Geometry Seminar
April 19, 2005, Tuesday, 6:00 p.m.
Room 613, Courant Institute
251 Mercer Street, New York

Improved Approximation Algorithms for Geometric Set Cover

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Abstract

Given a collection S of subsets of some set U, and M a subset of U, the *set cover* problem is to find the smallest subcollection C of S such that the union of the sets in C contains M; that is, C is the smallest cover of M. While the general problem is NP-hard to solve, even approximately, here we consider some geometric special cases, where usually $U = R^d$. Extending prior results, we show that approximation algorithms with provable performance exist, under a certain general condition: that for a random subset R of S and function $f(.)$, there is a decomposition of the part of U not covered by R into an expected $f(|R|)$ simple regions. We show that under this condition, a cover of size $O(f(|C|))$ can be found. Our proof involves the generalization of "shallow cuttings" to more general geometric situations. We obtain constant factor approximation algorithms for covering by unit cubes in R^3, for guarding a one-dimensional terrain, and for covering by similar-sized fat triangles in R^2. We also obtain improved approximation guarantees for fat triangles of arbitrary size, and for a class of fat objects.

Joint work with Kasturi Varadarajan.

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