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Towards a weighted version of the Hajnal-Szemerédi Theorem

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For a positive integer r>=2, a K_r-factor of a graph is a collection vertex-disjoint copies of K_r which covers all the vertices of the given graph. The celebrated theorem of Hajnal and Szemer\'edi asserts that every graph on n vertices with minimum degree at least (1-1/r)n contains a K_r-factor. In this note, we propose investigating the relation between minimum degree and existence of perfect K_r-packing for edge-weighted graphs. The main question we study is the following. Suppose that a positive integer r>=2 and a real t in [0,1] is given. What is the minimum weighted degree of K_n that guarantees the existence of a K_r-factor such that every factor has total edge weight at least tr(r-1)/2? We provide some lower and upper bounds and make a conjecture on the asymptotics of the threshold as n goes to infinity.

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