A Brief History of AI and Law

Frans Coenen and Trevor Bench-Capon
12 December 2017
AI & Law Workshop
BCS SGAI AI’17
Timeline

Early Work (<1980)
Foundations of An AI & Law Community (1987)
Case Based Reasoning and HYPO (1987)
Rule Based Systems and The MAKE Project (1990)
Deontic Logic (1991)
CABARET, a CBR and Rule Based Hybrid (1991)
Argumentation (1991)
Legal Document Processing and FLEXICON (1993)
Argumentation Frameworks (1995)
Ontology and ONLINE (1995)
E-Government and ZENO (1997)
Legal Text Summarisation and SALOMON (1998)
METAlex, The E-Power Project and Legal XML (2003)
Machine Learning and Data Mining (2005)
The Burden of Proof and CARNEADES (2007)
Opinion Mining, Social Media and AI & Law (2007)
Legal Text Information Retrieval and TREC (2010)
Multi Agent-based Systems, PADUA and PISA (2012)
AI & Law and the era of Big Data (2013)
Where Next --- Two Examples (2017)
AI & Law

AI and Law (Legal Informatics): The application and utilisation of techniques from the computer science domain of Artificial Intelligence to the legal application domain.
Early Work

Publications on what might be now be considered to be AI and Law can be traced back to the early 1950s --- Layman Allen (1956), "Symbolic logic: A razor-edged tool for drafting and interpreting legal documents".

The phrase AI & Law started to be used in the 1970s --- Bruce Buchanan and Thomas Headrick (1970), “Some speculation about artificial intelligence and legal reasoning”.

One early system of note is the TAXMAN system, a foundation for much future work (TAXMAN II in 1981) --- Thorne McCarty (1977), Reflections on Taxman: An Experiment in Artificial Intelligence and Legal Reasoning.
The birth of an AI & Law community can be argued to be the foundation of the International Conference on AI and LAW (ICAIL) which was first held in Boston in May 1987 (the 16th ICAIL was held this year).

In Europe the first conference of the “Stichting Juridische Kennissystemen” (JURIX), which translates to the “Foundation for Legal Knowledge Systems”, was held in 1988.
International Association for AI and Law (IAAIL) was inaugurated in 1991.

The Journal of Artificial Intelligence and Law was launched in 1992.

JURISIN series of workshops started in 2007 in Japan.
Case Based Reasoning and HYPO

Work in the 1980s was directed at: (i) Information extraction and information retrieval of various kinds, and (ii) the construction of expert systems of various kinds.

There was much discussion as to whether rule based or case based was the best way to go.

In the context of CBR the HYPO reasoning with cases and “hypotheticals” system is of note --- Edwina Rissland and Kevin Ashley (1987), “A case-based system for trade secrets law”.

The Significance of HYPO are that:

- It is the first system that the reasoned with cases in the legal domain, and
- It was the catalyst for many subsequent systems (CABARET, CATO, IBP).
Rule Based Systems and The MAKE Project

- Rule based approaches took a fairly standard (for the time) expert systems approach.
- The Toulmin method of informal reasoning was popular.
- Early example --- Marek Sergot et al. (1986), The British Nationality Act as a logic program.
- Collaborative project between ICL, British Coal and the University of Liverpool.
- Focus on:
  - Industrial injury claims, and
  - The maintenance of legal expert systems.
Deontic Logic(s)

Another focus of the late 1980s and early 1990s was work on various logical formalisms.

In particular Deontic logics, which was popularised within the AI and Law community in the 1980s --- Henning Herrestad (1991), *Norms and formalization*.

Used the the notation:

- OA - it ought to be the case that A
- PA - it is permissible that A

Added the following axioms to standard propositional logic:

- O(A→B) → (OA→OB)
- PA → (not O not A)

Argued to be suited to the representation of domains where we have norms providing compensations for violations, such as in the case of contact law.
CABARET, a CBR and Rule Based Hybrid

Following on from HYPO, CABARET Adopted a CBR and Rule base hybrid approach--- Edwina Rissland and David Skalak (1989), *Combining case-based and rule-based reasoning: a heuristic approach*.

