Title

Streaming Algorithms Via Reductions

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Abstract

In the "streaming algorithms" model of computation we must process data "in order" and without enough memory to remember the entire input. We study reductions between problems in the streaming model with an eye to using reductions as an algorithm design technique. Our contributions include:

* "Linear Transformation" reductions, which compose with existing linear sketch techniques. We use these for small-space algorithms for numeric measurements of distance-from-periodicity, finding the period of a numeric stream, and detecting cyclic shifts.

* The first streaming graph algorithms in the "sliding window'" model, where we must consider only the most recent L elements for some fixed threshold L. We develop basic algorithms for connectivity and unweighted maximum matching, then develop a variety of other algorithms via reductions to these problems.

* A new reduction from maximum weighted matching to maximum unweighted matching. This reduction immediately yields improved approximation guarantees for maximum weighted matching in the semistreaming, sliding window, and MapReduce models, and extends to the more general problem of finding maximum independent sets in p-systems.

* Algorithms in a "stream-of-samples" model which exhibit clear sample vs. space tradeoffs. These algorithms are also inspired by examining reductions. We provide algorithms for calculating F_k frequency moments and graph connectivity.

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