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**A general homomorphism polynomial and sparse/dense symmetries of constraint problem on random graphs.**

Abstract:

I will discuss a multivariate polynomial counting homomorphisms from a graph  $G$  to a specific weighted graph  $K_q$ . From this polynomial a number of different constraint and optimization problem for  $G$ , such a maximum independent sets, can be solved in polynomial time. As a consequence of the properties of the polynomial we find that many such problem can be solved in unexpected polynomial time for both sparse and very dense random graphs.