Multiscale methods for discrete optimization problems

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In many real-world problems, a big scale gap can be observed between micro- and macroscopic scales of the problem because of the difference in mathematical (engineering, social, biological, physical, etc.) models and/or laws at different scales. The main objective of multiscale algorithms is to create a hierarchy of problems, each representing the original problem at different coarse scales with fewer degrees of freedom. We will talk about different strategies of creating these hierarchies for large-scale discrete problems such as graph linear arrangement, network compression, graph partitioning, network generation, and constrained 2D-layout. These strategies are inspired by the classical multigrid frameworks: Geometric Multigrid, Algebraic Multigrid and Full Approximation Scheme. We will present in details a framework for linear time Algebraic Multigrid based multiscale algorithms for the minimum p-discrepancy, partitioning and compression problems.

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