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Multi-secant extensions of BFGS

When dealing with a large-scale optimization problem, classical second-order methods, such as Newton's method, are no longer practical because it requires iteratively solving a large-scale linear system of order n. For this reason, Quasi-Newton(QN) methods, like BFGS or Broyden's method, are introduced because they are more efficient than Newton's method. This project focuses on multi-secant extensions of the BFGS method, to improve its Hessian approximation properties. Unfortunately, doing so sacrifices the matrix estimate's positive semi-definiteness, and steps are no longer assured to be descent directions. Therefore, we apply a perturbation strategy, inspired by the 'Haynsworth inertia additivity formula', to construct an almost-secant positive-definite Hessian estimate matrix. This strategy has a low computational cost, involving only rank-2 updates with variable and gradient successive differences. We also explore several ways of improving this method, accepting and rejecting older updates according to several nondegeneracy metrics. Future goals include extending these techniques to limited memory versions.