北京大学前沿计算研究中心
Center on Frontiers of Computing Studies, Peking University

静园5号院 杰出讲座

CFCS 杰出讲座系列 Distinguished Lecture Series

The Four Color Theorem with Linearly Many Reducible Configurations and Linear Time Coloring



Prof. Mikkel Thorup

Department of Computer Science
University of Copenhagen

Host: 姜少峰 助理教授

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Abstract

We present a linear time 4-coloring algorithm for planar graphs, improving on the previous quadratic time algorithm by Robertson et al. from 1996. Such an algorithm cannot be achieved by the known proofs of the Four Color Theorem (4CT) which only show the existence of a reducible configuration. We show that every planar triangulation contains linearly many pairwise non-touching reducible configurations or obstructing cycles of length at most 5 (which all allow for making effective 4-coloring reductions). Based on this we present a simple O(n log n) algorithm to 4-color any planar graph. The running time of the 4-coloring is reduced to linear using new data structures.

Biography

Mikkel Thorup (born 1965) has a D.Phil. from Oxford University from 1993. From 1993 to 1998 he was at the University of Copenhagen. From 1998 to 2013 he was at AT&T Labs-Research. Since 2013 he has been back as Professor at the University of Copenhagen. He is currently a VILLUM Investigator heading Center for Basic Algorithms Research Copenhagen (BARC).

Mikkel is a Fellow of the ACM, a Fellow of AT&T, and a Member of the Royal Danish Academy of Sciences and Letters. He is co-winner of the 2011 MAA Robbins Award in mathematics and winner of the 2015 Villum Kann Rasmussen Award for Technical and Scientific Research, which is Denmark's biggest individual prize for research. He was co-winner of the 2021 AMS-MOS Fulkerson Prize and the 2021 ACM STOC 20-year test of time award. He is also co-winner of the FOCS'26 Best Paper Award for a fast algorithm to 4-color planar graphs.

Mikkel's main work is in algorithms and data structures, where he has worked on both upper and lower bounds. Recently one of his main focusses has been on hash functions unifying theory and practice. Mikkel prefers to seek his mathematical inspiration in nature, combining the quest with his hobbies of bird watching and mushroom picking.