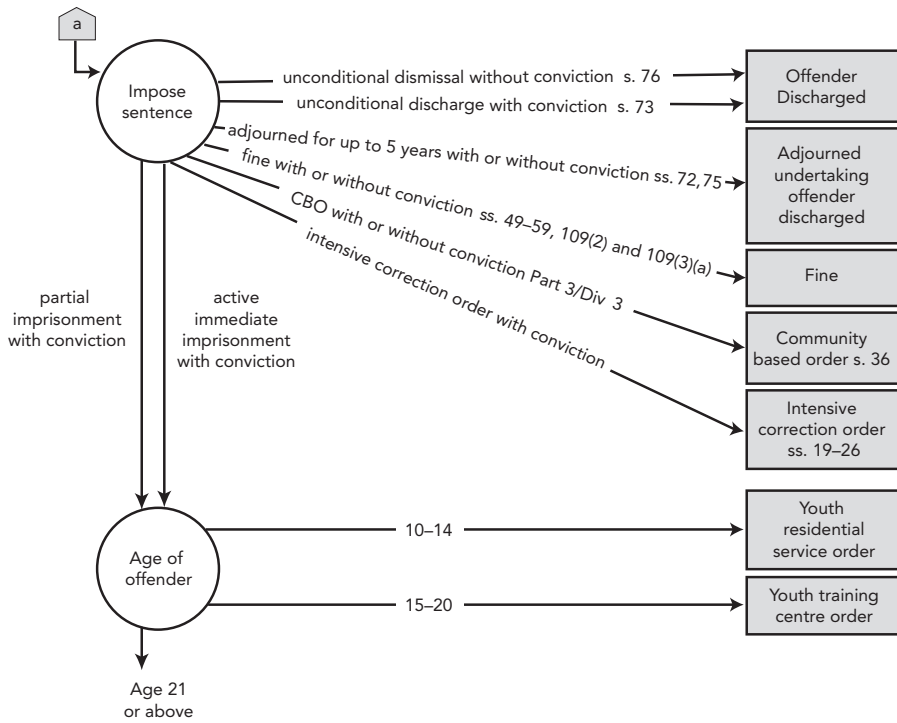


Figure 4. Sentencing model—part of the procedural decision tree⁹⁹

Figure 4 shows part of the procedural decision tree. “Impose sentence” is a discretionary decision and the factors that influence this decision are shown in more detail in figures 5 to 8.

99. Sections refer to the *Sentencing Act 1991* (Vic.), *ibid.*

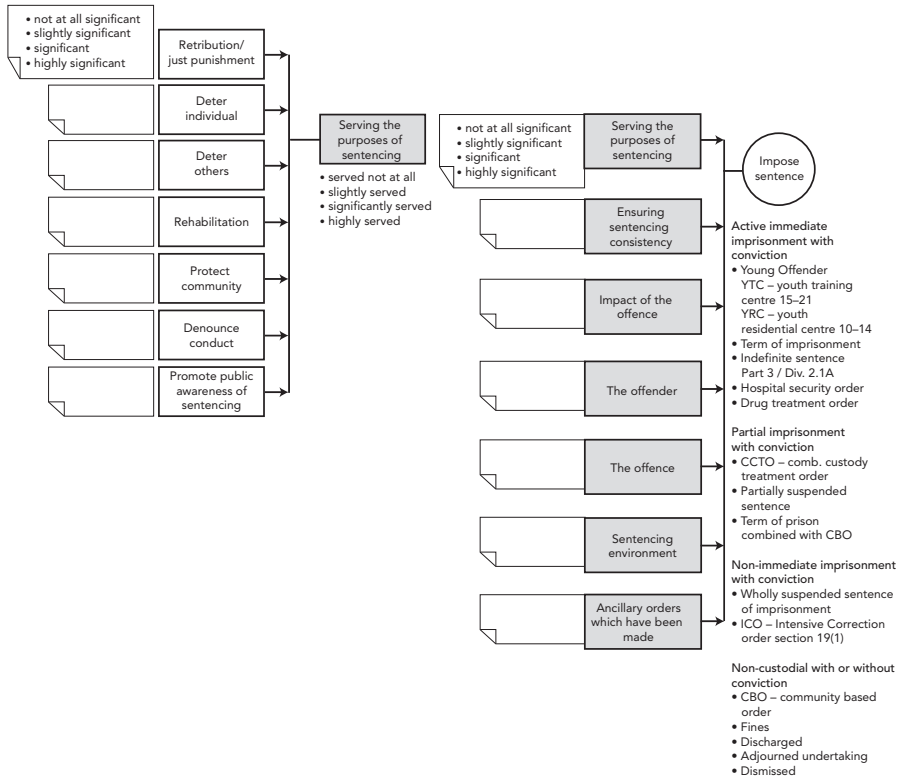


Figure 5. Top-level sentencing argumentation model with expansion of first node

Figure 5 depicts two argumentation models and should be read from right to left. As has been discussed above in section 1.3, argumentation models are one means of demonstrating the contributing factors to a discretionary decision. The right-hand model shows the top-level argumentation model for the main node “impose sentence” (refer to figure 4 where this decision forms part of the procedural decision tree). The right-hand model of figure 5 shows the sentencing outcomes of the “impose-sentence” decision and the seven main factors contributing to this discretionary decision. Each of the seven factors can vary in its significance. The possible data values for the first factor—“serving the purposes of sentencing”—are shown fully expanded. The left-hand model of figure 5 shows the node “serving the purposes of sentencing” further expanded, including data values for its first node. The potential outcomes of the left-hand model in turn become the input-data values to the right-hand model.

Figures 6 to 8 provide further detail of the main contributing factors shown in the right-hand model of figure 4. These figures provide expanded versions of the nodes “impact of the offence,” “the offender” and “the offence.”

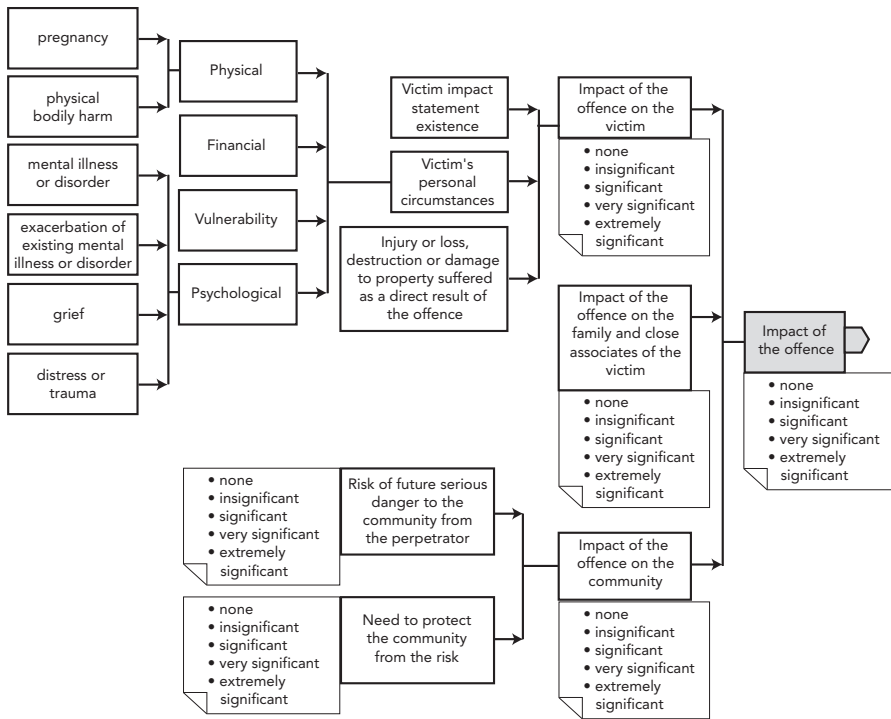


Figure 6. Argumentation sentencing model: Impact of the offence

Figure 6 shows an expanded version of the figure 5 node "impact of the offence." In the interests of keeping the diagrams readable, possible data values are only included for some of the nodes, as, for example, "impact of the offence upon the community." The impact of the offence is considered from three perspectives: the impact on the victim, the impact on the victim's family and close associates, and the impact on the community at large. There are many potentially relevant factors that could be considered when determining the impact of the offence upon the victim, including property loss and personal circumstances. Some of these are shown in a partially expanded form in this diagram. There is significant potential for this section of the model to be further expanded.

Figure 7 shows a partially expanded model of the figure 5 "offender" node. This model expands relevant factors about the offender from a time perspective relevant to commission of the crime—i.e. before, during and after the crime was committed. Other factors concerning the offender, shown unexpanded here, are concerned with the following: the offender's personal circumstances; any likely impact on the offender of recording a conviction or sending him or her to jail; and the offender's suitability for available courses, treatment and other programs that might assist in the offender's rehabilitation.