Key idea: Top level a (argument) tree derived from the rules, cases used to resolve the leaf nodes.

Essentially a shell that integrated reasoning with rules and cases with an emphasis on the application of rules containing ill-defined terms.

Operated using a collection of control heuristics directed at interleaving case-based methods and rule-based methods to construct an argument to support a particular interpretation.
Argumentation

Study of how conclusions are reached through logical reasoning in the context of debate, dialogue, persuasion and negotiation.

In the context of AI & law the relevance is with respect to: (i) the explanation of legal decisions, (ii) the structure of arguments in legal cases and (iii) the role that arguments can play in case-based reasoning.

Early work (1990s) featured work on strategies for generating arguments in the context of the CABARET system — David Skalak and Edwina Rissland (1991), "Argument moves in a rule-guided domain."

This was a foundation for later work focused on the characterisation and construction of legal argument dialogue games for legal reasoning.
The 1990s saw the start of work (on going) on intelligent legal document management tools.

One well documented example is FLEXICON --- Daphne Gelbart and Joe Smith (1993), *FLEXICON: an evaluation of a statistical ranking model adapted to intelligent legal text management.*

Used to summarise legal texts so as to facilitate rapid search.

FLEXICON features three elements: (i) original documents, (ii) multiple lexicons and (iii) machine generated formal lexical representations of each document (*FlexNotes*).

The quality of the FlexNotes depends on the lexicons and the adopted information extraction processes.
Argumentation frameworks were popularised within the AI community from the late 1990s onwards.


Broadly an argumentation framework $F=<A,R>$ comprises:

- A set of abstract arguments $A$, and
- A set of binary attack relations $R$.

A range of argumentation frameworks have been proposed within the AI & Law community: (i) logic based, (ii) value based, (ii) assumption based, (iv) .... .

Much subsequent work on argumentation frameworks, e.g. *Zeno*, ASPIC and Carneades.
The AI&Law community has been interested in summarising legal texts since its foundation.

Of note is the SALOMON system (project) --- Marie-Francis Moens (1997), *Abstracting of legal cases: the SALOMON experience*.

Summarises Belgian criminal cases from the case text.

Case category first identified based on the case structure and irrelevant text units were identified based on a knowledge base.

Informative text units of the alleged offences and of the opinion of the court extracted using statistical techniques.

Catalyst for much further including argumentation mining.
Ontology and ONLINE

“An explicit formal specifications of the terms in the domain and the relationships that exist among them”

The concept of ontologies was introduced to Computer Science in the early 1990s with the advent of the Semantic Web.

The first legal ontology can be argued to be that incorporated into ONLINE --- Andre Valente and Joost Breuker (1995), ON-LINE: an architecture for modelling legal information.

Online was a legal information management system with a legal reasoning facility provided by a legal ontology, the “Functional Ontology of Law”.

Interestingly the idea of legal ontologies shifts legal reasoning from a rules-oriented problem to a knowledge representation problem.

See also --- Trevor Bench-Capon (2004), Ontologies in legal information systems; the need for explicit specifications of domain conceptualisations.
The concept of e-Government (e-Democracy) was beginning to the recognised in the mid 1990s.

Directed at the usage of the internet to provide for digital interaction between governments and citizens. For example e-Petitions.

Zeno was one of the first attempts to define a formal model of argumentation to support online consultation systems for e-government --- Tom Gordon and Nikos Karacapilidis (1997), The Zeno argumentation framework.

The Zeno framework provided the foundation for a number of subsequent projects such as the Delphi Mediation Online System (DEMOS), Parmenedis --- Ann Macintosh (2009), Providing argument support for e-Participation.
The notion of the Semantic Web began to be taken seriously with in the AI & Law community in the early 2000s with attempts at adopting a Semantic Web approach in the context of legal resources, using jurisdiction independent XML standards to structure documents.

Early example is METAlex, an open XML standard for the markup of legal documents --- Radboud Winkels et al. (2003), Metalex: An XML standard for legal documents.

Developed as part of the European e-Power project, meant as an interchange format for legal documents.

Led to Legal XML, is a non-profit organization developing open standards for legal documents and related applications.
The Burden of Proof and CARNEADES

The Carneades system, developed from Zeno.

