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From non-differentiability to discrete geometry: B-differential, hyperplanes and matroids

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Systems of nonsmooth nonlinear equations of the form H(x) = 0 can often be solved by the semismooth Newton method. An adaptation of the classic Newton method, it yields fast local convergence with little cost per iteration, provided the B-differential of H has only nonsingular Jacobians at the solution. Such setting of nonsmooth H is encountered when complementarity problems are reformulated as nonsmooth equations thanks to the componentwise minimum function. This talk describes some properties as well as the computation of the of the B-differential of the componentwise minimum of two affine vector functions. This question, having connections with linear algebra, convex analysis and discrete geometry (hyperplane arrangement), can be answered numerically. We shall emphasize the role of duality and matroid circuits in this enumeration problem, and how theoretical insights serve the numerical aspect. These properties allow us to design a fundamentally different (dual) approach of the state of the art approach by Rada and Černý, which brings significant improvements. The Julia package in development considers features such as: primal and dual approach for hyperplane arrangements, the possibility to use rational coordinates, central and non-central arrangements.

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