

# Angelic Environment: Demonstration

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## ABSTRACT

A development environment for the Angelic Methodology.

## CCS CONCEPTS

• **Software and its engineering** → **Integrated and visual development environments**;

## KEYWORDS

ADF, Reasoning with Cases, Angelic Methodology

### ACM Reference format:

Latifa Al-Abdulkarim, Katie Atkinson, Sam Atkinson, and Trevor Bench-Capon. 2017. Angelic Environment: Demonstration. In *Proceedings of International Conference on Artificial Intelligence and Law, London, UK, June 12–15, 2017 (ICAIL’17)*, 2 pages. <https://doi.org/http://dx.doi.org/10.1145/3086512.3086546>

## 1 ANGELIC ENVIRONMENT

Although AI and Law has been around for more than thirty years there has been disappointingly little penetration into legal practice. One important exception is the approach to moving from written regulations to an executable expert system based on [10], which has been developed through a series of ever larger companies: Softlaw, Ruleburst and, currently, Oracle. In the past year or so, however, there is an unprecedented degree of interest in AI and its potential for supporting legal practice. This is evidenced by articles in the legal trade press such as *Legal Business*<sup>1</sup> and *Legal Practice Management*<sup>2</sup>; national radio programmes such as *Law in Action*<sup>3</sup> and *Analysis*<sup>4</sup> and Professional Society events, such as panels run by the Law Society of England and Wales<sup>5</sup>. The legal profession has never been so interested in, and receptive to, the possibilities of AI for application to their commercial

<sup>1</sup>*AI and the law tools of tomorrow: A special report.* [www.legalbusiness.co.uk/index.php/analysis/4874-ai-and-the-law-tools-of-tomorrow-a-special-report](http://www.legalbusiness.co.uk/index.php/analysis/4874-ai-and-the-law-tools-of-tomorrow-a-special-report). Websites accessed Jan 2017.

<sup>2</sup>*The Future has Landed.* [www.legalsupportnetwork.co.uk](http://www.legalsupportnetwork.co.uk). March 2015.

<sup>3</sup>*AI and the Law.* [www.bbc.co.uk/programmes/b07dlxmj](http://www.bbc.co.uk/programmes/b07dlxmj).

<sup>4</sup>*When Robots Steal Our Jobs.* [www.bbc.co.uk/programmes/b0540h85](http://www.bbc.co.uk/programmes/b0540h85).

<sup>5</sup>The full event of one such panel can be seen on youtube at [www.youtube.com/watch?v=8jPB-4Y3jLg](http://www.youtube.com/watch?v=8jPB-4Y3jLg).

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ICAIL’17, June 12–15, 2017, London, UK

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ACM ISBN 978-1-4503-4891-1/17/06...\$15.00

<https://doi.org/http://dx.doi.org/10.1145/3086512.3086546>

activities. There are a number of current opportunities which need to be taken if AI and Law is to move from the laboratory and into legal practice.

One of the major lessons that can be drawn from Softlaw and its successors is the need for a methodology. A methodology gives some assurance to clients that their engagement with AI has some prospects of success: they are not so interested in furthering research activities as in increasing profits and the use of an established methodology can allow them to know how their particular problem will be addressed and what will be produced at the end of the process. Equally important, as the Softlaw experience also showed, is the existence of tools to support the methodology. Such tools reinforce the methodology, make it more teachable and reproducible and shorten the development time. In this paper we describe a support environment for the recently developed Angelic methodology [2], which we believe can be used to develop applications that will meet some of the current needs of the legal profession.

A fuller description of the support environment and screen shots can be found in [3]. The basic Angelic Methodology was presented in [2]. The Angelic methodology is based on an Abstract Dialectical Framework (ADF) [8]. In ADFs nodes represent statements. The directed edges link nodes to a set of nodes required to determine their acceptability. Each node is associated with a set of *acceptance conditions*, which in the Angelic Methodology comprise a set of tests: sufficient conditions for accepting or rejecting the parent node, in terms of the status of its children. These tests are arranged in a priority order and a default is given to cover cases where none of the tests are satisfied. As used in the Angelic methodology there are no cycles and the ADF effectively forms a tree running from base level factors at the bottom (the leaf nodes) to a verdict at the top (the root node). The top levels of the structure correspond to the logical model of the Issue Based Prediction system [9] and the lower levels to the abstract factor hierarchy of CATO [4]. Once the structure has been established, acceptance conditions are supplied for each node.

