

Overview of Trevor Bench-Capon's Research

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October 30, 2013

Introduction

Trevor Bench-Capon is with no doubt one of the main figures in artificial intelligence and law and his work has been more widely influential across a number of topics in computer science. In this introduction we give a brief overview of his main contributions, with no hope to be complete. Looking at Trevor Bench-Capon's published work, one main development can be recognised: from knowledge representation to argumentation. In his earlier work, the main focus was on principled knowledge representation (often in logic programming) while the reasoning was secondary in that it followed the meaning of the representations. This focus is apparent from the title of a textbook on AI he wrote in 1990, titled *Knowledge Representation: An Approach to Artificial Intelligence* [6]. In his later work instead the focus was on forms of reasoning that go beyond the meaning of the representations. It is here that the notion of argumentation is central. In Bench-Capon's published work this shift becomes apparent roughly towards 2000. However, as Bench-Capon himself describes in [11], he has always had an interest in argument (meant to be persuasive) as opposed to proof (meant to be valid). This interest goes back to his years as a philosophy student in Oxford and as a trainee policy maker in the UK civil service. Some traces of this early part of his career can be found in his earlier publications, but that work is mainly on knowledge-based systems, with special emphasis on legal applications. Besides knowledge representation, this earlier work also concerned principled engineering methods for knowledge-based systems, with special emphasis on ontologies, which were a computing concept in their infancy at the time, and on validation and maintenance. This strand of work was very influential on more practically-oriented work in knowledge-based systems. His later work on argumentation is more foundational in nature since it laid the groundwork for a perspective on practical reasoning that is rooted in ideas from philosophy. Above all, Bench-Capon has put the persuasiveness of arguments and the importance in this respect of societal values on the research agenda of artificial intelligence.

As can be seen from inspecting his substantial personal bibliography, Bench-Capon has a vast collection of collaborators and rarely worked alone. His co-authors span various disciplines, both within and outside of computer science, and as such his collaborative work covers a rich variety of topics. Below we

survey some of the more major milestones of his research record, though there remain many interesting individual papers beyond those that we cover below.

1 Early years

Bench-Capon's undergraduate degree was in Philosophy, Politics and Economics at St. John's College, Oxford. He studied for this from 1972-1975 and gained a BA(Hons) first class. He won the Henry Wilde Prize for the best Philosophy First across all faculties in 1975. He continued his studies at Oxford from 1975-1977, earning a B.Phil and winning the John Locke Prize for Mental Philosophy in 1976. In 1980 at Oxford, Bench-Capon defended his D.Phil thesis titled *Can God be an Object of Reference?*, supervised by Michael Dummett (later Sir Michael). His philosophical education would shine through all of his later work. Another important influence was his years in the UK civil service (1978-1984). He first became a trainee policy maker, having the task to draft the arguments from which the minister responsible for the policy area chose to be the ones used in Parliament. This experience with policy argumentation in practice was invaluable for his later academic work on modelling argumentation about policy- and decision-making. In his last years in the civil service (at the Department of Health and Social Security) Bench-Capon worked on a project that investigated the potential for using knowledge-based systems in large legislation-based organisations. This sparked his interest in legal knowledge-based systems and later, legal argument, but also in software engineering methods for knowledge-based systems and ontologies. His work at the DHSS resulted in an edited volume [7].

2 Knowledge-based systems and ontologies

During his work at the DHSS Bench-Capon met Marek Sergot and Bob Kowalski, and he moved to the Department of Computing of Imperial College London in 1984, as a research assistant in the then world-famous Logic Programming Group led by Bob Kowalski. At Imperial Bench-Capon worked on the representation of legislation in logic programs [16, 31], and he further developed his interest in software engineering methods for knowledge-based systems. In 1987 Bench-Capon moved to Merseyside to work as a lecturer in the Department of Computer Science of the University of Liverpool and progressed to become a professor in 2004, remaining in this institute until his retirement in 2012.

A classic paper from his early Liverpool years is [12], about software engineering for knowledge-based systems. Its explicit focus is on legislation-based applications but its relevance is much wider. Among other things, it is one of the first papers in the literature on knowledge-based systems in which the importance of ontologies is stressed. The focus on ontologies became prominent in the KRAFT project, a collaborative research project between the Universities of Aberdeen, Cardiff and Liverpool, and British Telecom. Four of Bench-Capon's ten most cited papers (according to Google Scholar, accessed 21 October 2013)

are from this period and are on ontologies. This may counter any impressions that younger AI students might have of Bench-Capon being ‘just’ an argumentation researcher.

