A logical method for temporal knowledge representation and reasoning

Dr. Matei Popovici

University POLITEHNICA of Bucharest, Romania

Our method is aimed at representing and reasoning about time-dependent domains which have a non-Markovian evolution. More precisely, we refer to domains in which a future state cannot be predicted based on a finite number of past states. The method relies on a structure called temporal graph in order to store temporal information, and on a language (called LH) which allows expressing complex temporal relations between components of the temporal graph. The evaluation process of a LH formula is called LH model checking. We prove that the LH model checking problem is NP-complete. We also show that First-Order Logic cannot express temporal graph connectivity or the existence of a path between components of a temporal graph. We use this result to motivate the introduction and usage of the language LH. Also, we describe several applications for LH such as error prediction in HPC systems. Finally, we introduce two game-theoretic concepts suitable for describing optimal time-dependent behaviour in Multi-Agent Systems: the Nash Equilibrium and the Strong Nash Equilibrium. We provide complexity results for both solution concepts.