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MADALGO seminars by Gero Greiner, Technische Universität München

Sparse Matrix Multiplications in the I/O-Model

Abstract:

The talk overviews the multiplication of a sparse matrix with both vectors and matrices in the semiring I/O-model. Multiplying a sparse $N \times N$ matrix A , having kN non-zero entries, with a dense vector was considered by Bender, Brodal, Fagerberg, Jacob and Vicari in 2007. They determined its complexity for different layouts for storing A up to a certain sparsity. In this talk, we present results extending their work towards

- creating the matrix-vector product of A with multiple vectors simultaneously,
- multiplying A with a dense matrix B ,
- transposing A , which also yields a lower bound for creating the product of two sparse matrices A and B .

Furthermore, we show that in our model for most parameter settings, creating the matrix-vector product has the same complexity as evaluating the bilinear form. For all the considered tasks, upper and lower bounds that match up to constant factors are obtained for a wide range of parameters. Only the task of creating the product of two sparse matrices eludes matching bounds so far. Finally, we regard the task of permuting N elements, aiming to examine what makes a given instance difficult.