3 Shift towards argumentation

While 1995 Bench-Capon was mainly known as an expert on (legal) knowledge-based systems, he is nowadays primarily known as an argumentation researcher. It is hard to say when exactly this change occurred. As mentioned above, Bench-Capon had been interested in argumentation since his years as a philosophy student. One of his very first papers was [15] (presented at a conference in 1985), in which in fact the idea of rule-based argumentation systems was proposed (though not yet formalised). Although the paper was about legal reasoning, the ideas were of much wider relevance. It is fair to say that much of the work in the 1990s on argumentation-based inference was foreseen in this paper. However, Bench-Capon himself did not really do anything with these ideas until much later, in the new millennium.

A second route to argumentation came via Bench-Capon’s interest in explanation facilities of legal knowledge-based systems. In [17] the authors had the brilliant idea to annotate logic programs in terms of Stephen Toulmin’s famous argument scheme [32], indicating the different roles of various elements in the knowledge base by linking them to different elements of Toulmin’s scheme. For example, uses of negation as failure were linked to Toulmin’s rebuttals. This may have been Bench-Capon’s first encounter with the notion of an argument scheme, which later became so prominent in his research since 2000. Nevertheless, the main focus here was not on argumentation but on explanation dialogues, a line of research that was continued until [18].

Bench-Capon’s first paper that explicitly addressed legal argument as a central topic was his JURIX 1995 invited address, published in revised form as [8]. However, this paper mainly commented on work of others and Bench-Capon had not yet really found his own approach. There was, for instance, no reference in [8] to [22], while yet Dung’s abstract argumentation frameworks would become a major element of Bench-Capon’s work after 2000.

4 Argumentation as the central topic

Around 2000-2005 Bench-Capon found his approach through a combination of value considerations, abstract argumentation frameworks and (a bit later) argumentation schemes. It was in these years that Bench-Capon truly became an argumentation scholar. Since 2000 Bench-Capon consistently emphasised that arguments, as opposed to mathematical proofs, are not meant to be formally valid but to be persuasive, and he stressed that the persuasive force of an argument to a large extent depends on the legal or societal values held by the audience to which the argument is addressed. With “values” Bench-Capon did

not mean numbers but values in the sense of Perelman and Olbrechts-Tyteca [28], Perelman [27], that is, qualitative notions like health, economic competition, social equality, sanctity of property, avoidance of litigation, or legal certainty. The work of the legal philosopher and argumentation scholar Chaim Perelman served as inspiration for Bench-Capon’s work on value-based argument. His work since 2000 has several main strands, which are all based on the same coherent approach in which abstract argumentation frameworks capture the context-dependent evaluation of arguments, argument schemes account for the structure and content of arguments, and values capture the persuasiveness of arguments. We now briefly review his main work during these years, again with no hope to be complete.

Legal case-based reasoning with factors, dimensions and values [9] applied his newly found approach to factor-based legal reasoning with precedents. In AI & Law a tradition had emerged since the HYPO system of [30] to represent legal precedents as collections of (boolean) factors pro and con a decision and to express the decision with a preference over the factors. Bench-Capon now proposed to base these preferences over factors on preferences over values, so that cases that are different on the factors could still be regarded as similar in terms of values. Later he extended this view to HYPO’s so-called dimensions (essentially multi-valued factors) and, with Giovanni Sartor [14], he applied these ideas in a theory-construction approach, in which alternative theories that explain a given set of precedents are constructed. The approach was later implemented in software as part of work with Alison Chorley [21]. More recently, Bench-Capon has worked on re-casting these ideas in the form of argument schemes embedded in a formal framework for structured argumentation [35, 29]. Finally, the work on legal case-based reasoning was in Wardeh et al. [33] broadened to a multi-agent account of generating classification arguments from a database of examples.

Value-based abstract argumentation frameworks In [10], his most cited paper, Bench-Capon abstracted these ideas to the level of [22]’s abstract argumentation framework (AFs). Dung’s AFs are just a set of arguments with all structure abstracted away, plus a binary relation of attack. Bench-Capon proposed to assign to each argument in an AF a legal or societal value and to allow for different orderings of these values, reflecting different audiences, or different ways to resolve the attacks. This results in so-called Value-based Argumentation Frameworks (VAFs). This paper gave rise to a series of follow-up papers of Bench-Capon and others in which VAFs were computationally studied; e.g. [19].