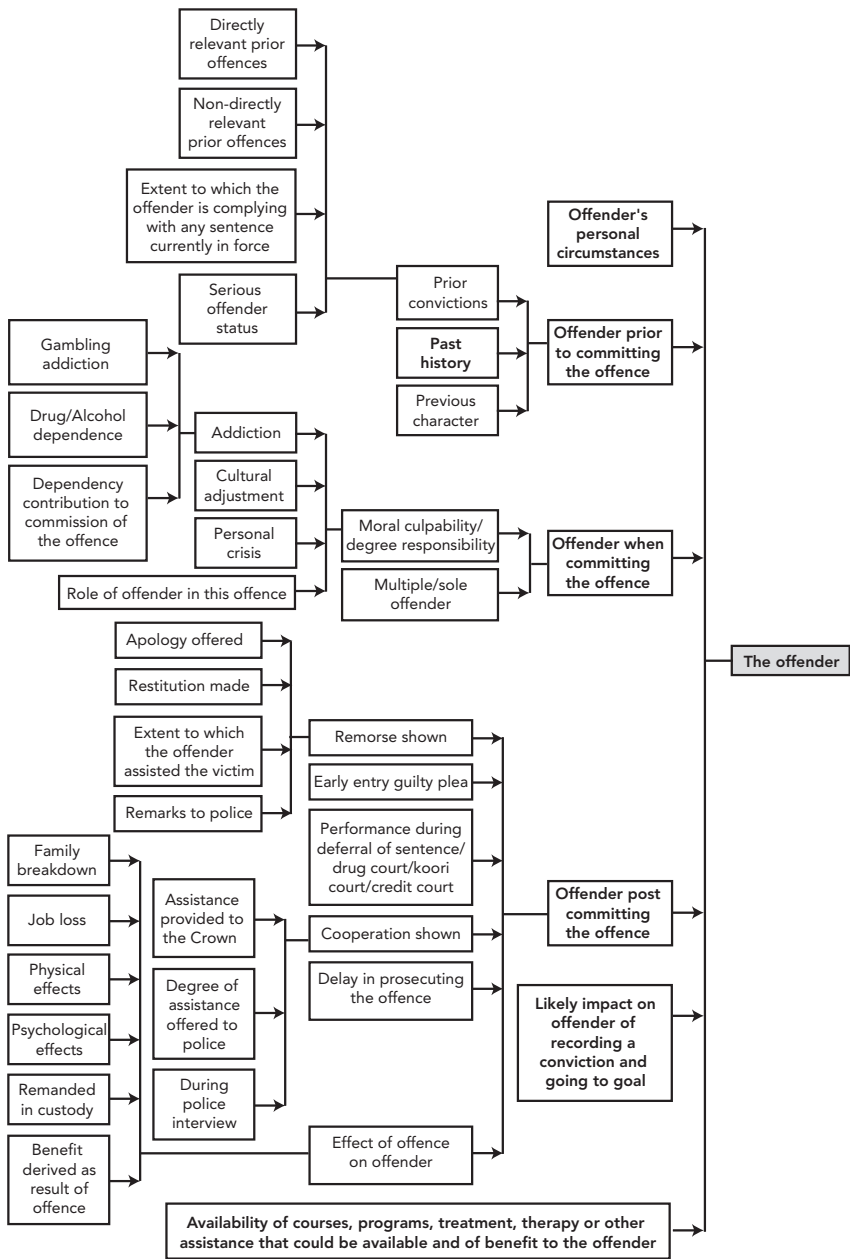


Figure 7. Sentencing argumentation model: The offender

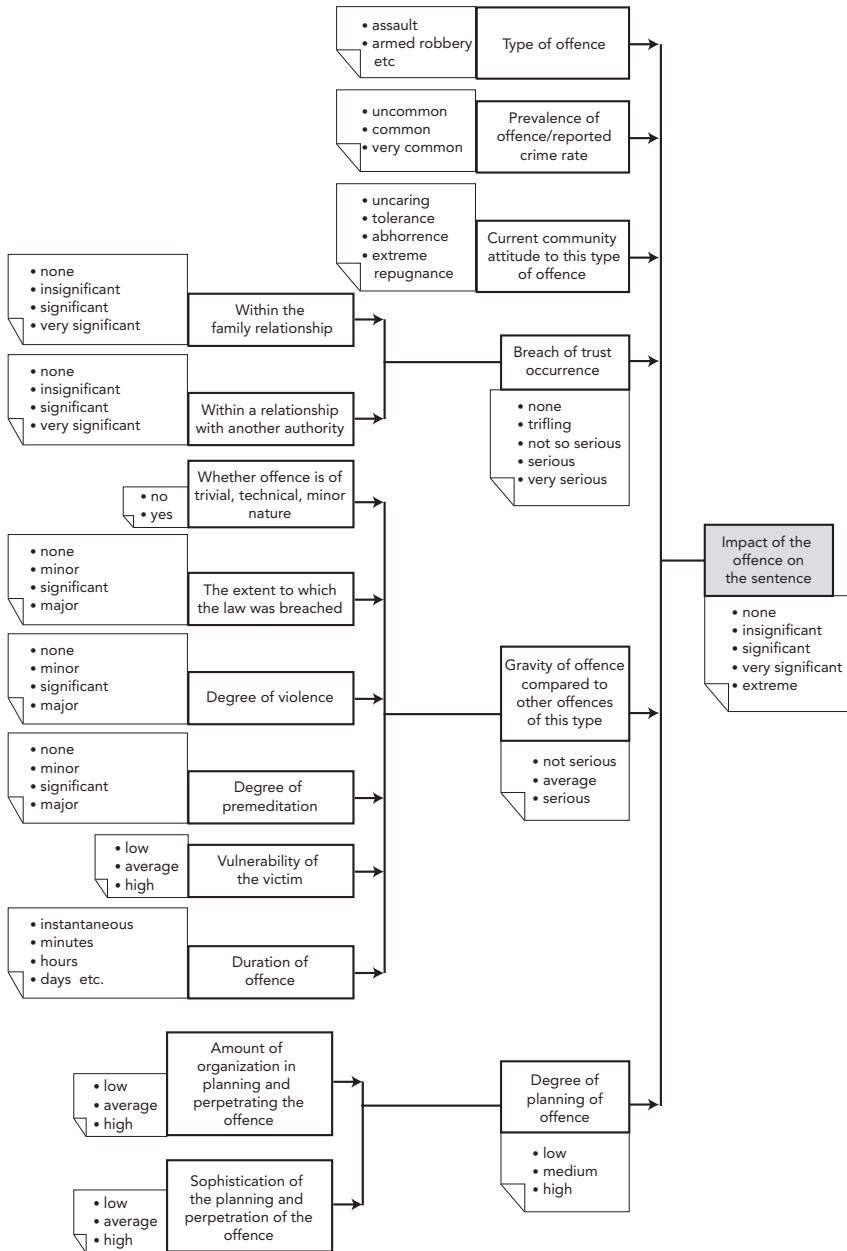


Figure 8. Sentencing argumentation model: The offence

Figure 8 expands figure 5's "offence" node. Here, the major contributing factors include the gravity of the offence, the amount of planning involved in the commission of the offence and any significant breach of trust that occurred during the execution of the crime. Also considered is the prevalence of this type of crime and community attitudes to the commission of such crimes.

The sentencing knowledge models, some of which are depicted in figures 3 to 8 above, are the result of an iterative refinement process involving knowledge engineers and legal experts. The models were evaluated through a review process involving legal-sentencing experts who had not provided legal expertise during the development of the model.

2.2. A Web-based implementation of the sentencing system

When the experts were satisfied that the knowledge model was complete and correct, it was implemented as a web-based application using the expert-system-shell "justReason."¹⁰⁰ This is a shell program available for open-source download and specifically designed to encode knowledge as decision-and-argument trees for the rapid generation of web programs. The open-source version of the shell has a built-in weighted-sum mechanism for implementing argument-tree inferences. "JUSTSYS" is an Australian start-up company that develops legal-knowledge-based systems for the internet. Its rationale for developing such tools came from the extended use of Toulmin Argument Structures for represented legal knowledge.¹⁰¹

JUSTSYS has recently launched "GetAid"¹⁰²—a web-based decision-support system for determining eligibility for legal aid, which consists of eight arguments. Clients of Victoria Legal Aid¹⁰³ use the GetAid system to determine their eligibility for Legal Aid. After passing a financial test, applicants for legal aid must pass a merit test. This assessment involves the integration of procedural knowledge found in regulatory guidelines with expert-lawyer knowledge that involves a considerable degree of discretion. Knowledge Discovery from Databases (KDD) was used to model the discretionary task. GetAid was developed in conjunction with web-based lodgement of applications for legal aid and has recently gone online.

