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Polyhedral Omega: A linear Diophantine system solver

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Abstract: Polyhedral Omega is a new algorithm for solving linear Diophantine systems (LDS), i.e., for computing a multivariate rational function representation of the set of all non-negative integer solutions to a system of linear equations and inequalities. Polyhedral Omega combines methods from partition analysis with methods from polyhedral geometry. In particular, we combine MacMahon's iterative approach based on the Omega operator and explicit formulas for its evaluation with geometric tools such as Brion decomposition and Barvinok's short rational function representations. In this way, we connect two branches of research that have so far remained separate, unified by the concept of symbolic cones which we introduce. The resulting LDS solver Polyhedral Omega is significantly faster than previous solvers based on partition analysis and it is competitive with state-of-the-art LDS solvers based on geometric methods. Most importantly, this synthesis of ideas makes Polyhedral Omega by far the simplest algorithm for solving linear Diophantine systems available to date. This is joint work with Felix Breuer.

Date : Wednesday, April 29, 2015
Time: 2pm
Place: TB 250, Boğaziçi University