A fast algorithm for equitable coloring. (English) Zbl 1224.05176


An equitable \( k \)-colouring of a graph is a proper vertex colouring with \( k \) colors, in which the sizes of any two colour classes differ by at most one. It was conjectured by P. Erdős and proved by A. Hajnal and E. Szemerédi [Combinat. Theory Appl., Colloquia Math. Soc. János Bolyai 4, 601–623 (1970; Zbl 0217.02601)] that every graph with maximum degree at most \( r \) admits an equitable \((r + 1)\)-colouring. The authors present a less complicated and shorter proof of this celebrated Hajnal-Szemerédi theorem by using new methods and recombining old ideas. Their proof yields, moreover, a simple \( O(n^2) \) time algorithm for obtaining an equitable \((r + 1)\)-colouring, where \( n \) is the vertex number of the given graph with maximum degree at most \( r \). This algorithm is faster than those obtained previously in [H. A. Kierstead and A. V. Kostochka, Comb. Probab. Comput. 17, No. 2, 265–270 (2008; Zbl 1163.05015); M. Mydlarz and E. Szemerédi, Algorithmic Brooks’ theorem, manuscript].

H. A. Kierstead and A. V. Kostochka [J. Comb. Theory, Ser. B 98, No. 1, 226–234 (2008; Zbl 1127.05039)] improved the Hajnal-Szemerédi theorem by showing that any graph, in which the degree sum of any two adjacent vertices is at most \( 2r + 1 \), has an equitable \((r + 1)\)-colouring. The authors conjecture that such a colouring can be constructed by a polynomial time algorithm.

Reviewer: Van Bang Le (Rostock)

MSC:

05C15 Coloring of graphs and hypergraphs
05C85 Graph algorithms (graph-theoretic aspects)

Keywords:
equitable vertex colouring of graphs; Hajnal-Szemerédi theorem

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References:


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