Figure 9 below illustrates a screen dump from the sentencing program as seen through a web browser such as Internet Explorer. The prompt is generated directly from the first node in figure 4. The presence of an argument tree underneath the "impose-sentence" node is depicted in the web page as a "Not Sure" button. On selecting "Not Sure," the user is presented with a list of prompts that derive from figure 5 and that drill down under their own control, with other "Not Sure" buttons, to prompts generated from figures 6, 7 or 8.

100. Please see <<http://www.justsys.com.au>>.

101. *Supra* note 64.

102. Maria Hall, Andrew Stranieri & John Zeleznikow, "A Strategy for Evaluating Web-Based Discretionary Decision Support Systems" in Yannis Manolopoulos & Pavol Navrat, eds., *Advances in Databases and Information Systems: 6th East-European Conference, ADBIS 2002, Bratislava, Slovakia, September 8-11, 2002. Proceedings*, vol. 2 (Heidelberg: Springer Verlag, 2002) 108, <<http://www.dcs.elf.stuba.sk/adbis2002/>>.

103. *Supra* note 97.



Figure 9. Sample justReason internet-deployed prototype

Figure 10 below illustrates a screen that the knowledge engineer in conjunction with domain experts used to set weights for the weighted-sum formulas that the open-source version of justReason uses to model the way in which sentencing decision-makers combine factors. “Addiction” is used as an example to demonstrate this process.

The extent to which “addiction” is a mitigating factor in an offence—first illustrated in the node labeled “addiction” in figure 7 above and portrayed in more detail on figure 10—is inferred from three factors: the extent of any addiction to drugs, the extent of addiction to gambling and the degree to which the addiction was a contributing factor.

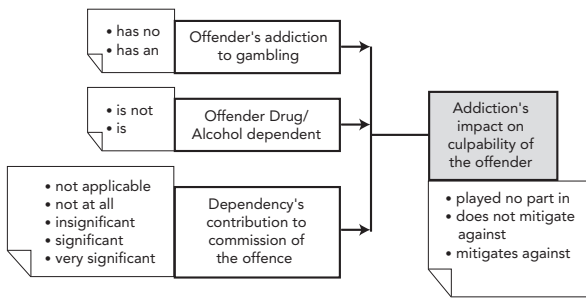


Figure 10. The impact of addiction on the culpability of the offender

In the current study, a knowledge engineer, in conjunction with a sentencing domain expert set weights. These weights were used by the inference mechanism of the web-based tool illustrated in figure 11. The weights are entered in the top half of figure 11 and the result of specific inferences is illustrated in the lower half. The domain expert and knowledge engineer first assign a weight (or ranking) to each value of the three factors. For example, the domain expert and knowledge engineer assigned a value of “30” where the dependency contributes to a very significant degree to the offence, “10” where the dependency contributes significantly, “2” where the dependency is insignificant and “1” where the dependency is not applicable. A weight of 10 is assigned to cases that involve drug dependency and the same weight is applied to cases involving gambling. An offender who committed burglary as a result of a drug addiction receives a score of 10 on the drug-dependency factor, a score of 1 on the gambling factor and a score of 30 on the extent of contribution factor making a total of 40.

Once weights have been assigned to variables, the knowledge engineer and domain expert assign a threshold to values of the inferred variable in order to classify the total into one of the values. The threshold assigned to represent cases where the claim that “addiction mitigates against the offender’s culpability” was “20.” Thus, any total that exceeds 20 will result in the inference that the addiction mitigates against culpability. Any total between 2 and 20 results in the inference that the addiction does not mitigate against culpability.

The weighted-sum mechanism is very flexible and, by and large, experts can assign weights and a threshold for the system to quite easily infer accurate claims. However, a mechanism is included for domain experts to be able to declare an exception to the weighted-sum formula. Whilst the weights and thresholds set by the knowledge engineer and domain expert are accurate for most cases, they can, on a small proportion of possible cases, result in inferences deemed incorrect by the domain expert. If attempts at changing the weights do not resolve this problem, the weights can be retained and a specific exception entered in a look-up table. In these cases, the inference engine uses the look-up table inference rather than the value calculated by the weighted-sum formula.

offender_dependency_cont	offender_drugs	offender_gambling	Claims
not applicable - 1	is not - 1	has no - 1	mitigates against - 20
not at all - 1	is - 10	has an - 10	does not mitigate against - 12
insignificant - 2			played no part in - 2
significant - 10			
very significant - 30			

click and drag to resize

The extent to which any addiction or dependency contributed towards the commission of the offence is:

The offender drug or alcohol dependent

The offender has addiction to gambling

Addiction
mitigates against
the culpability of the offender

Figure 11. Web-based tool to capture inferring weights from experts

The implementation of an inference with the use of a weighted-sum formula is readily understood by experts and has resulted in the articulation of accurate inferences by experts in a range of knowledge-based systems. Currently, weights and thresholds cannot be derived from databases of past sentencing decisions because the data required is typically stored in narrative form in a judgment and rarely appears in structured form in a database.

