THE UNIVERSITY OF CHICAGO

COMPUTATIONAL AND APPLIED MATHEMATICS COLLOQUIUM

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Nonarchimedean Degenerations of Convex Programming — In Which Tropical Geometry Shows That Log-Barrier Interior Point Methods Are Not Strongly Polynomial

THURSDAY, May 24, 2018, at 5:00 PM
Jones 226, 5747 South Ellis Avenue

ABSTRACT

Linear programming, and more generally convex semialgebraic programming, makes sense over any ordered nonarchimedean field, like a field of real Puiseux series. Nonarchimedean instances encode classical parametric instances with a suitably large parameter. Tropical geometry allows one to study such instances by combinatorial means. In particular, it reveals that, under genericity conditions, solving a nonarchimedean feasibility problem is equivalent to deciding who the winner is in a mean payoff game. Indeed, nonarchimedean linear programs correspond to deterministic mean payoff games, whereas nonarchimedean semidefinite programs correspond to perfect information stochastic mean payoff games. In this way, one arrives at a counter example: a family of linear programs, with large coefficients, for which log-barrier interior point methods have a non strongly polynomial behavior: they make a number of iterations exponential in the number of constraints and variables. The same approach also leads to positive algorithmic results. For instance, tropical semidefinite programs can be solved in a much more scalable way than classical semidefinite programs. This talk is based on a work with Allamigeon, Benchimol and Joswig, on the tropicalization of the central path, and with Allamigeon and Skomra, on the tropicalization of semidefinite programming.

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