Industrial & Systems Engineering

Seminar Announcement

Efficient Algorithms for Solving Optimization Problems without Accruing Roundoff Errors

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Abstract: LU and Cholesky matrix factorizations play a central role in solving linear programming models. Therefore, it is disconcerting that in many instances the roundoff errors accrued during the construction and implementation of these factorizations lead mathematical programming software to misclassify suboptimal solutions as optimal and even feasible problems as infeasible and vice versa. These and other erroneous conclusions have the potential to refute the validity of optimizers' solutions to mixed-integer programs. Hence, reducing these factorizations' associated roundoff errors or eliminating them altogether is imperative for guaranteeing the correctness of optimization software in solving today's complex problems. Evidently, this accompanying guarantee must be obtained with competitive computational efficiency in order to render the enhanced optimization solvers viable in practice.

This talk addresses these mandates by introducing the Roundoff-Error-Free (REF) LU and Cholesky factorizations and corresponding REF substitution algorithms, which combine to solve linear systems of equations efficiently without accruing roundoff errors. The featured computational tools rely on integer-preserving Gaussian elimination and, consequently, they avoid the trappings of exact rational arithmetic operations. In addition, I describe a novel push-and-swap methodology for updating the REF LU and Cholesky factorizations (e.g., required within the revised simplex), which becomes necessary because applying the traditional delete-insert-reduce update methodology virtually wipes out all the computational savings expected of the factorization update process. Lastly, this talk outlines how the developed REF factorization framework is to be implemented in state-of-the-art optimization solvers to provide accurate solutions efficiently.

Bio: *Adolfo R. Escobedo* is a PhD candidate in the Department of Industrial and Systems Engineering at Texas A&M University. He received his B.A. degree in Mathematics from California State University, Los Angeles in 2009. His research interests are in the theory and application of mathematical programming, specifically in the design and analysis of algorithms, optimization of power systems, and decision theory. Adolfo's work has been published in *INFORMS Journal of Computing*, *IIE Transactions*, and *IEEE Transactions on Power Systems.* He recently received an honorable mention in the INFORMS Junior Faculty Interest Group Forum Paper Competition for his joint work with Erick Moreno-Centeno on roundoff error free factorizations, and he received the Texas A&M Energy Institute Fellowship on two consecutive years for his power systems research as a member of the ARPA-E Robust Adaptive Topology Control project.

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