However, in the past we have conducted projects that ascertain the weights of relevant factors in a domain that had "shopping-list" statutes. "Split Up"¹⁰⁴ is a hybrid-rule-based/neural-network system¹⁰⁵ that uses textbooks, heuristics, expert advice and cases to model that part of the Australian *Family Law Act 1975*¹⁰⁶ dealing with property division. The Act directs a decision-maker to take into account the past contributions of each party to a failed marriage in addition to their resources for coping with life into the future. Rather than offering one definition for "contributions" and one for "needs," the statute presents

104. Stranieri et al., *supra* note 30 at 153.

105. A neural network receives its name from the fact that it resembles a nervous system in the brain. It consists of many self-adjusting processing elements cooperating in a densely interconnected network. Each processing element generates a single output signal, which is transmitted to the other processing elements. The output signal of a processing element depends on the inputs to the processing element: each input is gated by a weighting factor that determines the amount of influence that the input will have on the output. The strength of the weighting factors is adjusted autonomously by the processing element as data is processed. Neural networks are particularly useful in law because they can deal with (a) classification difficulties, (b) vague terms, (c) defeasible rules and (d) discretionary domains.

106. *Family Law Act 1975* (Cth.), <<http://scaletext.law.gov.au/html/pasteact/0/229/top.htm>>.

a “shopping list” of factors to be taken into account in arriving at a property order. For example, the age, state of health and financial resources of each partner are explicitly mentioned in the statute as relevant factors and, yet, their relative levels of importance are left unspecified.

Although the statute presents a flat list of relevant factors without specifying how these factors relate to each other, we realized that the factors could be placed in a hierarchy. The development of the hierarchy required specific knowledge supplied by domain experts. A sophisticated hierarchy of 94 factors presented in figure 12 was elicited. Figure 12 demonstrates that the factors relevant for a percentage split determination (extreme right of figure) are past contributions of a husband relative to those of the wife, the husband’s future needs relative to those of the wife and the wealth of the marriage. The factors relevant for a determination of past contributions are the relative direct and indirect contributions of both parties, the length of the marriage and the relative contributions of both parties to the homemaking role. No attempt is made in figure 12 to represent the way in which relevant factors are combined to infer factors higher in the hierarchy. The hierarchy of figure 12 provides a structure that was used to break down the task of predicting an outcome into 35 sub-tasks. Outputs of sub-tasks further down the hierarchy are used as inputs into sub-tasks higher in the hierarchy. Solid arcs in figure 12 represent inferences drawn with the use of rule sets whereas dashed arcs depict inferences performed using neural networks (or indeed any other KDD technique). It should be noted that the hierarchy modelled in figure 12 does not coincide with the models that we described in section 1.3. The hierarchy in figure 12 was developed in 1994 and 1995, eight years before the sentencing models were developed.