The methodology of [2] can be enhanced [1] by linking the base level factors to facts through the use of *dimensions* [11]. Base level factors are equated with points on, and ranges in, dimensions. The Angelic methodology thus draws upon three decades of AI and Law research, and has been evaluated thoroughly in a research context. We feel, therefore that it provides a sound foundation on which to base our support environment.

The support environment comprises a database (implemented using Oracle) to record the encapsulation of the

domain theory and an extensible set of tools operating on the database.

The key Tables are those which hold the structure of the ADF. These are a Table for the *Nodes* (i.e. the set  $S$  of Statements) and a Table for the *Links* between them.

As in [2], the acceptance conditions take the form of a set of tests, each of which gives a sufficient condition for accepting or rejecting the node. They are associated with Tables for *Tests* and *BodyTerms*.

As well as the ADF structure, we need to hold information about the domain. This data is held in Tables for the *Domain*, *Cases*, *Dimensions*, *Dimension Points* and *Case Facts*.

The database described thus holds all the information produced by an analysis following the Angelic methodology: covering the domain theory expressed as an ADF, the domain itself and individual cases within the domain. The database supports the analyst both by storing the information in a convenient and systematic form, and by driving the analysis, acting as a “checklist” to show where there are gaps and more information needs to be discovered.

Angelic environment also provides an extensible set of tools which use the information encapsulated in the database. The tools are accessed through a GUI (see [3]). The tools developed so far are:

**Visualisation.** The first tool supports visualisation of the domain. The visualisation has a circular layout with the root node, the verdict, in the centre. Presentation in this manner supplies a useful focus for discussion with clients and also facilitates the identification of errors and omissions. Even more importantly it can suggest the need for further nodes.

**Case Input.** This tool facilitates the entry of the facts relating to a particular case. For each dimension relating to the domain of the case, the appropriate point of that dimension can be entered using a drop-down menu offering the set of points on that dimension.

**Information.** This tool facilitates querying the database to retrieve information for particular items and provide links to externally held information which can give access to the original sources and commentaries on them.

**Knowledge Base Generation.** This tool uses the *tests* to construct a Prolog Program, where each node which is not a base level factor has its own set of clauses and the base level factors form the facts for a given case.

**Computation Using Dimensions.** This tool computes a value for the verdict node using dimension points as prototyped in [6].

To test and evaluate the facilities we populated the database with information from the property law related to wild animals cases introduced into AI and Law by [7]. Since that paper did not discuss dimensions, we drew our dimensions and dimension points from [5]. For a proper evaluation we will need to use the environment in an analysis of a variety of new and untried domains with actual users. We are in a good position to do this since we have on-going engagement with several different law firms which will give the opportunity to exercise these tools in practice.

In order for research ideas in AI and Law to make an impact on the legal profession, it is necessary that there is some confidence that usable applications will be delivered. Such confidence is greatly increased by a well founded methodology and a support environment, since that provides some reassurance that the problem will be tackled in a systematic and reproducible manner. We believe that the tools we have described in this paper provide a number of advantages for teams following the Angelic methodology.

- The existence of the database can help drive the analysis by indicating exactly what knowledge is needed, what has been collected and what remains to be discovered. This makes the analysis more systematic, objective, transparent and repeatable.

- The information is recorded and stored in a systematic fashion facilitating exchange of information within the team, and reporting to clients.

- Tools such as the visualisation and information tools facilitate the exploration and validation of the analysis, presentation of results, and suggest areas for refinement.

- Other tools facilitate the collection, entry, storage and use of test data, and the execution of the test data to identify problems and the need for potential refinements.

We believe that the work described in this paper will provide invaluable assistance in further applications of the Angelic methodology, and that opportunities to extend the tool set will be identified as a result of using the environment. We see the development of such support tools as essential if the current interest in AI that is being shown in the legal profession is to bear real fruit in terms of the widespread adoption of the techniques developed in AI and Law research.

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