

A Multilevel Approach for l-1 Regularized Convex Optimization with Application to Covariance Selection

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We present an iterative multilevel framework for solving l-1 regularized convex optimization problems, which are common in the fields of computational biology, signal processing and machine learning. Such l-1 regularization is utilized to find sparse minimizers of convex functions, and is mostly known for its use in the LASSO problem, where the l-1 norm is applied to regularize a quadratic function. Taking advantage of the (typical) sparseness of the solution, we create a multilevel hierarchy of similar problems, which are traversed back and forth in order to accelerate the optimization process. This framework is applied for solving the Covariance Selection Problem, where the inverse of an unknown covariance matrix of a multivariate normal distribution is estimated, assuming that it is sparse. To this end, an l-1 regularized log-determinant optimization problem needs to be solved. This task is challenging for large-scale data sets because of time and memory limitations. Our numerical experiments demonstrate the efficiency of the multilevel framework for solving both medium and large scale instances of this problem.