

Department of Philosophy

Dietrich College of Humanities and Social Sciences

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Philosophical Logic

The logical study of notions like necessity, knowledge, time and the conditional has a long pedigree, going back as far as the work of Aristotle and the Stoic School. This study continues in the modern era, and indeed gained considerable momentum during the past century, in part due to the development of both model-theoretic and proof-theoretic methods in first-order logic. The study of alethic modalities (notions of necessity and possibility) has always received special attention. The philosopher C.I. Lewis provided pioneering insights into the syntax of various modal systems and S. Kripke (together with S. Kanger and G. von Wright) provided the foundations of a model theory, which has been deeply influential throughout the second half of the past century. However, recent research in philosophical logic has not been limited to the study of alethic modal operators within the Kripkean framework. Dana Scott has been among the researchers who advocated both the study of other modalities, like epistemic and temporal ones, as well the use of multiple modalities in the study of concrete applications. In addition, Scott and Richard Montague proposed (independently) an alternative to Kripkean semantics (sometimes called neighborhood semantics) which has proved to be quite useful in current applications in computer science and epistemology. Probabilistic, algebraic and structuralist models have also been intensively studied for both modal and conditional notions. Finally, various epistemic and conditional operators have been recently characterized in terms of underlying inductive theories of non-probabilistic kind.

The logical systems developed by philosophers have been widely applied in various fields, from Economics to Computer Science. This is part of an on-going process of cross-fertilization. On the one hand, these fields have expanded in such a way that their borders have come to overlap those of various branches of philosophy (like epistemology and applied logic). On the other hand, new advances in philosophical logic are not only uniquely driven by regulative ideals like symmetry and reflective equilibrium, but also by requirements like computational realizability. Linguistics is another area where philosophically motivated logical methods have been importantly applied in order to solve interesting empirical problems. In the 1970's, R. Montague proposed a method for providing a model theoretic semantics for natural language, which later became the foundation of the modern approach to natural language semantics. Montague used an intensional type theoretic logic as his translation language, and worked with a fairly restricted fragment of English. Since then, his basic method has been enriched by the use of increasingly complex formal tools to represent semantic content; and it has been applied to a much wider selection of sentence types.

Various members of the department are engaged in the investigation of non-classical logics, or in research which involves the application of logic to particular problems in a philosophically motivated way. M. Simons has worked on a number of issues in the formal semantics of natural language, including the semantics of definite descriptions, of pronouns and of disjunction. H. Arlo-Costa has worked extensively on conditional and epistemic logic and has applied his work in various logics for AI (like non-monotonic logic). He is also interested in the study of probabilistic models of the conditional formulated in terms of non-standard conditional probability. This work is intimately related to recent investigations on theories of belief change and also to the on-going study of the interest and limitations of non-standard analysis to solve decision problems (see the area related to methodology). S. Awodey is interested in novel interpretations of modal logic, such as for computability and intensionality in type theory.

Several members of the faculty have theoretical interests related to applications of epistemic logics in AI, DAL, the theory of games and decisions as well as learning theory. Arlo-Costa's recent work includes modeling qualitative probability with the tools of first order neighborhood semantics of classical epistemic operators. This work, in turn, has applications in AI, computational linguistics and in the epistemic foundations of the theory of games. C. Bicchieri has done extensive work on the logical foundations of game theory, by applying both epistemic logics and various formalisms recently proposed in AI. K. Kelly has investigated logics of knowledge in a variety of papers, using a rich multi-modal environment whose underlying semantics is provided by learning theory. A. Bjorndahl has investigated epistemic structures in multi-agent systems, especially games, using a variety of modal logics. He is particularly interested in the use of such logics as tools for defining and analysing such systems, and the role of logical expressivity in this context.

Both foundational and applied work in philosophical logic is currently done in other departments of Carnegie Mellon as well. Just to mention two examples, see F. Pfenning and the work of R. Griffiths in the foundations of quantum mechanics which appeals to ideas first developed by conditional logicians.

Contact

Graduate Application

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