An Almost-Linear Time Algorithm for Maximum Flow and More

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Abstract

In this talk, I will explain a new algorithm for computing exact maximum and minimum-cost flows in almost-linear time, settling the time complexity of these basic graph problems up to subpolynomial factors.

Our algorithm uses a novel interior point method that builds the optimal flow as a sequence of approximate minimum-ratio cycles, each of which is computed and processed very efficiently using a new dynamic data structure.

By well-known reductions, our result implies almost-linear time algorithms for several problems including bipartite matching, optimal transport, and undirected vertex connectivity. Our framework also extends to minimizing general edge-separable convex functions to high accuracy, yielding the first almost-linear time algorithms for many other problems including entropy-regularized optimal transport, matrix scaling, p-norm flows, and isotonic regression.

This talk is based on joint work with Li Chen, Yang P. Liu, Richard Peng, Maximilian Probst Gutenberg, and Sushant Sachdeva [1]. Our result appeared in FOCS'22 and won the FOCS best paper award.

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References

1 Li Chen, Rasmus Kyng, Yang P. Liu, Richard Peng, Maximilian Probst Gutenberg, and Sushant Sachdeva. Maximum flow and minimum-cost flow in almost-linear time. In *2022 IEEE 63rd Annual Symposium on Foundations of Computer Science (FOCS)*, pages 612–623, 2022. doi:10.1109/FOCS54457.2022.00064.

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