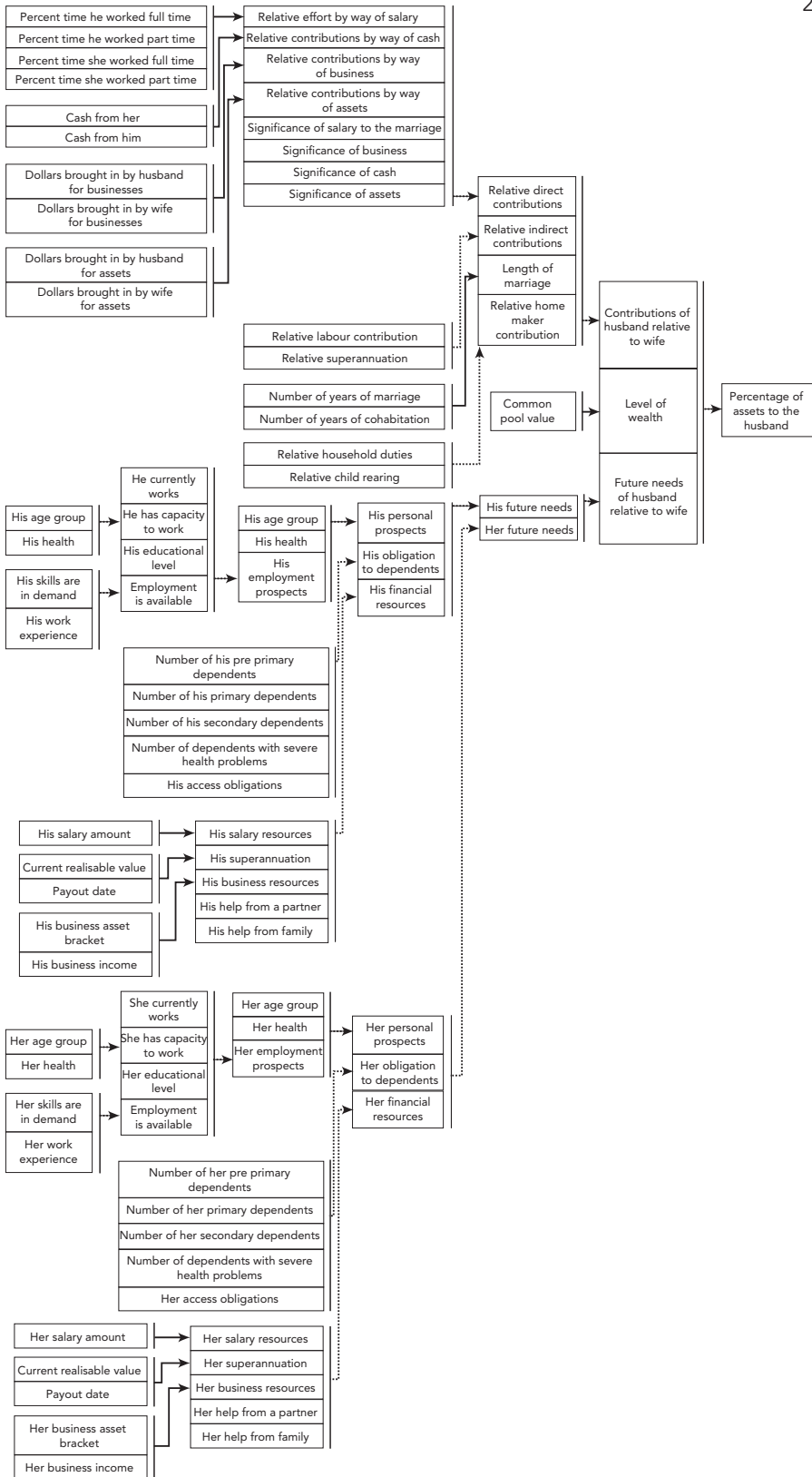


Figure 12. Hierarchy of relevant factors for percentage split determination

Fayyad and others claim that the KDD process involves five stages: data selection, data pre-processing, data transformation, data mining¹⁰⁷ and evaluation.¹⁰⁸ The Split Up database consists of 103 commonplace cases¹⁰⁹ recorded in free text. To use these commonplace cases, we had to transform them into a pre-designed template that consisted of 94 factors.

Zeleznikow, Sourdin and Stranieri, in conjunction with JUSTSYS and Victoria Legal Aid, have received an Australian Research Council Linkage grant, with title Knowledge Discovery in Discretionary Legal Domains. One goal of this project will be to learn the relative weights of factors used in sentencing decision-making.

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3. THE BENEFITS AND LIMITATIONS OF BUILDING A SENTENCING DECISION SUPPORT SYSTEM

SCHILD AND OTHERS NOTE that the development of decision support systems that model the exercise of legal discretion has important ramifications for the way in which justice is administered.¹¹⁰ The following section highlights some of these expected benefits and discusses some of the concomitant risks and disadvantages that require acknowledgement and subsequent careful management.

3.1. How sentencing decision support systems benefit the legal community

Frase has noted that the consensus in North America in support of a substantial reduction in judicial discretion via sentencing guidelines emerged as a result of the convergence of a disparate coalition of interests.¹¹¹ Conservatives were concerned about undue influence whilst liberals contended that wide discretion produced unjust disparities.

Zdenkowski claims that Australian attempts to constrain judicial discretion in sentencing decision-making derive from law-and-order populism and a perception that sentence severity should be increased. He notes that, as with any mandatory measure, criticism has been directed at its inflexibility and consequent potential for capricious and Draconian operation, for the shifting of discretion to prosecutors (with the resulting lack of opportunity for review), and for fewer guilty pleas and resulting cost and delay.¹¹² In Australia, mandatory sen-

107. Data mining is a problem-solving methodology that finds a logical or mathematical description, eventually of a complex nature, of patterns and regularities in a set of data.

108. Usuma M. Fayyad, Gregory Piatetsky-Shapiro & Padraig Smyth, "The KDD Process for Extracting Useful Knowledge from Volumes of Data" (1996) 39:1 Communications of the ACM 27 at 29.

109. A commonplace case is one that does not provide any lessons by itself, but together with numerous like cases can be used to derive conclusions. The Split Up project used commonplace cases to learn the relative weights of factors. Landmark cases would not be appropriate, as they would introduce new factors that had not previously been considered in judicial decision-making.

110. *Supra* note 48 at 61.

111. Richard S. Frase, "Sentencing Guidelines in Minnesota and Other American States: A Progress Report" in Chris Clarkson & Rodney Morgan, eds., *The Politics of Sentencing Reform* (Oxford: Clarendon Press, 1995), 169 at 170. See also Richard S. Frase & Benjamin N. Berger, "Sentencing Guidelines in Minnesota, 1978–2003" in Michael Tonry, ed., *Crime & Justice, A Review of Research*, vol. 32 (Chicago: University of Chicago Press, 2004) 131 at 141, <<http://ssrn.com/abstract=623281>>.

112. *Supra* note 24 at 61.

tencing has discriminated against the indigenous community.¹¹³ Zdenkowski states that, although there is considerable doubt as to the efficacy of the mandatory-sentencing regime, there is no unequivocal evidence either way.¹¹⁴ However, Tony claims that there is significant evidence that mandatory penalties do not have the desired effect on crime reduction.¹¹⁵

In commenting upon the Northern Territory's mandatory minimum imprisonment laws for property offenders,¹¹⁶ Flynn noted that offenders have been treated very harshly, resulting in imprisonment for trivial property offences, such as stealing a can of beer, breaking a light and pouring water onto an electronic cash register. He claims the legislation potentially violates Australia's human-rights obligations.¹¹⁷

As Zeleznikow notes, the development of our legal decision support systems has led to:

- Consistency—as, by replicating the manner in which decisions are made, decision support systems are encouraging the spreading of consistency in legal decision-making;
- Transparency—as, by demonstrating how legal decisions are made, legal decision support systems are leading to a better community understanding of legal domains and as this has the desired benefit of decreasing the level of public criticism of judicial decision-making;
- Efficiency—as one of the major benefits of decision support systems is to make firms and organizations more efficient; and
- Enhanced support for dispute resolution—as users of legal decision support systems are aware of the likely outcome of litigation and thus are encouraged to avoid the costs and emotional stress of legal proceedings.¹¹⁸

Despite protracted arguments about what is meant by consistency in sentencing, there is universal acceptance that consistency of approach should be an essential feature of sentencing decision-making. The Supreme Court of New South Wales in *R. v. Jurisic*¹¹⁹ held that:

There is a need to ensure consistency in sentencing decisions. Inconsistency offends the principle of equality before the law and is a manifestation of injustice. Public criticism of particular sentences for inconsistency or excessive leniency is sometimes justified.

The English Court of Appeal has established a technique of guideline judgments, in which the Court formulates general principles and, sometimes, gives an indication of appropriate range to guide trial courts.

