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Towards a Logic-based, Unifying Framework for Computing

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Computing, as a scientific discipline, lacks a unifying framework. It consists, instead, of diverse techniques in such various areas as programming, databases, and Artificial Intelligence.

Logic programming was an early attempt to provide a unifying framework for computing, based on the use of logic for knowledge representation and problem-solving. This attempt had only limited success, arguably because it failed to address adequately the fundamental role of state transition systems in computing.

In this talk, I sketch a logic-based framework for state transition systems, in which states can variously represent sets of shared variables, relational databases, Herbrand models, or mental representations of the real world. Given an initial set of goals, the computational task is to solve the goals by generating an appropriate sequence of actions and associated state transitions. Logically, the task is to make the goals true by generating a model of the goals with an explicit representation of time. Operationally, the task is solved by maintaining only the current state, updating the state destructively. Frame axioms, which express that any facts not affected by an action persist from one state to the next state, are true in the model, but are not used operationally to generate it.

Robert Kowalski studied at the University of Chicago, the University of Bridgeport, Stanford University, the University of Warsaw, and the University of Edinburgh, where he completed his PhD in 1970. He was a Research Fellow at the University of Edinburgh until 1975, when he joined Imperial College London, becoming Professor of Computational Logic in 1983.

During the 1980s, Kowalski was actively involved in the British response to the Japanese Fifth Generation Project. At its peak in 1987, the Logic Programming Group, which he headed at the time, numbered approximately 50 researchers and support staff. He also served as an advisor to the UNDP Knowledge Based Systems Project in India and to DFKI, the German Institute for Artificial Intelligence. He co-ordinated the European Community Basic Research Project, Compulog, and was the founder of the European Compulog Network of Excellence. He served as the Head of the Department of Computing at Imperial College from 1997 to 1999, after which he was appointed Professor Emeritus and Senior Research Fellow. Since 2009, he has been an advisor to the World Health Organisation.

Kowalski is a Fellow of the Association for the Advancement of Artificial Intelligence, the European Co-ordinating Committee for Artificial Intelligence, and the Association for Computing Machinery. He received the IJCAI (International Joint Conference of Artificial Intelligence) award for Research Excellence in 2011.

Kowalski's book *Computational Logic and Human Thinking – How to be Artificially Intelligent* was published by Cambridge University Press in July 2011.