Seminar on Combinatorial Computing
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Testing first order graph properties

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Abstract

Let P be a property of graphs. An ϵ-test for P is a randomized algorithm which, given the ability to make queries whether a desired pair of vertices of an input graph G with n vertices are adjacent or not, distinguishes, with high probability, between the case of G satisfying P and the case that it has to be modified by adding and removing more than ϵn^2 edges to make it satisfy P. The property P is called testable, if for every ϵ there exists an ϵ-test for P whose total number of queries is independent of the size of the input graph. In this talk we study the testability of first order graph properties, showing that properties not containing a quantifier alteration of type "$\forall\exists$" are always testable, while some properties containing this alteration are not.

Our results are proven using a combinatorial lemma, a special case of which, that may be of independent interest, is the following. A graph H is called ϵ-unavoidable in G if all graphs that differ from G in no more than $\epsilon|G|^2$ places contain an induced copy of H. A graph H is called δ-abundant in G if G contains at least $\delta|G|^{|H|}$ induced copies of H. If H is ϵ-unavoidable in G then it is also $\delta(\epsilon, |H|)$-abundant. (Joint work with Noga Alon, Eldar Fischer and Michael Krivelevich.)

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