113. Louis Schetzer, "A Year of Bad Policy: Mandatory Sentencing in the Northern Territory" (1998) 23:3 *Alternative Law Journal* 117 at 118.

114. *Supra* note 24 at 61.

115. Michael Tony, *Sentencing Matters* (New York: Oxford University Press, 1996) at 140.

116. See *Sentencing Act 1995* (N.T.), ss. 78(A) and 78(B) for persons 17 years and over, <http://www.austlii.edu.au/au/legis/nt/consol_act/sa121/>.

117. Martin Flynn, "Fixing a Sentence: Are there any Constitutional Limits" (1999) 22:1 *U.N.S.W.L.J.* 280 at 284ff.

118. Zelenikow & Stranieri, "A framework", *supra* note 64.

119. *Supra* note 40 at 216 per Spigelman CJ.

This Court has frequently stated principles of general application with respect to appropriate sentences for particular offences....

The formal step of issuing guideline judgments is a logical development of what the Court has long done. Such judgments may reinforce public confidence in the integrity of the process of sentencing[.]

Guideline judgments should now be recognised in New South Wales as having a useful role to play in ensuring that an appropriate balance exists between the broad discretion that must be retained to ensure that justice is done in each individual case, on the one hand, and the desirability of consistency in sentencing and the maintenance of public confidence in sentences actually imposed, and in the judiciary as a whole, on the other.

Such guidelines are intended to be indicative only. They are not intended to be applied in every case as if they were rules binding on sentencing judges. Guideline judgments are a mechanism for structuring discretion not restricting discretion.

This project has developed a technological tool to help human decision-makers achieve consistency in their approach to sentencing. By doing so, we hope that arguments for more extreme sentencing restrictions on the judiciary, such as mandatory sentencing regimes, are diminished. Intelligent legal decision support systems can also act in the service of justice by promoting transparency in decision-making.

Support systems that offer useful and accurate advice about sentencing, can, if made available to the wider community, contribute to public confidence in the legal system and to a more just society. Decision transparency—that is, demonstrating how legal decisions are arrived at—can also be improved, thus promoting better community understanding of the law and reducing public criticism.¹²⁰

Decision support systems also have a capacity to assist in negotiation (by providing an indicative range of outcomes and identifying areas of difference) and in support training and potentially may enable those involved in the legal system to be provided with accessible and cost-effective advice as to potential outcomes. As mentioned previously Zeleznikow, Stranieri and Sourdin have received further funding through an Australian Research Council grant to extend the models reported in this paper and to build a prototype application. Part of the project involves modelling negotiations between the Office of Public Prosecution and the barristers of defendants who plead guilty to criminal charges. Negotiations are conducted with respect to both the plea and sentencing suggestions.

120. John Zeleznikow, "Building Intelligent Legal Decision Support Systems: Past Practice and Future Challenges" in J.A. Fulcher & L.C. Jain, eds., *Applied Intelligent Systems: New Directions* (Berlin: Springer Verlag, 2004) 201 at 203.

3.2. Caveat/Limitations

Although the benefits that this technology provides are clearly evident, there are also associated risks and disadvantages that require acknowledgement and careful management. The responsibility and independence of the decision-maker may be threatened and human staff may become deskilled or even redundant. Sometimes there is a conflict of interest between different stakeholders and the systems support some users better than others. They may mislead the user as to the status of the knowledge contained in the system. Thus, the user needs to know exactly which questions are answered by the system and its limitations.

Consistency and control may not always be the desired outcomes of using an intelligent decision support system and they may be disadvantageous, particularly when users are regulated by its use. When automated systems are used to enforce legislation, they may regulate the behaviour of users by enforcing consistency and standardization—that is, by controlling how a decision is made and how users conduct their work tasks.¹²¹ The ability of a human decision-maker to introduce an element of humanity in special circumstances is compromised.

Sometimes this standardization of user behaviour is intended and at other times it is just an inadvertent by-product, which may or may not be recognized by the system developers, as it may only become apparent when the system is operational. It is important that such regulatory effects should at least be identified during an *ex ante* evaluation process. The standardization and consistency enforced by a decision support system can provide a control mechanism for those in power, permitting their power to be increased by ensuring that their provisions are carried out absolutely.¹²² This automated enforcement could replace an ouster clause in legislation and thus prevent judicial interpretation of the law, which could, in turn, effect a redistribution of the constitutional balance of power. According to Whitby, there is a benefit when the judiciary is seen to some extent to be in conflict with the legislature, as this supports the constitutional requirement for the various organs of authority to act as checks on each other. By attempting to create an aura of certainty, the use of automated judicial decision support may upset this fine balance.¹²³

Schild considers it inappropriate for computers to make legal decisions and recommends that their use in legal decision-making should, rather, be confined to a support role assisting human decision-makers in their work.¹²⁴ Zeleznikow concurs with this view.¹²⁵

Susskind in his published essay, "The computer judge: Early thoughts," explores the issue further.¹²⁶ He reports on a conversation between John

121. Anja Oskamp & Maaike Tragter, "Automated Legal Decision Systems in Practice: The Mirror of Reality" (1997) 5 A.J. & L. 291 at 291, 312.

122. Blay Whitby, "AI and the Law: Proceed With Caution" in Mervyn E. Bennun, ed., *Computers, Artificial Intelligence and the Law*, (Chichester, England: Ellis Horwood, 1991) 4 at 7–8.

123. *Ibid.* at 9.

124. Uri Schild, *Expert Systems and Case Law* (Chichester, England: Ellis Horwood, 1992) at 16, 20.

125. *Supra* note 120 at 204.

126. Richard E. Susskind, *Transforming the Law: Essays on Technology, Justice and the Legal Marketplace* (Oxford: Oxford University Press, 2000).