Argument schemes for practical reasoning and policy debates Having abstracted his initial ideas to the level of abstract argumentation frameworks to demonstrate how argument evaluation concerns defeasible matters of subjectivity, Bench-Capon together with Katie Atkinson and Peter McBurney

then turned attention to studying the instantiation of VAFs through argument schemes for practical reasoning, e.g. in [3, 4, 2, 20] (a preliminary version of this scheme was already in [10]). This in effect resulted in an argumentation-based theory of decision making, which has been applied in various contexts, such as legal case-based reasoning [1], democratic policy deliberation [34] and multi-agent systems [5].

Formal and computational analysis of abstract argumentation Above and beyond issues of knowledge representation and reasoning, other computational aspects related to value-based argumentation frameworks have also interested Bench-Capon. With Paul Dunne he published in *AI Journal* papers on computational aspects of abstract argumentation ([24, 25]), and with Sanjay Modgil he developed the idea of meta-argumentation frameworks [26].

5 Final observations

Although Bench-Capon mainly used logic-based techniques, he has methodologically always been open-minded, having used such diverse techniques as neural networks, constraint satisfaction, data-mining and heuristic search in his models of argumentation. Bench-Capon liked logic but he has never been a logician (and has often mused about not considering himself to be a computer scientist), perhaps because he was too interested in real knowledge, real reasoning and real argumentation. One thing that makes Bench-Capon's work so valuable is that he has always tried to connect his ideas to the real world. In his earlier work on knowledge-based systems the examples were always from real knowledge-based systems with real legislation, and in his later work on argumentation the modelled arguments were always real or realistic, from law, politics or related domains. It seems fair to say that Bench-Capon is not primarily known and influential for formalisms and theorems but for methods, ideas and ways of thinking and for lucid analyses of actual examples of argumentation. Having said so, he was not afraid of technical work, and his most-cited paper [10] on value-based argumentation frameworks is a technical one, and has been so influential because of the formalism presented in it that captures his ideas. Moreover, as briefly indicated above, he has published other technical papers of very high quality, such as his recent joint papers with Paul Dunne and with Sanjay Modgil. And there is this mysterious *AI Journal* research note from 1997 [23] that has received his first citation in this Festschrift in the chapter of Paul Dunne ...

Bench-Capon's legacy contains more than just his published work. With Paul Dunne, Bench-Capon founded the International COMMA conferences on Computational Models of Argument. Although the first COMMA conference in 2006 was technically a deliverable of the European ASPIC project led by John Fox, it was organised by Bench-Capon and Dunne at the University of Liverpool, while they also founded the COMMA Steering Committee and thus

gave the conference a solid grounding to build on, the success of which can be seen through the continued popularity of this bi-annual event.

In 2007 Bench-Capon and Dunne jointly edited a special issue on argumentation of the *AI Journal*, the world's premier journal in Artificial Intelligence [13]. This issue has been extremely influential in making argumentation a mainstream research topic in AI.

In December 2012 Bench-Capon became the fourth honorary member of JURIX, the Dutch Foundation for Legal Knowledge and Information Systems, for his outstanding contributions over the years to the annual JURIX conference. This conference has, very much helped by the fact that Bench-Capon decided to attend the third edition of in 1991 and to return virtually every year, developed from a modest national event into the main European conference in the field.

In his capacity of an editor-in-chief of the journal *Artificial Intelligence and Law* Bench-Capon has recently edited an extremely interesting special issue on 25 years of the International ICAIL conferences on Artificial Intelligence and Law. In this issue, 50 papers from these conferences are reviewed by 24 prominent scholars in the field in light of today's state-of-the-art, resulting in an excellent overview of a field in which Trevor Bench-Capon has been very much at home since he entered the academic profession.

Finally, while Bench-Capon's work has been major source of inspiration for many, the same can be said of his oral contributions. Everybody who has had a chance to meet with Bench-Capon in person must agree that there are very few people who are so engaging, stimulating, interesting, witty, insightful, original, and intelligent as Trevor Bench-Capon. Many of us have learned at least as much from talking to him as from reading his work. We hope that this volume provides a fitting tribute to Bench-Capon to recognise his contributions both through his work and his personal presence in the academic community.

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