Advanced Semantic WEB for Peer-to-Peer knowledge-bases: Intensional View-based Mapping and Epistemic Independency of Peers

Prof. Zoran Majkic
Applied Mathematics Department, University of Belgrade, Serbia;
Computer Science Department, University of Maryland, College Park, USA;
Dipartimento di Informatica e Sistemistica, Università di Roma "La Sapienza, Roma, Italy

Abstract:
In this talk I will summarize the work in last four years on Intelligent Semantic WEB for per-to-peer (P2P) systems with rich ontologies. Contemporary use of the term 'intension' derives from the traditional logical doctrine that an idea has both an extension and an intension. Although there is divergence in formulation, it is accepted that the extension of an idea (or concept) consists of the subjects to which the idea applies, and the intension consists of the attributes implied by the idea. The notion of ontology has become widespread in fields such as intelligent information integration, information retrieval, electronic commerce and semantic web. The meaning of concepts and views defined over some database ontology can be considered as intensional objects which have particular extension in some possible world: for instance in the actual world. Thus, non invasive mapping between completely independent peer databases in a P2P systems can be naturally specified by the set of couples of views, which have the same meaning (intension), over two different peers. Such a kind of mapping has very different semantics from the standard view-based mappings based on the material implication, commonly used for Data Integration Systems. The introduction of intensional equivalency generates the quotient intensional first order logic (FOL) and its semantics for query answering in P2P database systems. We introduce this formal intensional FOL by fusing the Bealer's intensional algebraic FOL with the possible-world semantics of the Montague's FOL modal approach to the natural language and we use the S5 Kripke frame to define the intensional equivalence relation between intensional views for peer databases. In practical implementations of P2P systems and their query answering algorithms, we are interested only for the actual world, where P2P databases have an actual extension. We show that such actual extension of P2P database system can be modeled by a particular multi-modal logic, where each peer database P is an epistemic logic system with its own modal operator "Peer P knows that..", while a global query answering, which depends on a sound P2P query rewriting algorithm, corresponds to the extension of an existential modal query formula. Finally, we present abstract coalgebraic semantics for such P2P database systems, which can be used as a mathematical (co)algebraic specification for implementations of a grid computing query answering system.