Editorial

An Undergraduate Degree in Practical Reasoning

Logic as a single, unified academic discipline does not exist today. To be a logician today, you need to train as a mathematician, philosopher or computer scientist. Not only will you need to master topics that might be peripheral to your main area of interest, but you will have less and less in common with fellow logicians working in other disciplines. Eventually you may even lose touch with the original purpose of logic: to develop and put into practice tools and techniques to help people reason and communicate more clearly and more effectively.

Only a few decades ago, students were taught Latin and geometry, largely for the purpose of teaching logic by osmosis. Today these subjects have fallen out of fashion, and no subject more directly concerned with teaching logic seems to have taken their place - a sad reflection of the lack of impact of academic logic on education and everyday life.

Ironically, never before has there been greater progress in the development of logic for practical purposes - applications in computer science to programming languages, program specification languages and databases; and applications in artificial intelligence to expert systems, natural language processing, and to knowledge representation and reasoning more generally.

And never before has logic been so influential in other disciplines concerned with human language and human reasoning. Indeed a number of scholars working in those disciplines have obtained important results of direct relevance to the theory and practice of human logic - about the deductive processing of natural language communications in linguistics, about human deduction in psychology and about the logic of norms and argumentation in the law. But these results have had little impact on the work of logicians working in the mainstream disciplines of mathematics, philosophy and computer science.

It would be unrealistic to expect logicians to abandon their host disciplines and to establish themselves in newly instituted departments of logic. It is not too ambitious, however, for like-minded logicians in different academic departments to collaborate on the development of an interdisciplinary, undergraduate degree course in practical, logic-based reasoning.

It is important that such a degree course should focus on teaching practical skills and should draw upon more academically oriented logic primarily to support more practical objectives. For this purpose, I propose that the course be driven by practical exercises in English composition (or any other natural language), legal reasoning, computing and artificial intelligence. These exercises should be supported by more theoretical study of logic, to the extent that those studies are relevant and appropriate to the use of logic in practice.

Perhaps the single most important subject to be studied in the course would be English (or other natural language) composition, increasing referred to in recent years by the traditional name of "rhetoric". These studies would teach not only how to use natural language precisely and clearly, but also how to connect sentences and larger units of communication coherently and effectively. The practical exercises could be supported by such books as Williams [7] 'Style: ten lessons in clarity and grace' and by more theoretical studies such as 'Relevance' by Sperber and Wilson [5].

Exercises in rhetoric need to be applied to challenging practical problems that require clear thinking and the ability to analyse and compare conflicting arguments. These are the skills of logical reasoning that constitute much of the subject matter of the field of jurisprudence. A good (and inspiring) English text for this purpose is Twinning and Meyers' [6] 'How to do things with rules'. Such a text could usefully be supported by more theoretical treatments of jurisprudence such as Hart's [1] 'The Concept of Law'.

The language of legislation is also a prime example of the way in which natural language can be used with almost mathematical precision. As I have argued elsewhere [4] , the language of legislation can be regarded as a logic-based programming language, whose purpose is to regulate the behaviour of society, analogously in broad terms to the way in which programs regulate the behaviour of computers. Thus exercises in natural language composition can usefully be linked with the analysis and interpretation of legislation, and these in turn can be linked with exercises in high-level, logic-based computer languages.

Exercises in logic-based computer languages could include languages for programming and program specification such as Prolog, as well as database query languages such as SQL. Programming exercises might usefully include the logical representation of rules and regulations, such as those explored in [4]. Such programming exercises would extend beyond those normally associated with conventional computer science and would more closely resemble applications in artificial intelligence.

Artificial intelligence is concerned both with constructing simulations of human intelligence and with engineering intelligent solutions to practical problem-solving tasks. For both purposes, logic has proved to be an increasingly powerful knowledge representation and problem solving paradigm.

The logics used in artificial intelligence build upon those developed in mathematics and philosophy, but extend them in significant ways. These extensions include the development of non-monotonic logics for default reasoning and of efficient automated reasoning procedures. In my opinion, these two developments have a significance for the practice of human reasoning which exceeds even their importance in artificial intelligence.

Non-monotonic logics for default reasoning address the problem which has always been the greatest obstacle to the use of logic in everyday life - the fact that hardly ever do general rules hold universally and without exception. Non-monotonic logics provide sound semantics for default reasoning and, in the case of negation as failure in logic programming, also effective reasoning techniques.

Automated reasoning procedures are often presented as machine-oriented methods that exploit the special characteristics of computers and are unsuited for use by human beings. In my book "Logic for Problem Solving" [3], I tried to argue that clausal form and resolution-based reasoning procedures not only provide a natural framework for human-oriented logic, but also compare favourably with non-logical, human-oriented problem-solving models such as and-or trees and so-called "procedural representations of knowledge". Today, I would be able to present a stronger argument by demonstrating in detail the close relationship between the language of legislation and clausal form.

These are the three (or four, if you regard artificial intelligence as distinct from computer science) main practical applications of logic towards which the course would be directed. Other subjects, including philosophical and mathematical logic, should be included as relevant and appropriate. For example, I would include readings from epistemology and philosophy of science, where logical views of knowledge and science play an important role, from psychology of human reasoning including such controversial works as Johnson-Laird and Byrne's [2] "Deduction", and from the many works that discuss the role of logic in the semantics and pragmatics of natural language.

I believe that such a degree course could truly teach students how to reason and communicate more clearly and effectively. No doubt, many difficulties will need to be overcome, even before one such course can be established. Perhaps the biggest will be to bridge the cultural gap between logically minded academics working in different disciplines. But interdisciplinary research in logic is already well advanced, as exemplified by this very journal. So perhaps the institution of such a degree course is just the logical next step in the collaboration that has already begun.

References

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