Software system developed for constructing, evaluating and visualising arguments from formal models of legal concepts, rules, and cases ---- Tom Gordon et al. (2007), The Carneades model of argument and burden of proof.

One of the first approaches to acknowledge, and take account of the “burden of proof”.

Led to the idea of “argumentative story telling” where we have two competing/conflicting stories --- Floris Bex (2011), Arguments, stories and criminal evidence: A formal hybrid theory.
Machine Learning and Data Mining

Machine learning and data mining have a long history.

The AI and Law community were slow to take up the concepts with first papers appearing in the mid 2000s.

First examples were directed at legal document summarisation utilising text mining techniques --- Ben Hachey and Claire Grover (2005), Automatic legal text summarisation: experiments with summary structuring.

Further work looked at:

- The classification of legal documents,
- Opinion mining from law blogs …
The idea of opinion mining in the context of recommender systems was a subject of much research in the machine learning community in the mid 2000s.

First example in the legal domain considered opinion mining in the context of Law blogs (“blawgs” that exist in the “blawgosphere”!) --- Jack Conrad and Frank Schilder (2007), Opinion mining in legal blogs.

The significance of Conrad and Frank is that it was the catalyst for much subsequent work relating social medial to the domain of AI & Law.
The first Text REtrieval Conference (TREC) was held in 1992.

Every conference features a number of Tracks (Workshops) each directed at particular current retrieval domain.

Each track has a challenge centered on given data sets.

From 2006 to 2011 TREC featured a Legal Track.

An idea that resulted from this, that has has significant influence within the AI and Law is e-Discovery founded on random sampling --- Douglas Oard et al. (2010), *Evaluation of information retrieval for E-discovery*. 
Multi Agent-based Systems, PADUA and PISA

In line with the AI& Law community’s practice of adopting technologies when and where they fit the aspirations of the community the mid 2000s saw the adoption of MAS.

The idea of agents arguing for or against a case.

Examples include the PADUA and PISA systems --- Maya Wardeh et al. (2012), *PISA: A Framework for Multiagent Classification Using Argumentation*.

Brought together data mining and argumentation under the MAS umbrella.

Examples founded on housing benefit scenarios.
The Big Data (Data Analytics) phenomena hit the headlines in the early 2010s.

In the legal context this was accompanied by the realisation that even routine civil litigation cases now required searching of extensive digital repositories.

Big data technology also allows:

- Large scale legal outcome prediction in the mold of machine learning but using deep learning techniques (RNNs, etc.).
- Provision of evidence extracted from public data sets using techniques from data analytics.
- And more
Where Next, Two Examples

A defining feature of the Big Data era is the fact that it has seen extensive interests and uptake from industry. This has been accompanied by a resurgence in interest in AI. The legal industry is no exception.

**Riverview Law:** Reasoning concerning contract renewal strategies in the context of very large numbers of contracts (tens of thousands) --- Matias Garcia-Constantino et al. (2016), *CLIEL: Context-Based Information Extraction from Commercial Law Documents.*

**Fletchers:** Decision making regarding medical negligence cases founded on medical records and transcripts.
Timeline Revisited

- Early Work (<1980)
- Foundations of An AI & Law Community (1987)
- Case Based Reasoning and HYPO (1987)
- Rule Based Systems and The MAKE Project (1990)
- Deontic Logic (1991)
- CABARET, a CBR and Rule Based Hybrid (1991)
- Argumentation (1991)
- Legal Document Processing and FLEXICON (1993)
- Argumentation Frameworks (1995)
- Ontology and ONLINE (1995)
- E-Government and ZENO (1997)

- Legal Text Summarisation and SALOMON (1998)
- METAlex, The E-Power Project and Legal XML (2003)
- Machine Learning and Data Mining (2005)
- The Burden of Proof and CARNEADES (2007)
- Opinion Mining, Social Media and AI & Law (2007)
- Legal Text Information Retrieval and TREC (2010)
- Multi Agent-based Systems, PADUA and PISA (2012)
- AI & Law and the era of Big Data (2013)
- Where Next --- Two Examples (2017)