Distinguished Lecturer Series

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Semi-Streaming Set Cover

Abstract: In this talk we consider the set cover problem under the semi-streaming model. This problem is a fundamental problem in theoretical computer science, and under the semi-streaming setting has a number of applications, e.g., in web crawling.

The underlying set system is formalized in terms of a hypergraph G = (V, E) whose edges arrive one-by-one, and the goal is to construct an edge cover F ⊆ E with the objective of minimizing the cardinality (or cost in the weighted case) of F. We also consider a parameterized relaxation of this problem, where given some $0 \leq \epsilon < 1$, the goal is to construct an edge $(1 - \epsilon)$-cover, namely, a subset of edges incident to all but an ϵ-fraction of the vertices (or their benefit in the weighted case). The key limitation imposed on the algorithm in the semi-streaming setting is that its space is limited to (poly) logarithmically many bits per vertex.

Our main result is an asymptotically tight trade-off between ϵ and the approximation ratio: We design a semi-streaming algorithm that on input graph G, constructs a succinct data structure D such that for every $0 \leq \epsilon < 1$, an edge $(1 - \epsilon)$-cover that approximates the optimal edge 1-cover within a factor of $f(\epsilon, n)$ can be extracted from D (efficiently and with no additional space requirements. The function $f(\epsilon, n)$ has the value of $f(\epsilon, n)=O(1/\epsilon)$ if $\epsilon > 1/\sqrt{n}$, and $f(\epsilon, n)=O(\sqrt{n})$ otherwise. In particular, for the traditional set cover problem we obtain an $O(\sqrt{n})$ approximation. This algorithm is proved to be best possible by establishing a family (parameterized by ϵ) of matching lower bounds.

Joint work with Yuval Emek.

Adi Rosén received his PhD in Computer Science in 1995 from Tel-Aviv University. He is currently Directeur de Recherche CNRS at LIAFA (Laboratoire d'Informatique Algorithmique: Fodemenets et Applications), a joint laboratory of the CNRS (French National Center for Scientific Research) and Université Paris Diderot. His research interests lie primarily in online algorithms and streaming algorithms, and in communication complexity. Adi Rosén also co-chairs the French-Israeli Laboratory on Foundations of Computer Science (FILOFOCS), a "virtual laboratory" joint to the CNRS and Tel-Aviv University.

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