McCarthy, the early artificial intelligence pioneer, and Joseph Weizenbaum, reported in 1984. McCarthy posed the question, "What do judges know that we cannot tell a computer?" and answered "Nothing," concluding that the goal of "building machines for making judicial decisions was perfectly in order."¹²⁷ Like Schild, Zeleznikow and others, Susskind strongly disagrees with this view. He points out the limitations of current computer technology in the areas of speech recognition, understanding pictures and natural language description. He notes that computers have not yet been programmed to "exhibit moral, religious, social, sexual and political preferences akin to those actually held by human beings, [we] expect...of judges..." nor the "creativity, craftsmanship, individuality, innovation, inspiration, intuition, commonsense and general interest in our world we expect of judges."¹²⁸ Essentially he is saying that computers are not human, but that judges are. He concludes that:

Computers will no doubt provide valuable assistance to the judiciary in the future, [but] it is neither possible now (or in the conceivable future) nor desirable ever (as long as we accept the values of Western liberal democracy) that computers assume the judicial function.¹²⁹

★

4. CONCLUSION

THOMAS CLAIMS THAT POLITICAL and public interest in sentencing is at a high level, though often public understanding of the realities of sentencing is limited and often judges are criticised for excesses of leniency and severity, in many instances in the same case.¹³⁰ Total consistency in the exercise of discretion by sentencers will never be achieved while humans have to make the decisions, but a mechanical appearance of consistency such as can be produced by too rigid guidelines is as capable of producing injustice.

Sir Samuel Romilly wrote an excellent summary of the goal of producing consistency in sentencing. He expressed the hope that "there might be, if not a perfect uniformity in the administration of justice, yet the same spirit always prevailing and the same maxims kept in view..."¹³¹

Our sentencing decision support system can help promote consistency and transparency.

If it is considered inappropriate for an intelligent sentencing decision support system to make sentencing decisions, what then are the potential benefits of the outcomes of the sentencing project? The web-enabled sentencing models are designed to provide automated support for human decision-makers

127. *Ibid.* at 286.

128. *Ibid.*

129. *Ibid.*

130. David A. Thomas, "Judicial discretion in sentencing" in Loraine Gelsthorpe & Nicola Padfield, eds., *Exercising Discretion: Decision-making in the criminal justice system and beyond* (Cullompton, Devon: Willan Publishing, 2003), 50 at 71.

131. Sir William Staunford, *Les Plees del Coron* and Sir Samuel Romilly, *Observations on the Criminal Law of England* (New York: Garland, 1978) at 16.

rather than to automate decision-making. This distinction is vital. "We should stress that any legal decision support systems should be used as tools for legal decision-makers; it would be most inappropriate for them to make legal decisions."¹³²

The main potential benefit of the sentencing project is in supporting the training of judges, magistrates, legal counsel and law students. The models promote a clearer understanding of the factors affecting judicial decision-making and, going beyond their potential as training tools, they provide a sound basis for discussion for those responsible for the task of reviewing sentencing guidelines. The models also assist counsel preparing to plead a case by reminding them in a structured manner of the factors that the sentencing decision-maker will consider, thus ensuring that all relevant factors are included in their arguments. The decision support system described in this paper offers direct benefits to the judiciary beyond training. It can assist a judicial decision-maker to identify relevant factors presented or not presented in counsel's arguments and provides a check-list or *aide-mémoire* when the decision-maker is preparing his or her judgment.

Sentencing studies typically focus on sentencing statistics, but this study is different because the emphasis is on the identification of the factors contributing to the sentencing decision and the relationships among them. It has been demonstrated that, despite apparent complexities, sentencing reasoning can be effectively modelled as a series of simple interlocking arguments. Such a series of models is the basis for an automated decision support system developed using both conventional and artificial-intelligence techniques.

The sentencing decision support system in this discretionary domain is complex and has a potential to have a significant impact. It is thus unsuitable for total automation and should remain within human control. Whereas automated decision-making is inappropriate, automated decision support is of benefit to decision-makers, to legal professionals who work in discretionary legal domains and the public alike.

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132. *Supra* note 120 at 204.

5.1. *The project team*

The team assembled for the sentencing project was multidisciplinary and its members were affiliated with several different institutions. Project team members from an academic background included:

- Mr. Domenico Calabrò, Solicitor-in-charge, Victoria Legal Aid (Broadmeadows), research liaison officer and sentencing expertise, <domenicoc@vla.vic.gov.au>;
- Dr. Maria Jean Hall, software engineer and modeller, researcher in Artificial Intelligence and Law, <jean_hall@bigpond.com>;
- Professor Tania Sourdin of the Law School at La Trobe University, Director, Conflict Resolution Research Centre, <T.Sourdin@latrobe.edu.au>;
- Dr. Andrew Stranieri of University of Ballarat, a co-author of the decision support system development methodology used and principal of JUST-SYS, <www.justsys.com.au>, a start-up company which provides tools to develop web-deployed, legal-knowledge-based systems, <a.stranieri@ballarat.edu.au>; and
- Professor John Zeleznikow of the School of Information Systems at Victoria University, co-author of the development methodology used, <john.zeleznikow@vu.edu.au>.

Legal expertise was provided by several practising lawyers associated with Victoria Legal Aid:

- Domenico Calabrò;
- David McKenzie—Senior Public Defender and criminal-law specialist, <davidmz@vla.vic.gov.au>;
- Jennifer Schubert—Team Leader, criminal-law specialist, <jens@vla.vic.gov.au>;
- Peter Matthews—Barrister, with much sentencing expertise;
- Carmen Randazzo, SC, Senior Public Defender and criminal-law specialist; and
- Nick Papas, Barrister, former Chief Public Defender and head of the criminal-law division of VLA and former Chief Magistrate of Victoria.