

Algebraic Algorithms for Finding Patterns in Graphs

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Abstract

I will give a gentle introduction to algebraic graph algorithms by showing how to determine if a given graph contains a simple path of length k . This is a famous problem admitting a beautiful and widely-known algorithm, namely the colour-coding method of Alon, Yuster and Zwick (1995). Starting from this entirely combinatorial approach, I will carefully develop an algebraic perspective on the same problem. First, I will explain how the colour-coding algorithm can be understood as the evaluation of a well-known expression (sometimes called the “walk-sum” of the graph) in a commutative algebra called the zeon algebra. From there, I will introduce the exterior algebra and present the algebraic framework recently developed with Brand and Dell (2018).

The presentation is aimed at a combinatorially-minded audience largely innocent of abstract algebra.

2012 ACM Subject Classification Theory of computation → Fixed parameter tractability; Mathematics of computing → Paths and connectivity problems; Mathematics of computing → Graph algorithms

Keywords and phrases paths, exterior algebra, wedge product, color-coding, parameterized complexity

Digital Object Identifier 10.4230/LIPIcs.CPM.2020.1

Category Invited Talk

Funding *Thore Husfeldt*: Supported by the Swedish Research Council grant VR-2016-03855 “Algebraic Graph Algorithms” and the Villum Foundation grant 16582 “Basic Algorithms Research Copenhagen (BARC)”.

Acknowledgements Based on joint work with Cornelius Brand and Holger Dell.

References

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31st Annual Symposium on Combinatorial Pattern Matching (CPM 2020).

Editors: Inge Li Gørtz and Oren Weimann; Article No. 1; pp. 1:1–1:1

Leibniz International Proceedings in Informatics



LIPICs Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany